

CATIA V5 Parametric Surface Modeling

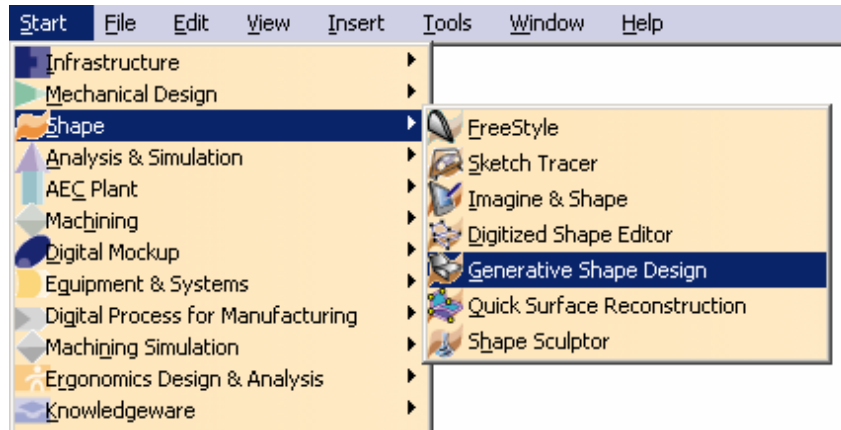
Version 5 Release 16



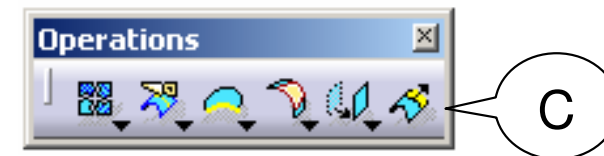
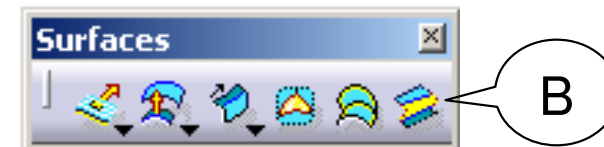
Generative Shape Design

A- 1

Toolbars in Generative Shape Design

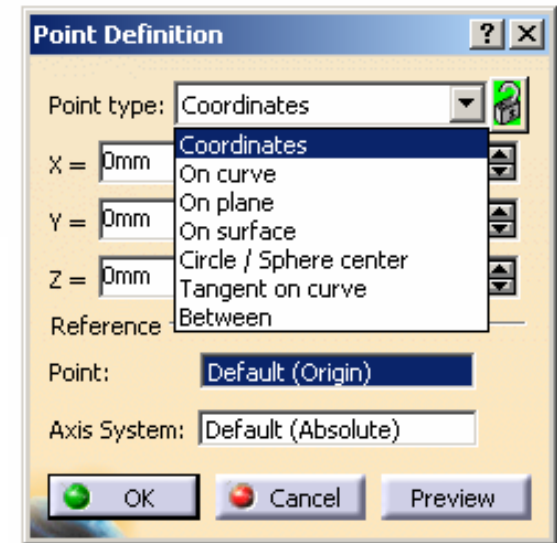



- A. **Wireframe:** Create 3D curves / lines/ points/ plane
- B. **Surfaces:** Create surfaces
- C. **Operations:** Join surfaces, Split & Trim surfaces, Change the 3D positions of surfaces, Fillets...
- D. **Replication:** Pattern, Powercopy...
- E. **Analysis:** Connection analysis, Draft analysis, curvature analysis...
- F. **Surface-based Features:** (On Part Design Workbench), create a solid from surfaces, modify the solid by a surface...



Point

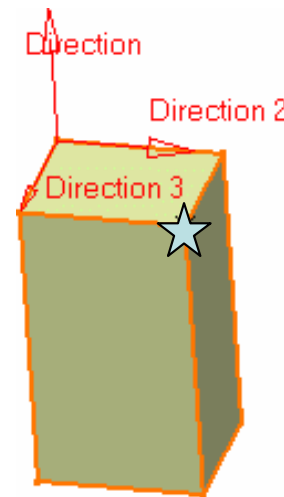
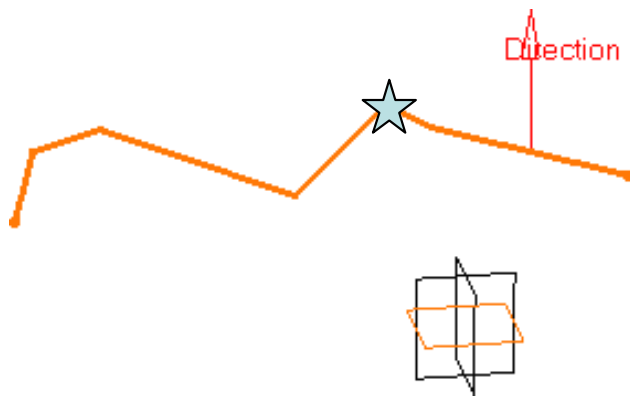
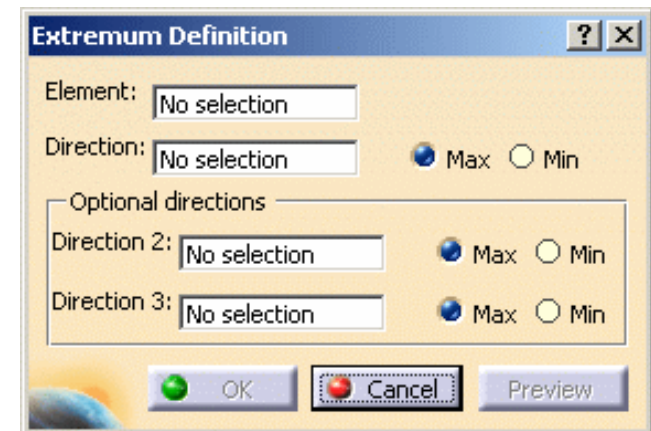
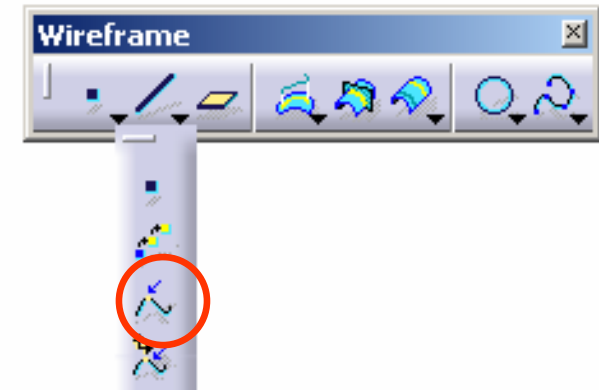
Point (Create a point in the 3D space)



Type	Description
Point by Coordinates	Create a point by defining its coordinates in 3D.
Point on a Curve	Create a point on a curve at a distance from a reference point.
Point on a Plane	Create a point on a plane at a distance from a reference point.
Point on a Surface	Create a point on a surface at a specified distance and direction from a reference point.
Point at a Circle/Sphere Center	Create a point at the center of a circle/Sphere.
Point Tangent on a Curve	Create curve tangent points for a specified direction.
Point Between Two Points	Create a point between two existing points using a ratio value.
Points Spaced on a Curve	Create several points equally spaced on a curve 

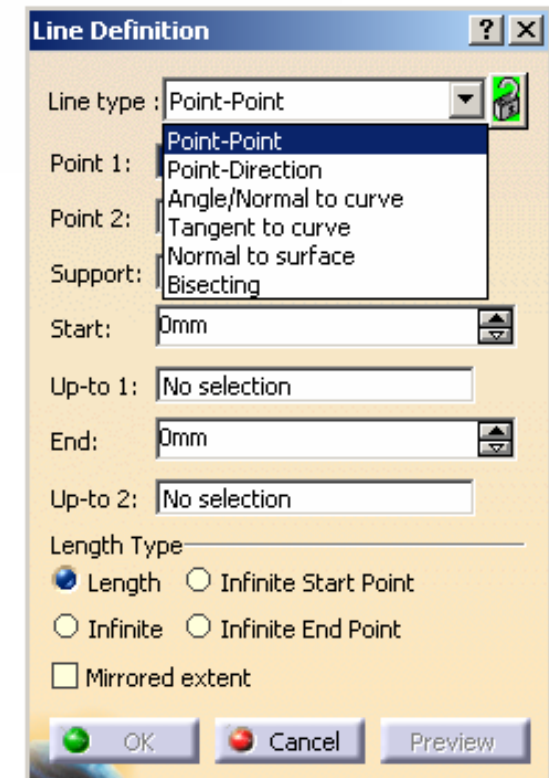
Extremum (max or min point)


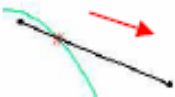
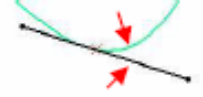



Extremum (create an extremum element (point, edge, or face), which is at the minimum or maximum distance on a curve, a surface, or a pad, according to given directions.)



Line









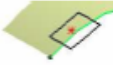
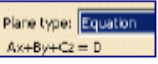


Line (Create a line in the 3D space)

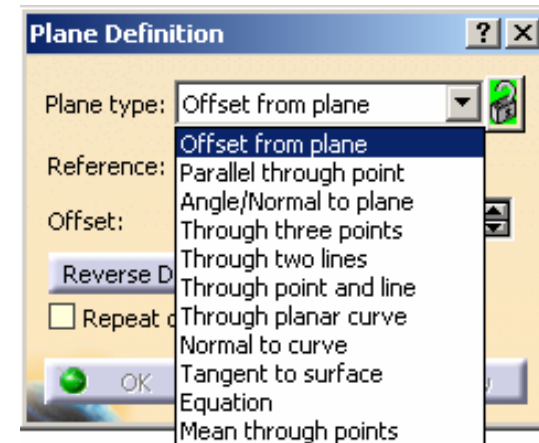


Type	Geometry	Description
Line Between Two Points		Create a line between two selected points.
Line from a Point and Direction		Create a line based on a reference point and a specified direction.
Line at an Angle or Normal to a Curve		Create a line at an angle to a curve that passes through a point.
Line Tangent to a Curve		Create a line tangent to a single curve, a point and a curve, or two curves.
Line Normal to a Surface		Create a line normal to a surface at a selected point.
Bisecting Line		Create a line that splits the angle between two lines into equal parts.

Plane

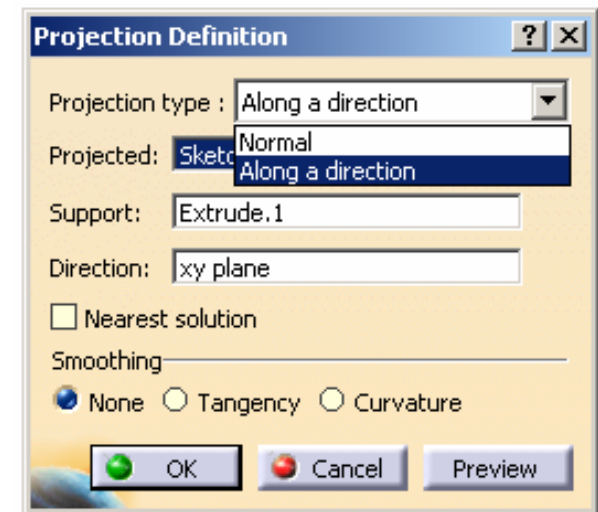
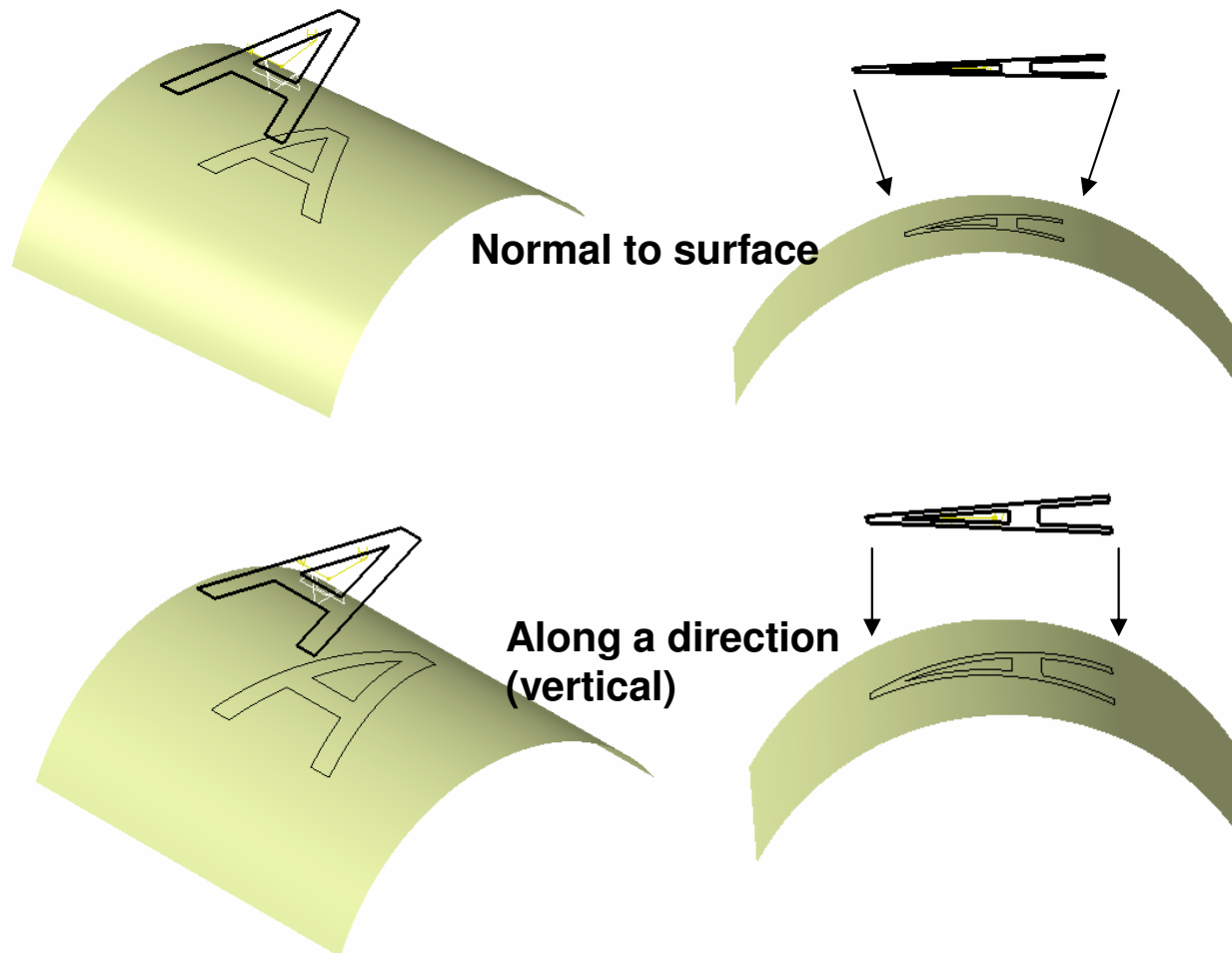
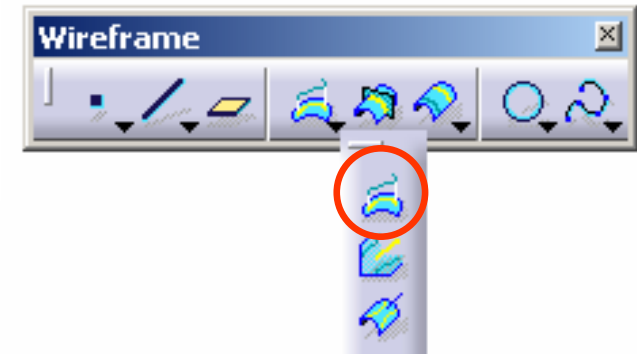
Plane (Create a plane in the 3D space)

Type	Geometry	Description
Offset Plane		Create a plane parallel to a reference plane offset at a distance.
Parallel Plane through a Point		Create a plane parallel to a reference plane through a point.
Plane at an Angle or Normal to a Plane		Create a plane at an angle to a reference plane based on a rotation axis.
Plane through 3 Points		Create a plane passing through 3 points.
Plane through 2 Lines		Create a plane passing through 2 lines.
Plane through a Point and a Line		Create a plane passing through a point and a line.
Plane through a Planar Curve		Create a plane passing through a planar curve.
Plane Normal to a Curve		Create a plane normal to a curve at a specified point.
Plane Tangent to a Surface		Create a plane tangent to a surface passing through a specified point.
Plane by an Equation		Create a plane by defining the components of the equation of the plane.
Mean Plane through Points		Create a plane defined as the mean through 3 or more points.
Plane Spaced Between 2 Planes		Create several planes spaced equally between 2 selected reference planes.



Projection onto a support

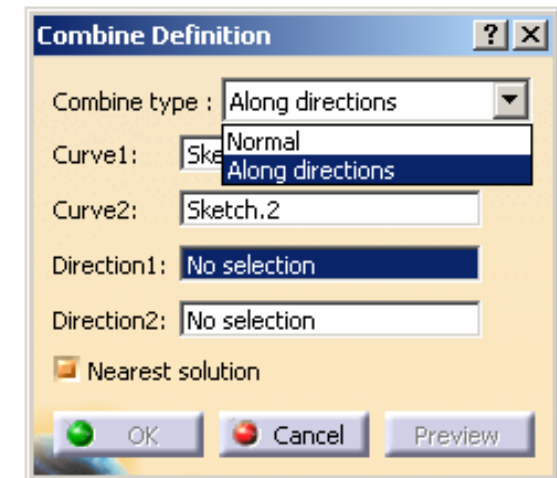
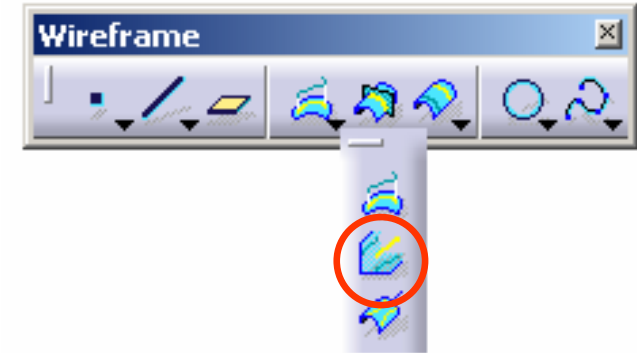
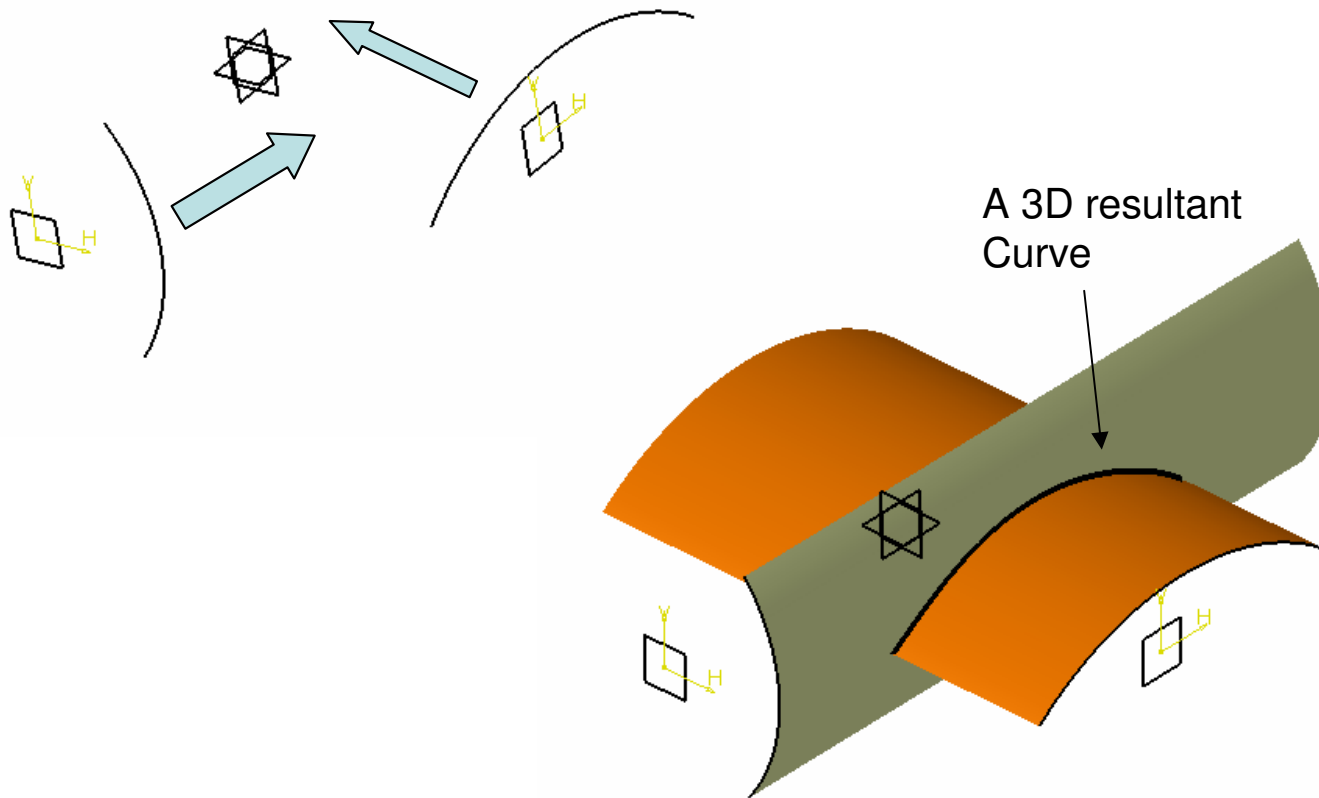
Projection (project one or more elements onto a support. The projection can be normal to surface or along a specified direction.)



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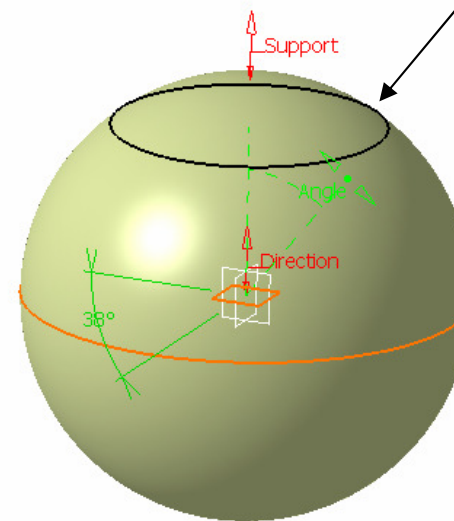
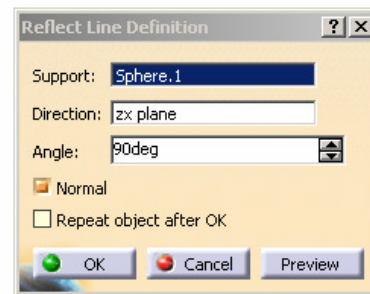
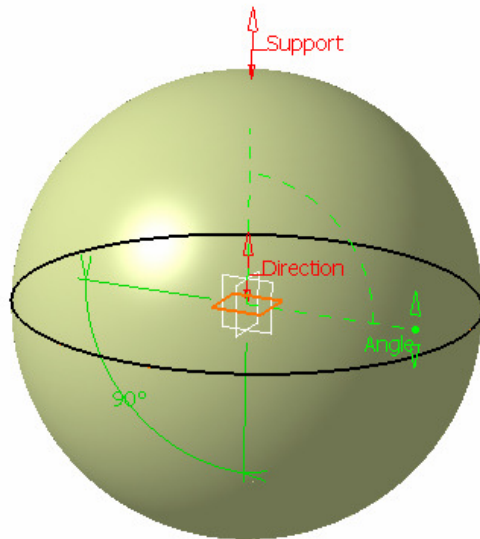
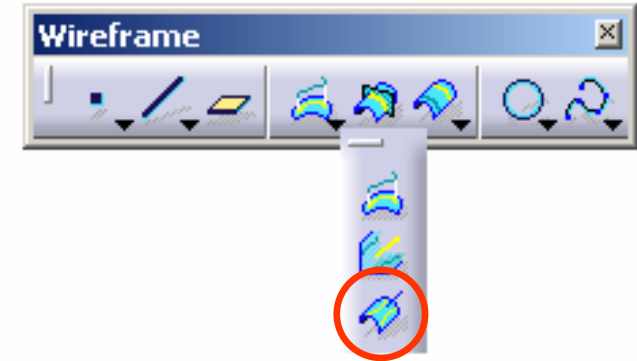
Combine Curves

Combine Curves (create a curve resulting from the intersection of the extrusion of two curves.)

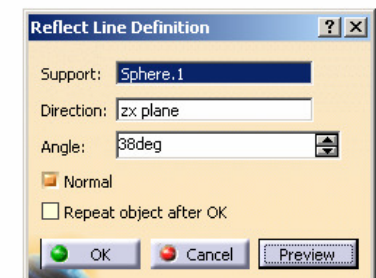


Reflect Line

Reflect Line (create curves for which the normal to the surface in each point present the same angle with a specified direction. They can be closed or open.)

