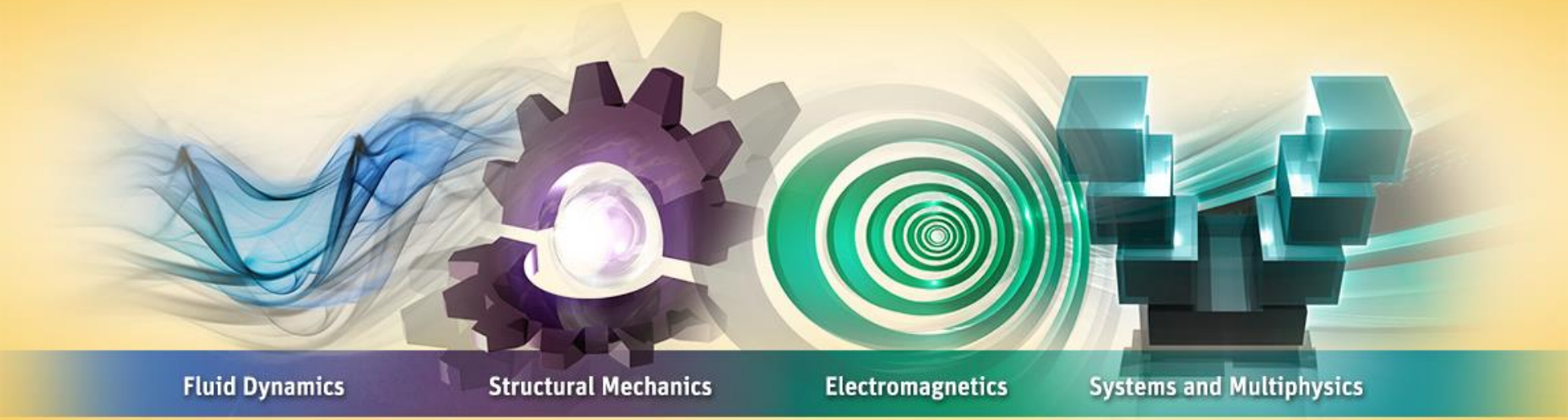
# Module 2:
# Creating Geometry




## Introduction to ANSYS SpaceClaim Direct Modeler

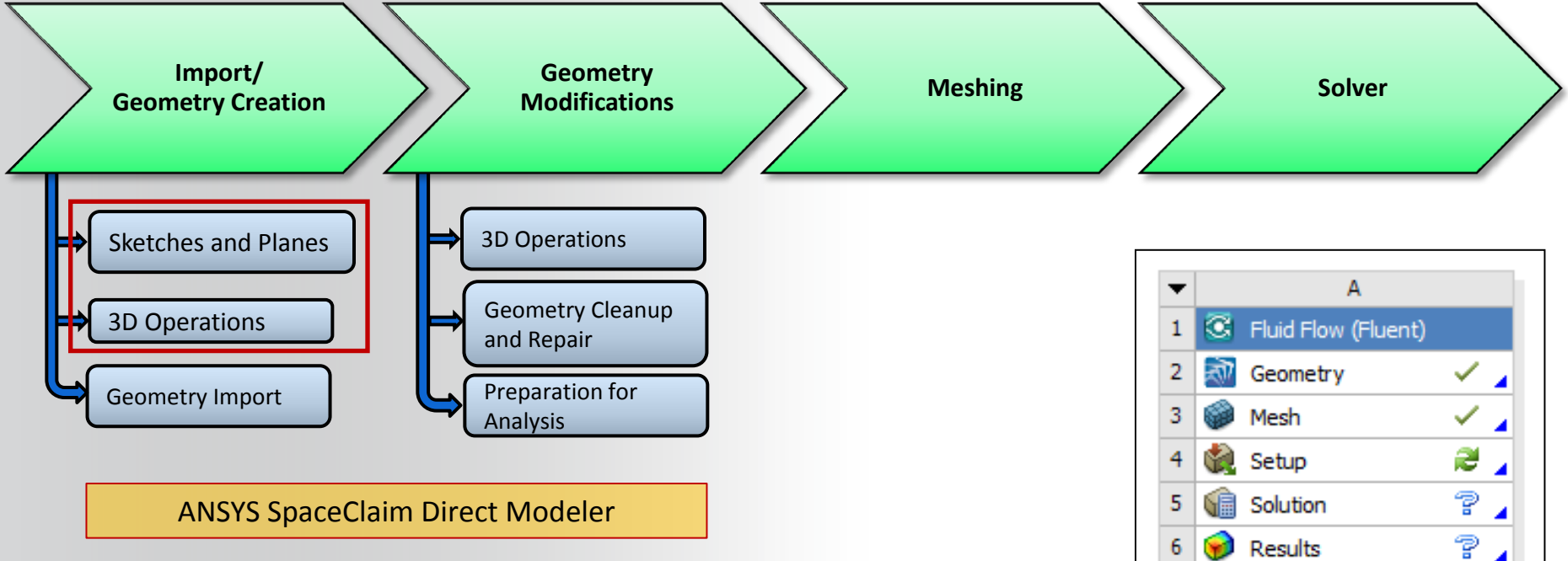
Realize Your Product Promise®

# Overview

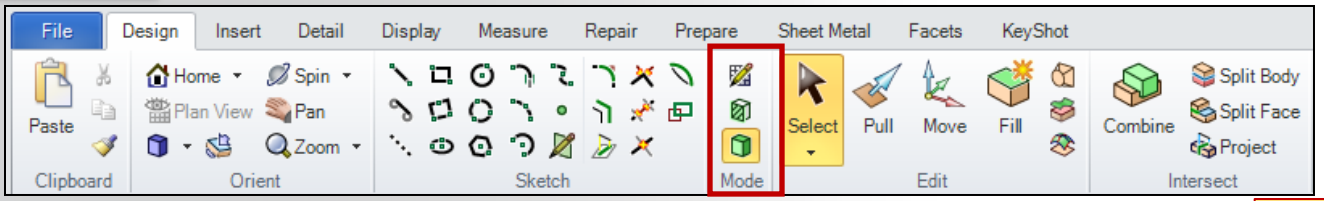
**In this module we will learn about:**

- **Modes in SCDM**
- **Sketching Tools**
- **3D Modeling Tools**
- **Display Controls**
- **Detailing**

# Preprocessing Workflow



# Modes in Spaceclaim Direct Modeler



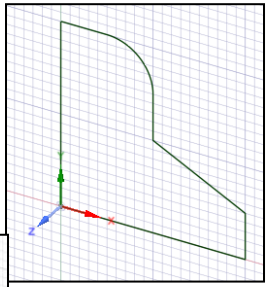

- **3 modes available for designing:**
  - **Sketch mode**

    **Enables sketch grid for creating 2D sketch**
  - **Section mode**

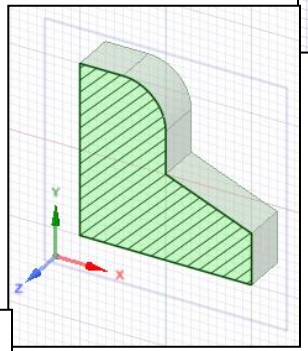
    **Enables editing of solid and surface bodies by working with their edges and vertices in "cross-section" view**
  - **3D mode**

    **Enables 3D modeling mode for creating/editing geometries**

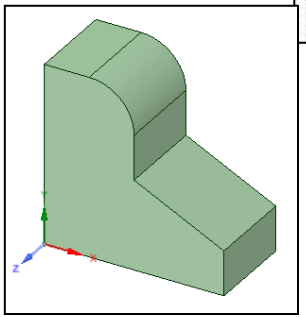
Sketch Mode



Section Mode



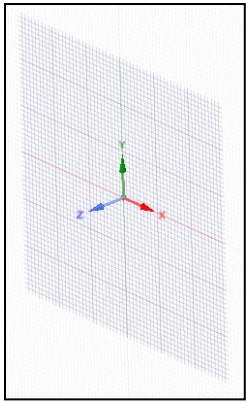
3D Mode



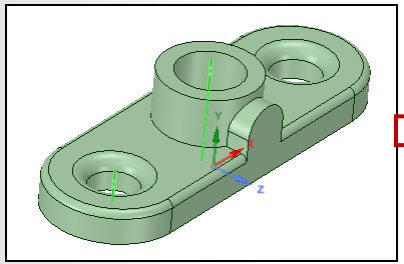
# Creating Sketches

## Sketch Grid

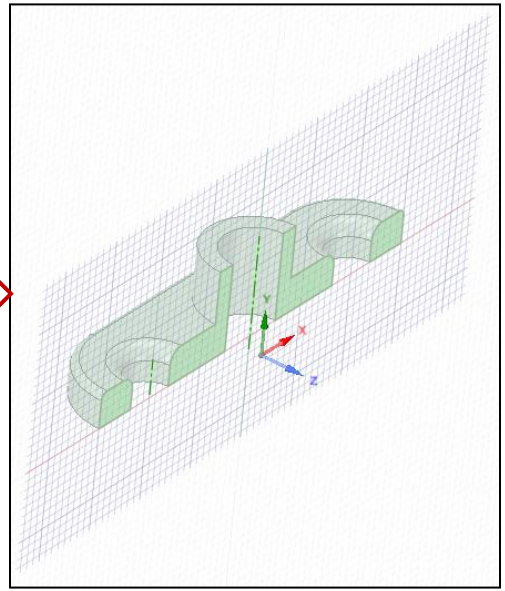
- Sketches are always created on a “Sketch Grid”
- Sketch Grid can be created on
  - Any planar surface
  - Any existing Plane
    - (details about plane creation discussed later)
  - Combination of any geometrical entities which define a planar surface
    - 2 coplanar lines
    - Line and 1 point
    - Coordinate axes etc.



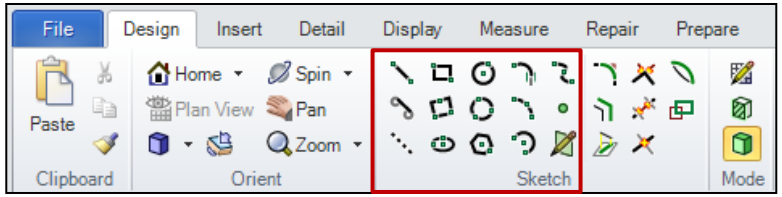
Sketch Grid



2 coplanar axes selected

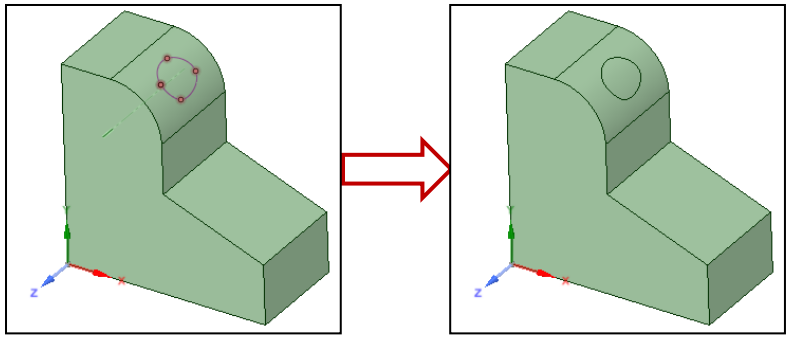


# Creating Sketches



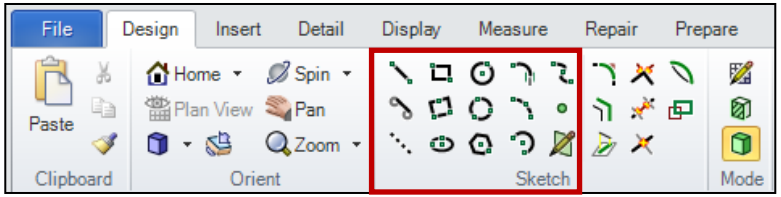

## Sketch Creation tools

- Hosts standard tools for creating sketches
  - Line
    - Single, polyline, tangent line, construction line
  - Rectangle
    - 2 point, 3 point
  - Circle
    - Center, 3 point
  - Ellipse
  - Polygon
  - Arc
    - Tangent, 3 point, sweep arc
  - Spline
  - Point
  - Face Curve
    - Sketch curve directly on face of body
    - Face need not be planar