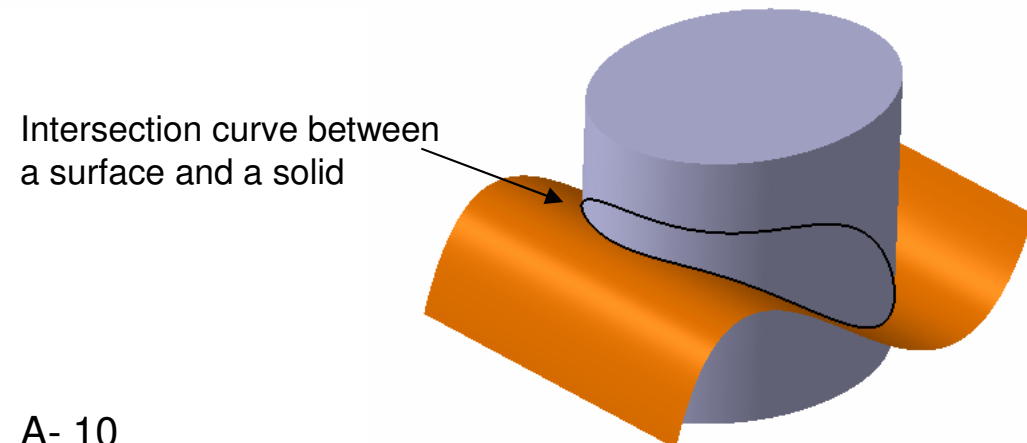
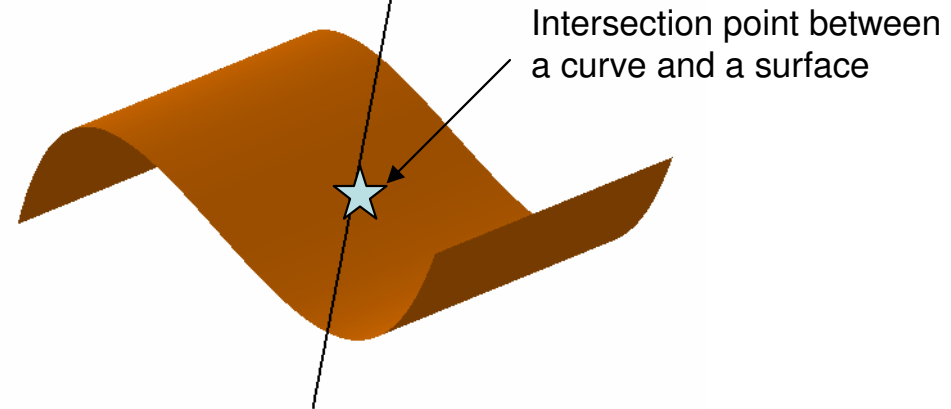
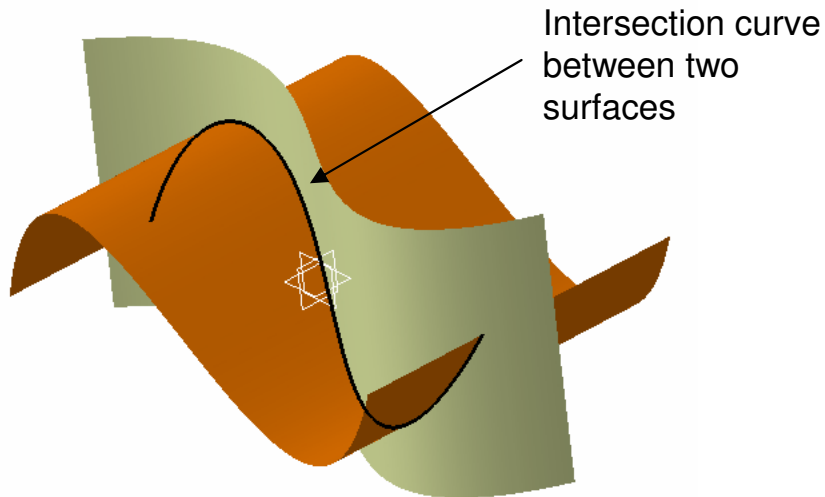


The normal of surface at all points along the curve is 38deg from the vertical axis



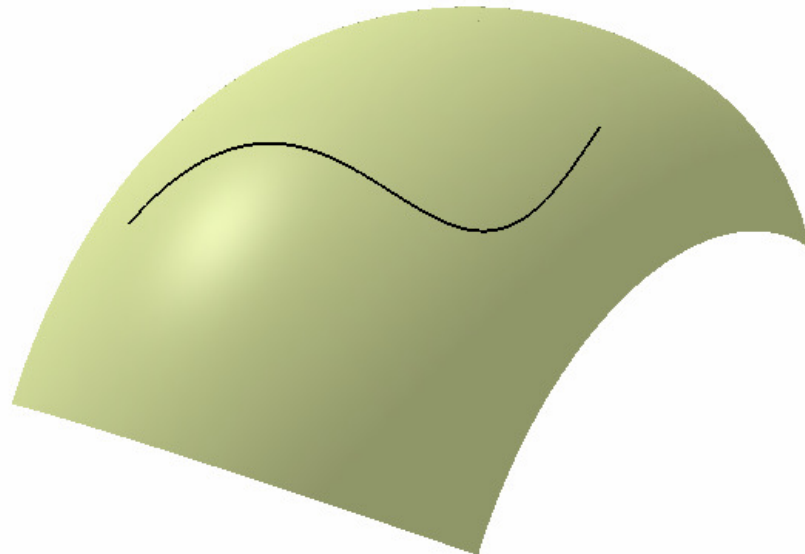
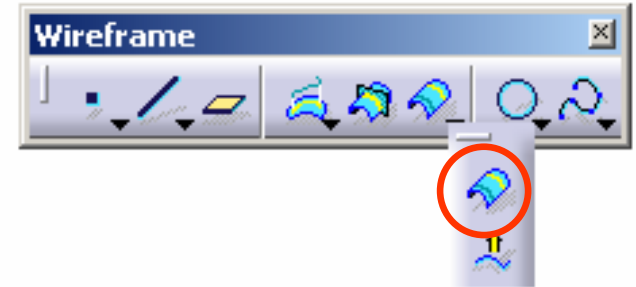
Intersection

Intersection (create wireframe geometry by intersecting elements.)



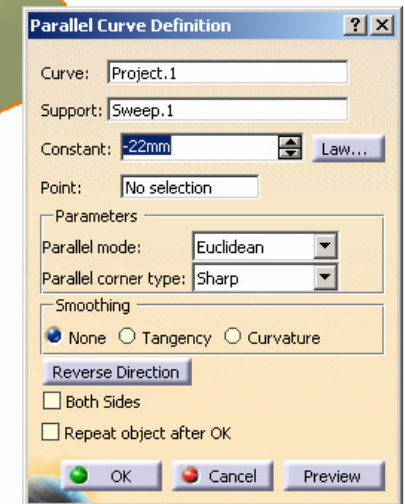
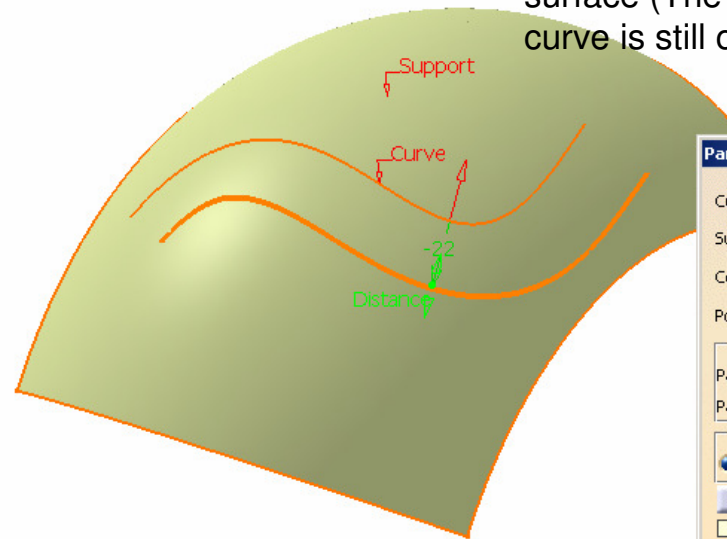
Parallel Curve

Parallel Curve (create a curve that is parallel to a reference curve.)



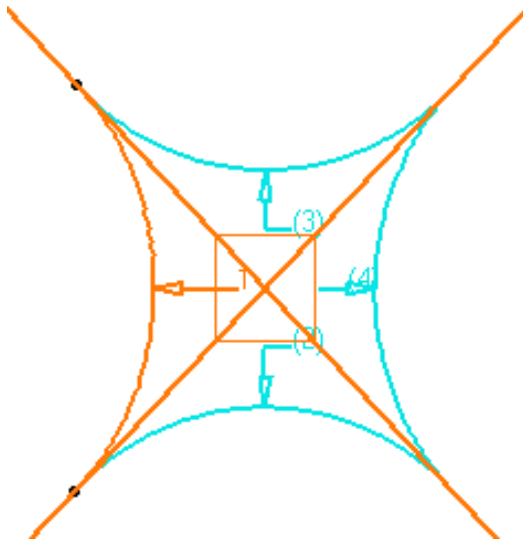
We have a curve lying on the surface

Offset the curve on the surface (The resultant curve is still on the surface)

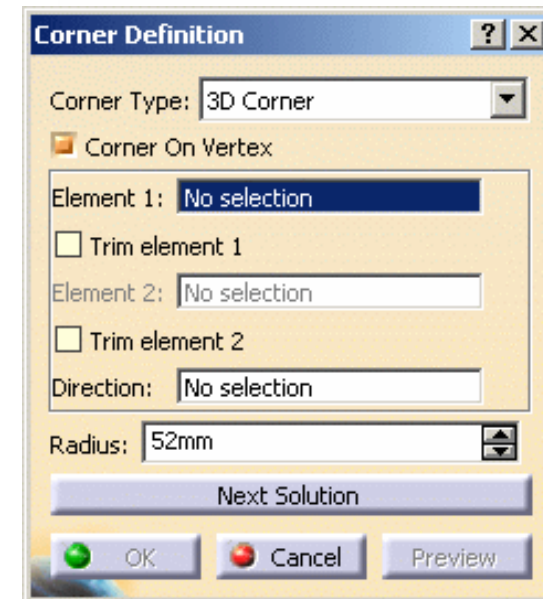
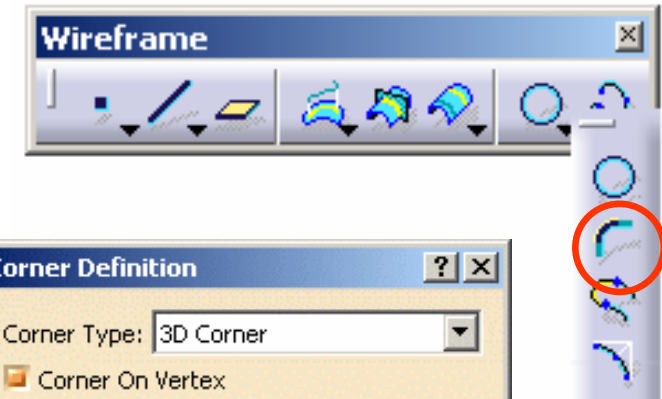


Corner

Corner (create a corner between two curves)

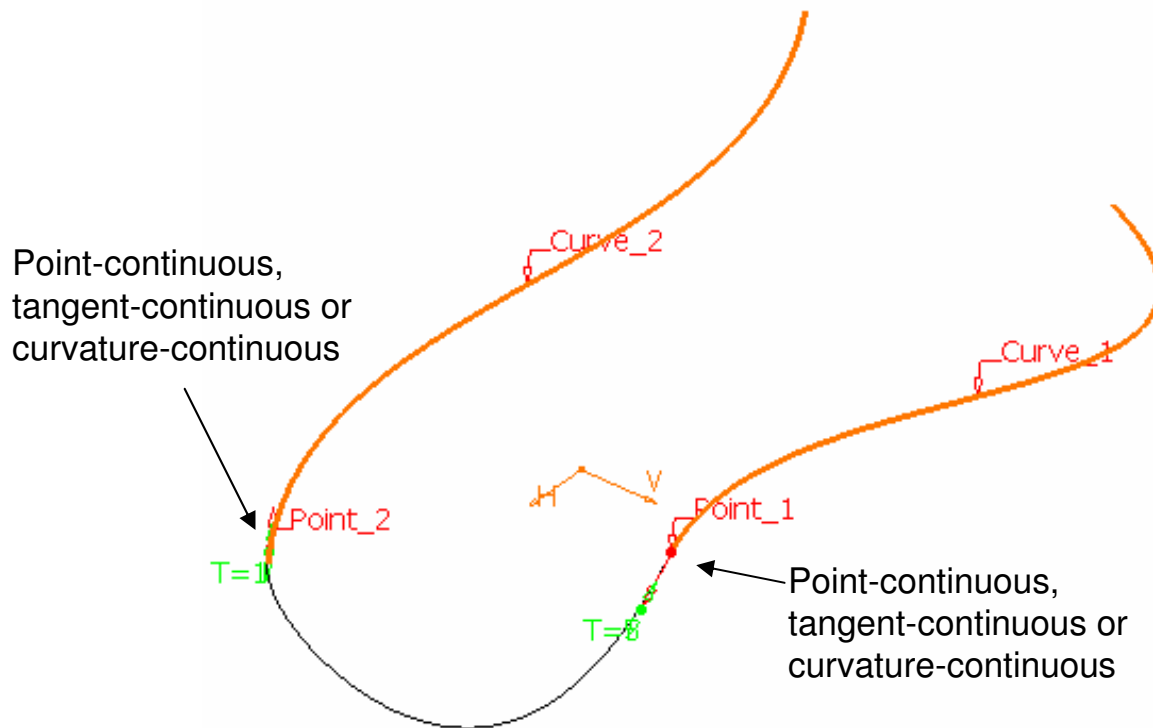
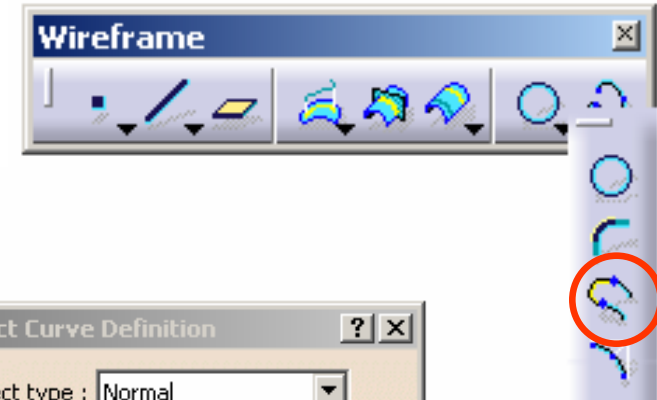


If several solutions may be possible, click the **Next Solution** button to move to another corner solution, or directly select the corner you want in the geometry

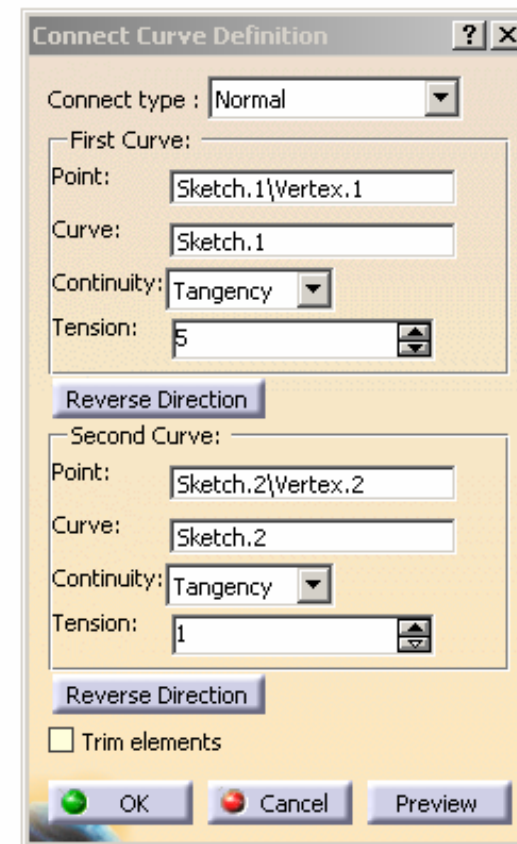


Connect Curve

Connect Curve (create a connecting curve between two curves.)

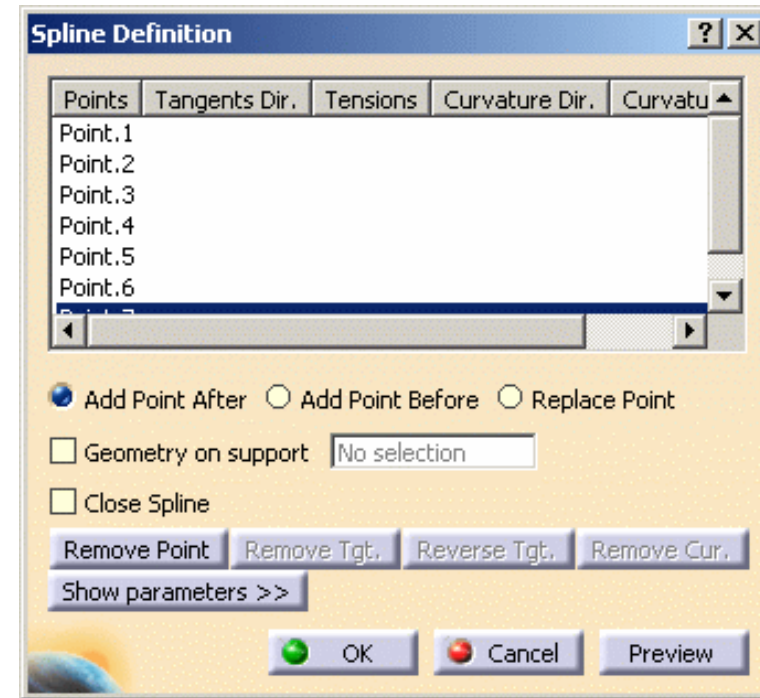


The curvature in the middle can be controlled by tension

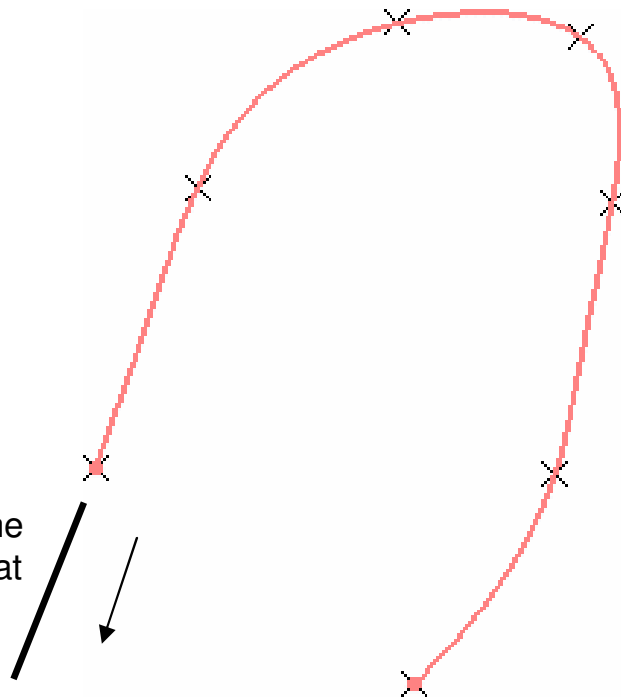


Spline Curve

Spline Curve (create a 2D/ 3D spline curve)

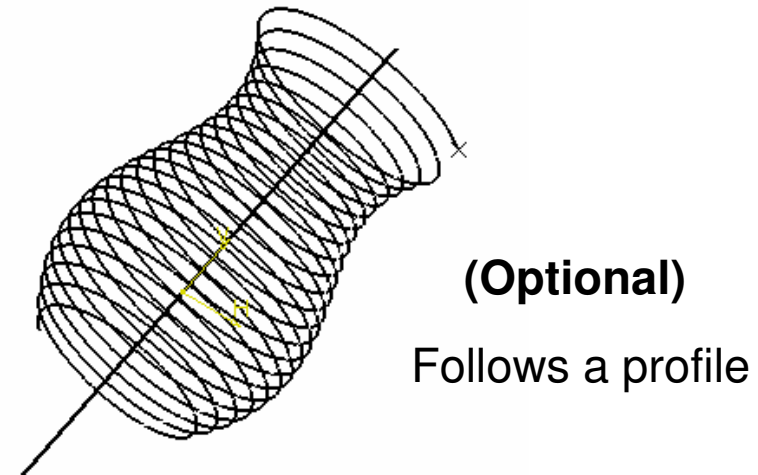
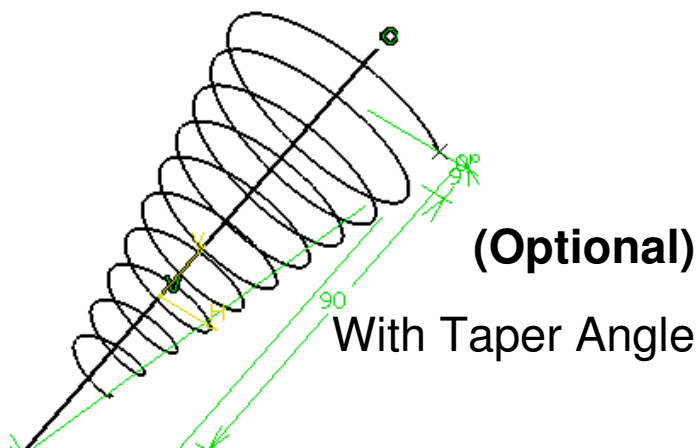
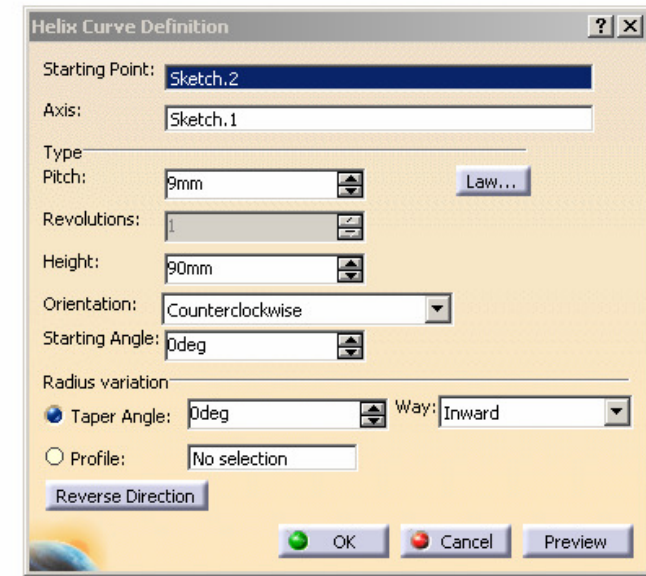
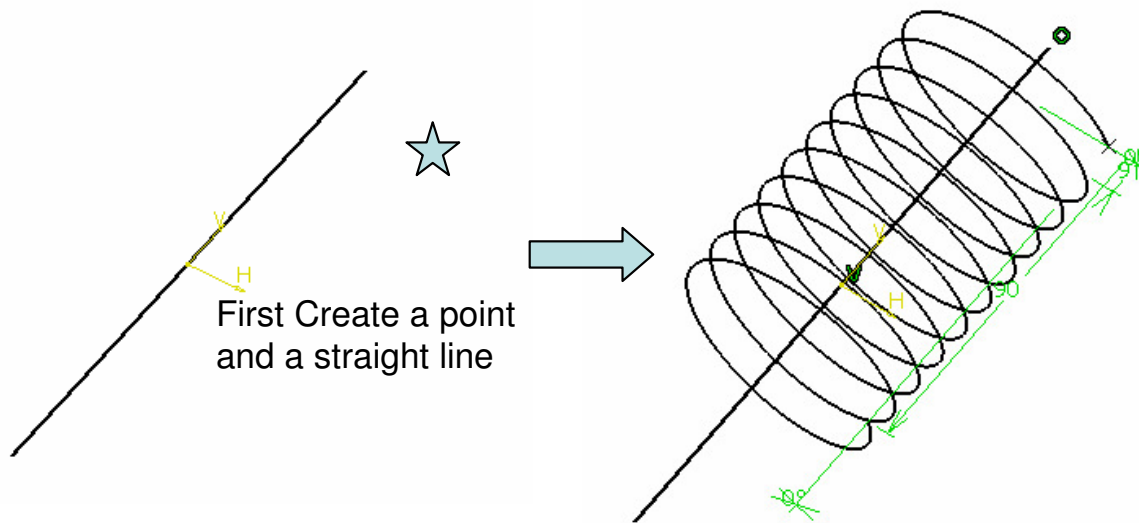


We can create an additional line to define the tangent direction at a point.



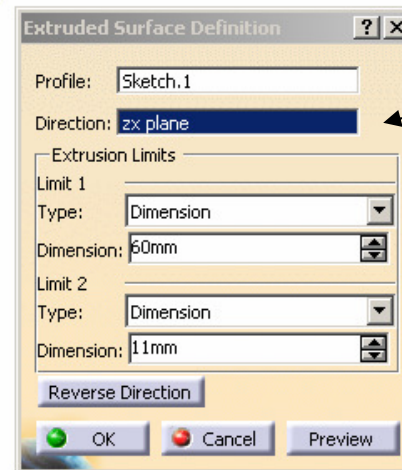
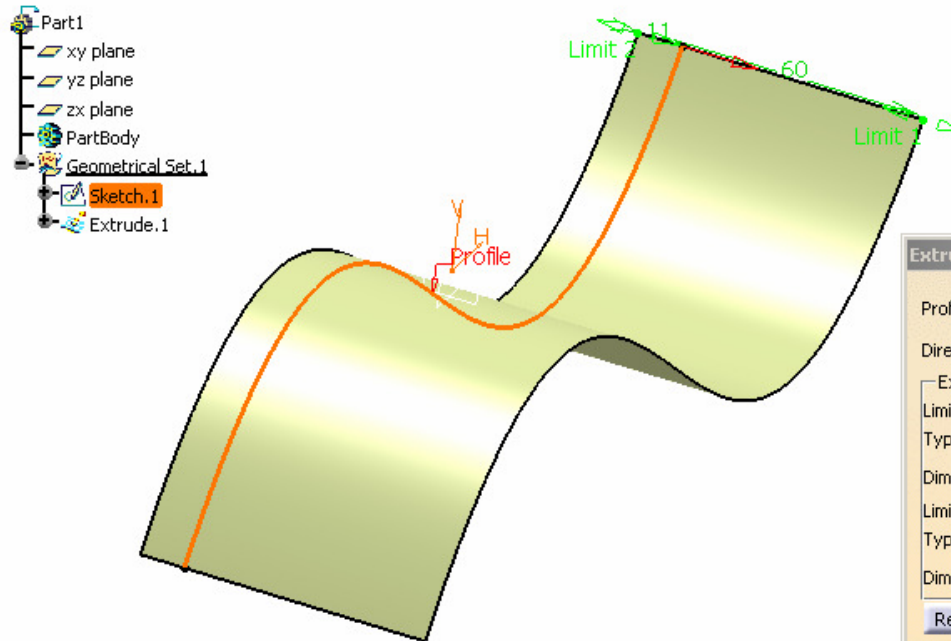
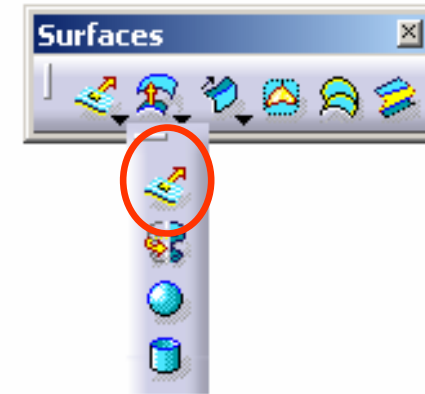
Helix

Helix (create a helix curve like a spring)



Extrude

Extrude (create a surface by extruding a profile along a given direction)

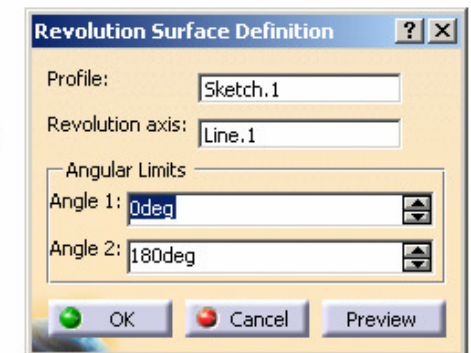
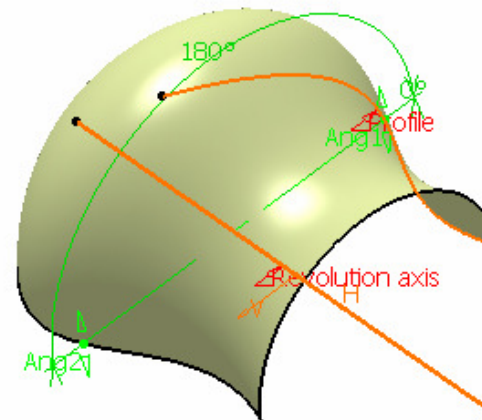
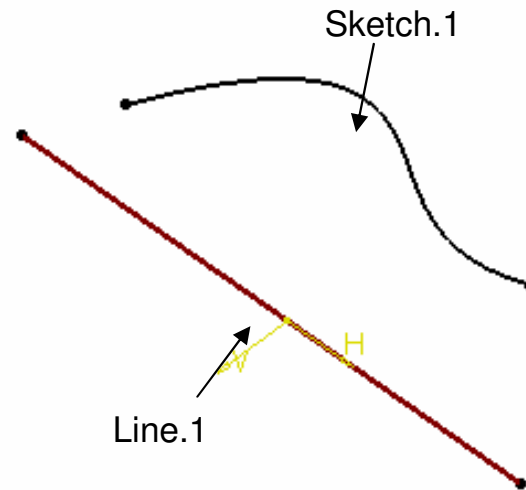
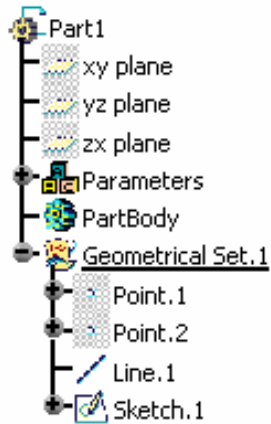


If the profile is planar, the direction will be its normal by default. But you can change it to other direction.