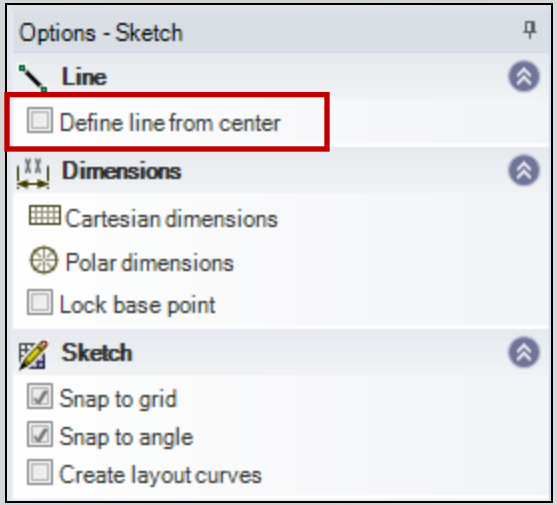


Face Curve

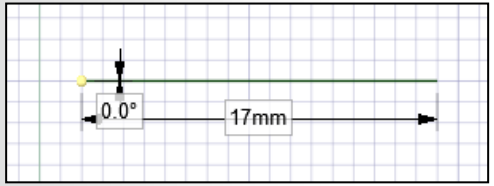
# Creating Sketches




## Line Tool

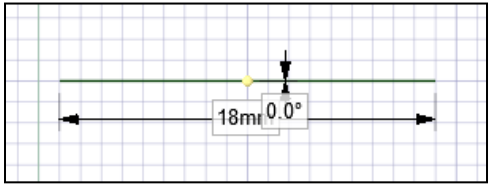



Define line from center - OFF



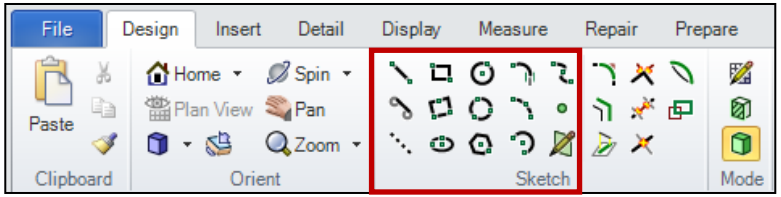

Line drawn from one end

Define line from center - ON

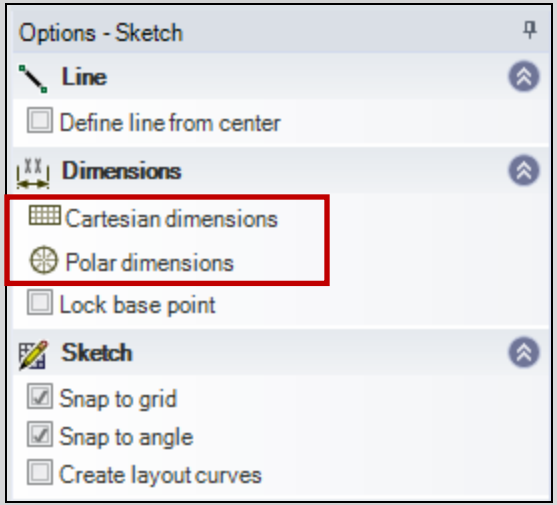



Equidistant line drawn from center

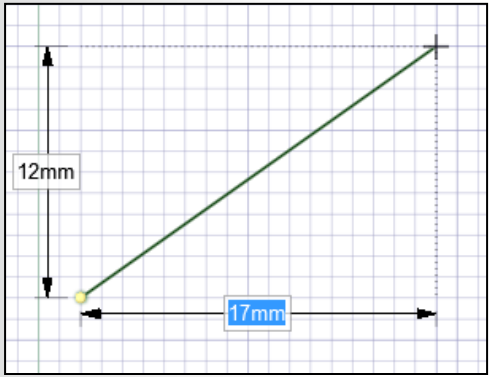
# Creating Sketches



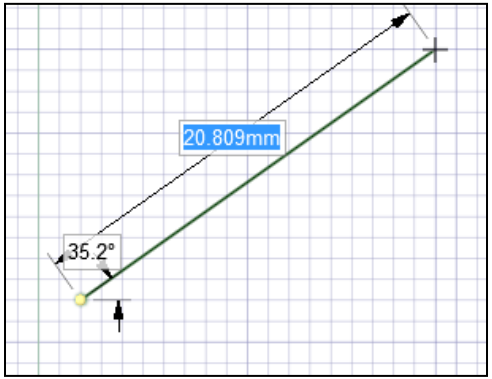

## Line Tool



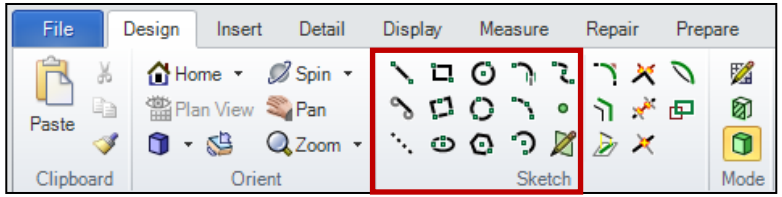

Cartesian Dimensions



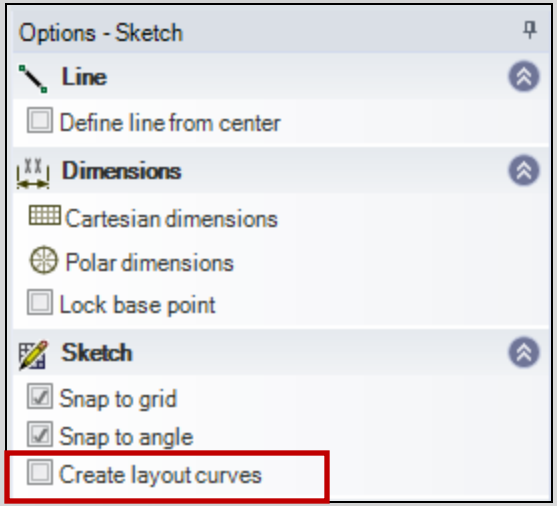

Polar Dimensions



# Creating Sketches

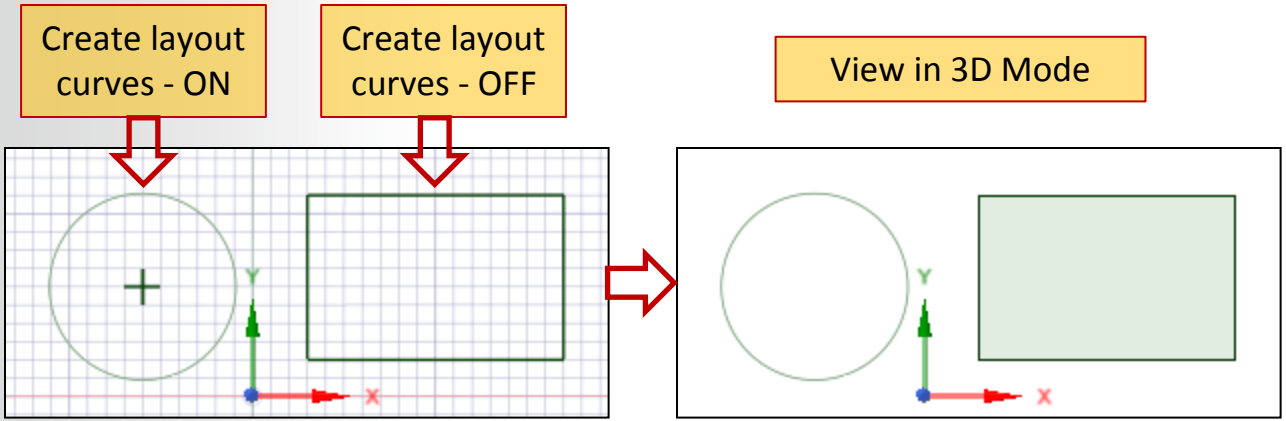



## Line Tool

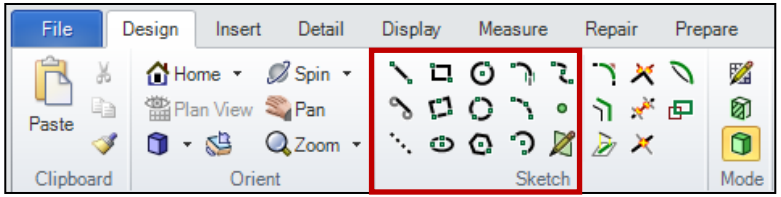



### Create layout curves

- Create curves which are not immediately needed to generate 3D objects
- Curves created are similar to a pencil drawing made on design

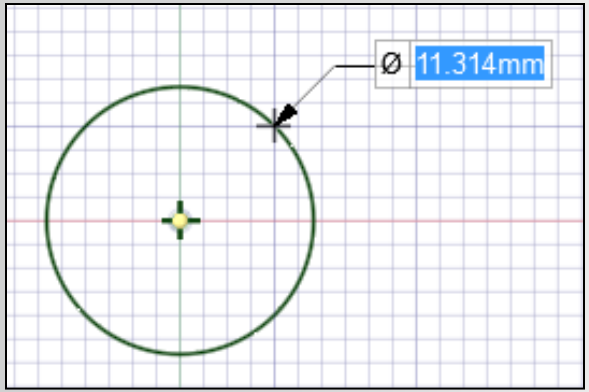


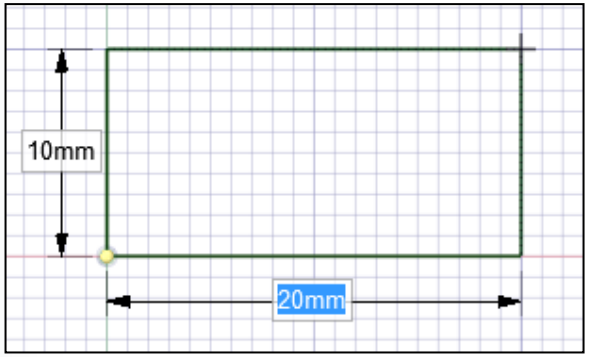
# Dimensioning Sketches




## Dimensioning

- **Specify sketch dimensions on-the-fly while creating sketches**
  - **Radius, Length, Width**
- **Use “Tab” key to switch between dimensions**

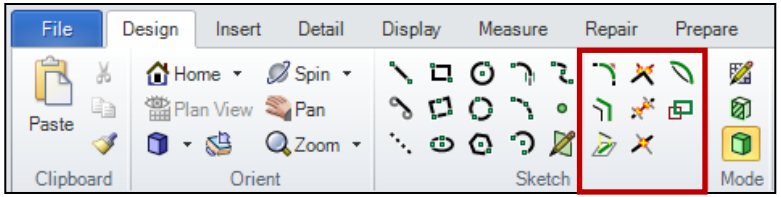


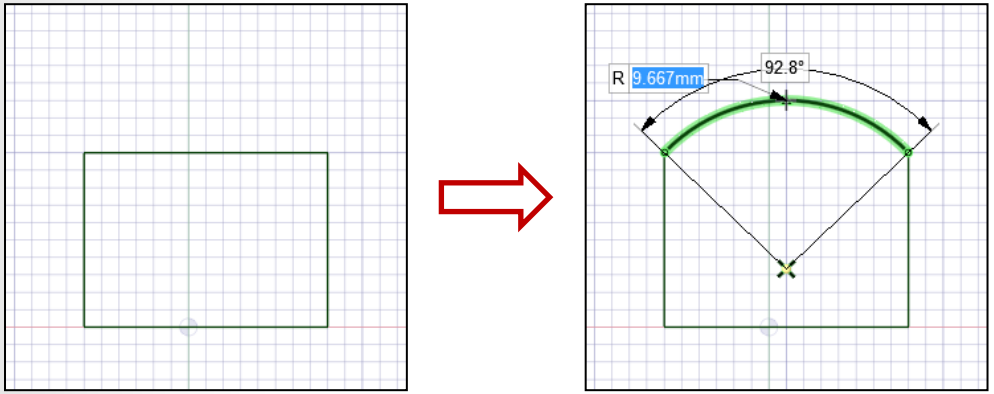



# Editing Sketches

## Sketch Editing tools

- Hosts standard tools for editing sketches
  - Fillet / Chamfer
  - Offset
  - Project
  - Create Corner
  - Trim
  - Split
  - Bend
  - Scale

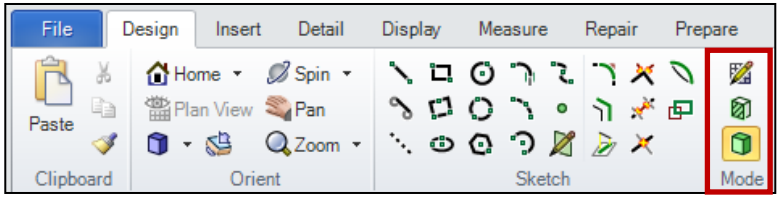


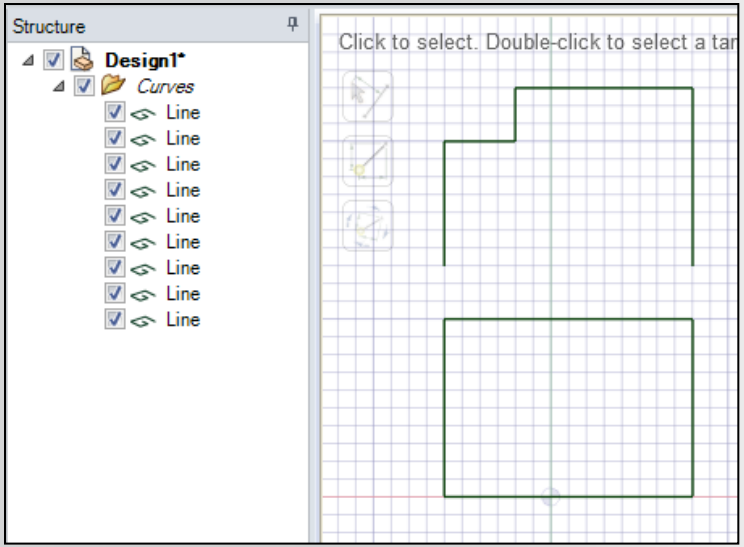




Bend tool

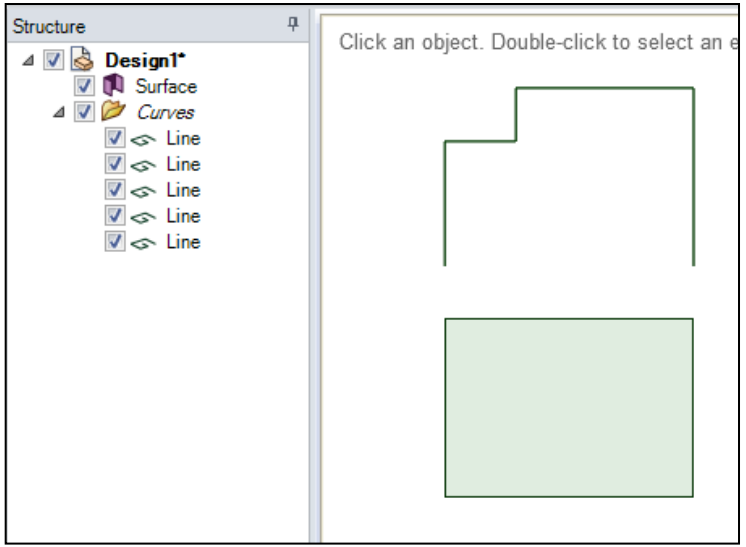
# Switching to 3D Mode

- **Switching to 3D mode converts**
  - **All closed sketch objects to surface bodies**
  - **All open sketch objects to curves**



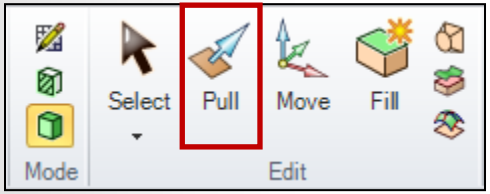

Switching to 3D Mode

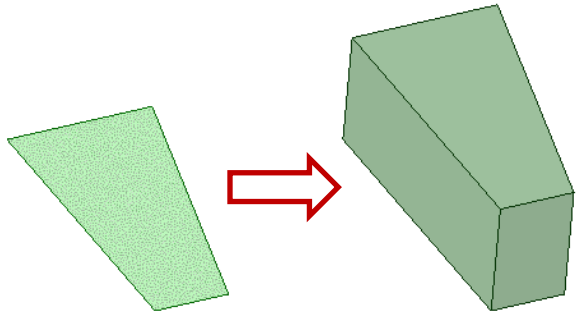


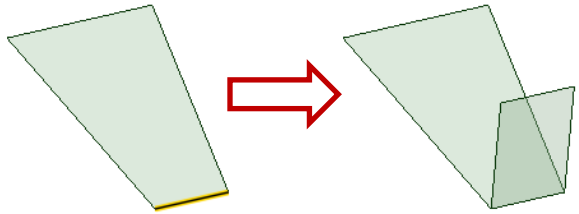
# Modeling Tools - Pull

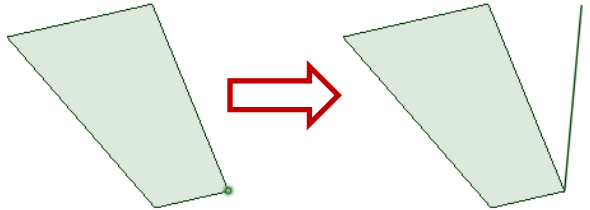
## Pull tool

- Used to convert sketches to 3D
  - Pulling a line creates a surface
  - Pulling a surface creates a solid
- Distort or deform existing geometry
- Drag the selected object in a chosen direction when Pull tool is active
- Multi-functional tool
  - Extrude, Revolve, Sweep, Offset and Draft faces
  - Create Rounds (Fillets), Chamfers or Extrude edges
  - Pull a point to create Line
- Several tool guides available to alter its behaviour

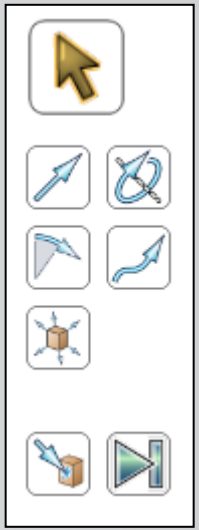






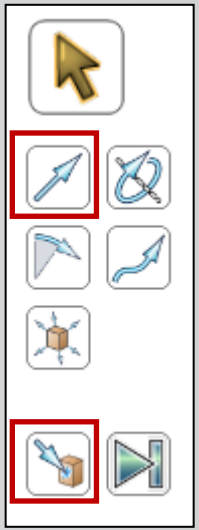
# Modeling Tools - Pull

Tool Guide

| | |
|---|---|
|  | **Select -** Select objects to pull |
|  | **Pull Direction -** Set direction of pull |
|  | **Revolve –** Set axis of revolution |
|  | **Draft -** Select entities (plane, planar face or edge) as pivot to create draft |
|  | **Sweep -** Select entities (edges, lines) to sweep along |
|  | **Scale –** Scale selected entities |
|  | **Up To -** Select destination object |
|  | **Full Pull –** Revolve 360 deg or pull upto trajectory end |

# Modeling Tools - Pull

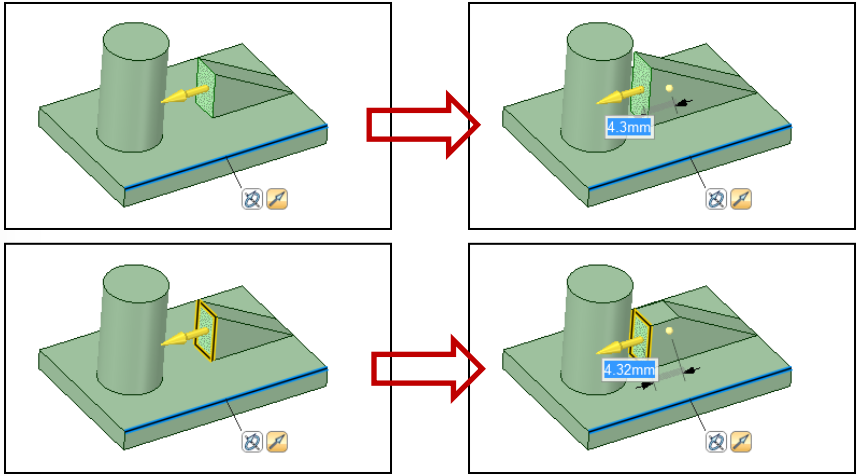
Tool Guide

Face selected for Pull
Blue Edge selected for Pull direction

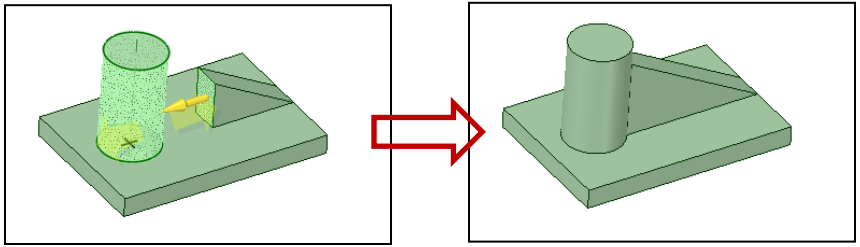
Face and its edges selected for Pull
Blue Edge selected for Pull direction

Face selected for Pull
Cylindrical face selected as destination

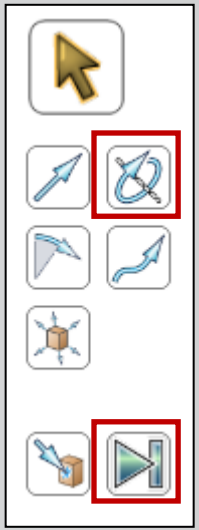
Pull Direction




Up To



# Modeling Tools - Pull

Tool Guide

Face selected for Pull

Blue Edge selected as axis of revolution

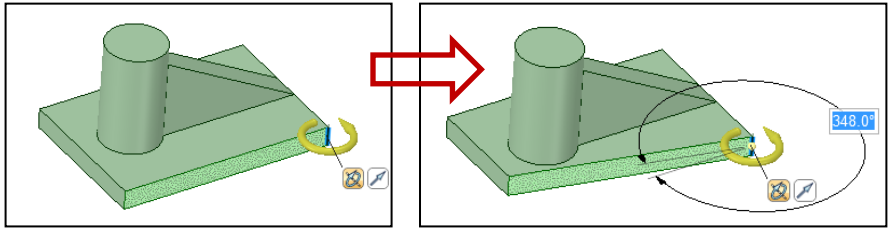
Face selected for Pull

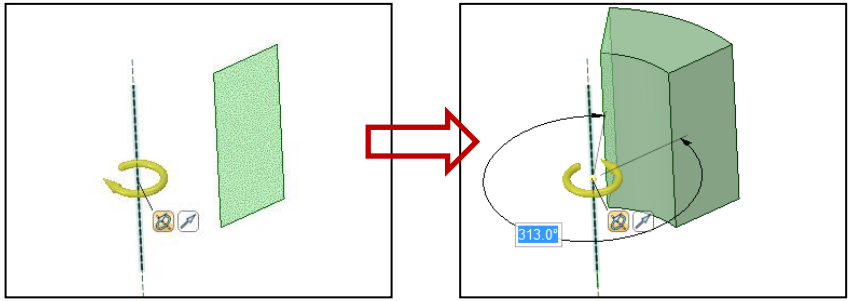
Blue Axis selected as axis of revolution

Face selected for Pull

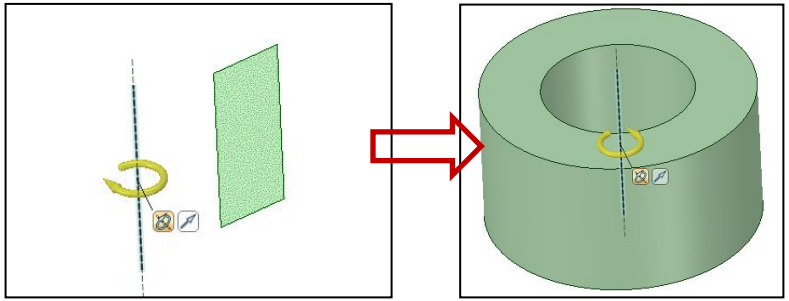
Blue Axis selected as axis of revolution