Revolve

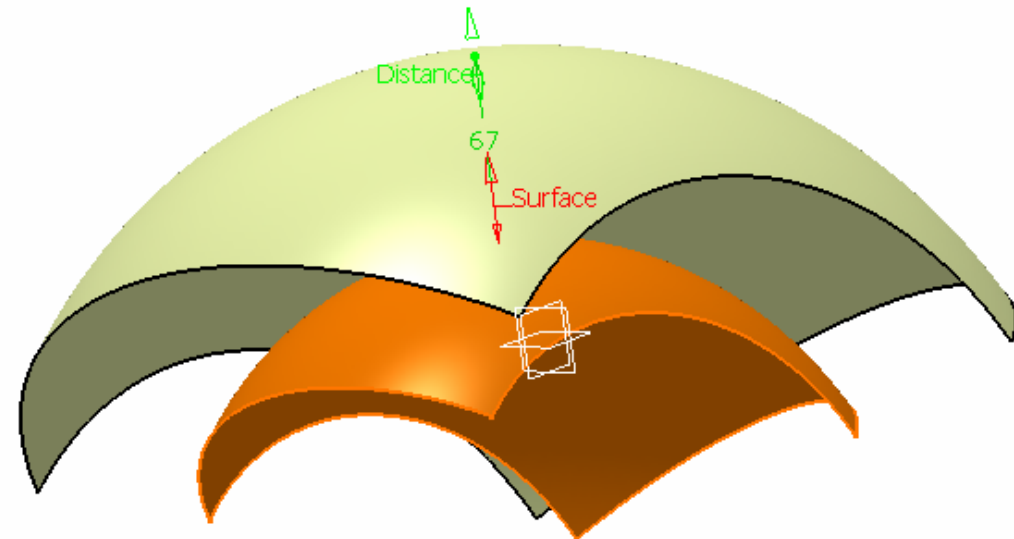
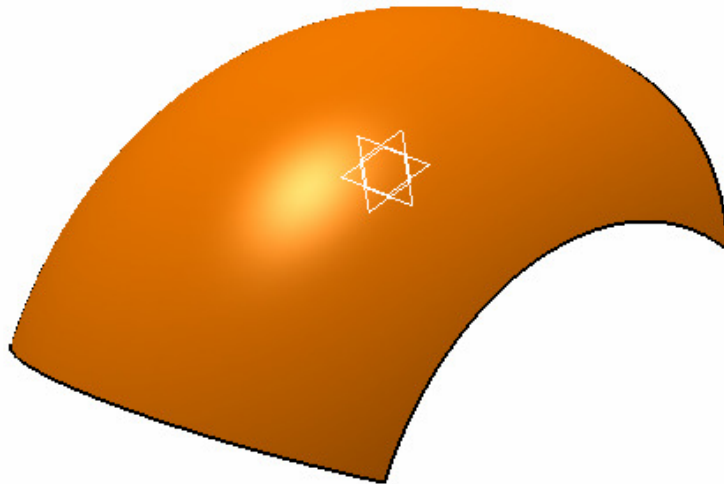
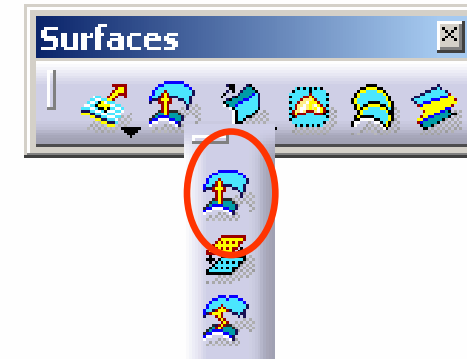
Revolve (create a surface by revolving a planar profile about an axis)

Remark: The axis must be a straight line.



Offset

Offset (create a surface, or a set of surfaces, by offsetting an existing surface, or a set of surfaces)

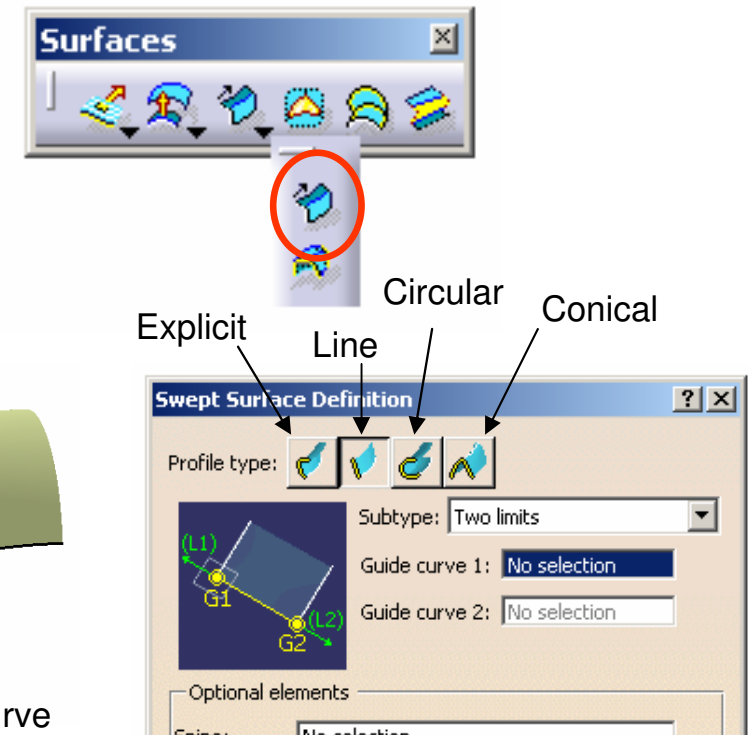
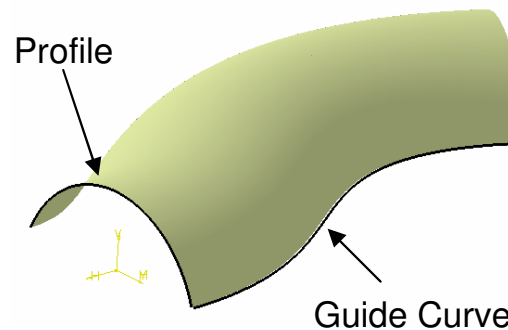


Sweep

Sweep (create a surface by sweeping out a profile along one or two guide curves)

Sweeping an **Explicit** profile

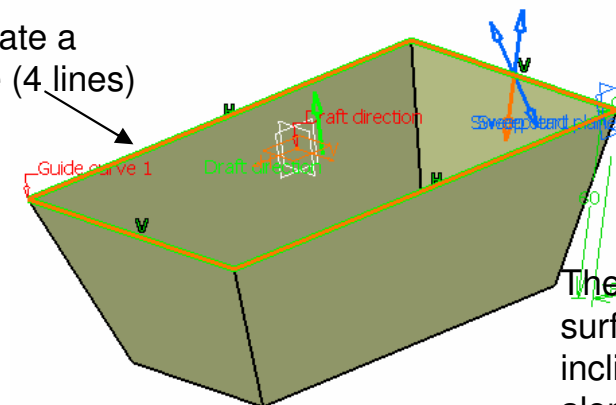
- With reference surface (optional)
 - With two guide curves (optional)
 - With pulling direction (optional)
- (We can use the above three options to control the profile orientation)



Sweeping a **Linear** profile

- Two limits
- Limit and middle
- With reference surface
- With tangency surface
- With reference curve
- With two tangency surfaces
- **With draft direction**

We first create a guide curve (4 lines)



Then create a draft surface by sweeping an inclined linear profile along a guide curve

Sweep – Con't

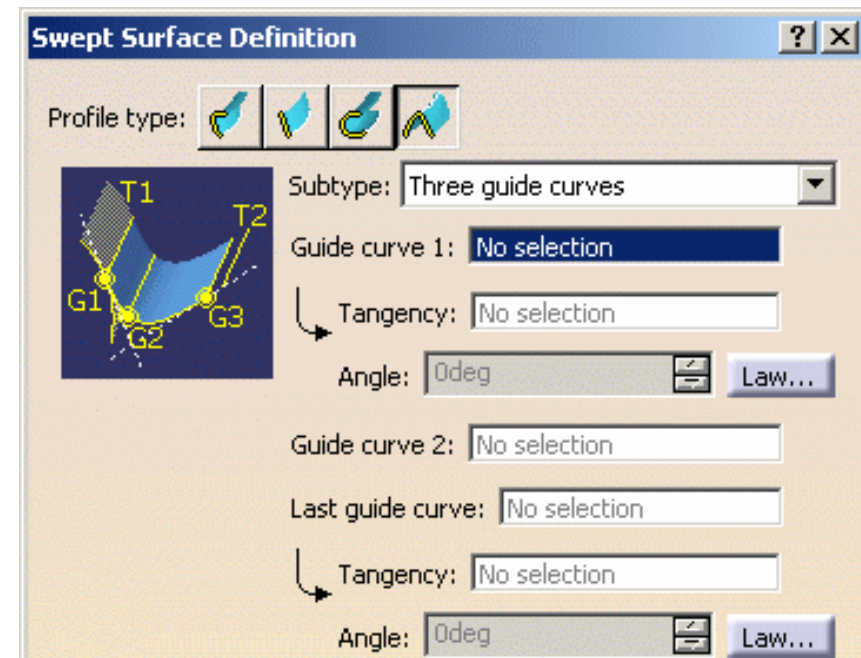
Sweeping a **Circular** profile

- Three guides
- **Two guides and radius**
- Center and two angles
- Center and radius
- Two guides and tangency surface
- One guide and tangency surface



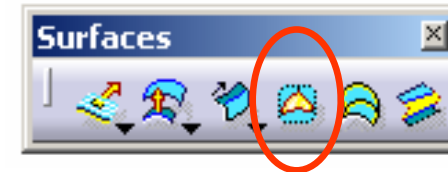
Sweeping a **Conical** profile

- Two guides
- **Three guides**
- Four guides
- Five guides



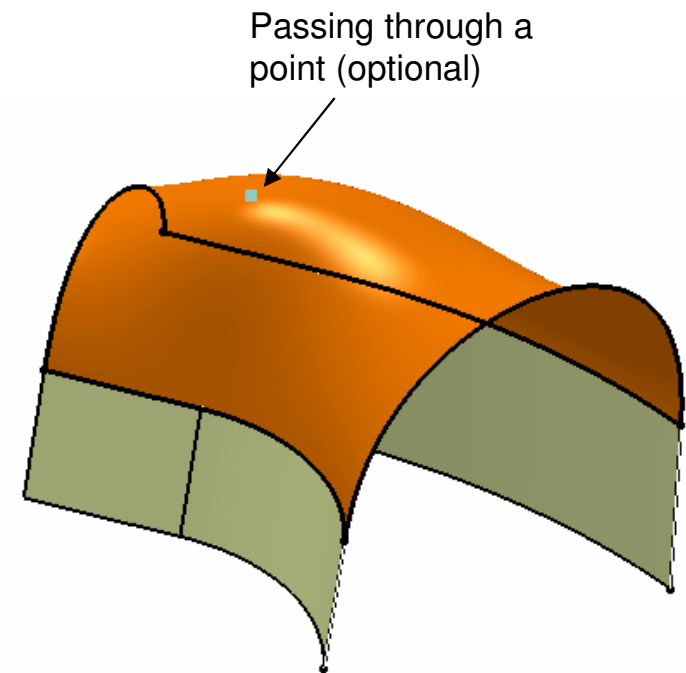
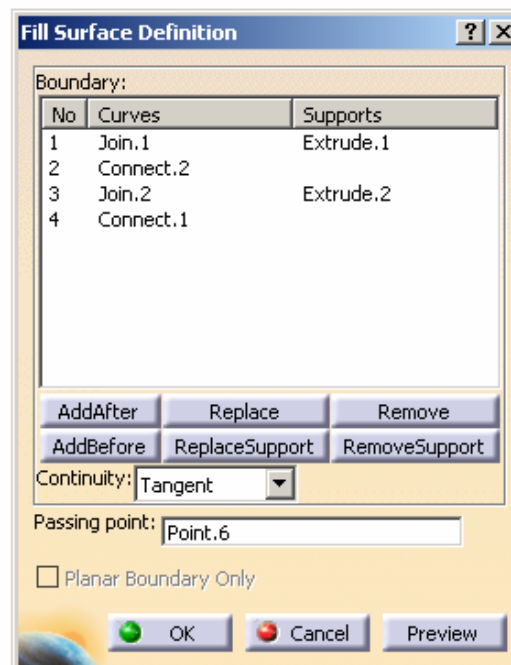
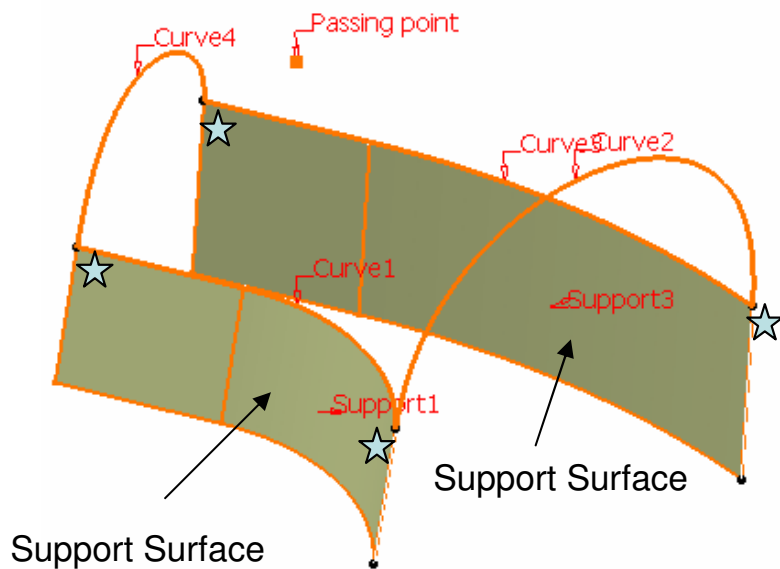
Fill

Fill (create a surface to fill the opening among a number of boundary segments)



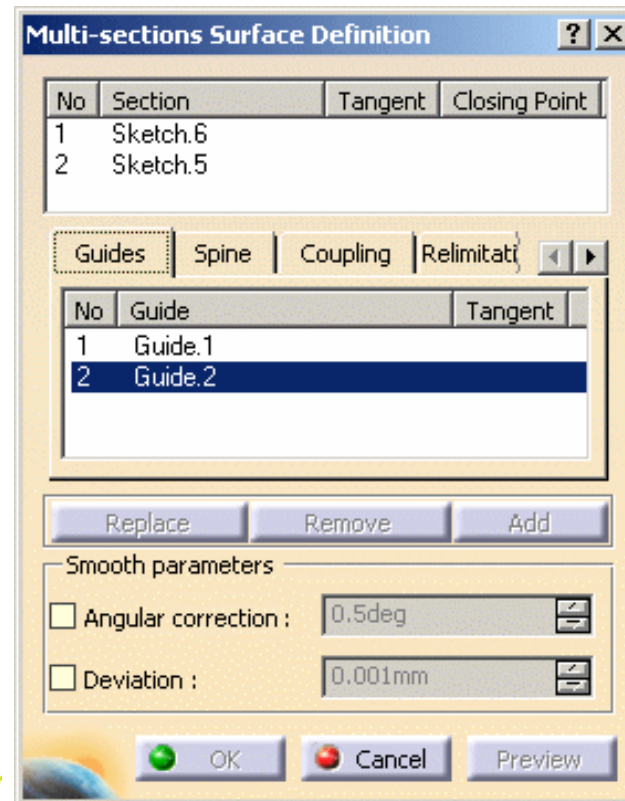
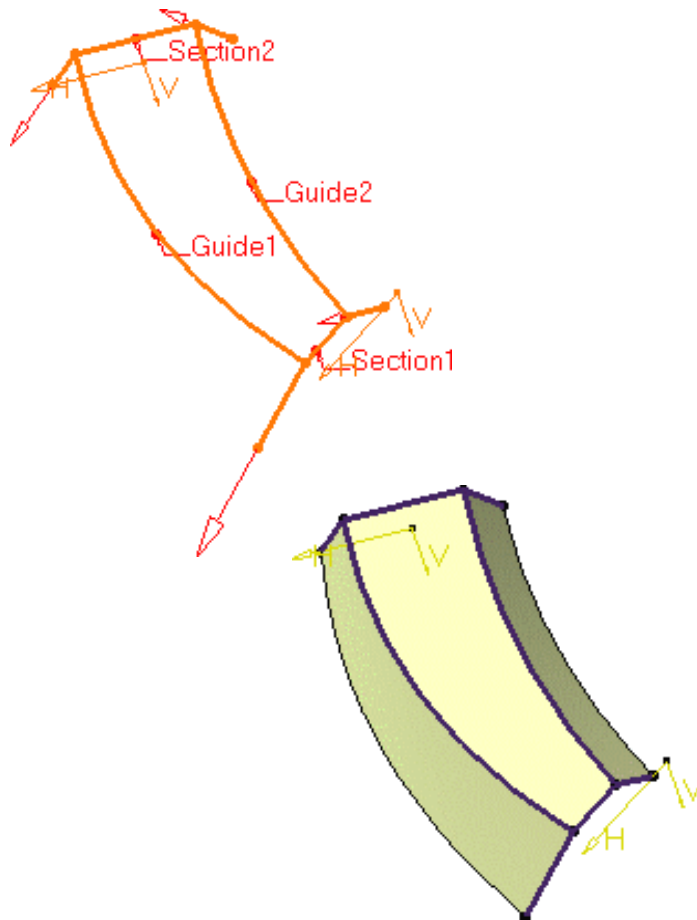
We can specify the desired continuity type between any selected support surfaces and the fill surface (Point, Tangent or Curvature continuous)

The four ☆ points must be tangent-continuous or curvature-continuous

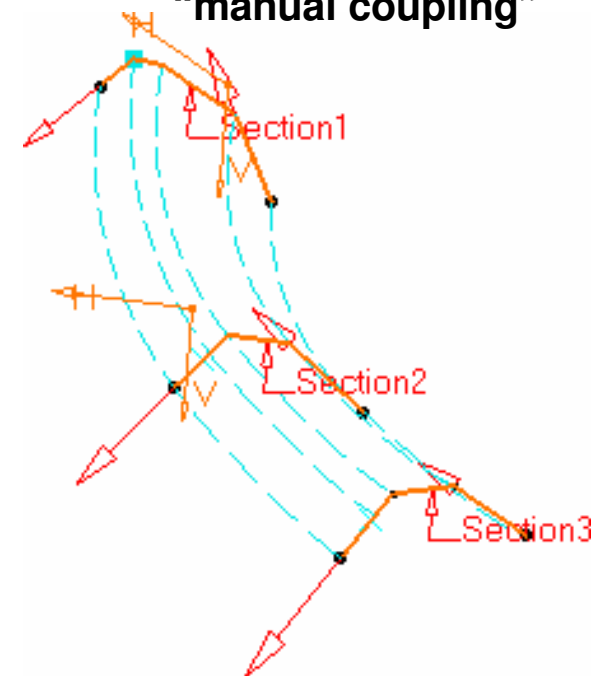


Multi-sections Surface

Multi-sections surface (create a surface by sweeping two or more section curves along an automatically computed or user-defined spine. The surface can be made to respect one or more guide curves.)

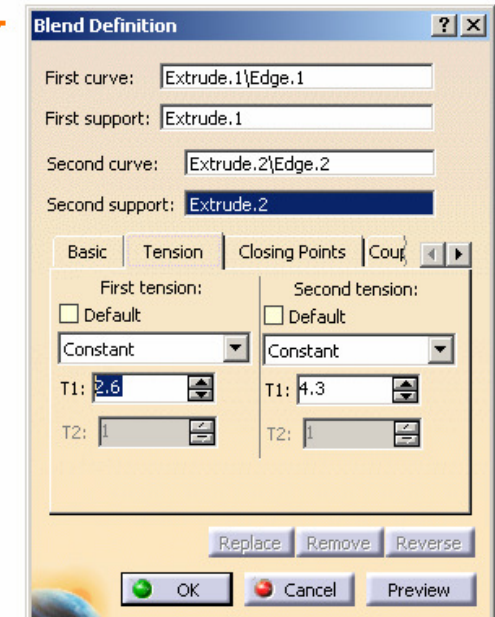
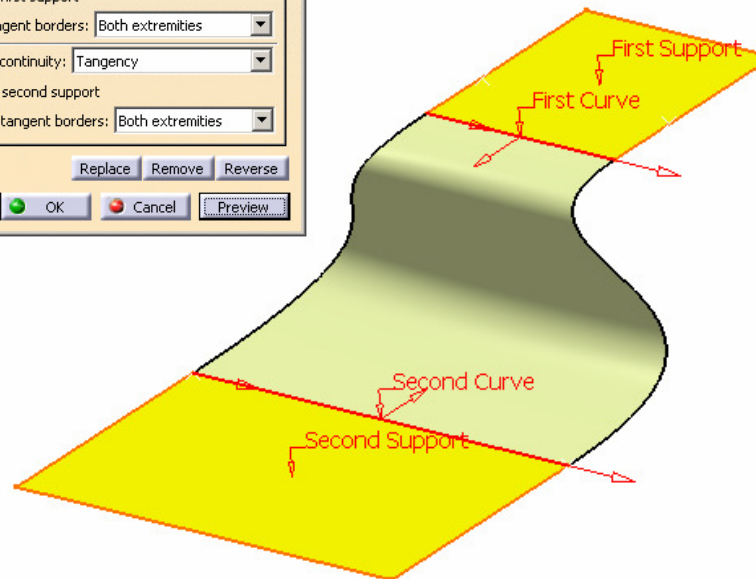
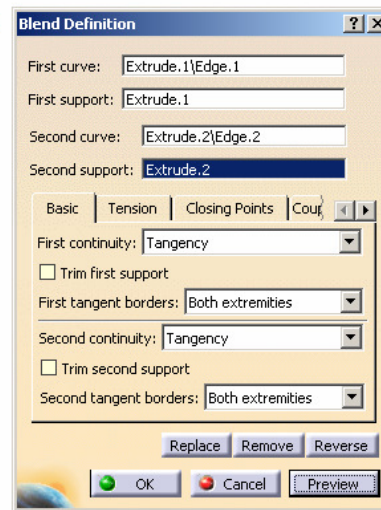
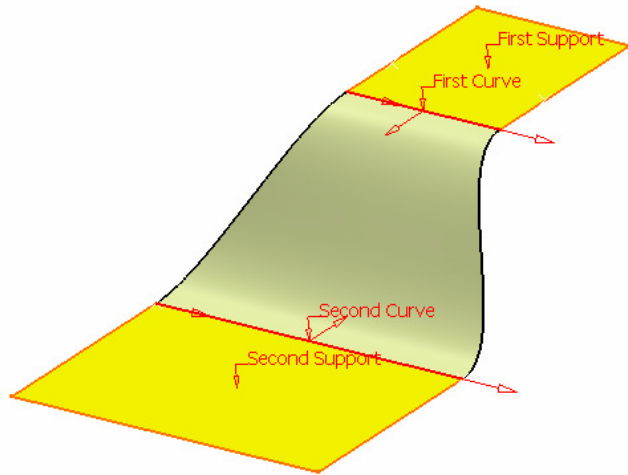


Further control point-point matching by "manual coupling"



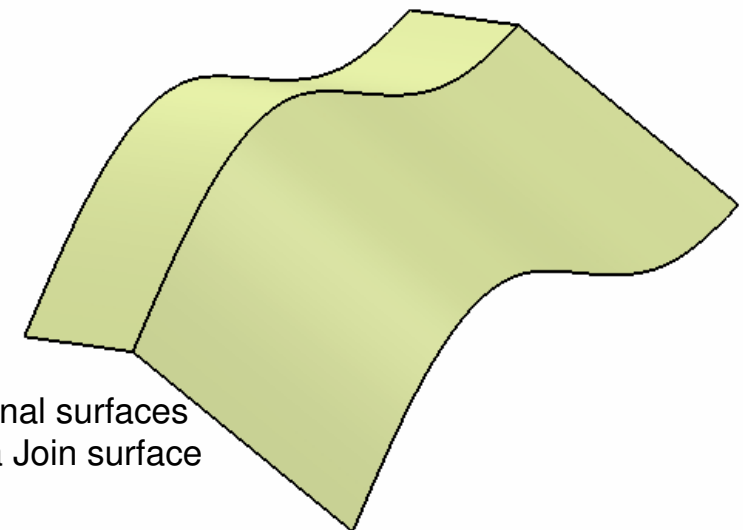
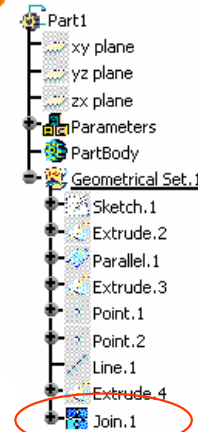
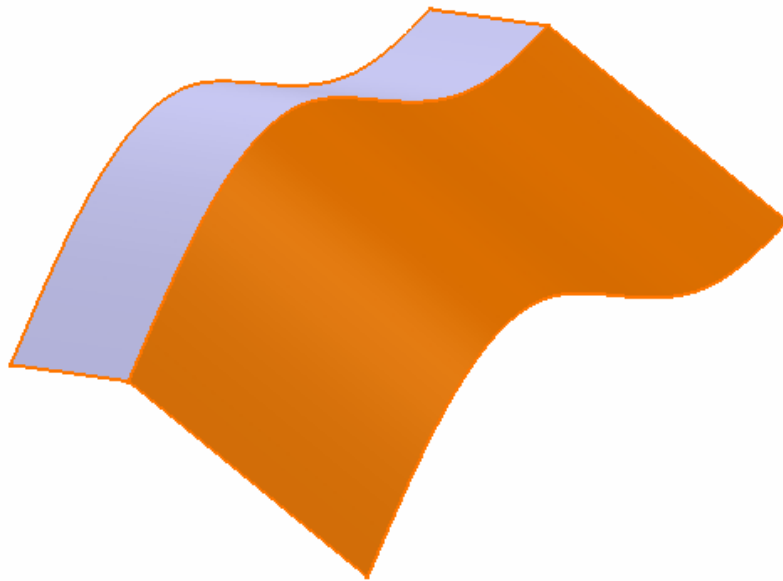
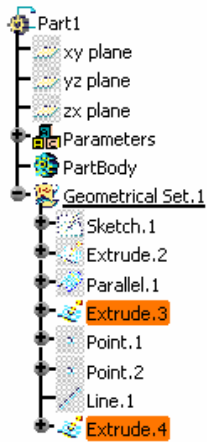
Blend

Blend (Create a surface between two wireframe elements or surface edges)



Join

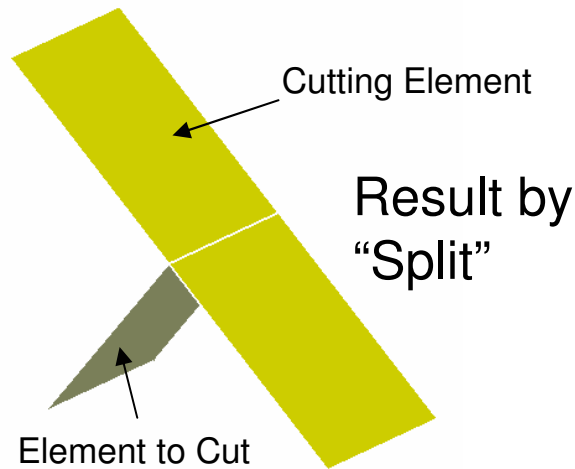
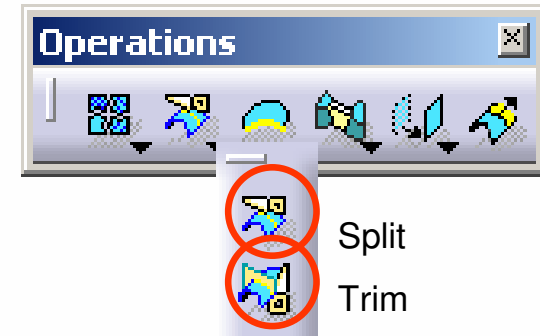
Join (join surfaces or curves as one element)



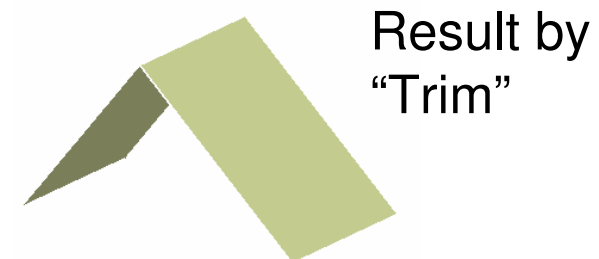
The two original surfaces are hidden; a Join surface is created

Split & Trim

Split (split a surface or wireframe element by means of a cutting element. You can split a wireframe element by a point, another wireframe element or a surface; or a surface by a wireframe element or another surface.)