Revolve

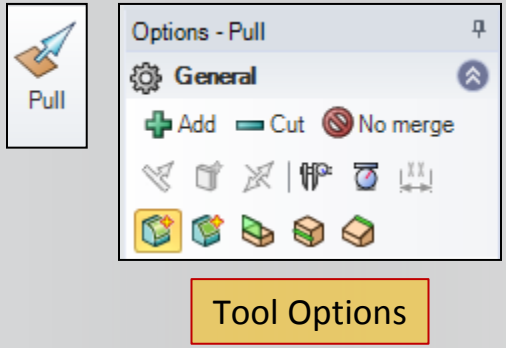


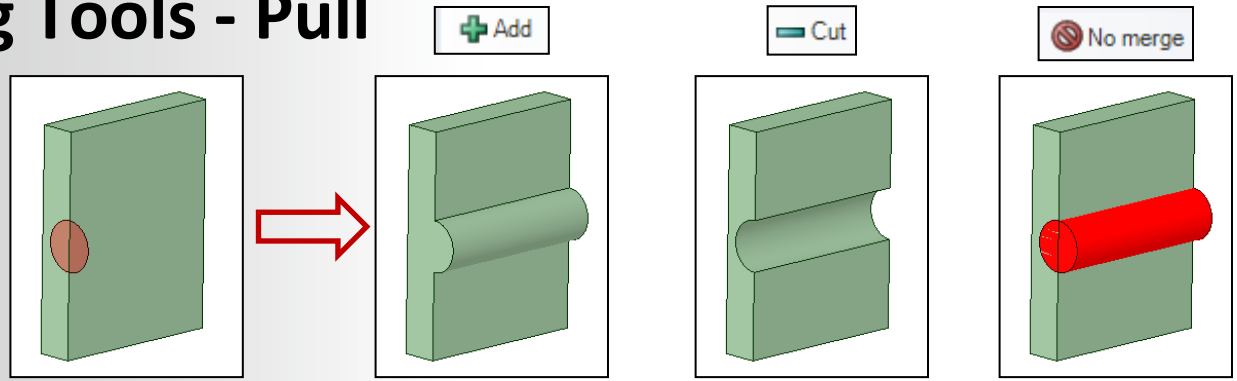

Revolve with Full Pull

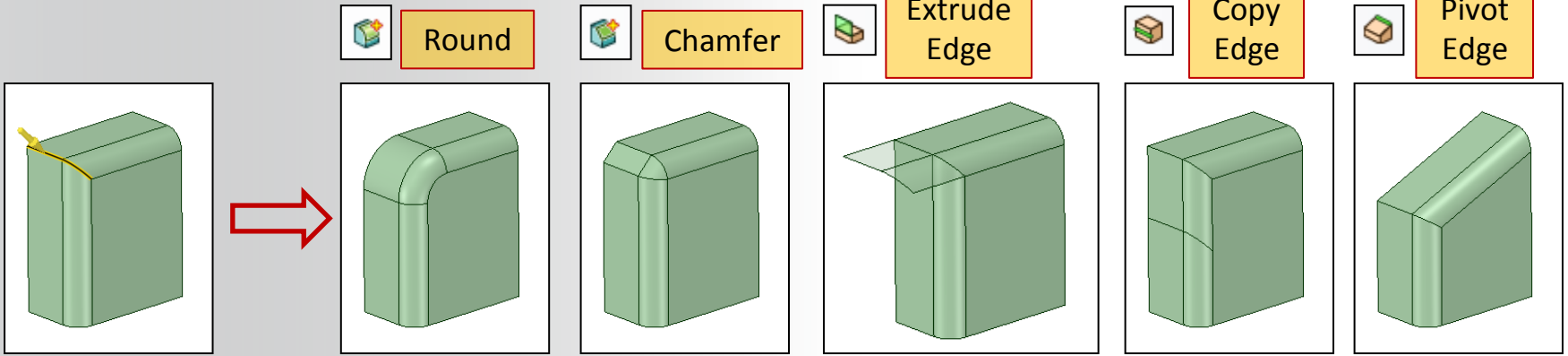


# Modeling Tools - Pull



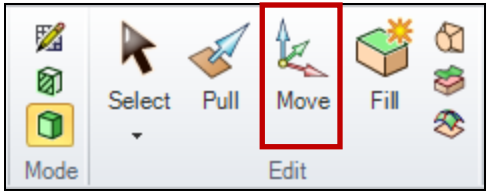

Tool Options




Face gets split

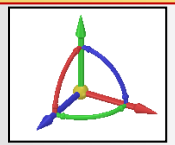
# Modeling Tools - Move



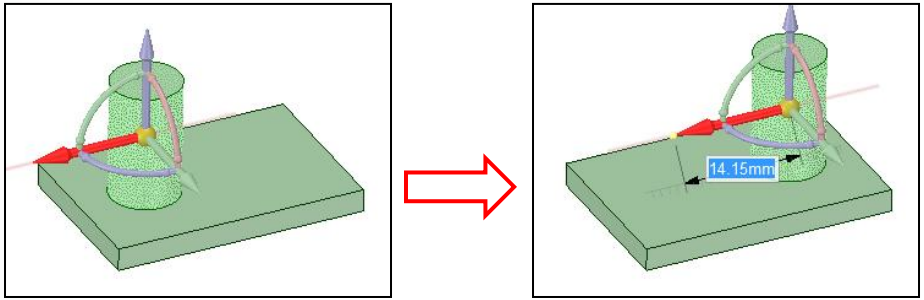

## Move tool

- Multi functional tool
  - Translate
  - Rotate
  - Pattern
- Move handle guides the direction of movement
  - Translational movement along 3 “linear” axes
  - Rotational movement along 3 “curved” axis
- Drag the selected object along the Move handle axis (linear, curved) to facilitate Move
- Distort or deform existing geometry
- Several tool guides available to alter tool behaviour

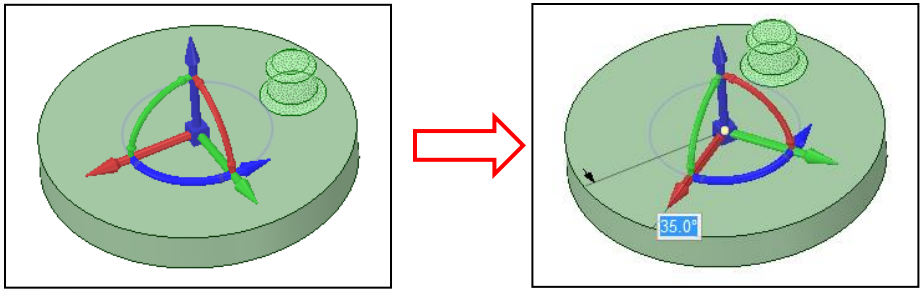
Move Handle



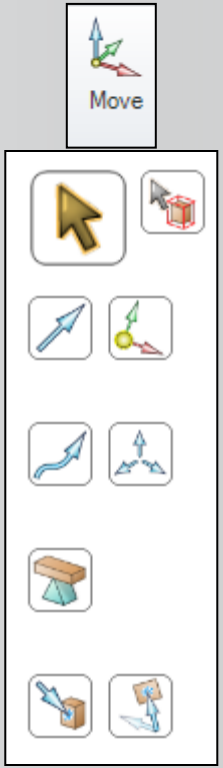
Translation movement




Rotational movement



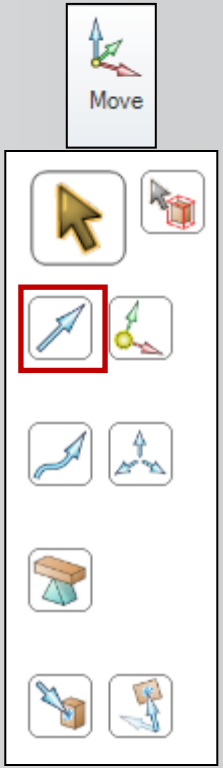
# Modeling Tools - Move




Tool Guide

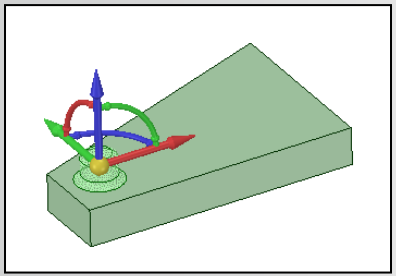
| | |
|---|---|
|  | **Select -** Select entities (faces, surfaces, solids, or components) |
|  | **Select Component -** Select solid |
|  | **Move Direction -** Set direction of move |
|  | **Anchor -** Change location of move handle |
|  | **Move Along Trajectory -** Select trajectory (edges, lines) to move along |
|  | **Move Radially about axis -** Move object radially about axis, line or linear edge |
|  | **Fulcrum -** Select plane or edge as pivot |
|  | **Up To -** Select destination object |
|  | **Orient To Object -** Orient object in selected direction |

# Modeling Tools - Move

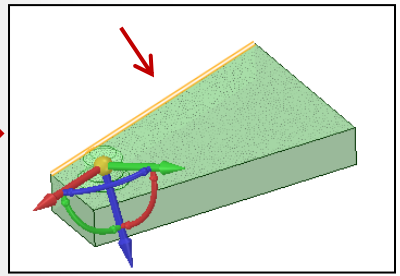



Tool Guide

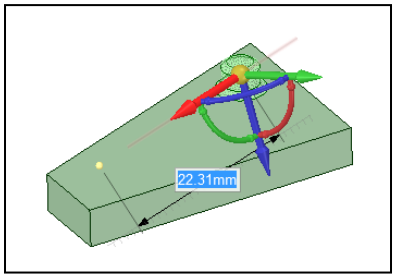
Move Direction



Select object for moving

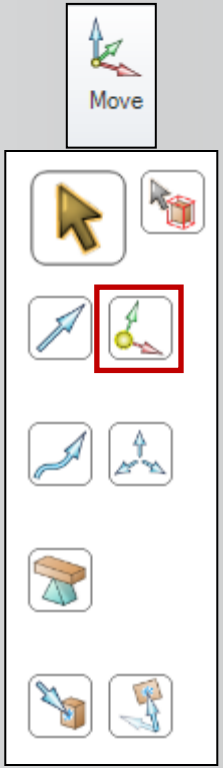


Select Edge as direction.
Move handle orients to align
Red axis with selected edge



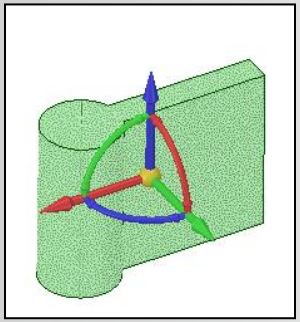

Drag selected object along
Red axis to move

# Modeling Tools - Move

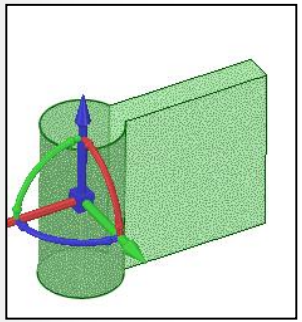



Tool Guide

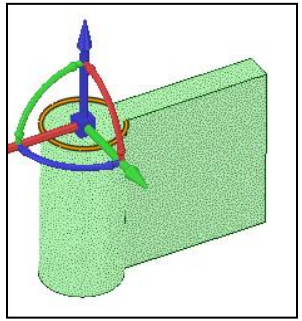
Anchor



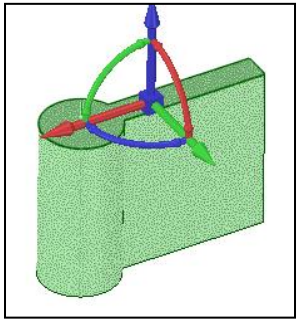
By default, Move handle located at centroid of selected entity



Move handle shifted to centroid of selected “face”



Move handle shifted to centroid of selected “edge”

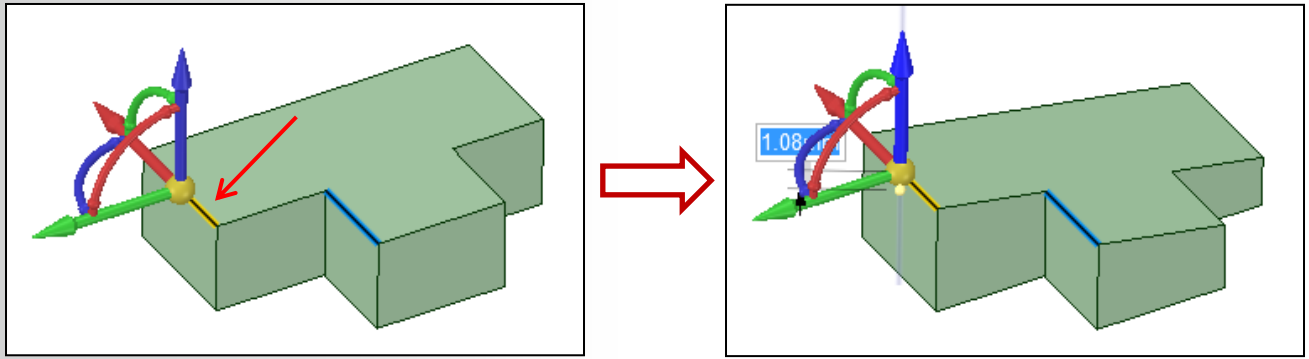


Move handle shifted to centroid of selected “face”

# Modeling Tools - Move

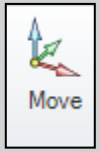

Tool Guide

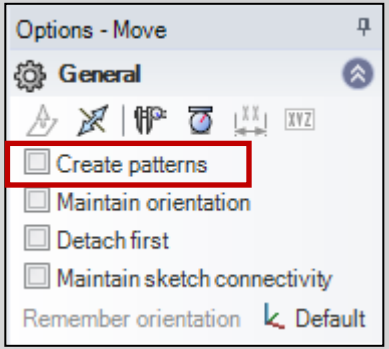
Fulcrum



Highlighted edge moved along “Blue” axis with “Blue edge” as fulcrum point

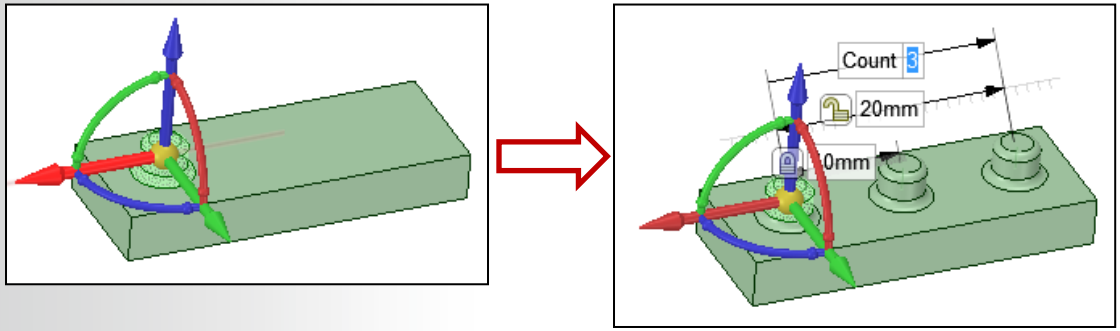
# Modeling Tools - Move



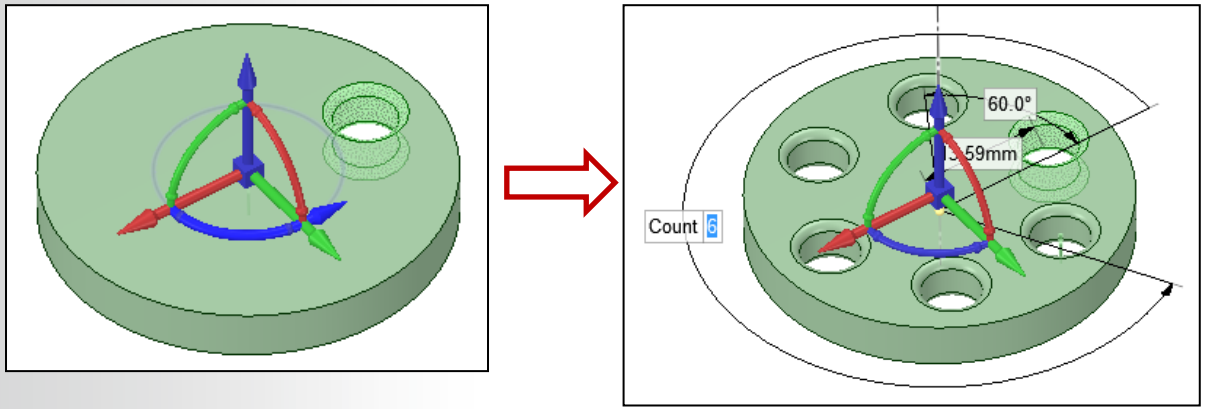




Tool Options

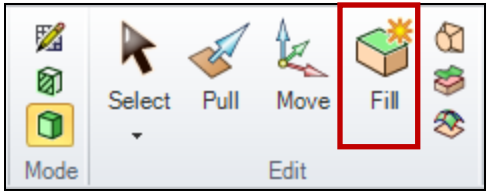
Rectangular Pattern




Circular Pattern

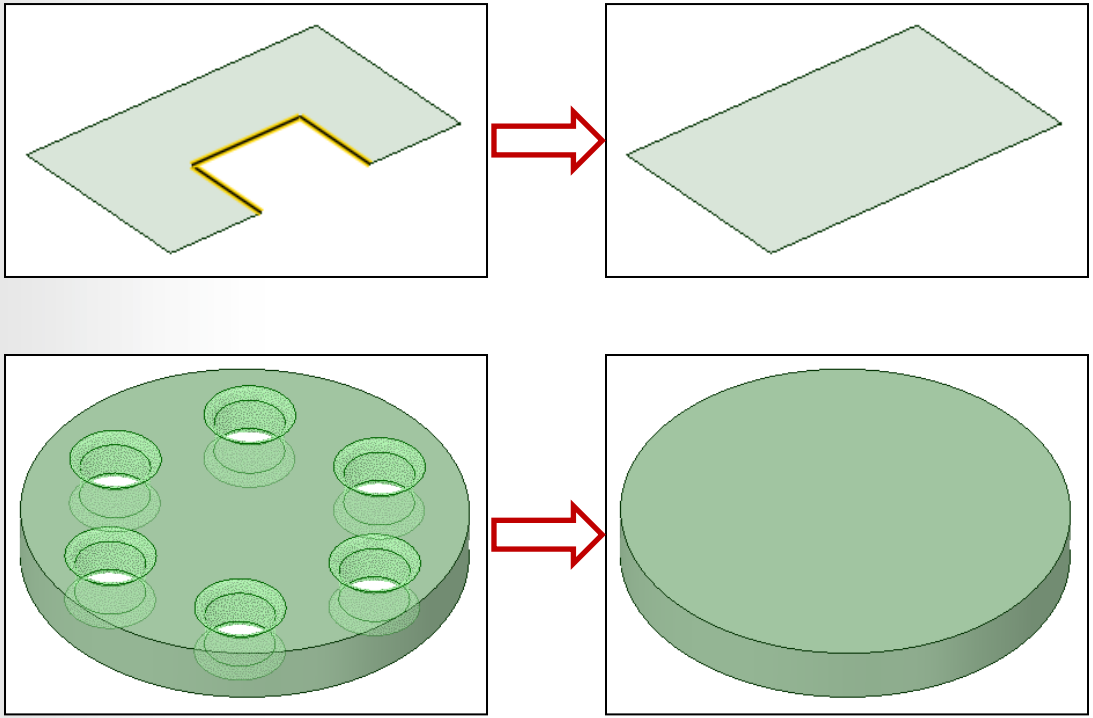


# Modeling Tools - Fill




## Fill tool

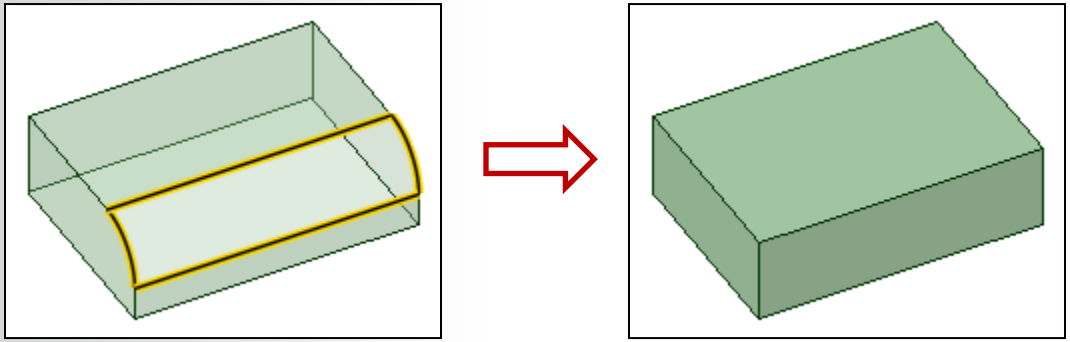
- Fill selected region with surrounding surface or solid
- Acts as a “healing” tool to remove:
  - Fillets
  - Chamfers
  - Holes
  - Protrusions
  - Depressions



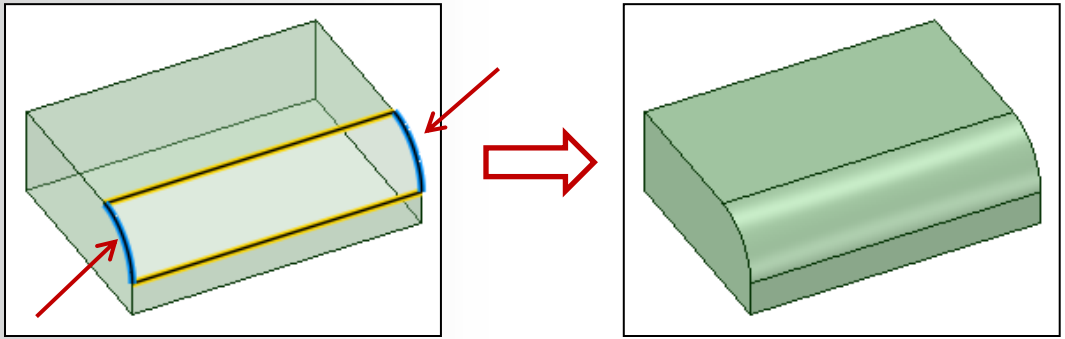
# Modeling Tools - Fill


Tool Guide

Fill (Default behavior)

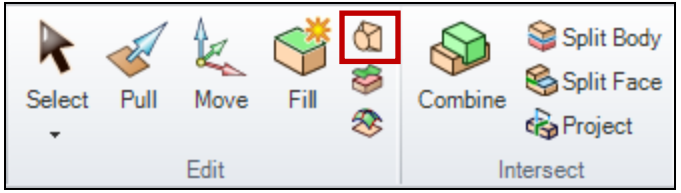


Fill – With Guide Curves



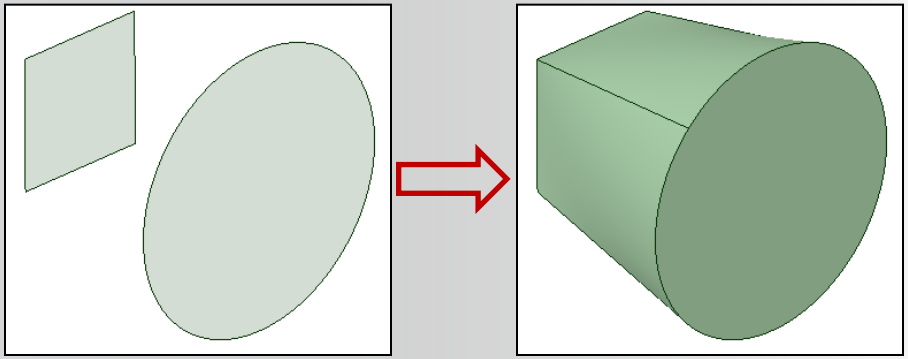
2 curve edges selected as guide curves

# Modeling Tools - Blend

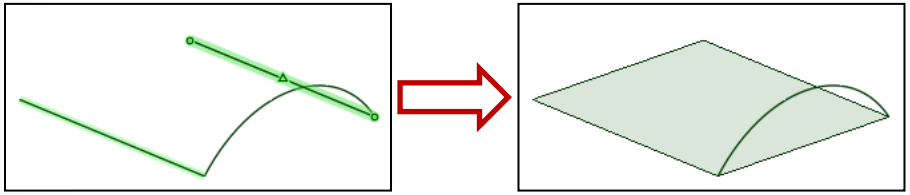



## Blend tool

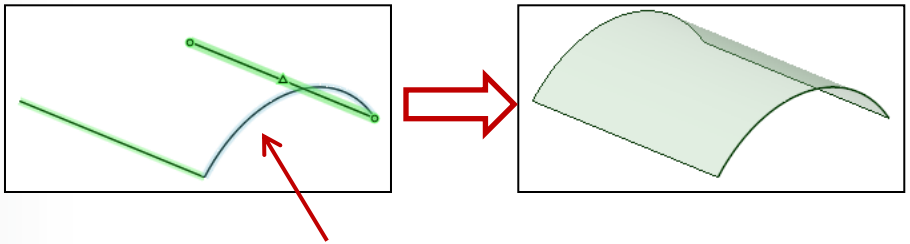
- Create blend between faces, surfaces, edges and curves



Without Guiding curve



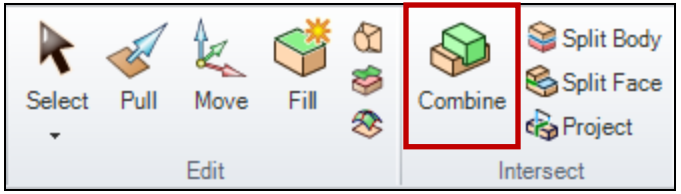
With Guiding curve

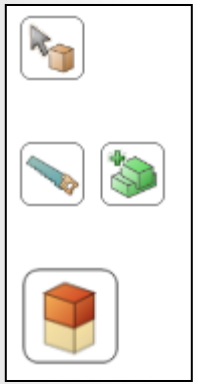


# Modeling Tools - Combine

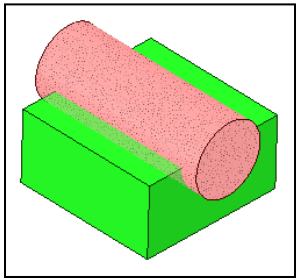
## Combine tool

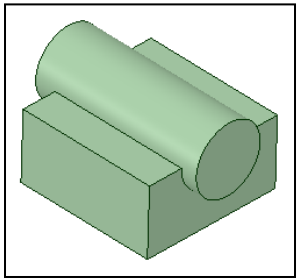
- Perform Boolean operations
  - Add
  - Subtract
- By default, second selected object acts as a cutter to perform subtract operation
  - Cutter tool guide gets activated once a body is selected
- Select multiple objects using “Ctrl” key to add them
  - “Merge” tool guide gets activated automatically
- Option to delete or retain left over region after subtract operation
  - “Regions to Remove” tool guide automatically gets activated after subtract operation



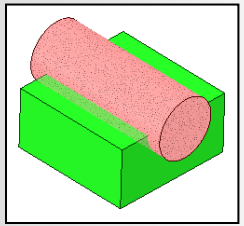



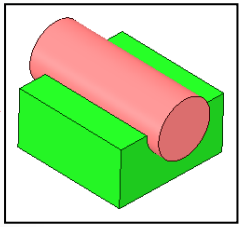
Merge multiple objects



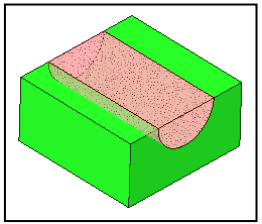


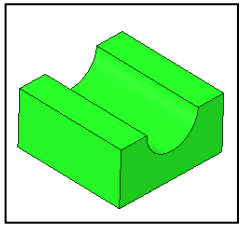
Select cylinder as cutter





Select region to remove

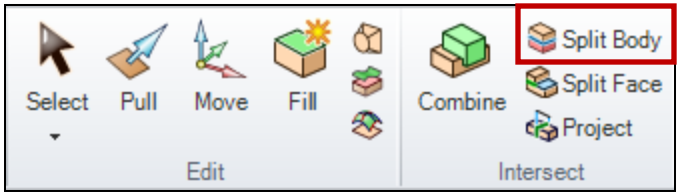




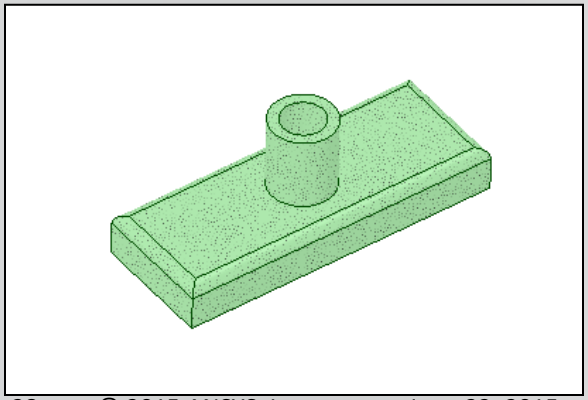
# Modeling Tools – Split Body

## Split Body Tool

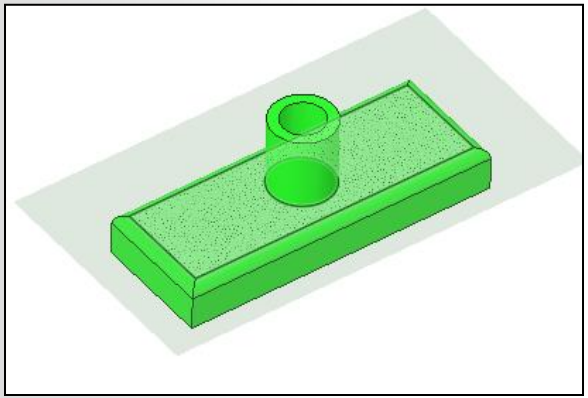
- **Split solid body using:**
  - **Face**
  - **Plane**
  - **Planar surface**
- **Split surface body using edge**