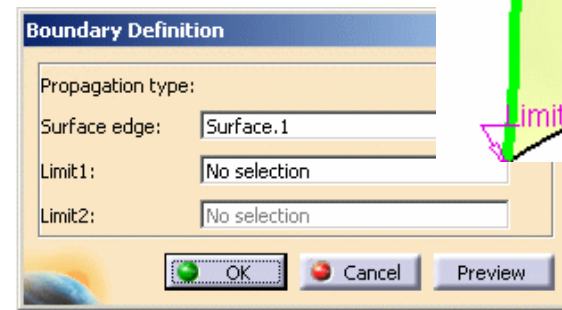
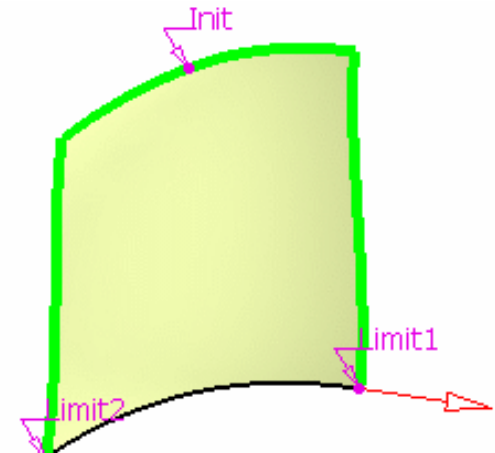
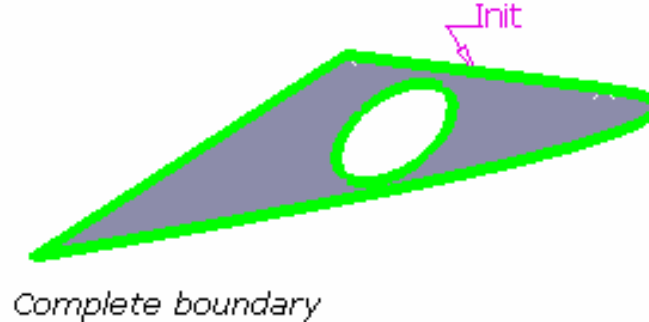
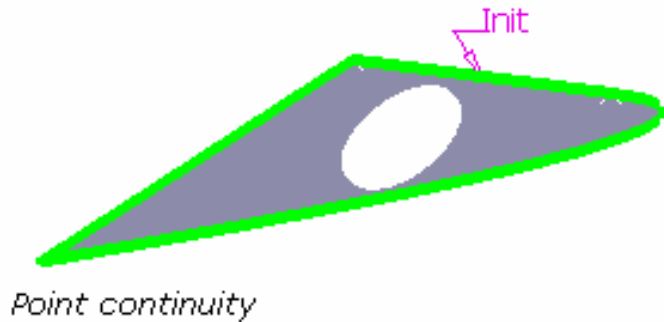
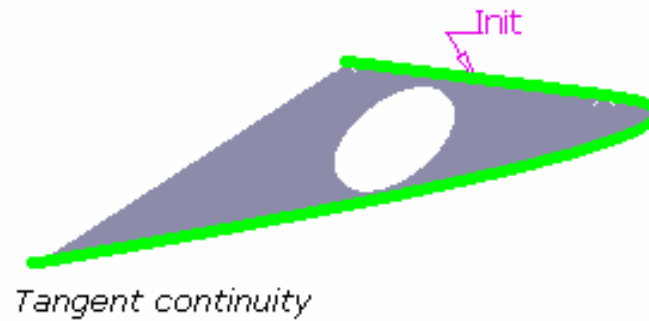
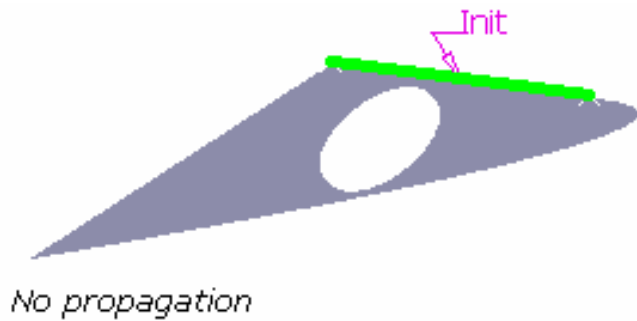
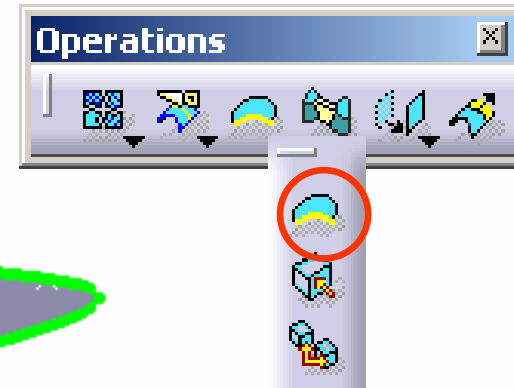


Trim (trim two or more surface or wireframe elements)



Boundary

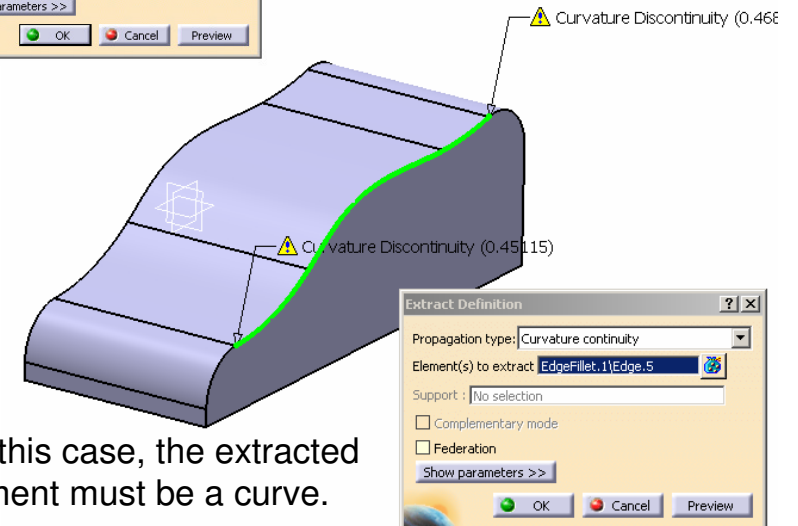
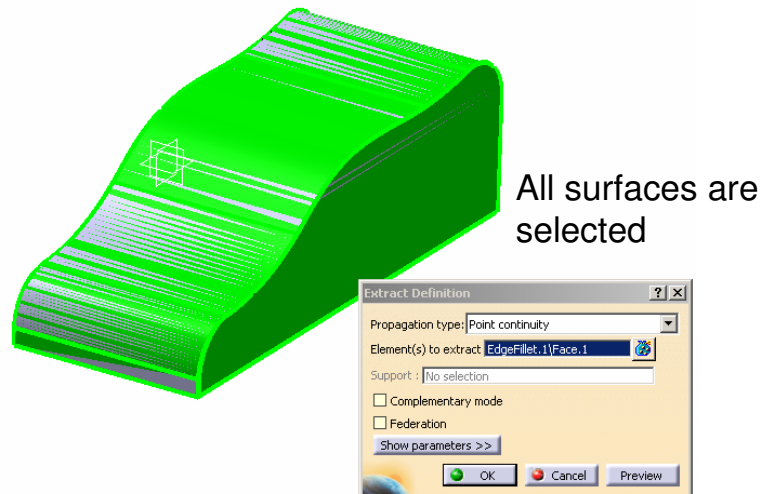
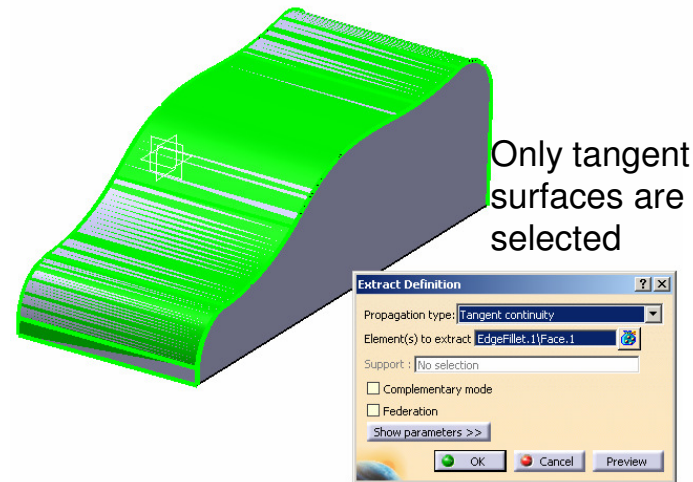
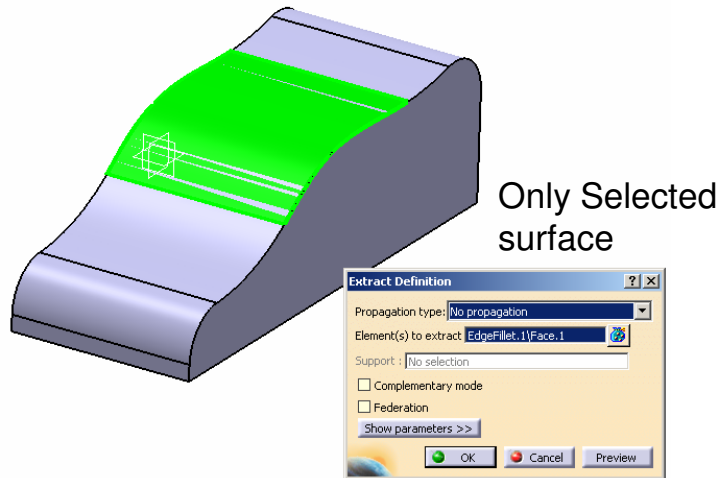
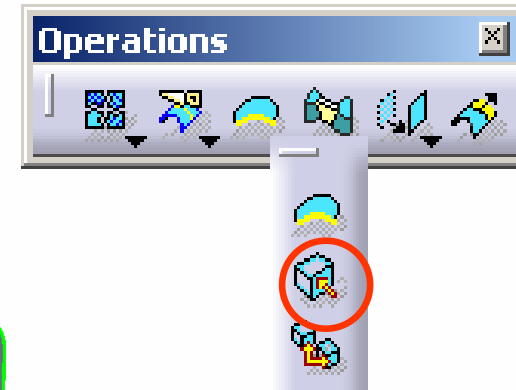
Boundary (create the boundary curve of a surface)



We can select limit points to limit the boundary

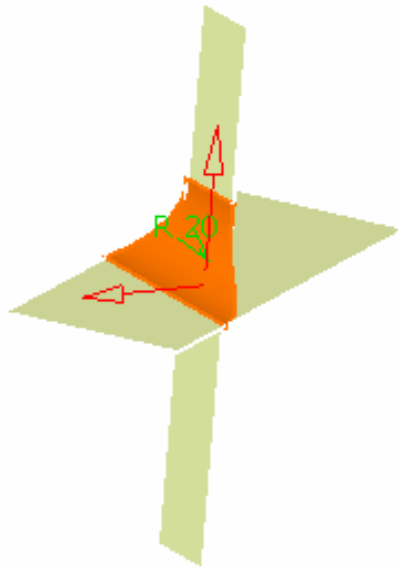
Extract

Extract (extract from elements (curves, points, surfaces or solids))

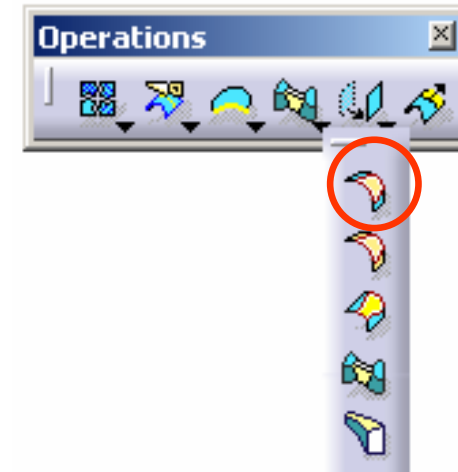


Shape Fillet

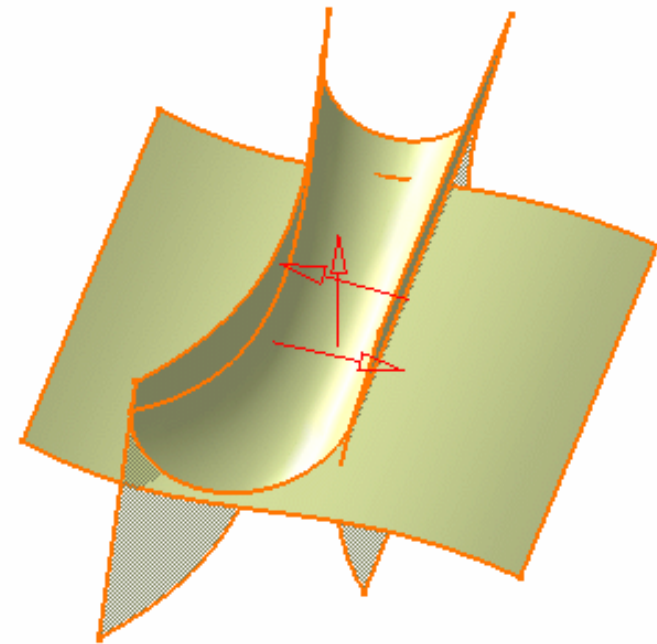
Bi-tangent Shape Fillet (create a shape fillet between two surfaces)



Smooth: a tangency constraint is imposed at the connection between the fillet surface and the support surfaces, thus smoothing the connection.

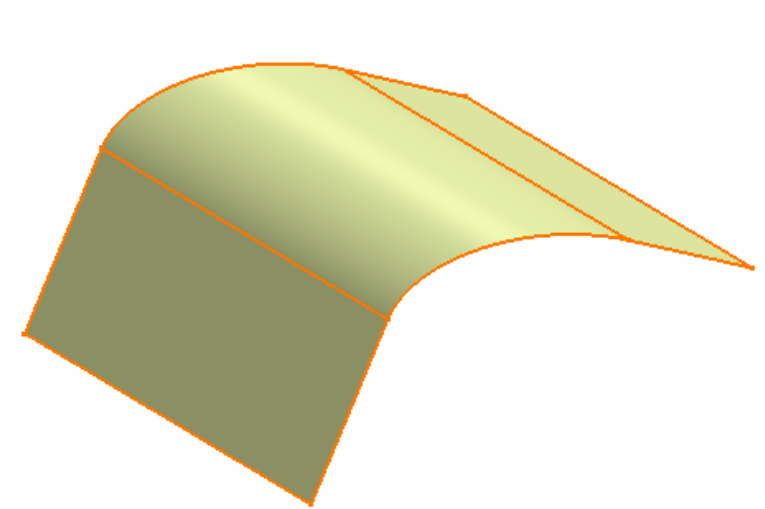
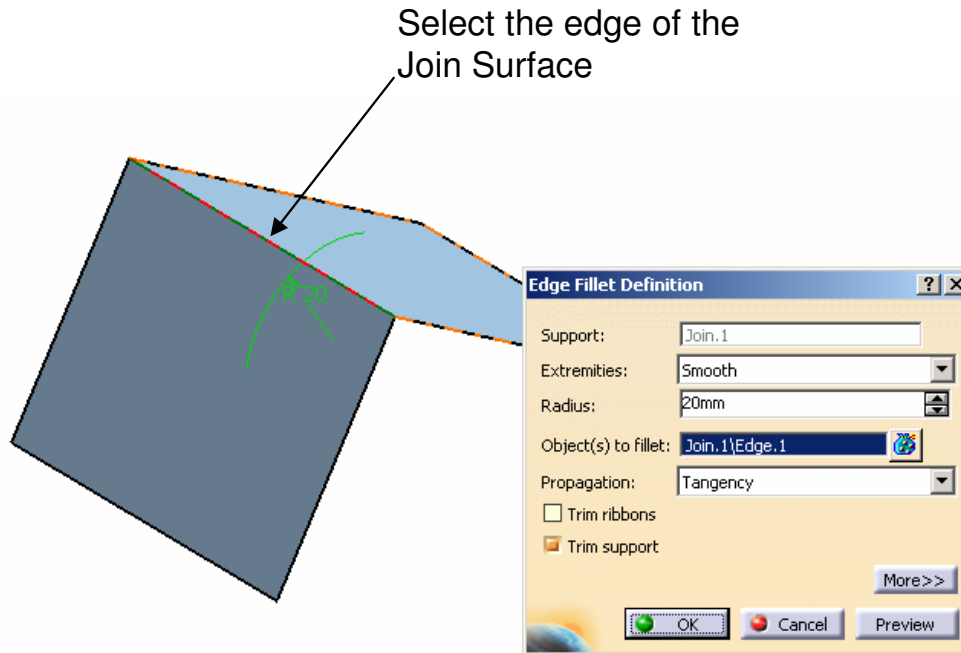
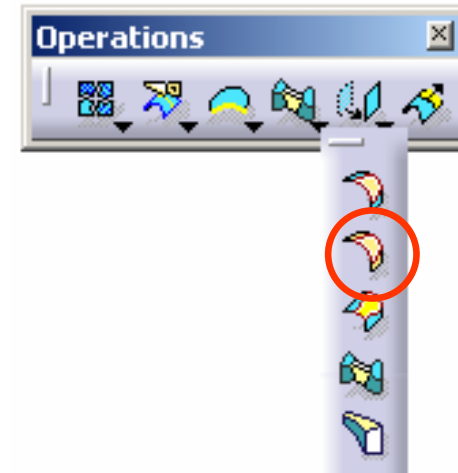


Tri-tangent Shape Fillet (create a shape fillet between three surfaces)



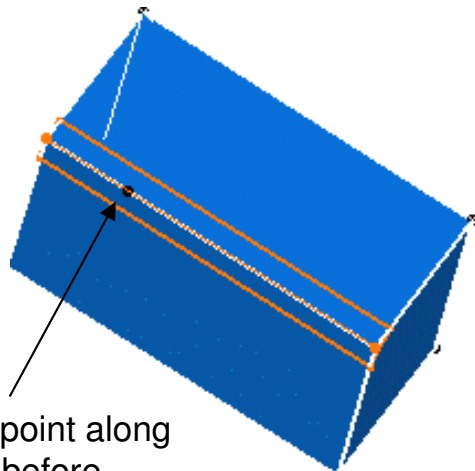
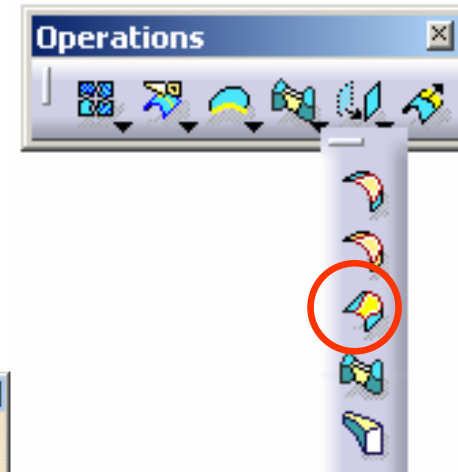
Edge Fillet

Edge Fillet (create a constant radius fillet along the internal edge of a joined surface)

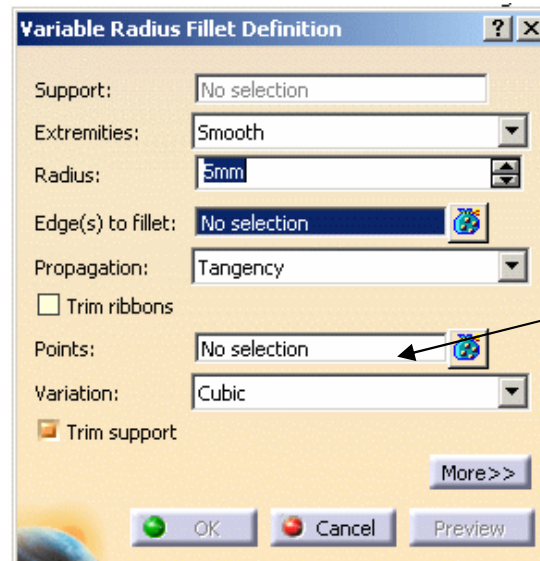


Variable Fillet

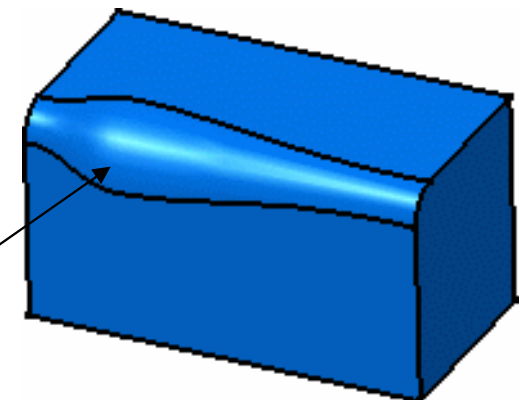
Variable Fillet (create a variable radius fillet. In this type of fillet, the radius varies at selected points along a selected edge. The fillet surface is obtained by rolling a sphere, which radius would vary, over the selected edge.)



Create a point along the edge before filleting



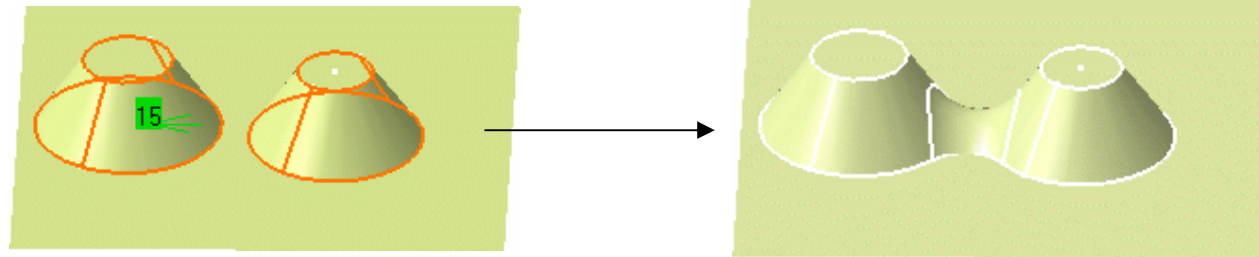
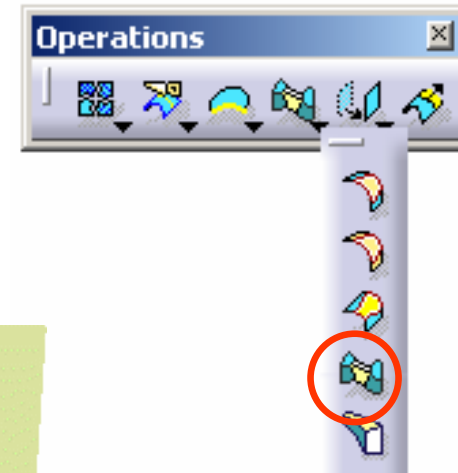
Click the box and select the point



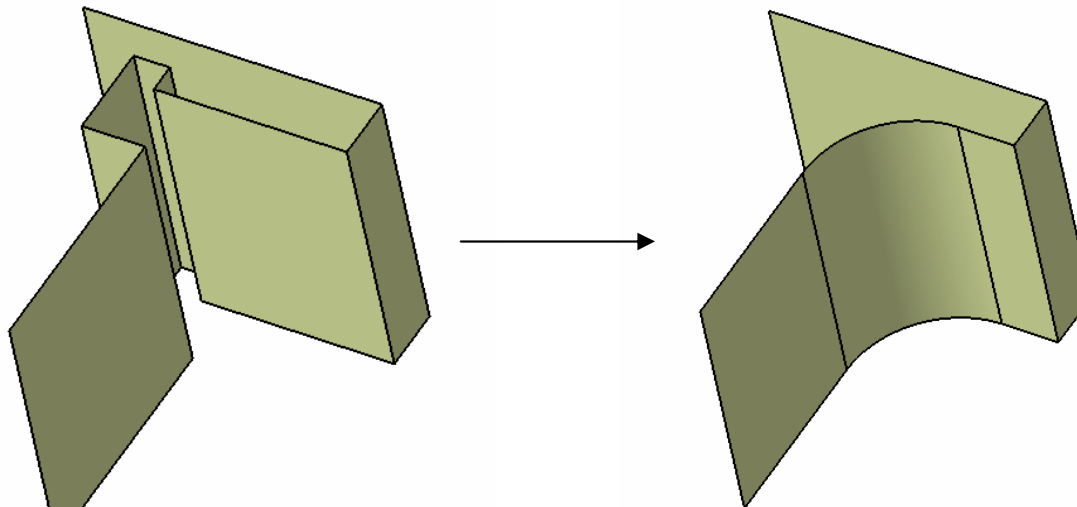
After entering a new value for this point, we have a different radius here

Face-Face Fillet

Face-Face fillet (create a face-face fillet. The fillet surface is obtained by rolling a sphere, which radius is larger than the distance between the selected elements, between the selected surfaces.)