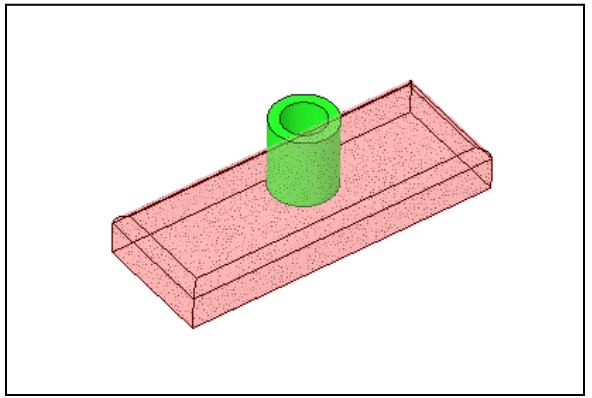

Select body to split



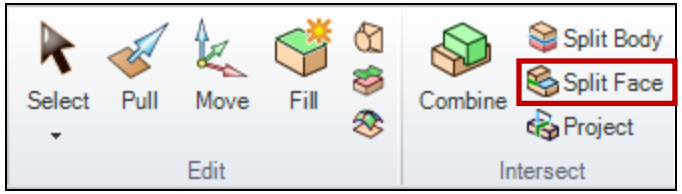
Select face to cut body



Select region to remove (optional)



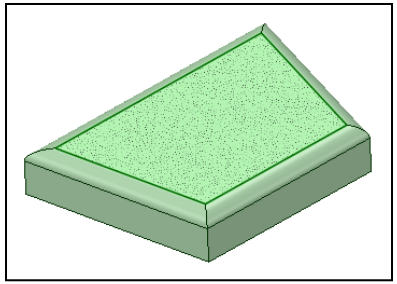
# Modeling Tools – Split Face




## Split Face Tool

- **Split face using:**
  - **UV Cutter point**
  - **Perpendicular cutter point**
  - **2 cutter points**
  - **Face**

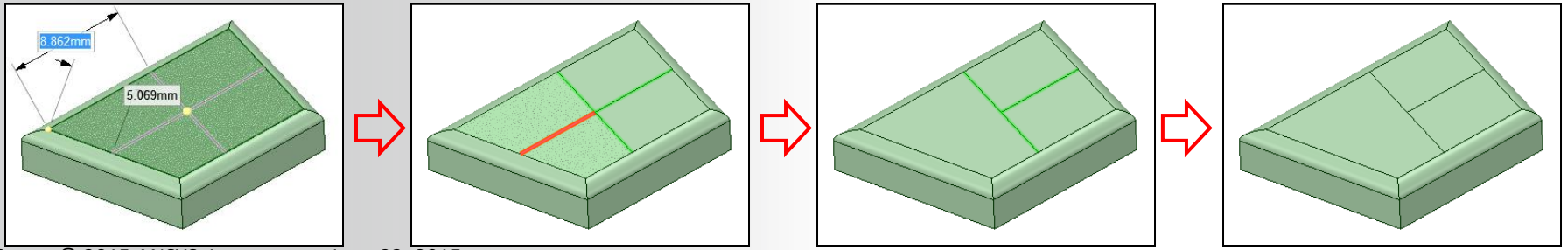
UV cutter point



Face to be split

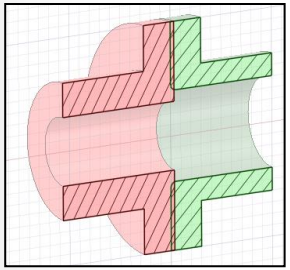
Move mouse over face to preview split. Click to split face at selected location

Select unwanted edges (red) to remove



# Modeling Tools – Working in Section Mode

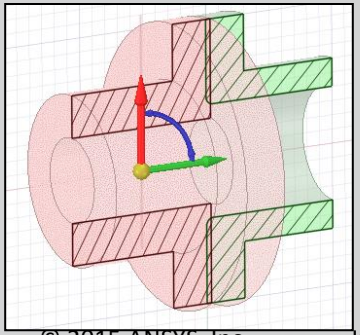
- **Section mode helps to edit solids and surfaces by working with their edges in a cross section**
- **Useful for complex models that requires repair/cleanup of internal details**



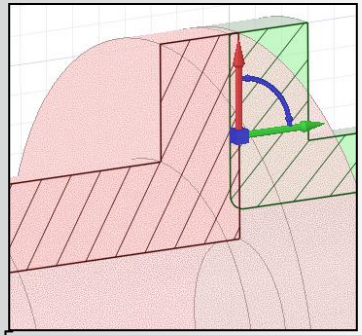
Problems with geometry:
Overlap
Small feature (fillet)
Inconsistent inner hole diameters

1. Remove overlap using Move tool

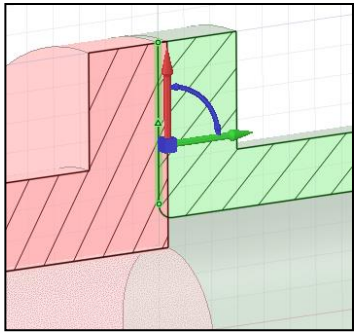
Enable “Select Component” tool guide and select any edge to select the solid body



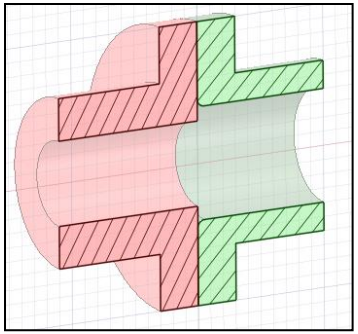
Select “Anchor“ tool guide and position move handle on outermost edge



Select “Up To” Tool guide and select green highlighted edge

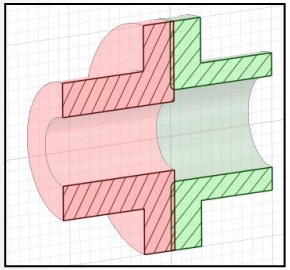


Body is now touching adjacent body (no overlap)



# Modeling Tools – Working in Section Mode

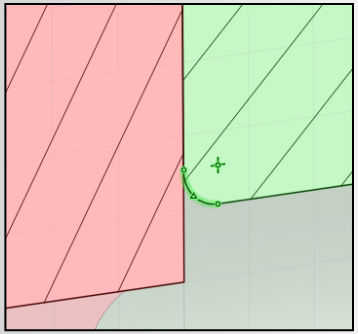
- **Section mode helps to edit solids and surfaces by working with their edges in a cross section**
- **Useful for complex models that requires repair/cleanup of internal details**



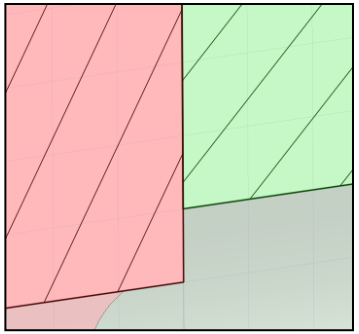
Problems with geometry:
Overlap
Small feature (fillet)
Inconsistent inner hole diameters

2. Remove small feature (fillet) using Fill tool

Select edge representing fillet

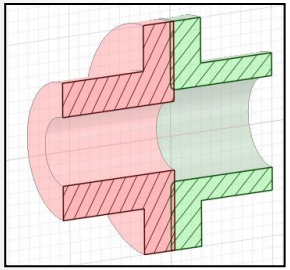


Fillet is now removed



# Modeling Tools – Working in Section Mode

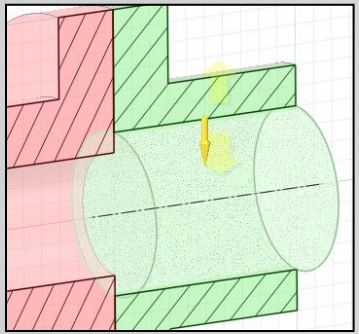
- **Section mode helps to edit solids and surfaces by working with their edges in a cross section**
- **Useful for complex models that requires repair/cleanup of internal details**



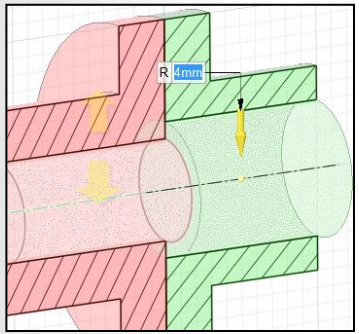
Problems with geometry:
Overlap
Small feature (fillet)
Inconsistent inner hole diameters

3. Make inner holes diameter consistent using Pull tool

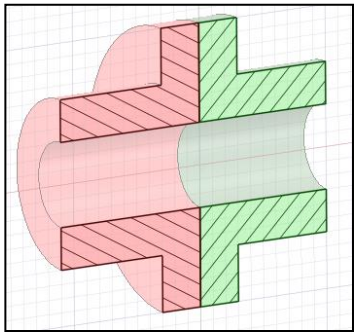
Select edge representing hole



Using “Up To” tool guide, select inner edge of adjacent body




Final geometry

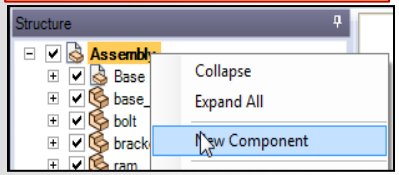


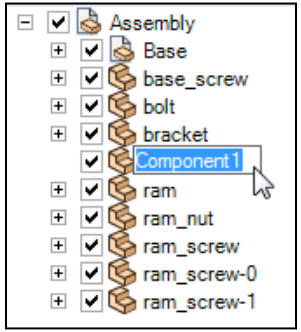
# Modeling Tools – Working with Assemblies

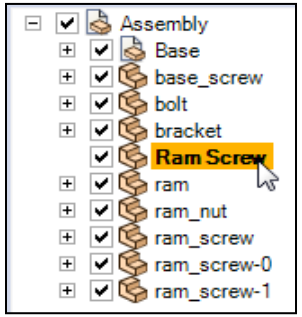
## Components

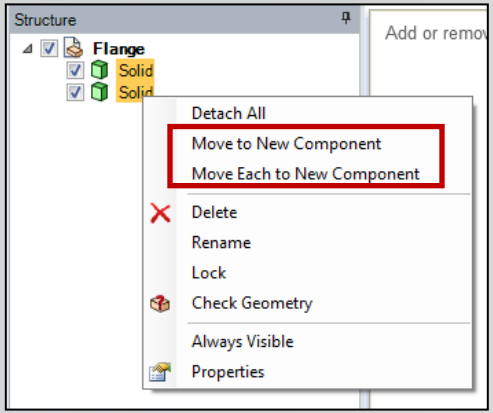
- **Create components to better organize bodies in the Structure tree**

Right click on topmost assembly to create "New component"

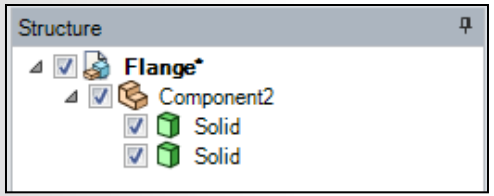


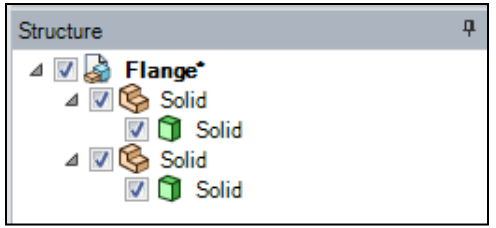




Move to New Component



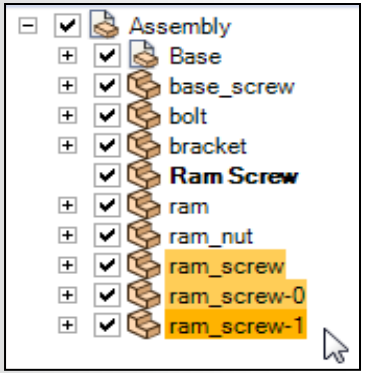

Move Each to New Component

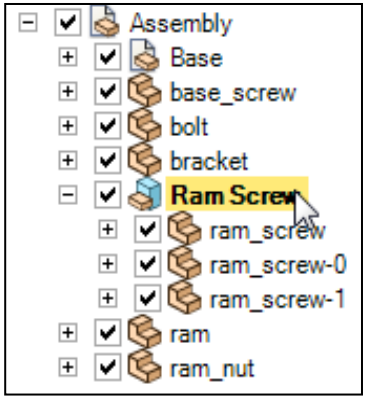


# Modeling Tools – Working with Assemblies

## Components

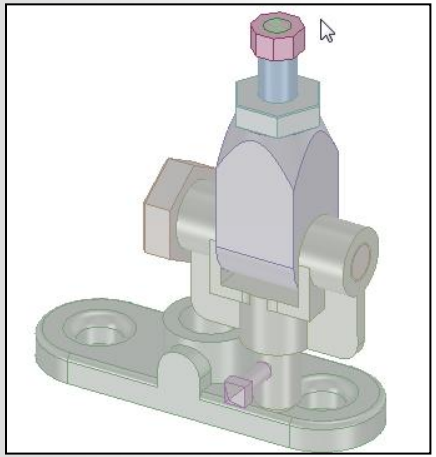
- Reorder bodies/components using drag and drop




## Active Component

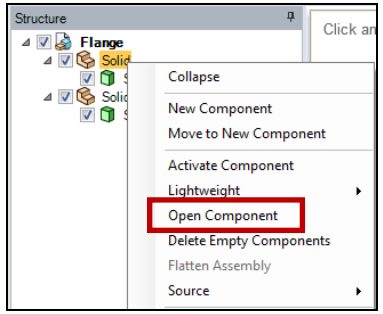
- Allows to work with objects within that component
- Other components get greyed out
- To activate, right click on the component and select “Activate Component”

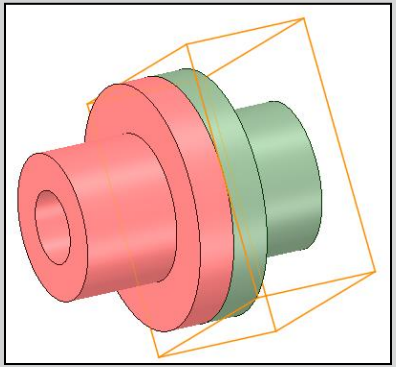


# Modeling Tools – Working with Assemblies

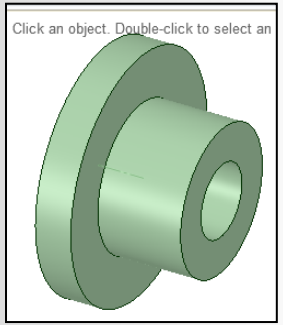
## Open Component

- **Ability to work on a specific component by opening it in a new session**
  - **Right click and select “Open Component”**
- **Changes made to the component objects get reflected in the original model**

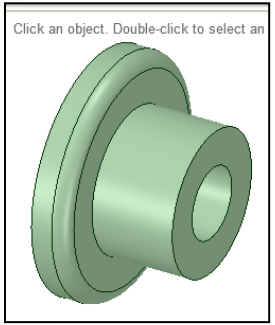


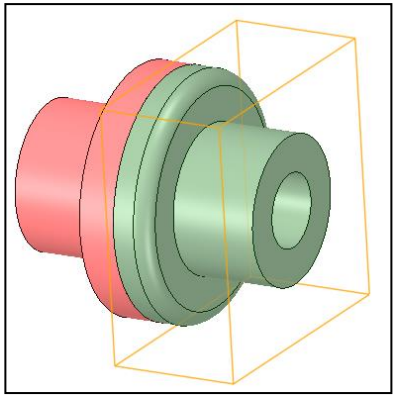
Component opened in new session




Changes made to component (added fillet)



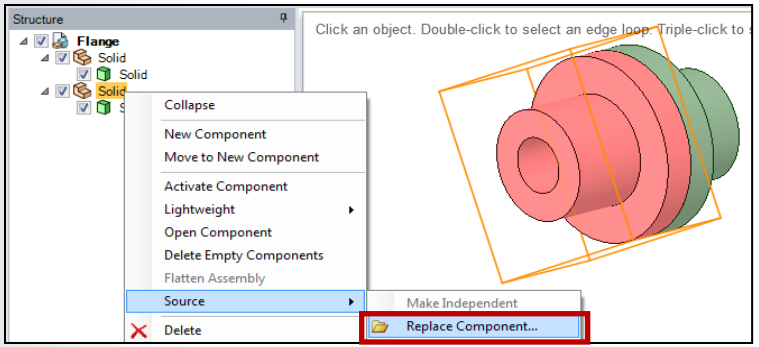

Changes reflected in original model

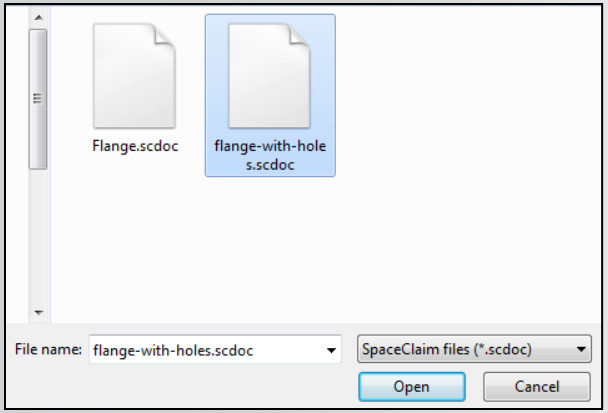


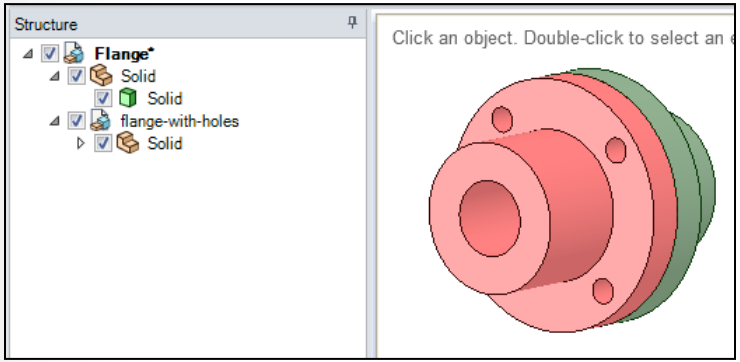
# Modeling Tools – Working with Assemblies

## Replace Component

- **Replace an existing component with another saved component**
  - **Reuse existing models**



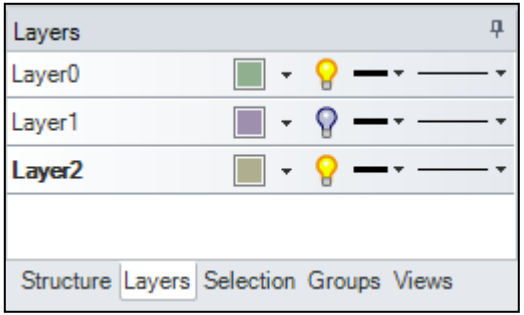



# Modeling Tools – Working with Layers

## Layers

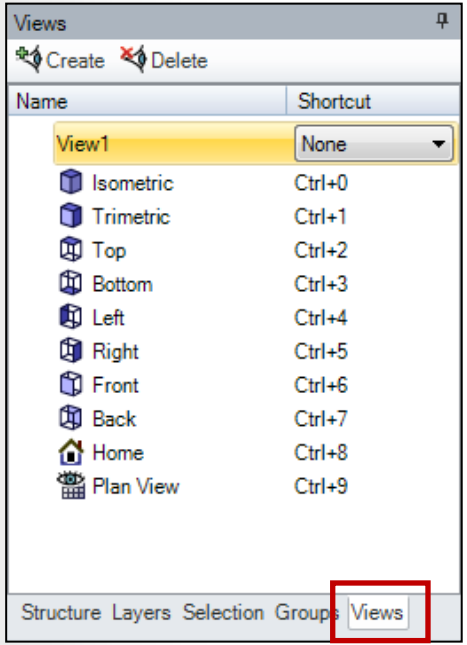
- Useful for grouping objects based on visual characteristics
  - Visibility
    - Click bulb icon to change visibility
      - Objects are hidden
      - Objects are visible
  - Color
  - Linestyle
- Right click in Layers panel and select “New” to create a new layer
  - Set appropriate layer color
  - All new objects created in this layer will have the same layer color
- To add selected objects to a layer, right click on the desired layer and select “Assign To Layer”



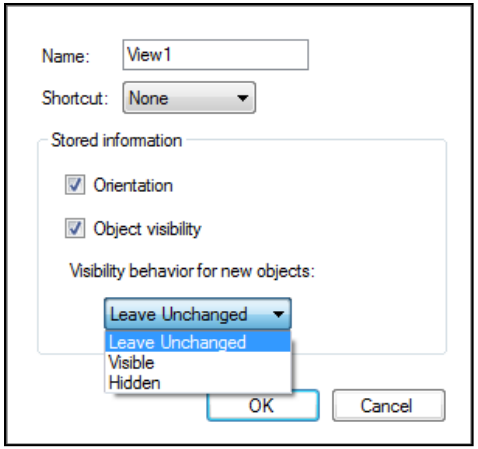
# Modeling Tools – Managing Views

## Views

- Change shortcuts for standard views
- Create custom views to save object orientation and visibility
- Control visibility behavior for custom views
  - Leave Unchanged: New objects retain their visibility
  - Visible: New objects become visible
  - Hidden: New Objects get hidden

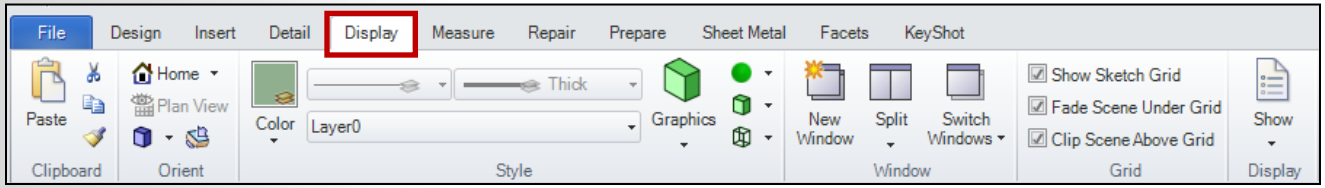



Create View Panel



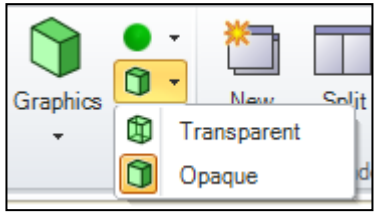
# Display

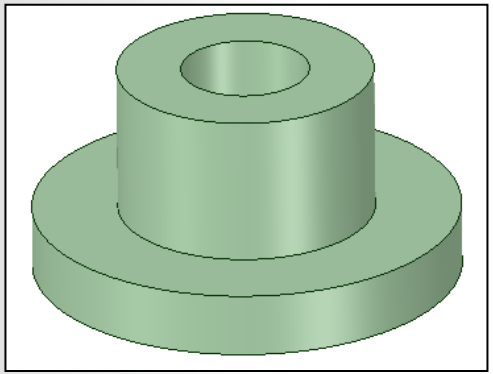
## Display tab



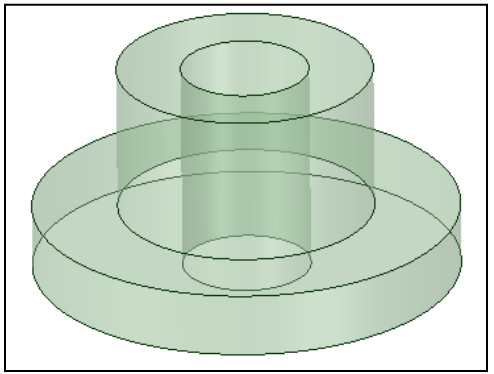

- **Hosts several features for managing display of geometry**
  - **Cut, Copy, Paste objects**
  - **Standard and custom view**
  - **Change object color**
  - **Manage layers**
  - **Change graphics mode**
    - **Wireframe, shaded etc.**
  - **Rendering options**
  - **Change transparency**
  - **Arrange graphics windows**
  - **Etc.**