Remark: This is a "Joined" Surface

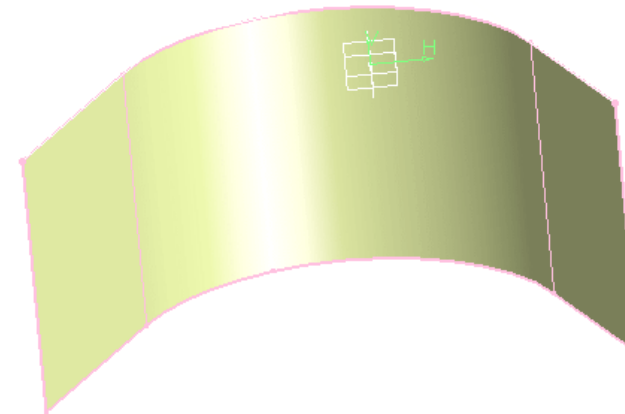
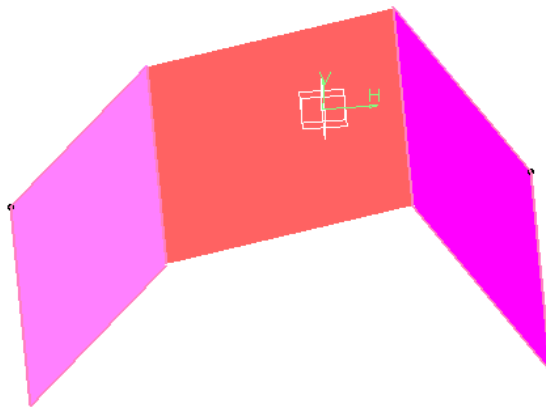
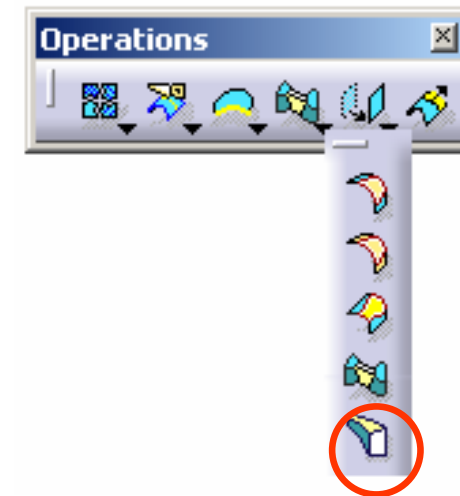


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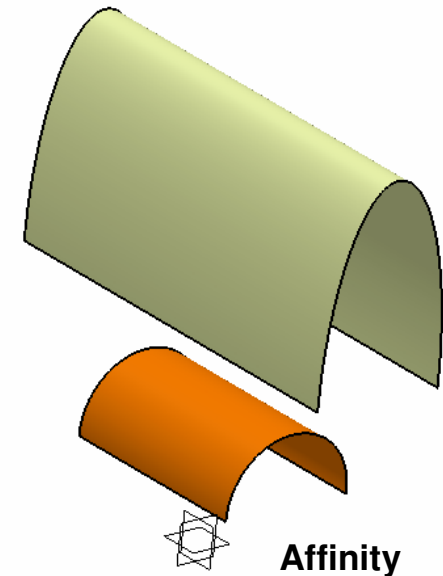
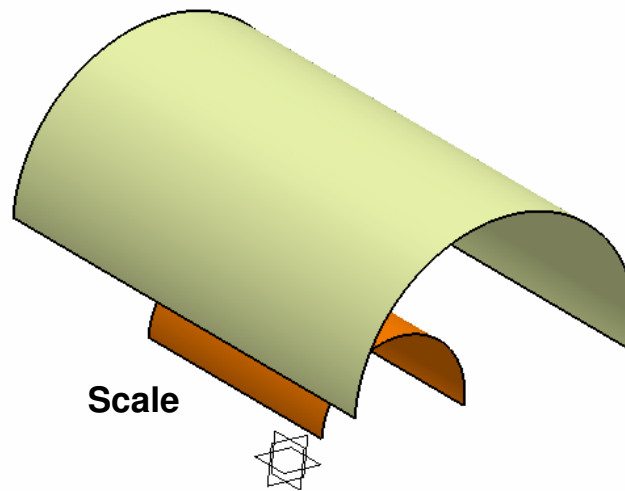
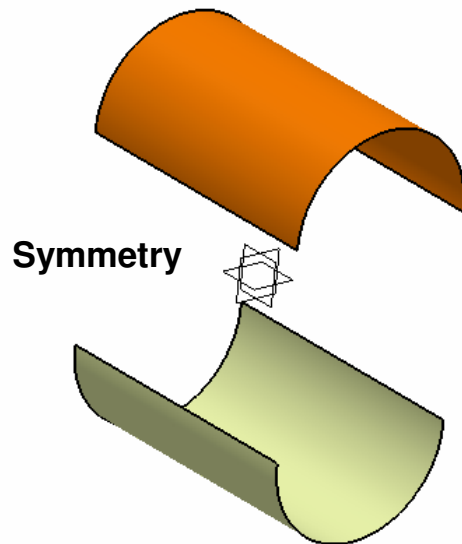
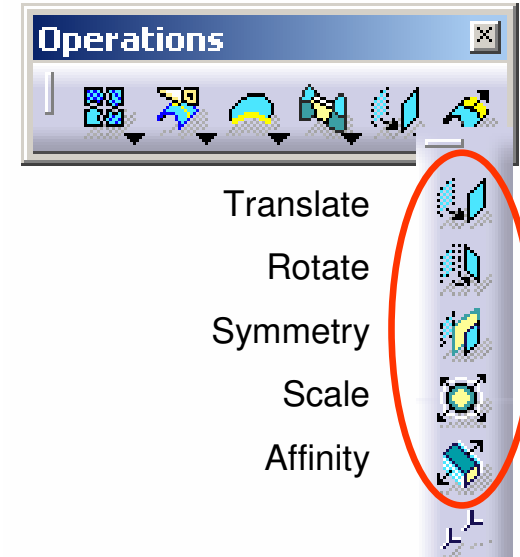
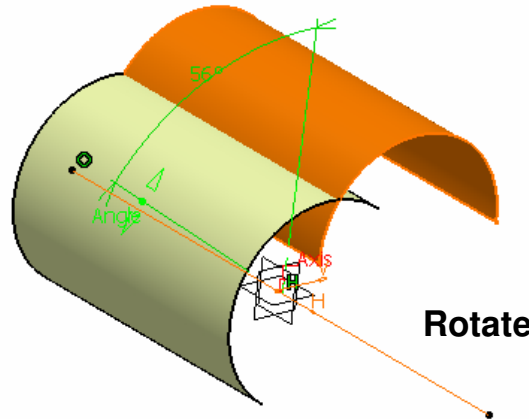
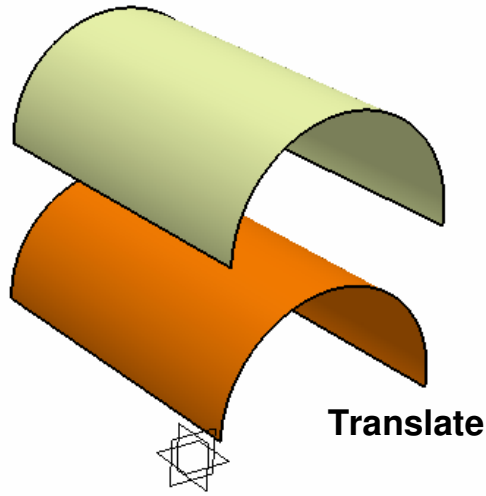
We can add this fillet between two faces that are not touching each other

Tri-tangent Fillet

Tri-tangent Fillet (The creation of tritangent fillets involves the removal of one of the three faces selected, as the fillet surface is obtained by rolling a sphere, which radius is automatically computed to be larger than the removed surface, between the selected surfaces.)

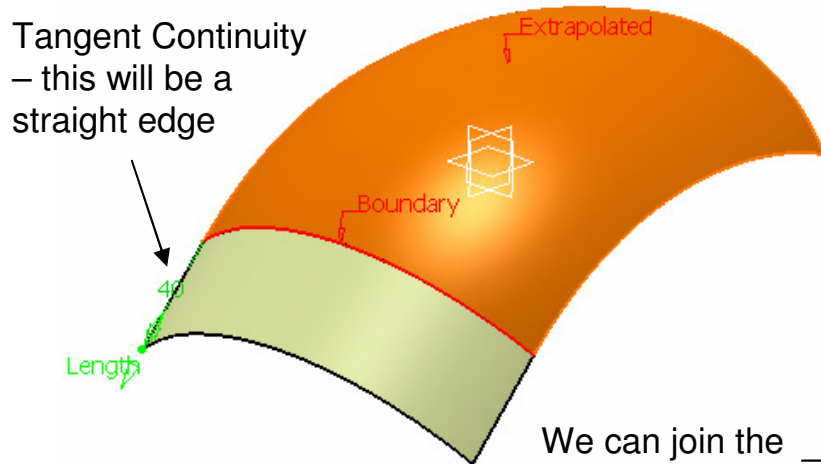


Translate, Rotate, Symmetry, Scale

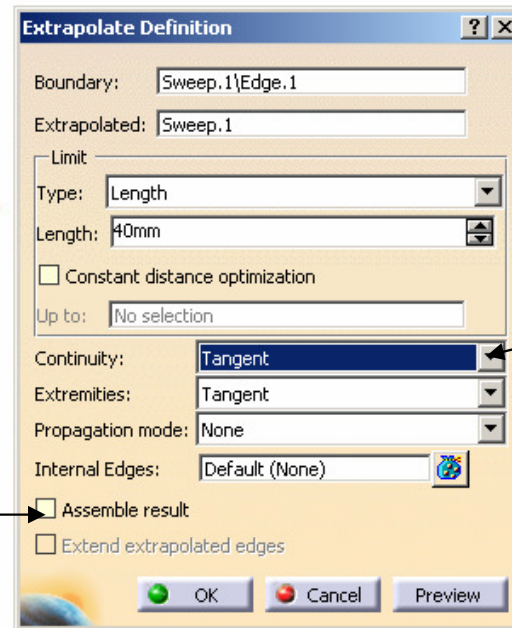


Extrapolate

Extrapolate a surface boundary:

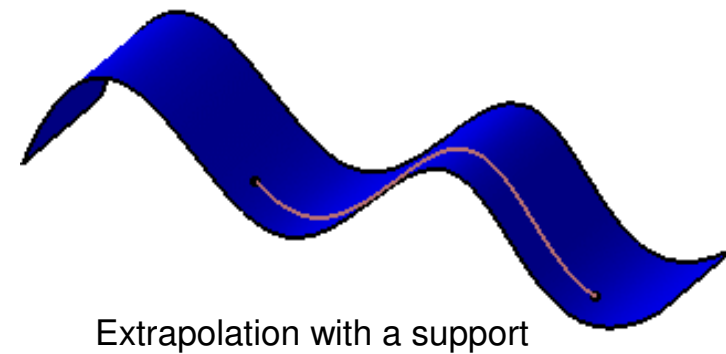
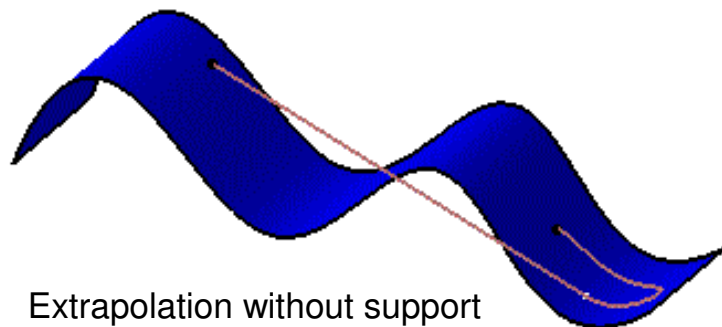


We can join the extrapolated surface with the original surface

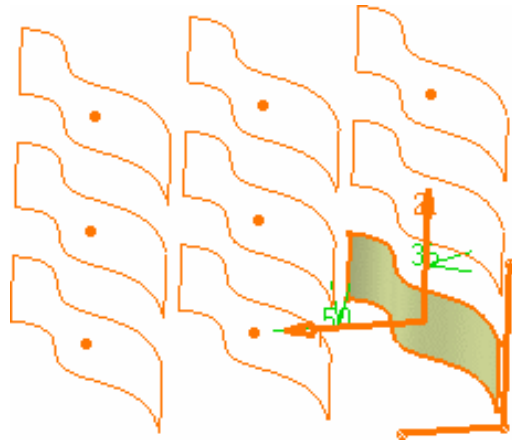


Tangent/Curvature

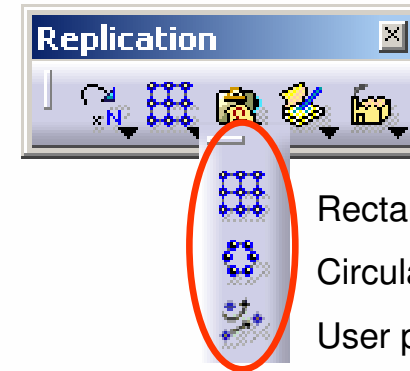
Extrapolate a Curve:



Patterns



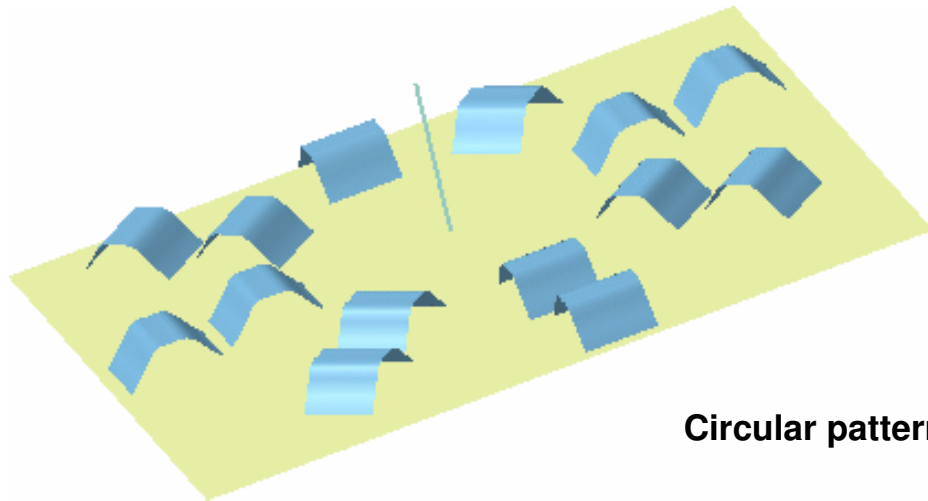
Rectangular pattern



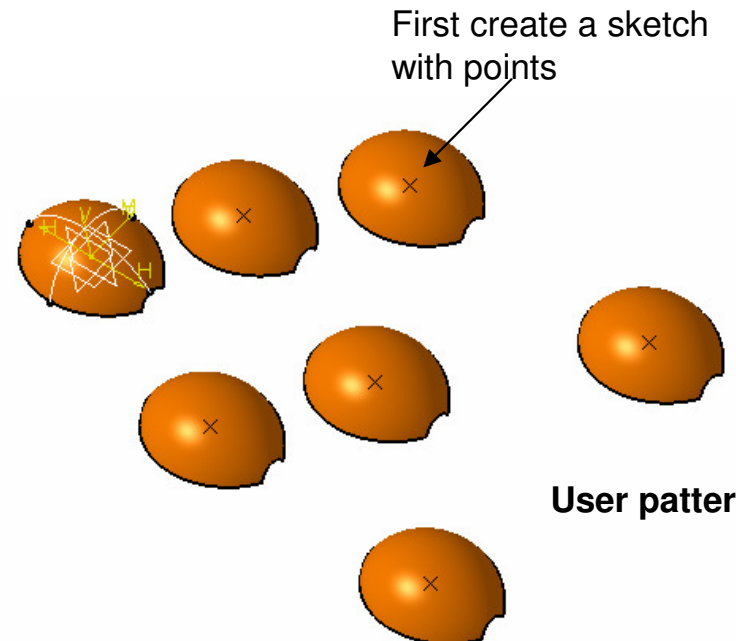
Rectangular pattern

Circular pattern

User pattern



Circular pattern



User pattern

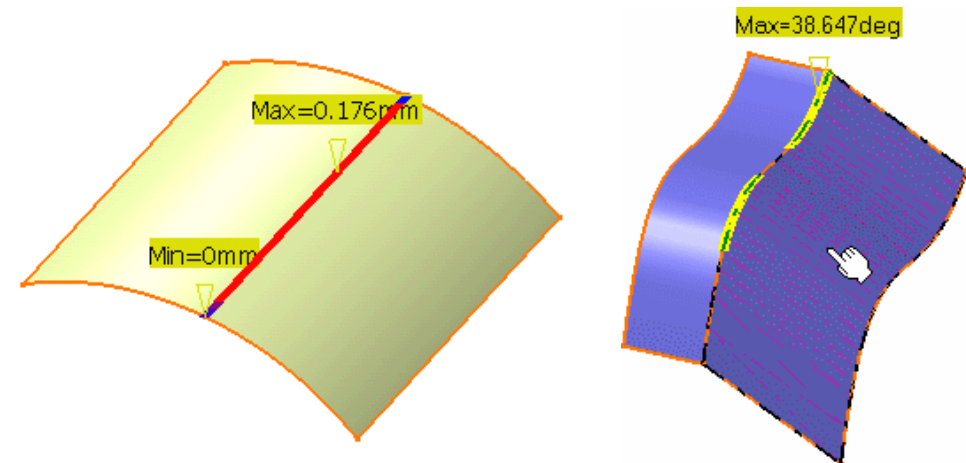
Connect Checker

Connect Checker (analyze how two surfaces are connected)

Distance - minimal distance between two vertices

Tangency - angle between two surfaces

Curvature Difference $(|C2 - C1|) / ((|C1 + C2|) / 2)$



Curve Connect Checker

(analyze how two curves are connected)

Distance - minimal distance between two vertices

Tangency - angle between two curves

Curvature Difference $(|C2 - C1|) / ((|C1 + C2|) / 2)$

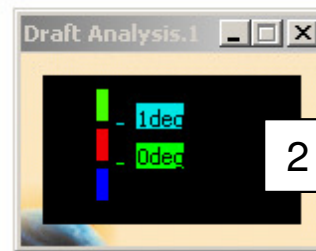
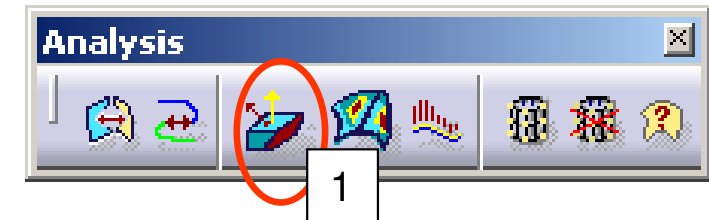


Draft Analysis

Draft Analysis

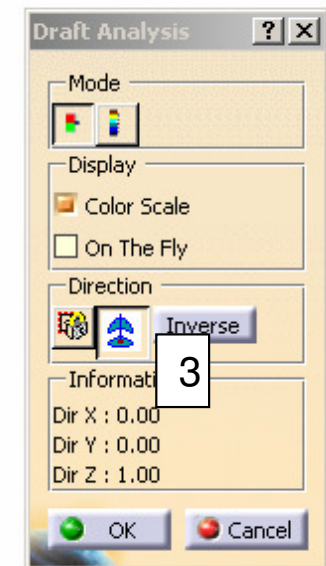
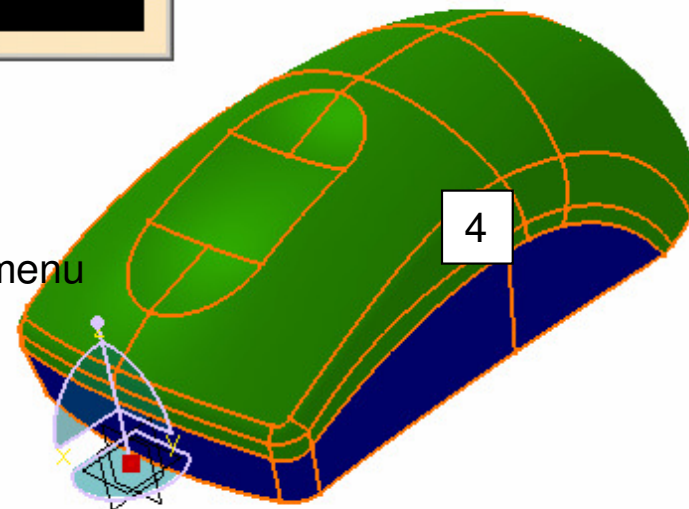
(analyze the draft angle on a surface)

(Remark: To view the draft result, we need to use the Shading with Material mode.)



STEPS:

1. Click "Feature Draft Analysis"
2. Define the color scale (e.g. -1, 0, +1 deg)
3. Click the option "Compass" on the pop-up menu
4. Select all surfaces

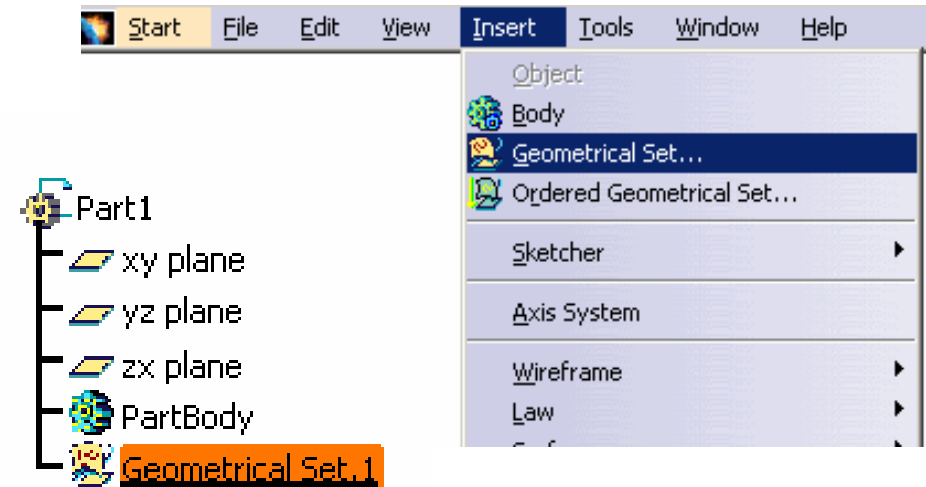


Create a New Geometrical Set

To CREATE a new geometrical set:-

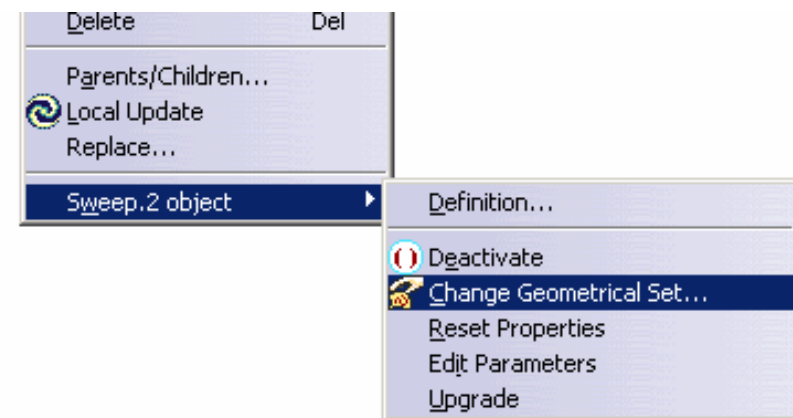
- Select “Insert/Geometrical Set...” on the top menu
- Click ok

(Remark: Provided that Hybrid Design is disabled, a geometrical set will be created automatically when the first wireframe/ surface/ plane is created)



To MOVE a surface from One Geometrical Set to the other:-

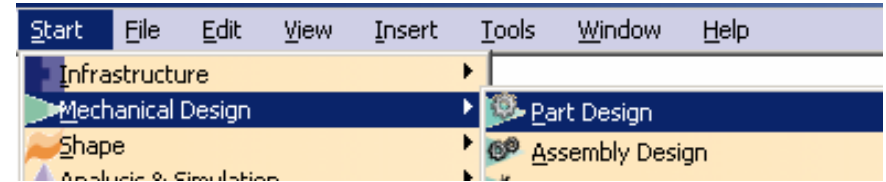
- Right-click on the surface to access the contextual menu
- Select “Change Geometrical Set...”
- Select the other geometrical set from the list of Destination



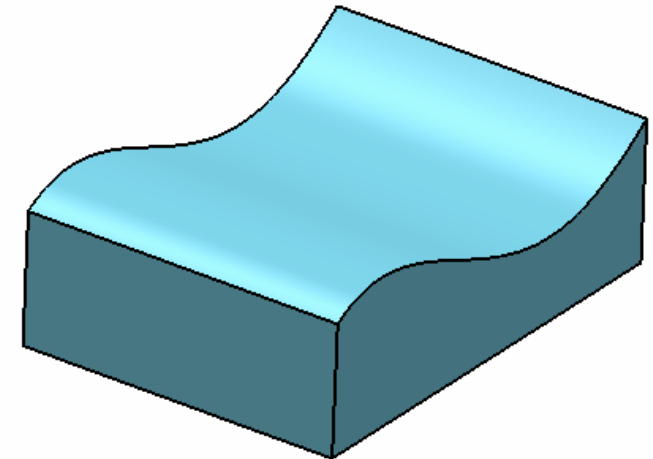
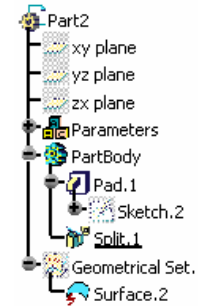
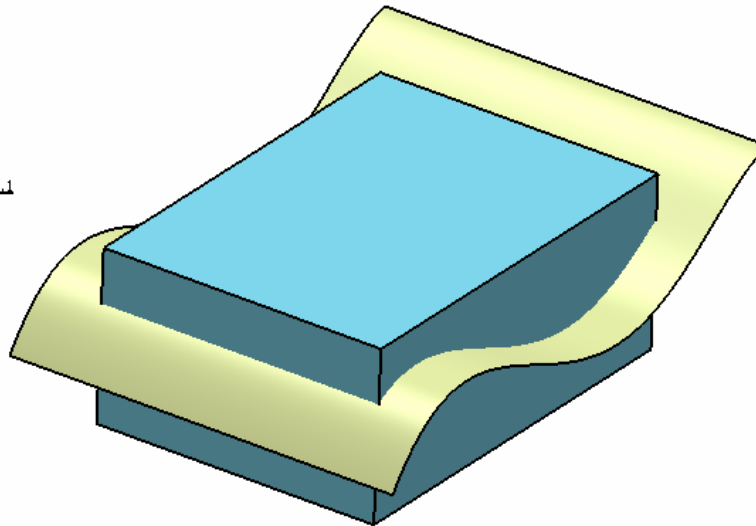
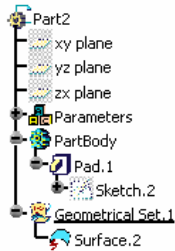
Split (by Surface)

Remark:

The surface-based features (Split, Thick Surface, Close surface & Sew) are available only on **Part Design** Workbench

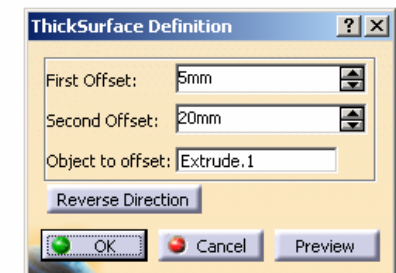
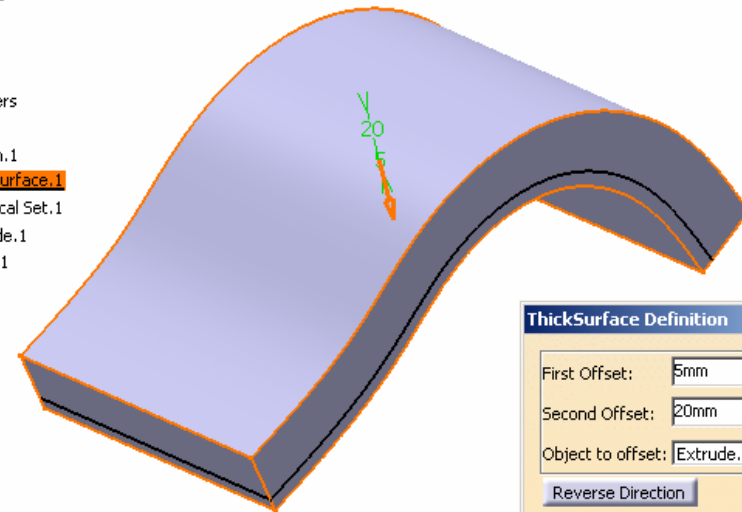
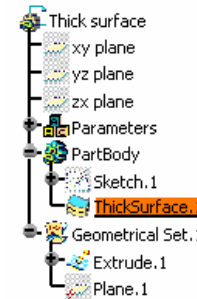
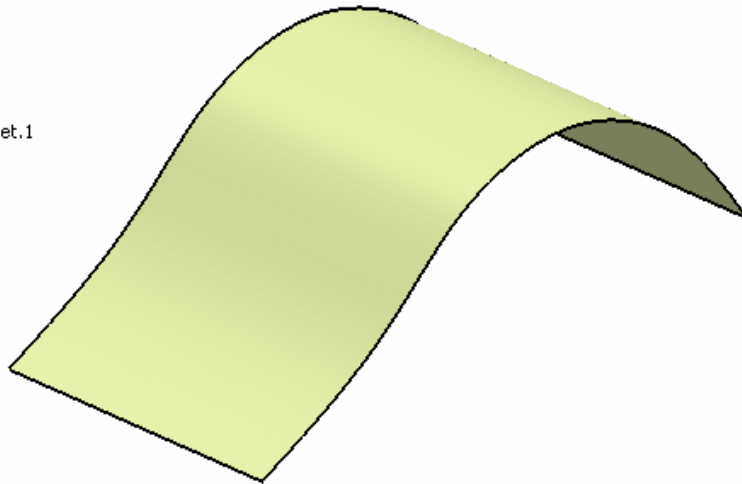
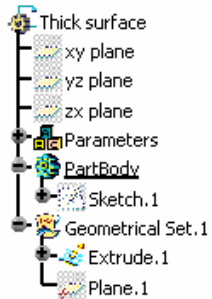


Split (split a solid with a plane, face or surface)



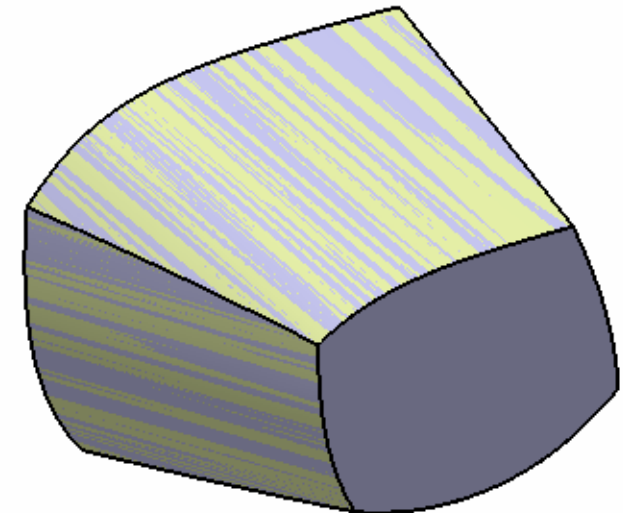
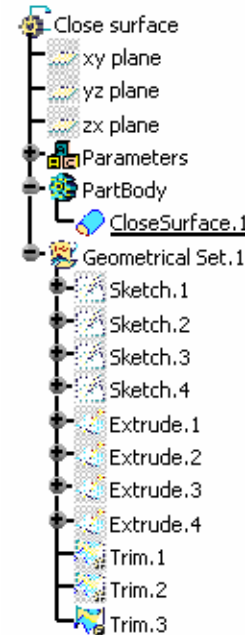
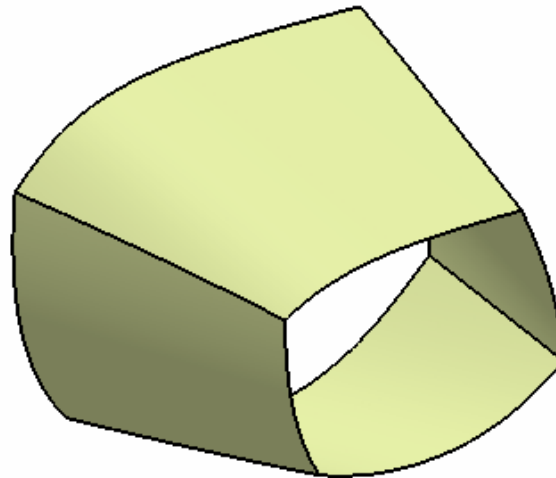
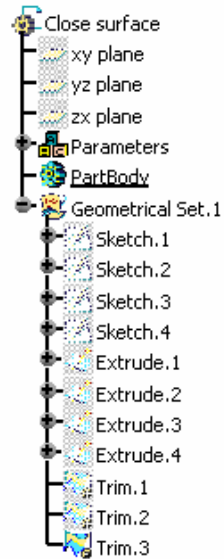
Thick Surface

Thick Surface (add material to a surface in two opposite directions or in one direction)



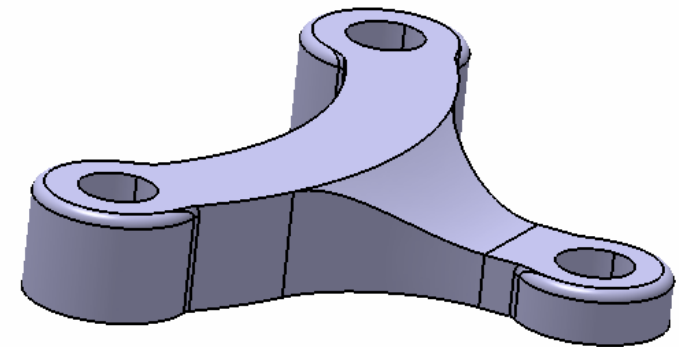
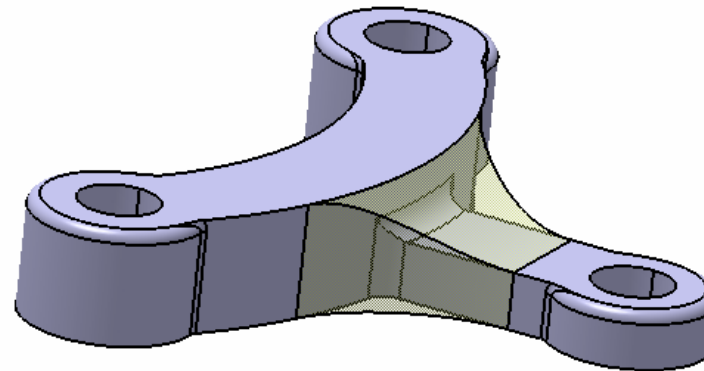
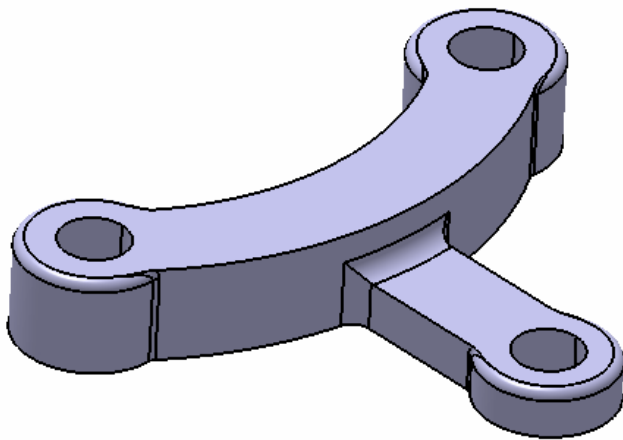
Close Surface

Close Surface (Add material inside the enclosed surface so that a solid is created)

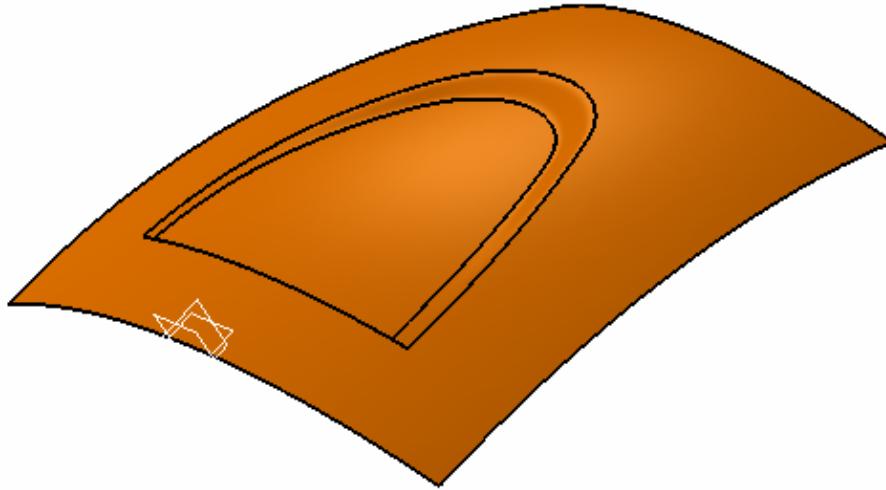


Sew Surface

Sew Surface (a Boolean operation combining a surface with a body. This capability adds or removes material by modifying the surface of the solid.)

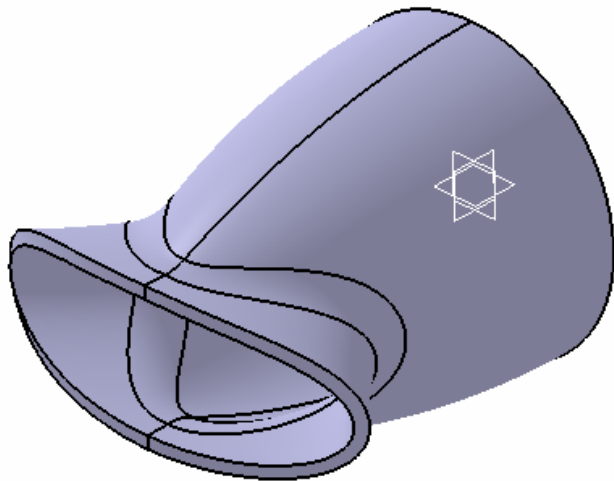


Exercise



Exercise 1

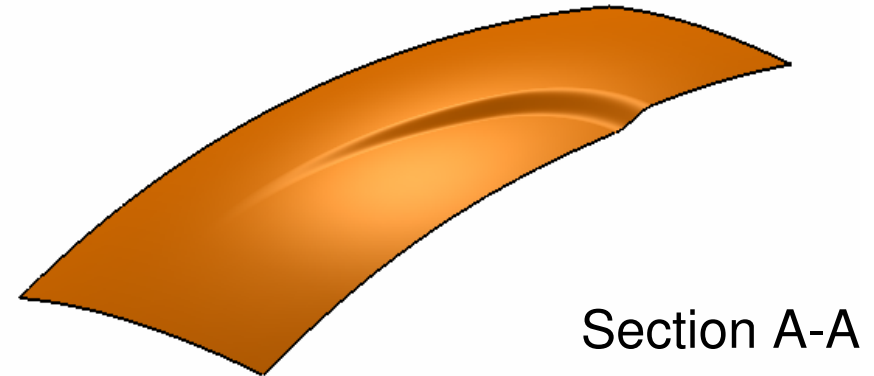
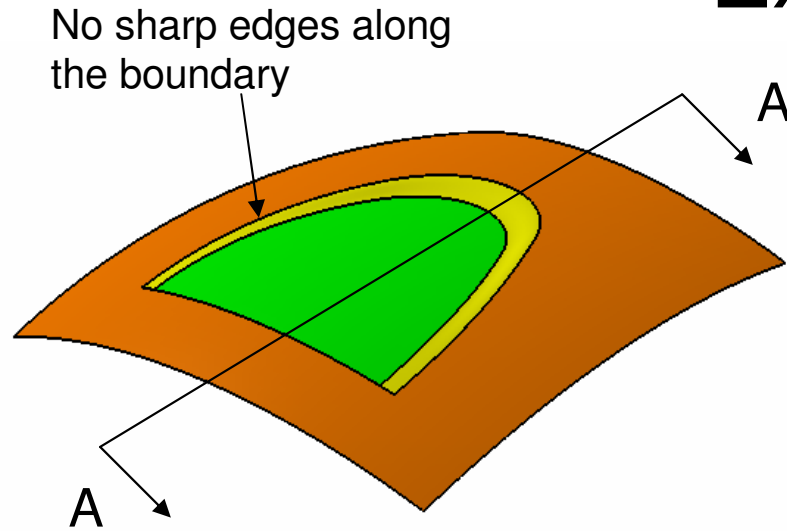
- Sweep/ Extrude/ Offset
- Blend/ Split/ Boundary
- Fill/ Join



Exercise 2

- Revolve/ Sweep/ Split
- Shape Fillet/ Extrude
- Symmetry/ Join
- Thick Surface

Exercise 1



(1) Start/Shape/Generative Shape Design

(2) To make a Sweep surface:-

- Click “**Sketch**” icon and select **yz plane**
- Draw an **arc** (R500) with one end (0,0) as shown in Fig.1
- Click “Exit” to complete
- Deselect Sketch.1
- Click “**Sketch**” icon again and select **zx plane**
- Draw an **arc** (R400) with symmetric endpoints as shown in Fig.2
- Click “Exit” to complete

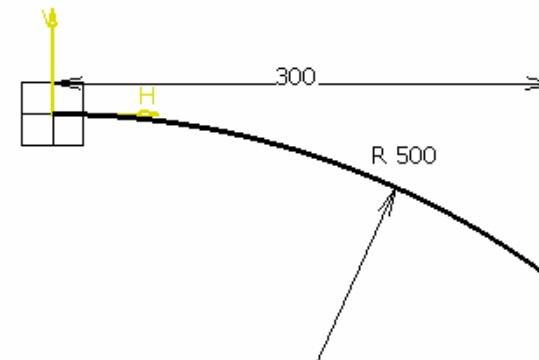


Fig.1

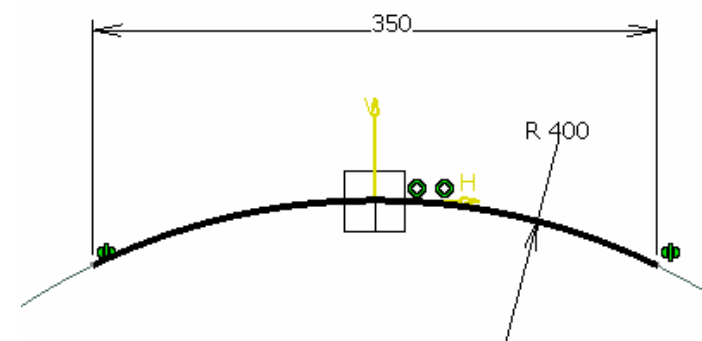


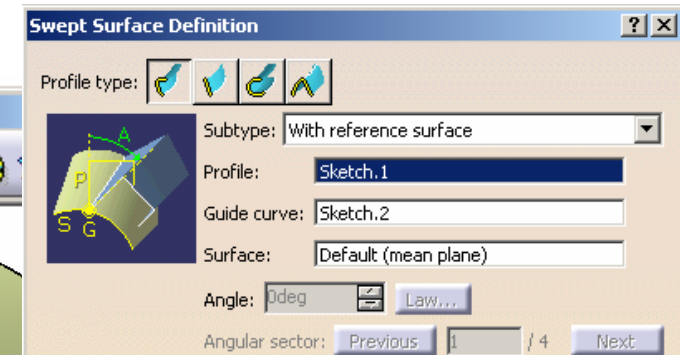
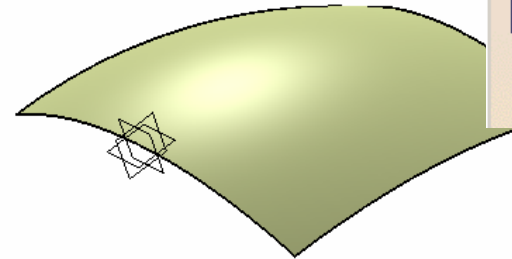
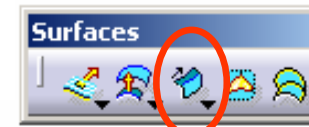
Fig.2

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Exercise 1

(Con't)

- Click “**Sweep**” icon
- Select “**Explicit**” as **Profile Type**
- Select **Sketch.1** as **Profile**
- Select **Sketch.2** as **Guide Curve**
- Click ok to complete
- **Hide Sketch.1 & Sketch.2**



(3) To make an Offset Plane:-

- Click “**Plane**” icon
- Select **xy plane** as **Reference**
- Enter 160mm as **Offset** (*upward*)
- Click ok to complete

(4) To make a sketch on the offset plane:-

- Click “**Sketch**” icon and select **Plane.1**
- Draw the Profile as shown in Fig.3
- Click “**Exit**” to complete

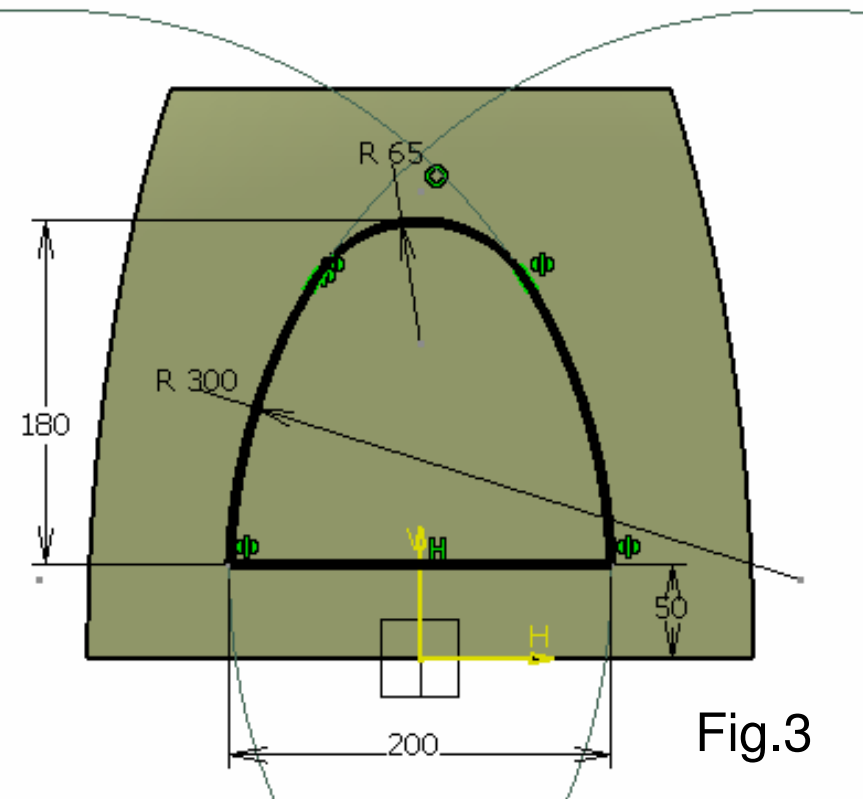


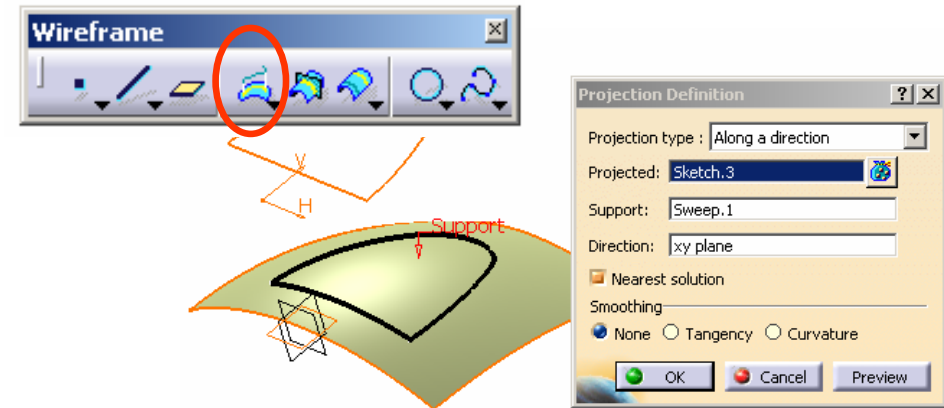
Fig.3

A- 45

Exercise 1

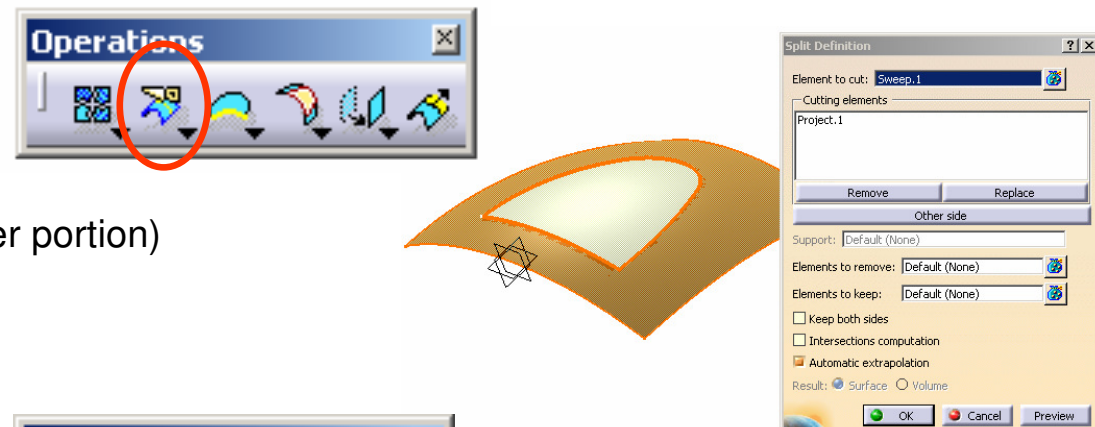
(5) To Project the sketch onto the surface:-

- Click **“Projection”** icon
- Select **“Along a direction”** as **Projection type**
- Select **Sketch.3** as **Projected**
- Select **Sweep.1** as **Support**
- Select **xy plane** as **Direction**
- Click ok to complete



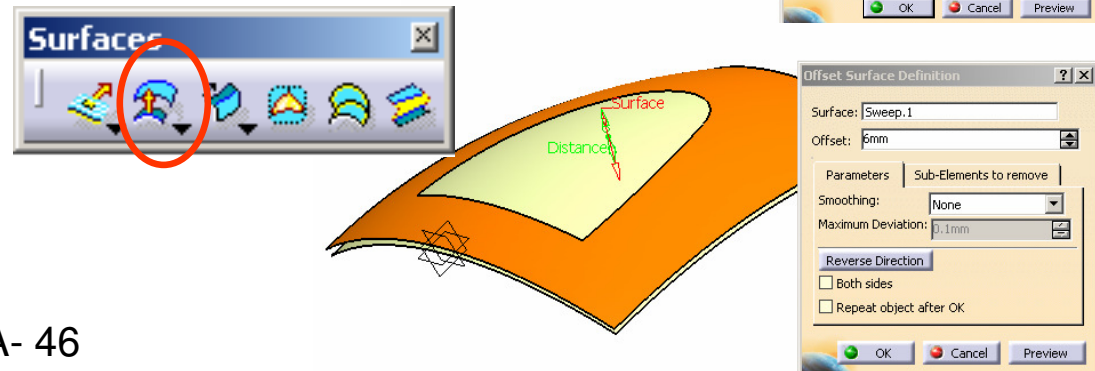
(6) To Split the surface:-

- Click **“Split”** icon
- Select **Sweep.1** as **Element to cut**
- Select **Project.1** as **Cutting element**
- (Click **“Other Side”** option to choose the outer portion)
- Click ok to complete
- **Hide Sketch.3 & Project.1**



(6b) To Offset the surface:-

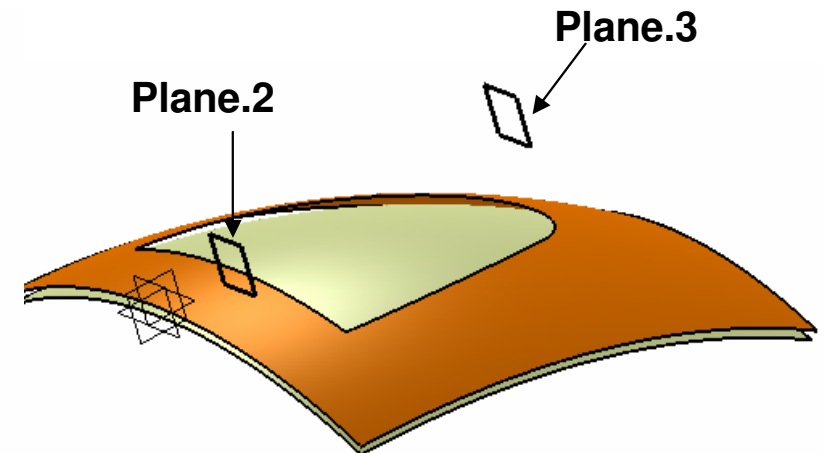
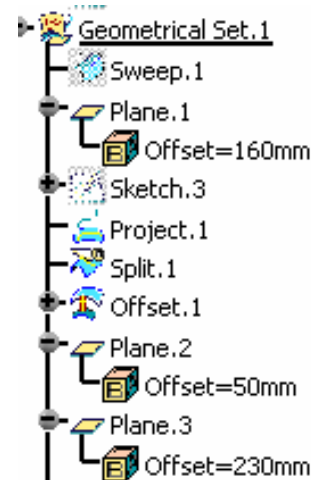
- Click **“Offset”** icon
- Select **Sweep.1** as **Surface**
- Enter **6mm** as Offset (Downward)
- Click ok to complete



Exercise 1

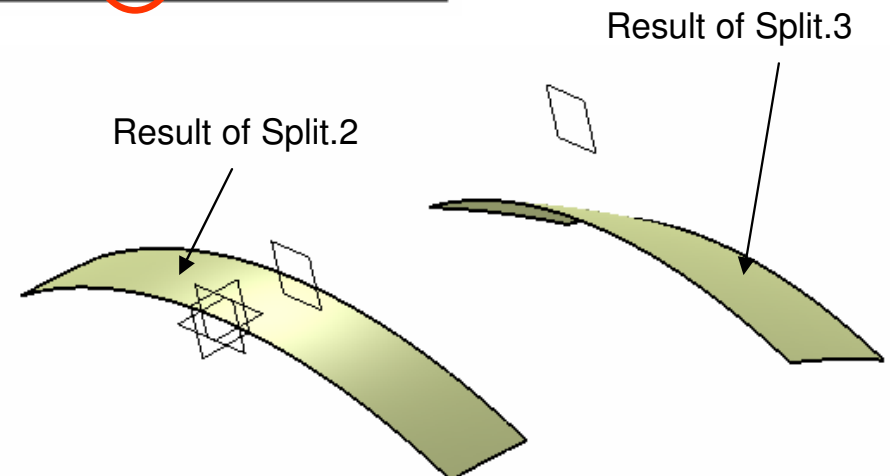
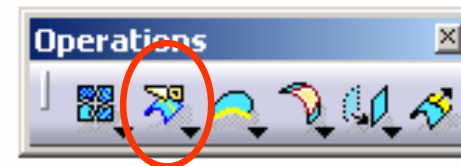
(7) To Create Two offset planes:-

- Click **"Plane"** icon
- Select **zx plane** as **Reference**
- Enter **50mm** as **Offset** (positive side)
- Click ok to complete
- Click **"Plane"** icon again
- Select **zx plane** as **Reference**
- Enter **230mm** as **Offset** (positive side)
- Click ok to complete