Change Transparency



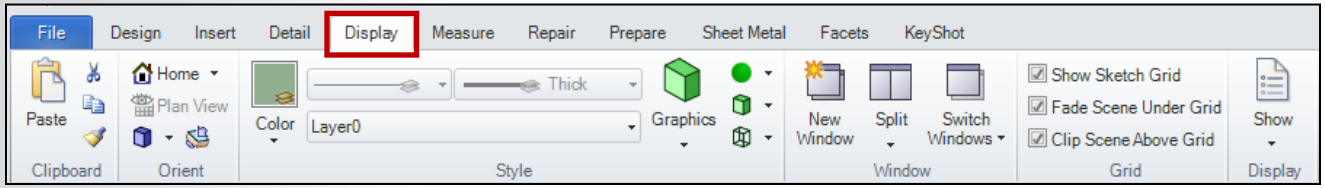



Opaque



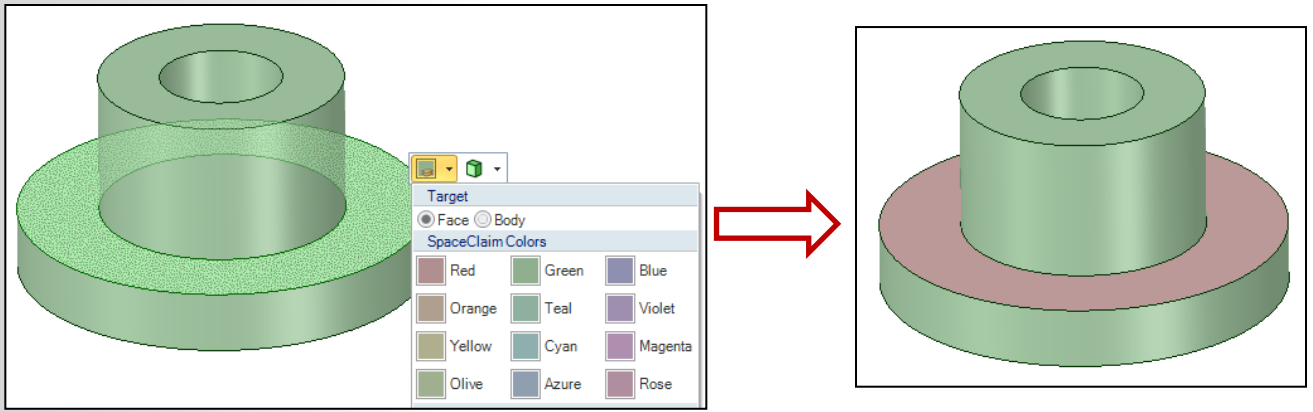
Transparent

# Display

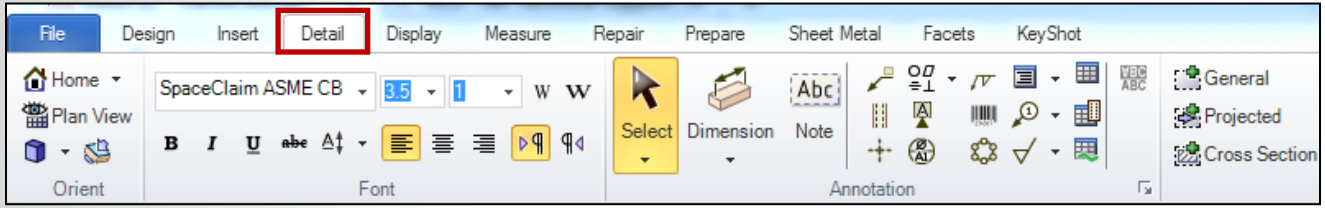



## Display tab

- Change face color
  - Select face
  - Right click and open Color panel
  - Select “Face” target
  - Select desired color

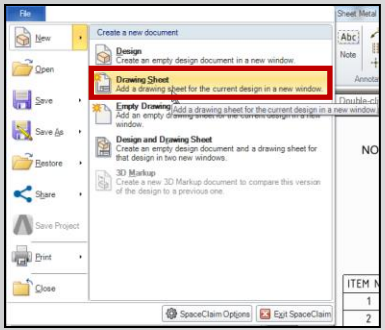


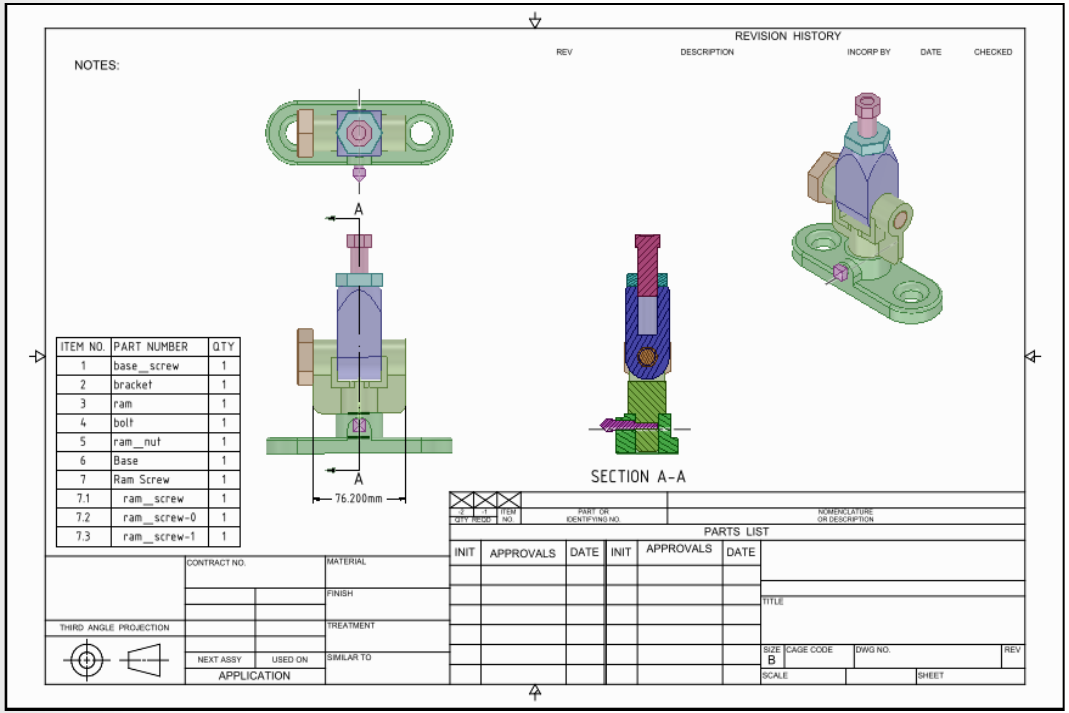
# Detailing




## Detail tab

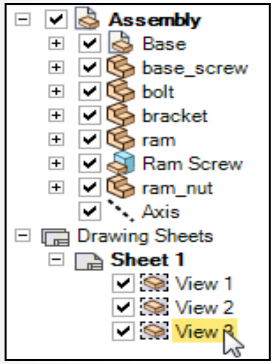
- Create drawing sheets for the current model. Views of the design are created automatically which can then be edited or moved on the sheet.
- Drawing sheets are saved within your design.
- To insert a new drawing sheet go to File > New > Drawing Sheet

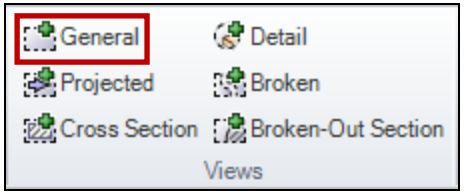


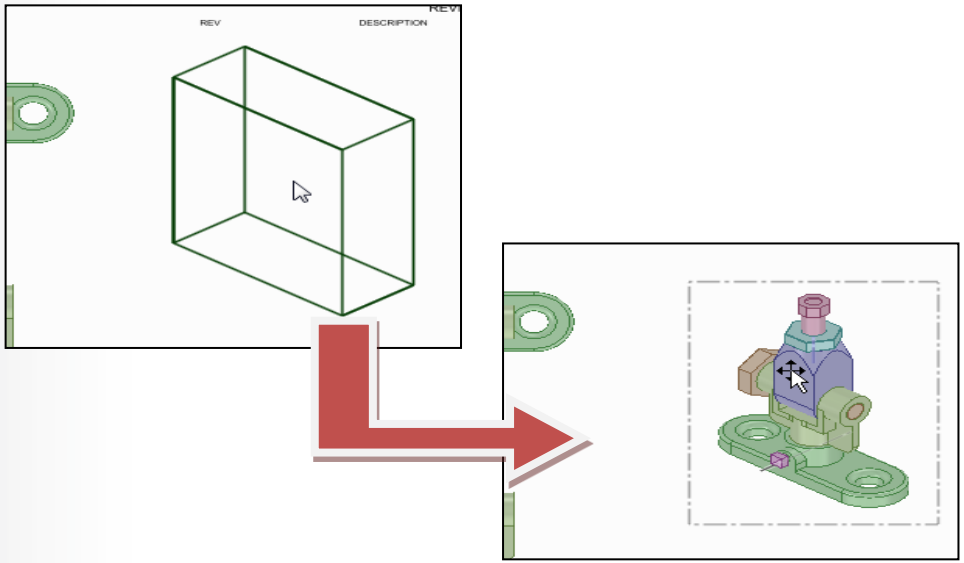



# Detailing

- You can add Dimensions, Cross Sections, General Views, and Annotations
- In the Structure tree, expand ‘Drawing Sheets’ and then ‘Sheet 1’ to show the Views on the sheet
- To insert a new General view
  - Click on ‘General’ button in the Views Ribbon group.
  - Place the preview box in the empty area on the sheet.
  - Note: Select a View (inside the dashed grey outline) and drag to move it on the Drawing Sheet.

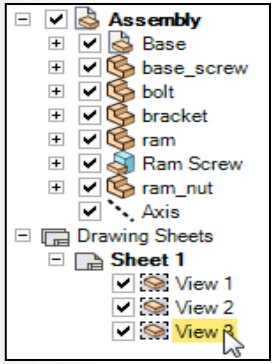


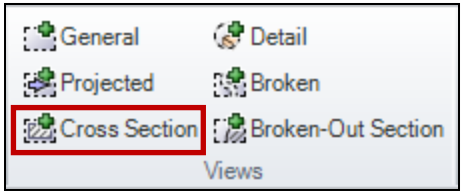



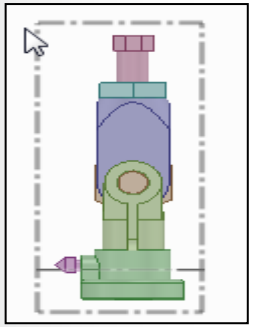



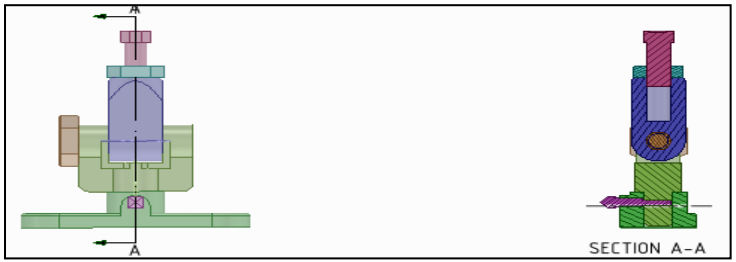
# Detailing

- **To view the cross-section**
  - **Select the ‘Cross Section’ button.**
  - **Select View 3 (the Side view).**
  - **Drag the mouse over View 1 (the Front view). As you move the mouse, View 3 should appear as a cross section.**
  - **Click to place the section plane.**



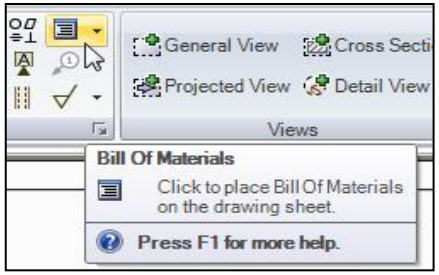



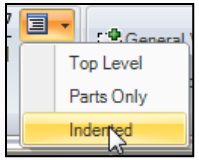



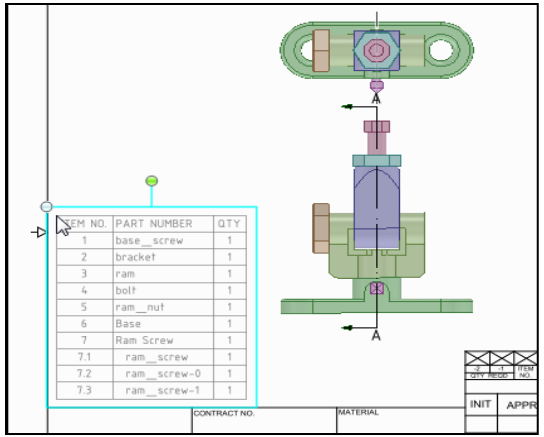



# Detailing

- **Insert Bill of Materials**
  - **Select the Bill of Materials button in the Annotation Ribbon group.**
  - **Select Indented from the dropdown.**
  - **Place the BOM in the corner of the Drawing Sheet.**



# Detailing

- **Add Annotation**
  - **You can add Notes, Dimensions, Geometric Tolerances, Surface Finish, Datum Symbols, Center Marks, Center Lines, and Threads.**
  - **Use the 'Select' tool to select the highlighted object**
  - **Use the 'Dimension' tool to create a measured dimension.**
    - **Select one side of the 'bracket,' then the other.**
    - **Note: Placing a dimension with one reference will display the length of the edge, and with two references will display the distance or angle between them.**
  - **Use the Note tool to enter text onto the plane**