(8) To Split Surfaces:-

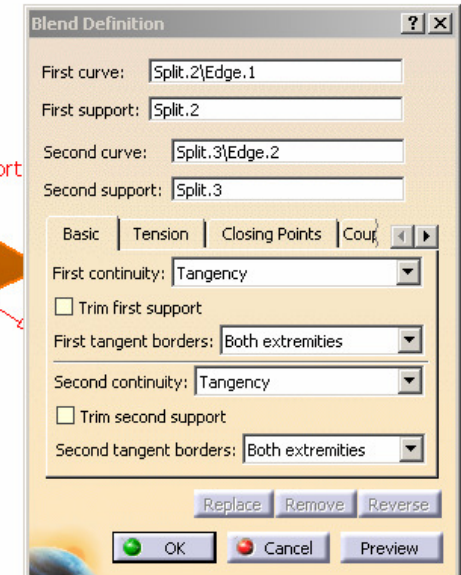
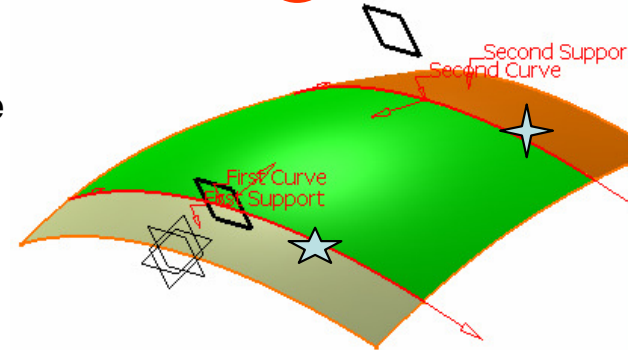
- **Hide Surface Split.1; Show Surface Sweep.1**
- Click **"Split"** icon
- Select **Sweep.1** as **Element to cut**
- Select **Plane.2** as **Cutting element**
- Click **"Other Side"** option to choose the smaller portion
- Click ok to complete
- Click **"Split"** icon again
- Select **Offset.1** as **Element to cut**
- Select **Plane.3** as **Cutting element**
- Click **"Other Side"** option to choose the smaller portion
- Click ok to complete



Exercise 1

(9) To Create a Blend:-

- Click “**Blend**” icon
- Select the edge of **Split.2** ★ as **First Curve**
- Select **Split.2** as **First Support**
- Select the edge of **Split.3** ★ as **Second Curve**
- Select **Split.3** as **Second Support**
- Select **Tangency** for First continuity and Second continuity
- Click ok to complete



(10) To make a sketch on the offset plane:-

- Click “**Sketch**” icon and select **Plane.1**
- Draw the Profile as shown in Fig.4
- Click “Exit” to complete

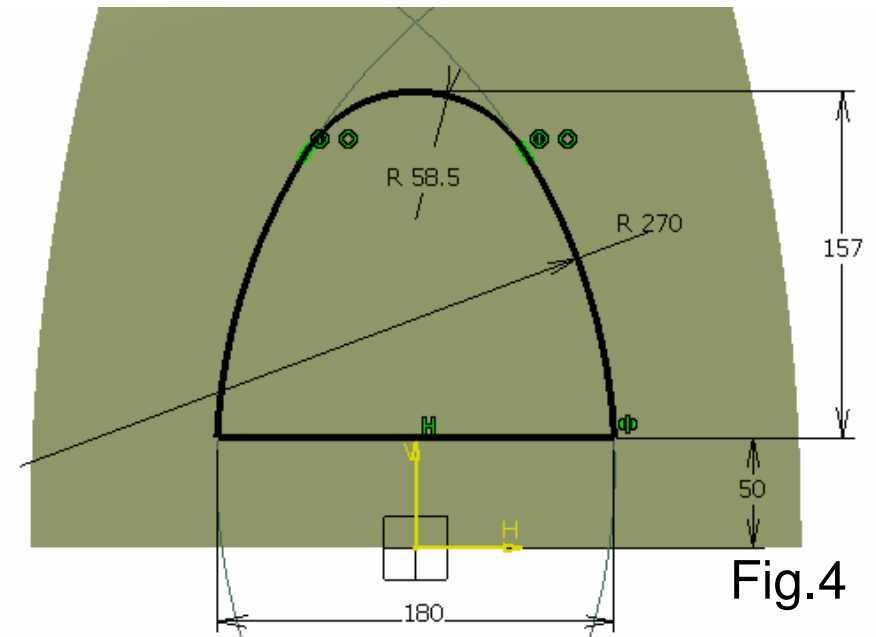


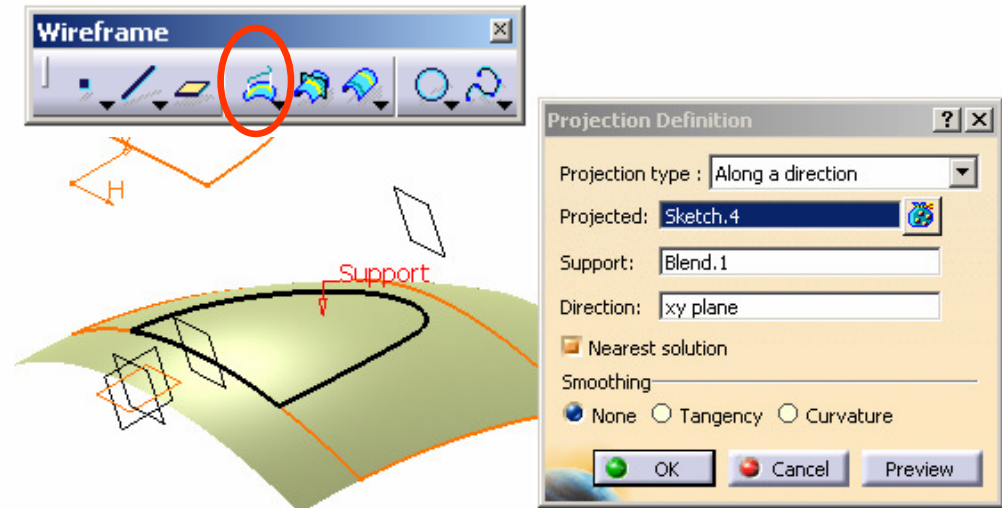
Fig.4

A- 48

Exercise 1

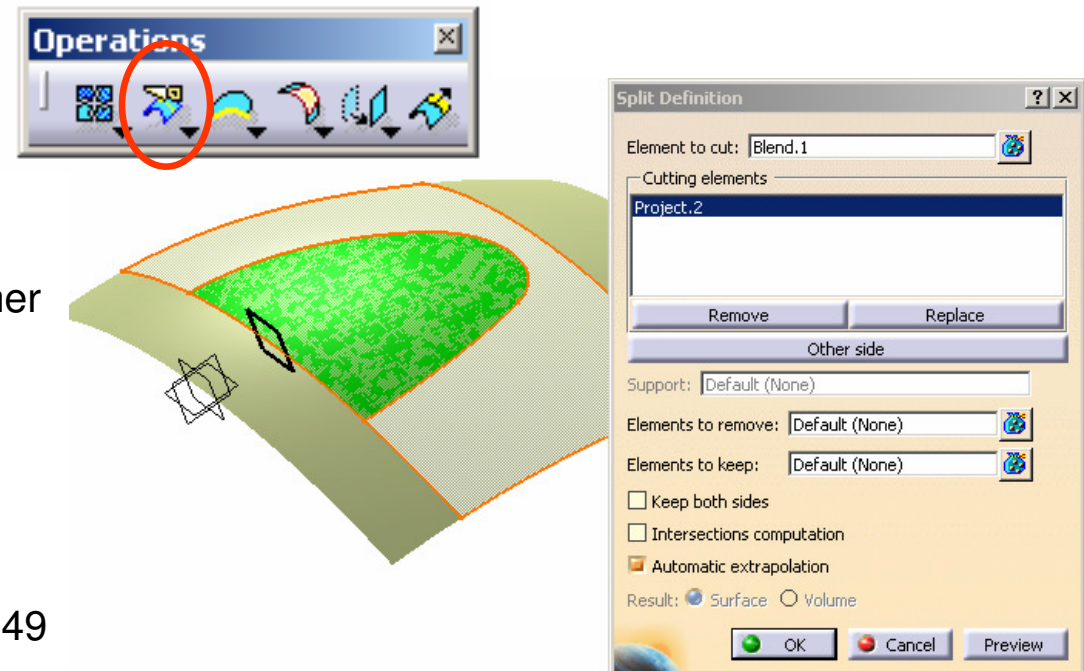
(11) To Project the sketch onto the Blend:-

- Click “**Projection**” icon
- Select “**Along a direction**” as **Projection type**
- Select **Sketch.4** as **Projected**
- Select **Blend.1** as **Support**
- Select **xy plane** as **Direction**
- Click ok to complete



(12) To Split the Blend:-

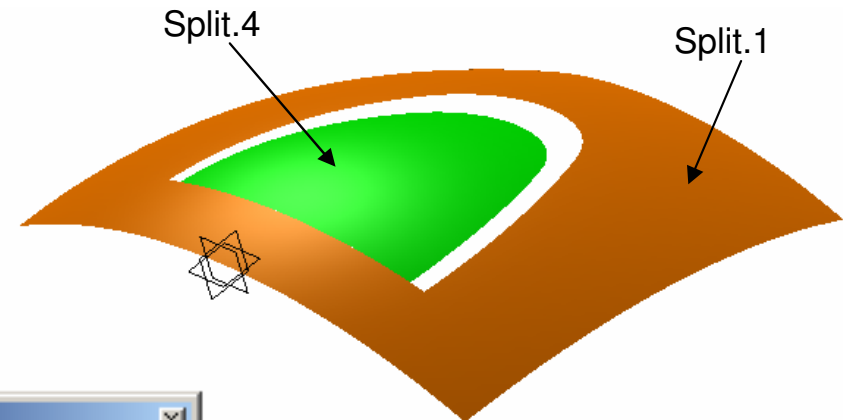
- Click “**Split**” icon
- Select **Blend.1** as **Element to cut**
- Select **Project.2** as **Cutting element**
- (Click “**Other Side**” option to choose the inner portion)
- Click ok to complete
- **Hide Sketch.4 & Project.2**



Exercise 1

(13) To Hide all constructive elements:-

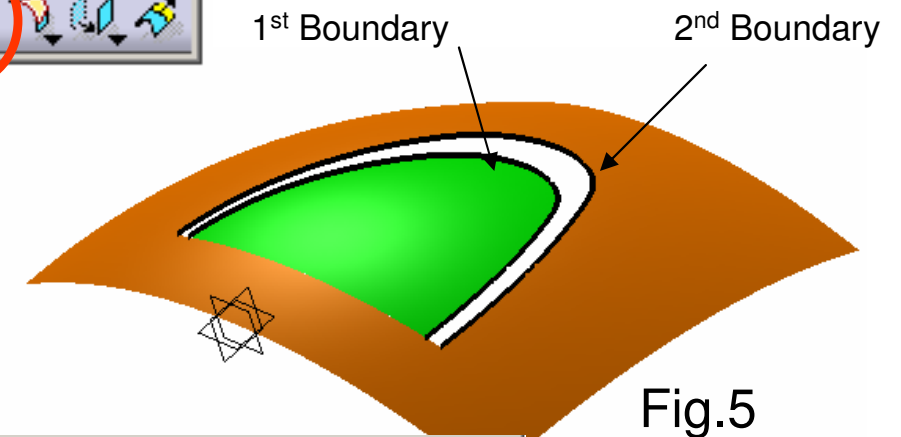
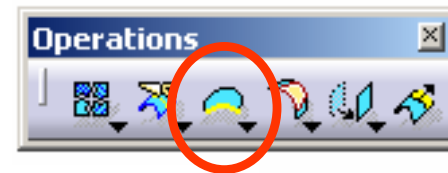
- Hide all elements except **Split.1** & **Split.4**



(14) To make 4 boundaries:-

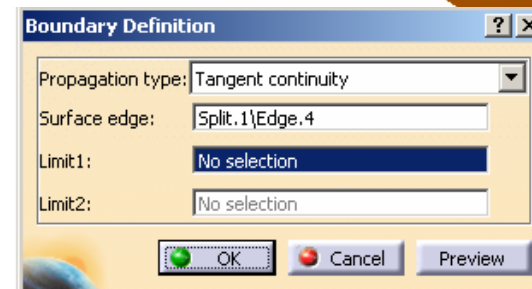
(1st Boundary)

- Click "**Boundary**" icon
- Select "**Tangency continuity**" as Propagation type
- Select the edge as shown in Fig.5
- Click ok to complete




(2nd Boundary)

- Click "**Boundary**" icon again
- Select "**Tangency continuity**" as Propagation type
- Select the edge as shown in Fig.5
- Click ok to complete




Exercise 1

(3rd Boundary)

- Click "**Boundary**" icon again
- Select the edge as shown in Fig.6
- Select the point  as **Limit 1**
- Click ok to complete

(4th Boundary)

- Click "**Boundary**" icon again
- Select the edge as shown in Fig.6
- Select the point  as **Limit 1**
- Click ok to complete

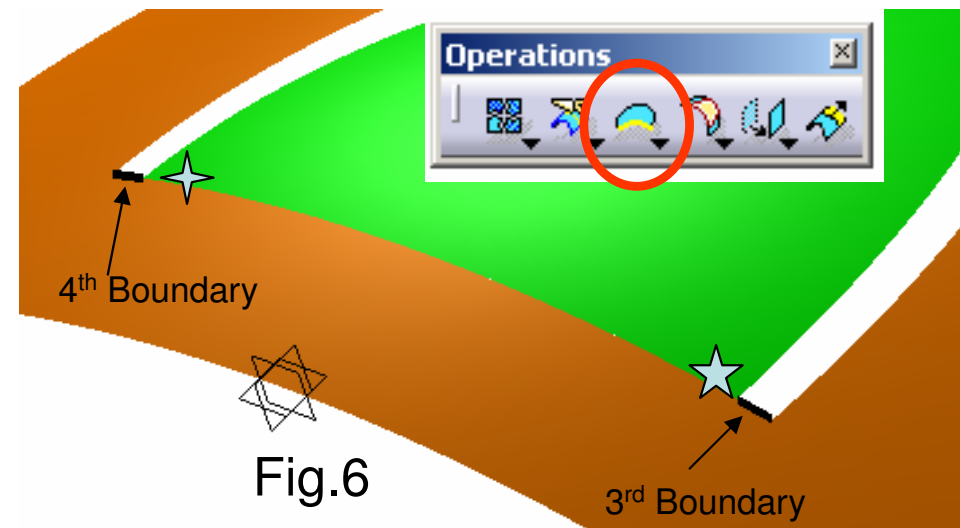
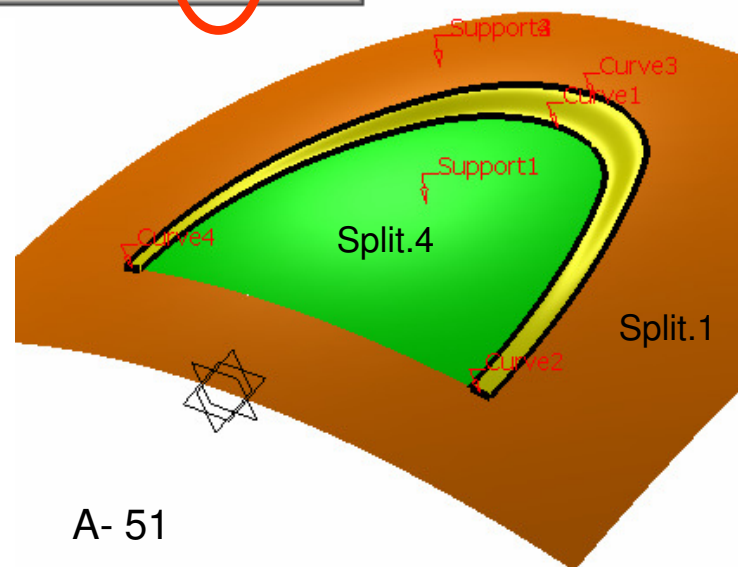


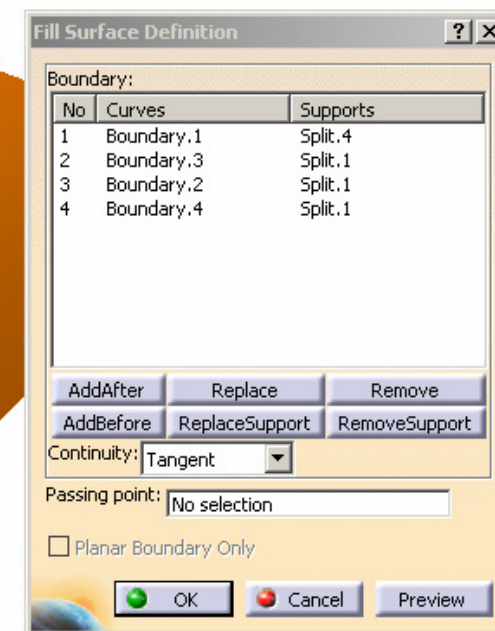
Fig.6

(15) To Create a Fill:-

- Click "**Fill**" icon
- Select **Boundary.1** then **Split.4** then **Tangent**
- Select **Boundary.2** then **Split.1** then **Tangent**
- Select **Boundary.3** then **Split.1** then **Tangent**
- Select **Boundary.4** then **Split.1** then **Tangent**
- Click ok to complete



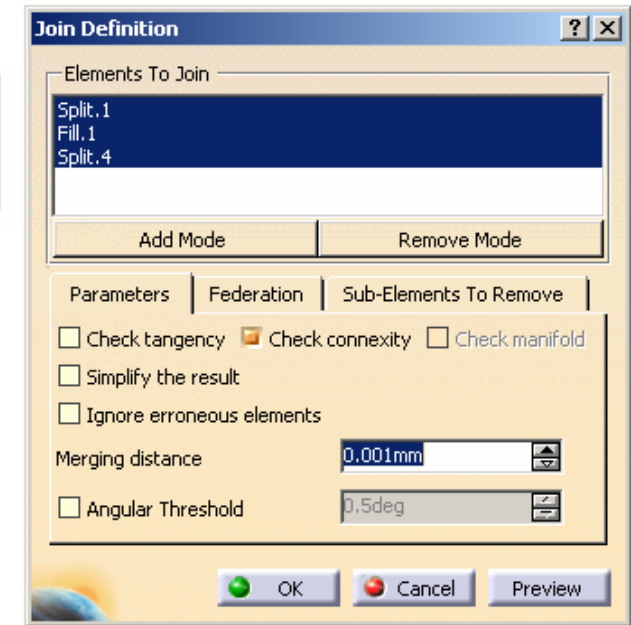
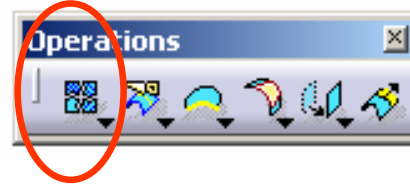
A- 51



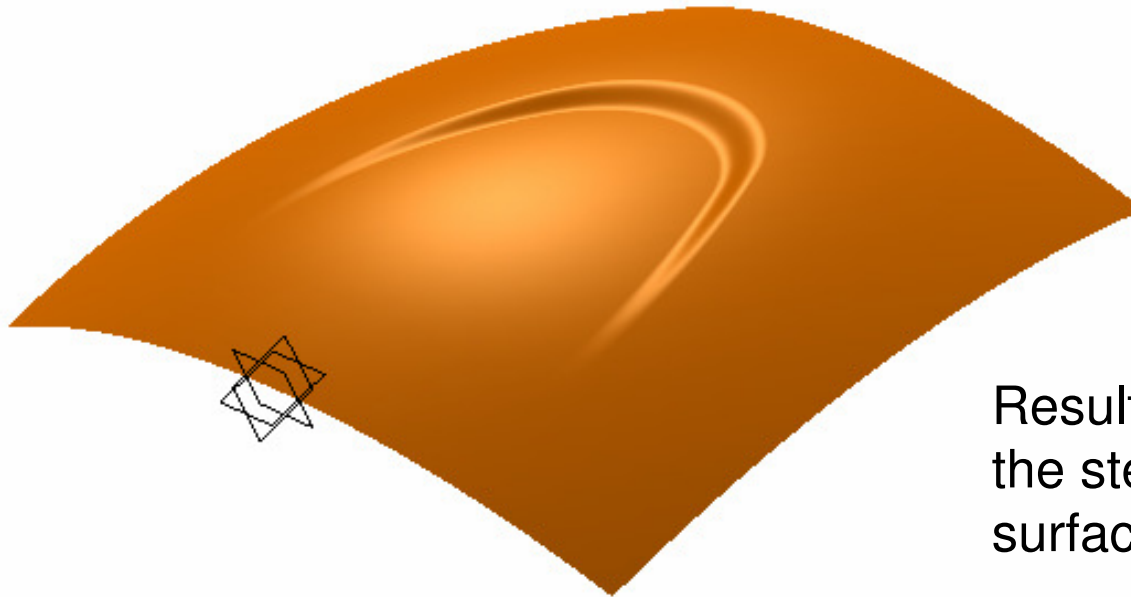
Exercise 1

(16) To Join surfaces:-

- Click “Join” icon
- Select **Split.1, Fill.1 & Split.4**
- Click ok to complete



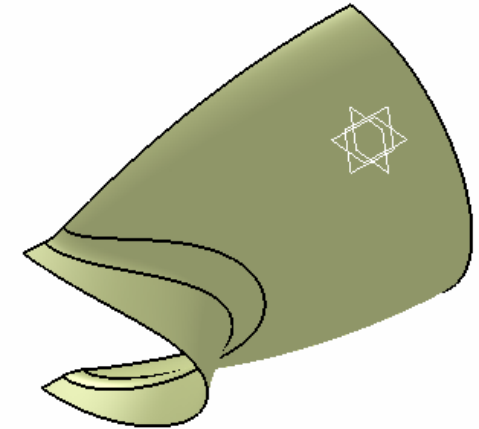
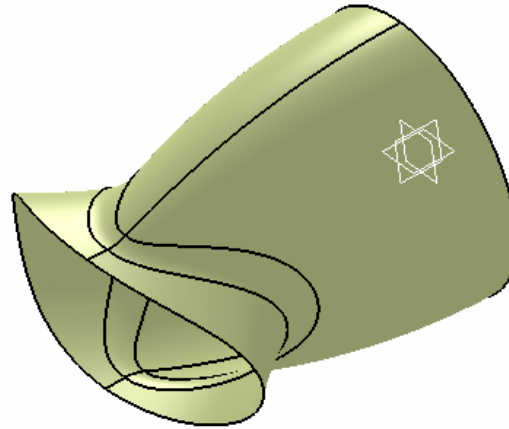
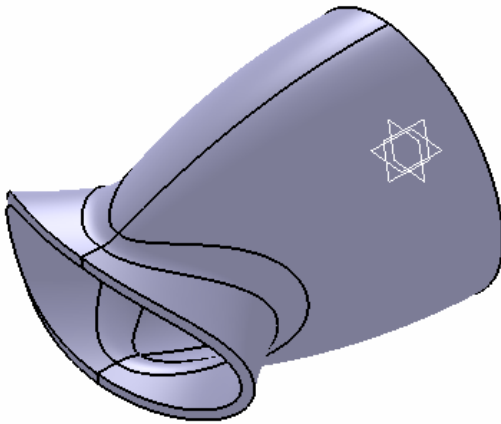
(17) Hide all Boundaries



Result: No sharp edge between the step-down and the original surface

END of Exercise.1

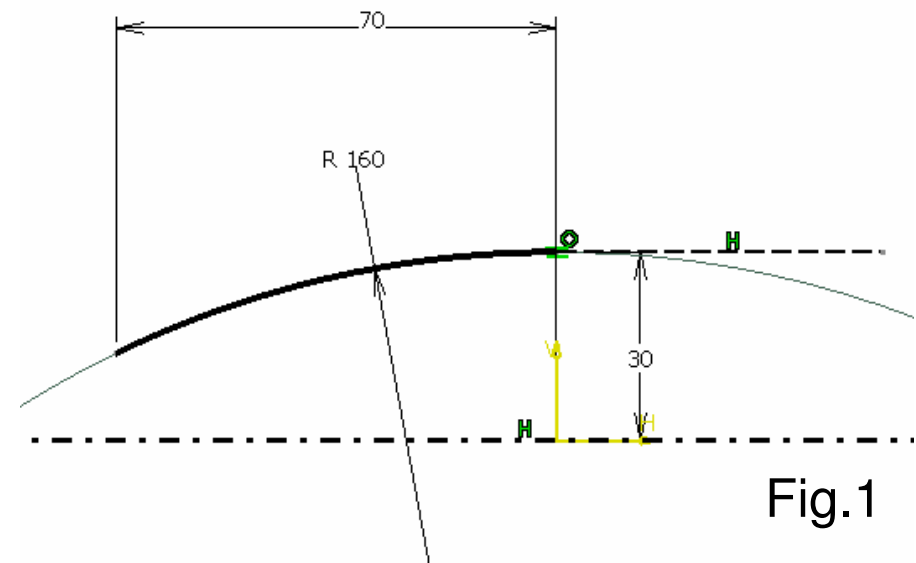
Exercise 2



(1) Start/Shape/Generative Shape Design

(2) To make a Revolve surface:-

- Click “**Sketch**” icon and select **zx plane**
- Draw an **arc** (R160) with one end (0,30) as shown in Fig.1, which should be tangent to a horizontal axis
- Draw another horizontal axis on x-axis (which will be selected to be the axis of rotation later)
- Click “Exit” to complete

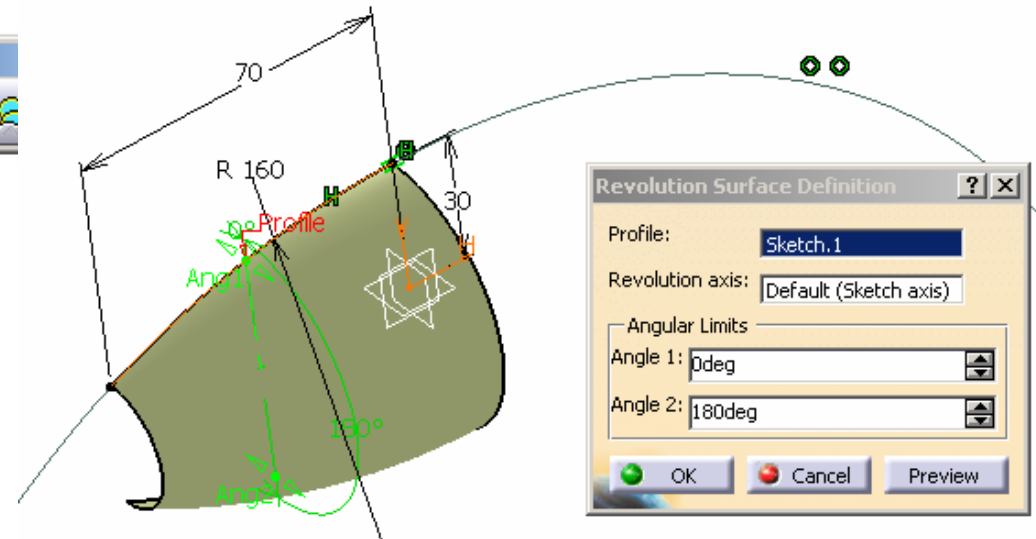


A- 53

Exercise 2

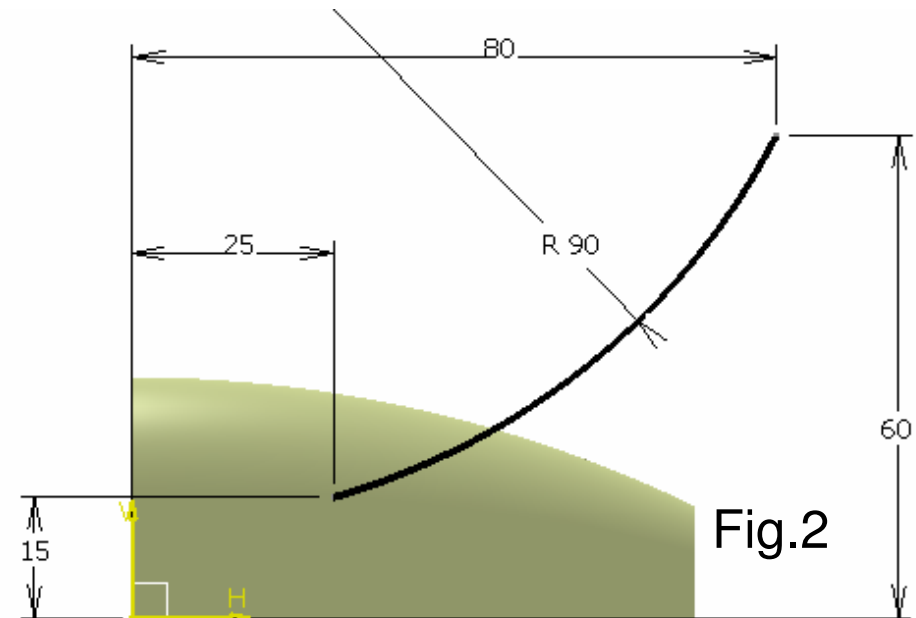
(con't)

- Click “**Revolve**” icon
- Select **Sketch.1** as **Profile**
- (Sketch axis will be selected as **Revolution axis**)
- Enter 0deg as **Angle.1**
- Enter 180deg as **Angle.2**
- Click ok to complete
- **Hide Sketch.1**



(3) To make the 2nd Sketch:-


- Click “**Sketch**” icon and select **xy Plane**
- Draw an Arc (R90) as shown in Fig.2
- Click “**Exit**” icon to complete




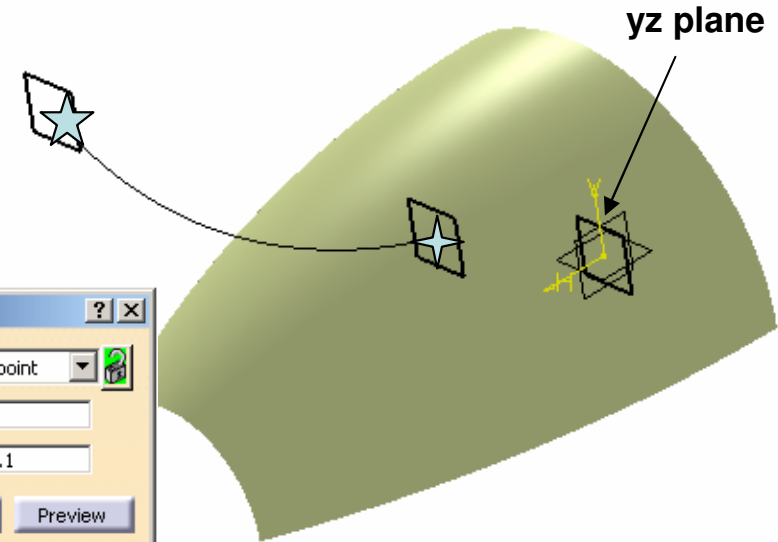
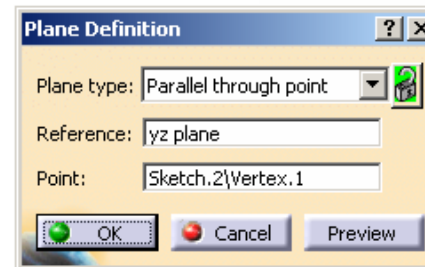
A- 54

Exercise 2

(4) To make reference planes:-

- Click **"Plane"** icon
- select **yz Plane**
- **then select the end point**  **of the arc**
- ("Parallel through point" will be automatically selected as "Plane Type")
- Click ok to complete

- Click **"Plane"** icon again
- select **yz Plane**
- **then select the end point**  **of the arc**
- Click ok to complete



(5) To make the 3rd Sketch:-

- Click **"Sketch"** icon and select **Plane.1**
- Draw an ellipse with one end touching **Sketch.2** as shown in **Fig.3**
- (While adding the constraint (D30), right-click and select "semiminor axis")
- Click Exit to complete

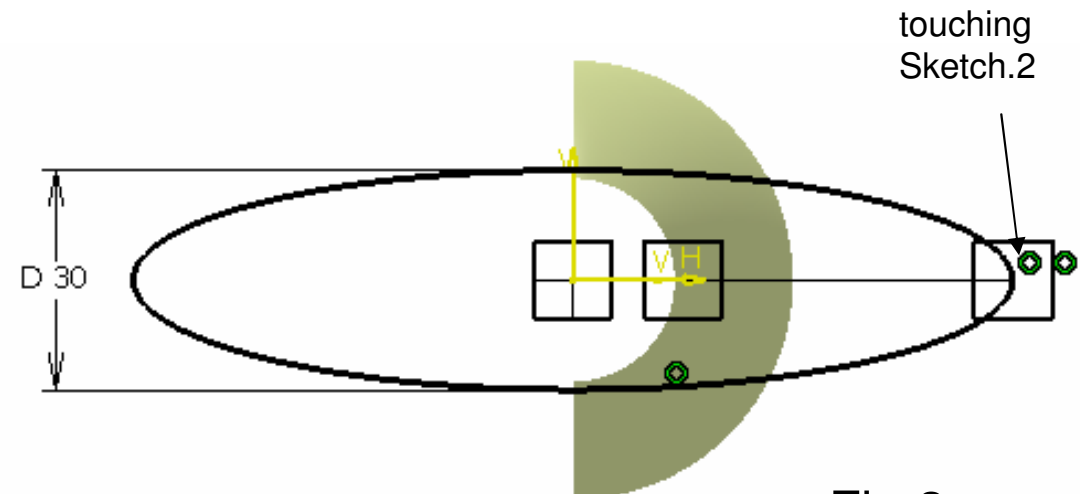
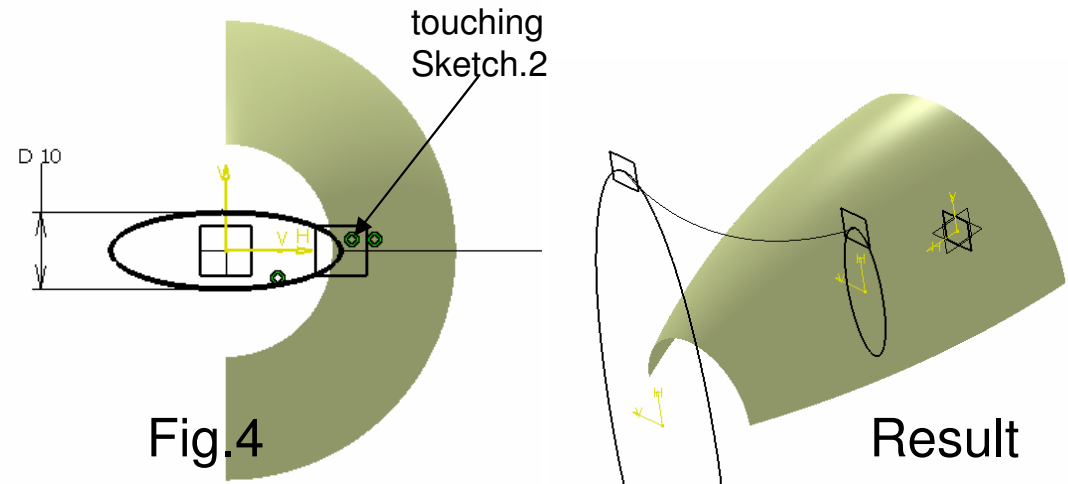


Fig.3

Exercise 2

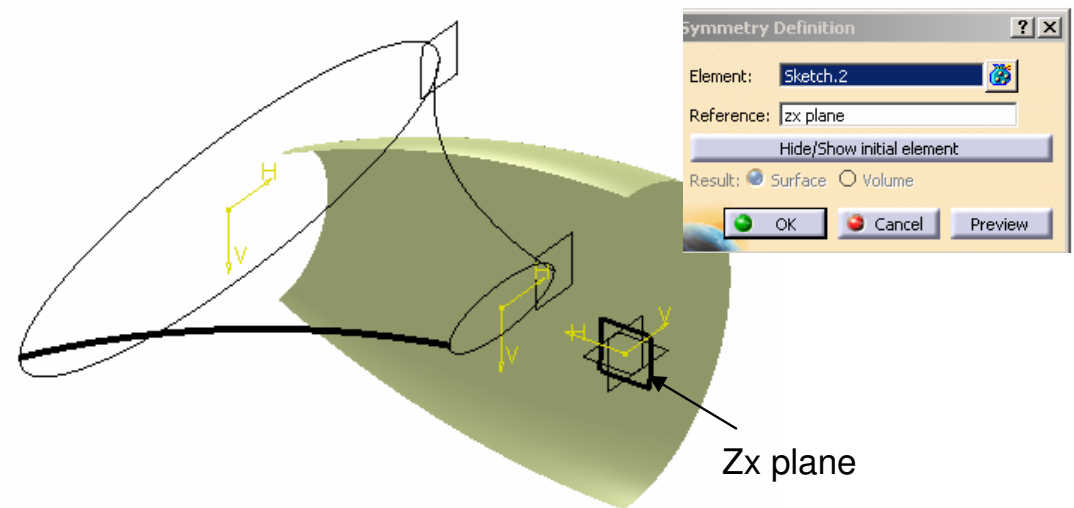
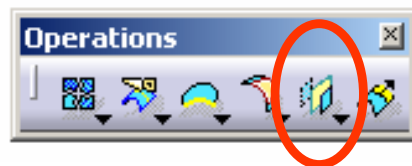
(6) To make the 4th Sketch:-

- Click “**Sketch**” icon and select **Plane.2**
- Draw an ellipse with one end touching **Sketch.2** as shown in **Fig.4**
- (While adding the constraint (D10), right-click and select “semiminor axis”)
- Click Exit to complete



(7) To make a symmetric curve:-

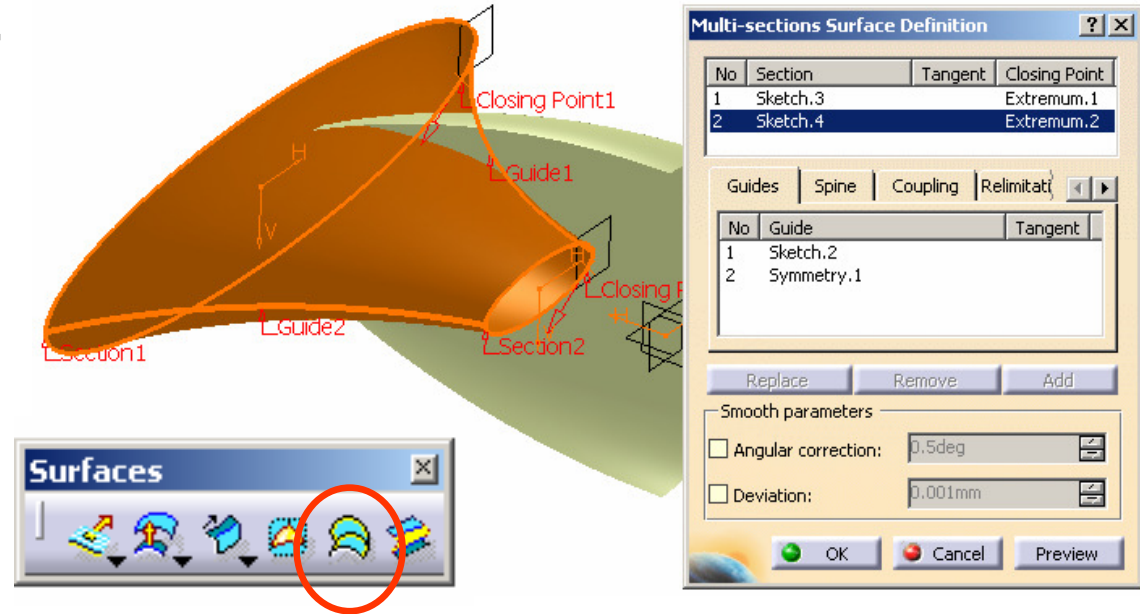
- Click “**Symmetry**” icon
- Select **Sketch.2** as **Element**
- select **zx Plane** as **Reference**
- Click ok to complete



Exercise 2

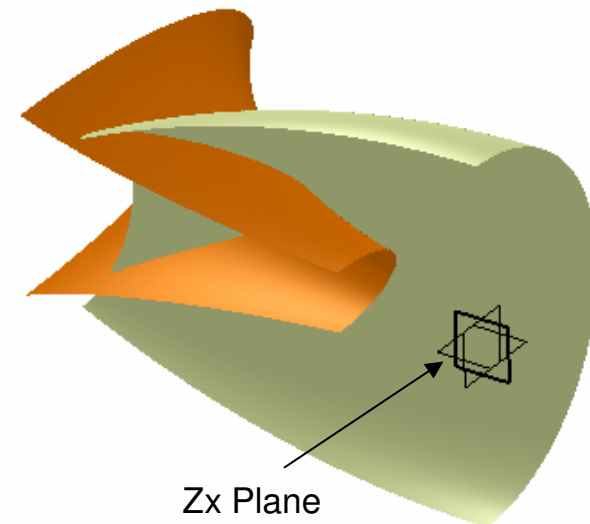
(7) To make a Multi-sections Surface:-

- Click “**Multi-sections Surface**” icon
- Select **Sketch.3** as **Section#1**
- Select **Sketch.4** as **Section#2**
- Select **Sketch.2** as **Guide#1**
- Select **Symmetry.1** as **Guide#2**
- Click ok to complete
- **Hide Sketch.2, Sketch.3, Sketch.4, Symmetry.1, Plane.1 & Plane.2**



(8) To Split the surface:-

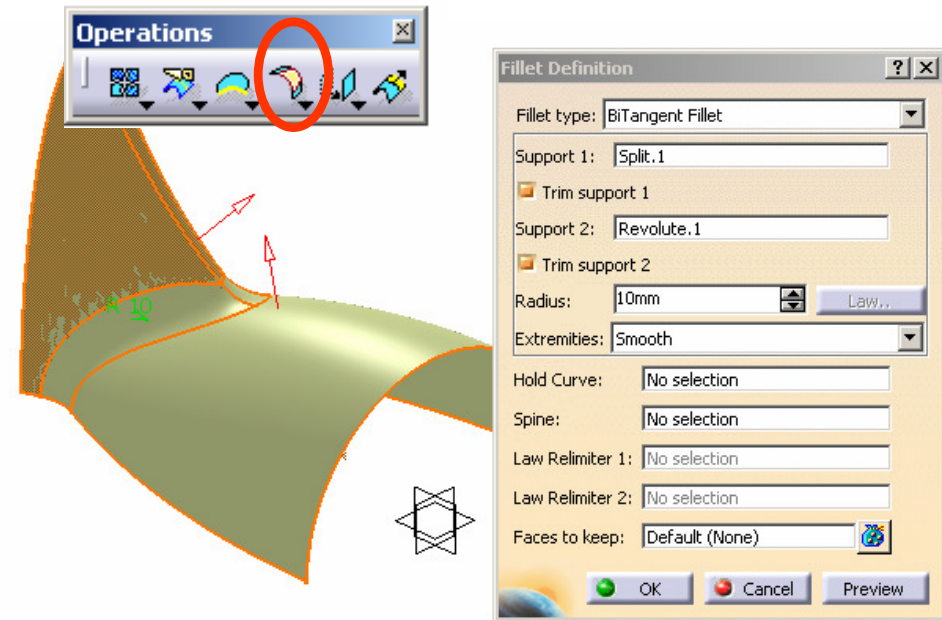
- Click “**Split**” icon
- Select **Multi-sections Surface.1** as **Element to cut**
- Select **zx Plane** as **Cutting element**
- (Click “**Other Side**” option to choose the correct portion)
- Click ok to complete



Exercise 2

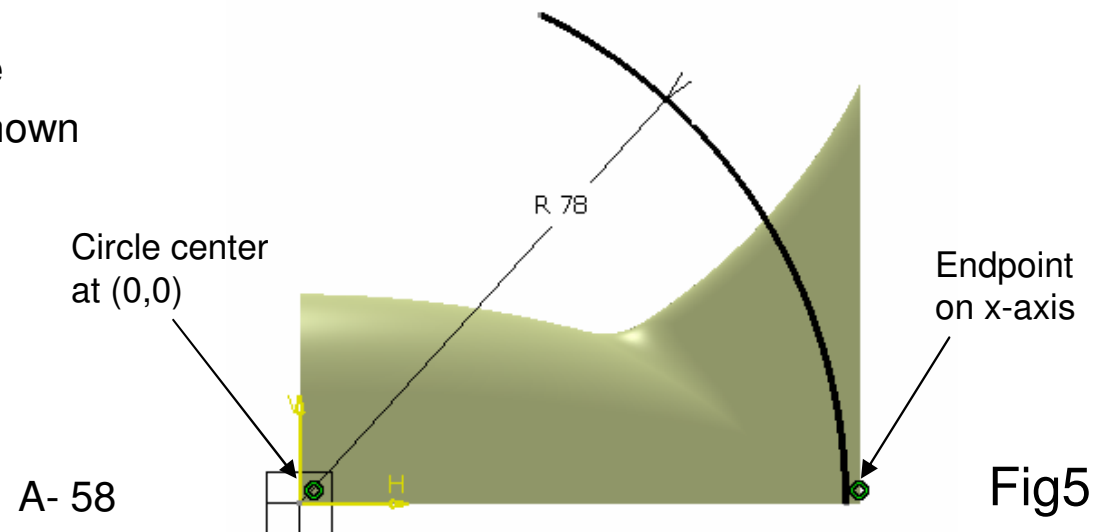
(9) To make a Fillet between 2 surfaces:-

- Click “**Shape Fillet**” icon
- Select **Split.1** as **Support.1**
- Select “**Trim Support.1**”
- Select **Revolute.1** as **Support.2**
- Select “**Trim Support.2**”
- Enter 10mm as **Radius**
- (Click on the red arrow if it is not pointing outward)
- Click ok to complete



(10) To make 5th Sketch:-

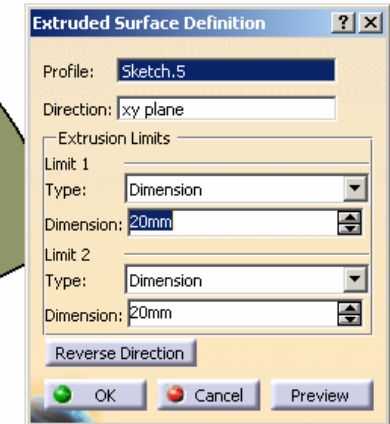
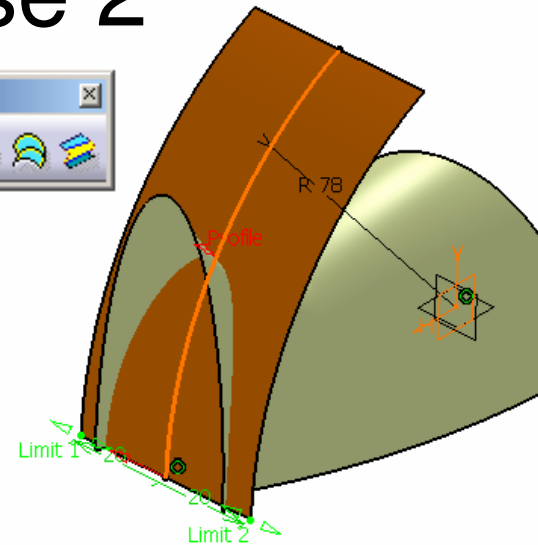
- Click “**Sketch**” icon and select **xy Plane**
- Draw an Arc (R78, center at (0,0)) as shown in Fig.5
- (One endpoint must be on x-axis)
- Click ok to complete



Exercise 2

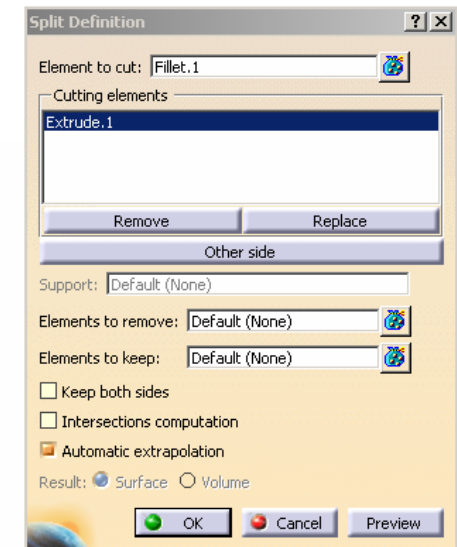
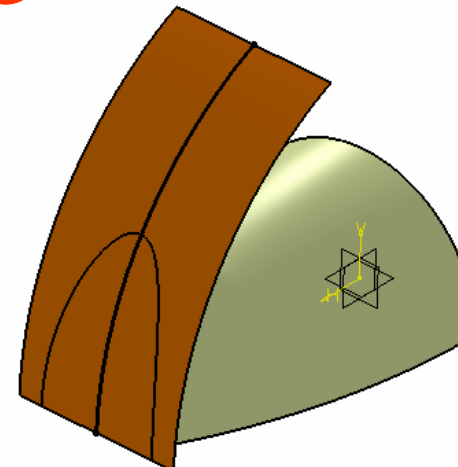
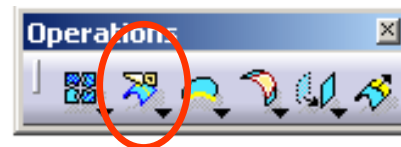
(11) To make an Extrude:-

- Click “**Extrude**” icon
- Select **Sketch.5** as **Profile**
- (The Sketch Plane, **xy Plane** will be automatically selected as **Direction**)
- Enter 20mm as **Limit.1**
- Enter 20mm as **Limit.2**
- Click ok to complete



(12) To Split Surface:-

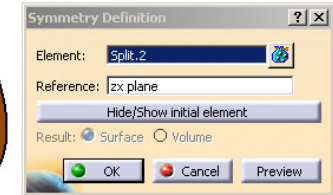
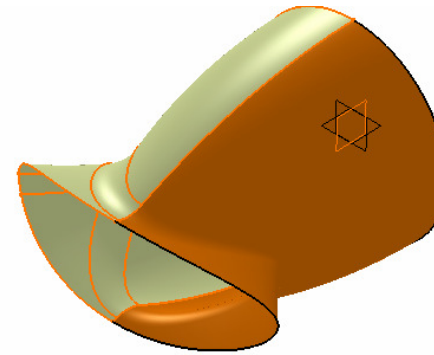
- Click “**Split**” icon
- Select **Fillet.1** as **Element to cut**
- Select **Extrude.1** as **Cutting element**
- (Click “**Other Side**” option to choose the bigger portion)
- Click ok to complete
- **Hide Extrude.1 & Sketch.5**



Exercise 2

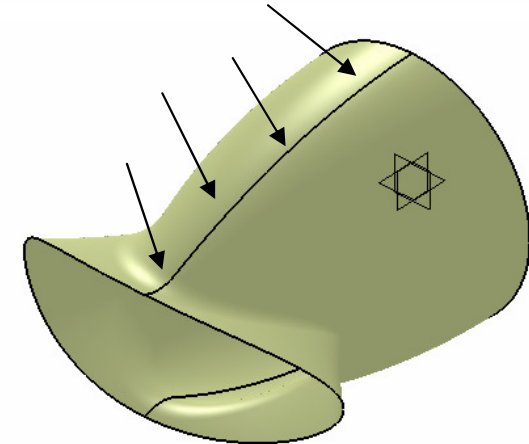
(13) To make a Symmetry:-

- Click “Symmetry” icon
- Select **Split.2** as **Element**
- Select **zx Plane** as **Reference**
- Click ok to complete



(14) To visual-check the tangency continuity along the interface:-

- Click “Shading” icon
- (All black surface edges now disappear)
- Check if any sharp edge appears along the centre interface. If yes, go back to previous step(s) to correct the error.



(15) To Join Surfaces:-

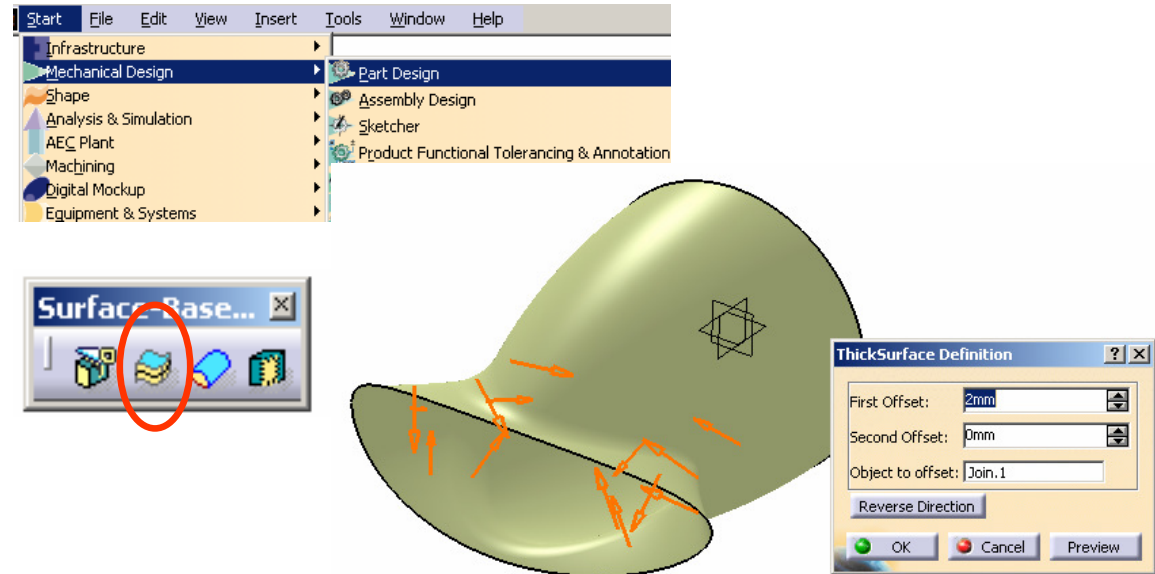
- Click “Join” icon
- Select **Split.2** and **Symmetry.2** as **Elements to Join**
- Click ok to complete
- (Split.2 & Symmetry.2 will be hidden automatically)



Exercise 2

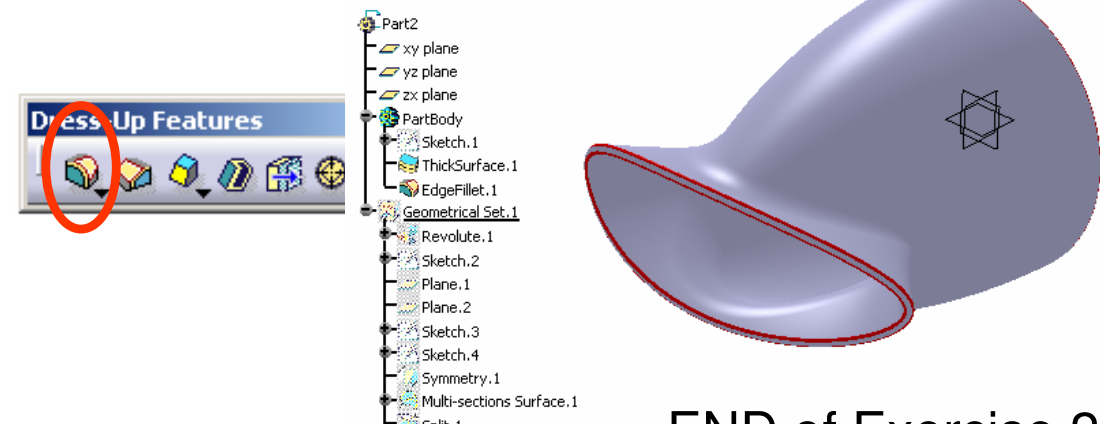
(16) To make a Solid:-

- Start/Mechanical Design/Part Design
- Click “**Thick Surface**” icon
- Click ok on the pop-up warning window
- Select **Join.1** as **Object to Offset**
- Enter 2mm as **First Offset**
- (If the red-arrows are not pointing inward, click “Reverse Direction” or directly click on an arrow to change the direction)
- Click ok to complete
- **Hide Geometrical Set.1**



(17) To add Fillets onto the solid:-

- Click “**Edge Fillet**” icon
- Select **all sharp edges**
- Enter 0.5mm as **Radius**
- Click ok to complete



END of Exercise.2