EXERCISE BOOK

Student Notes:

CATIA - Virtual Design Training
Exercises

CATIA Surface Design Expert

Version 5 Release 21
July 2011

EDU_CAT_EN_GSD_AX_V5R21

Student Notes:

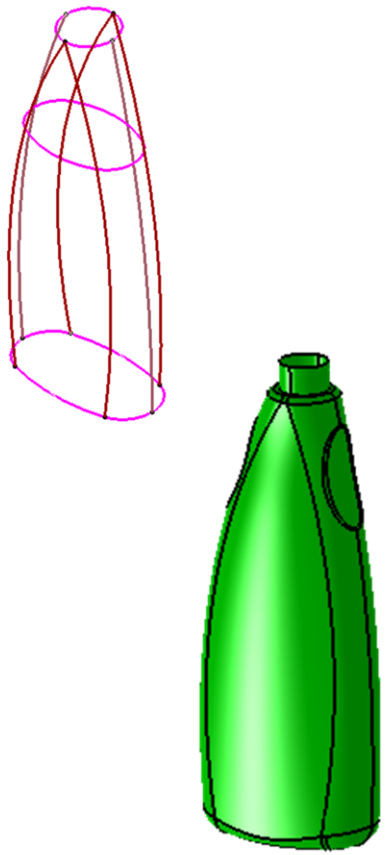
Shampoo Bottle

Recap Exercise: Surface Design Overview

40 min

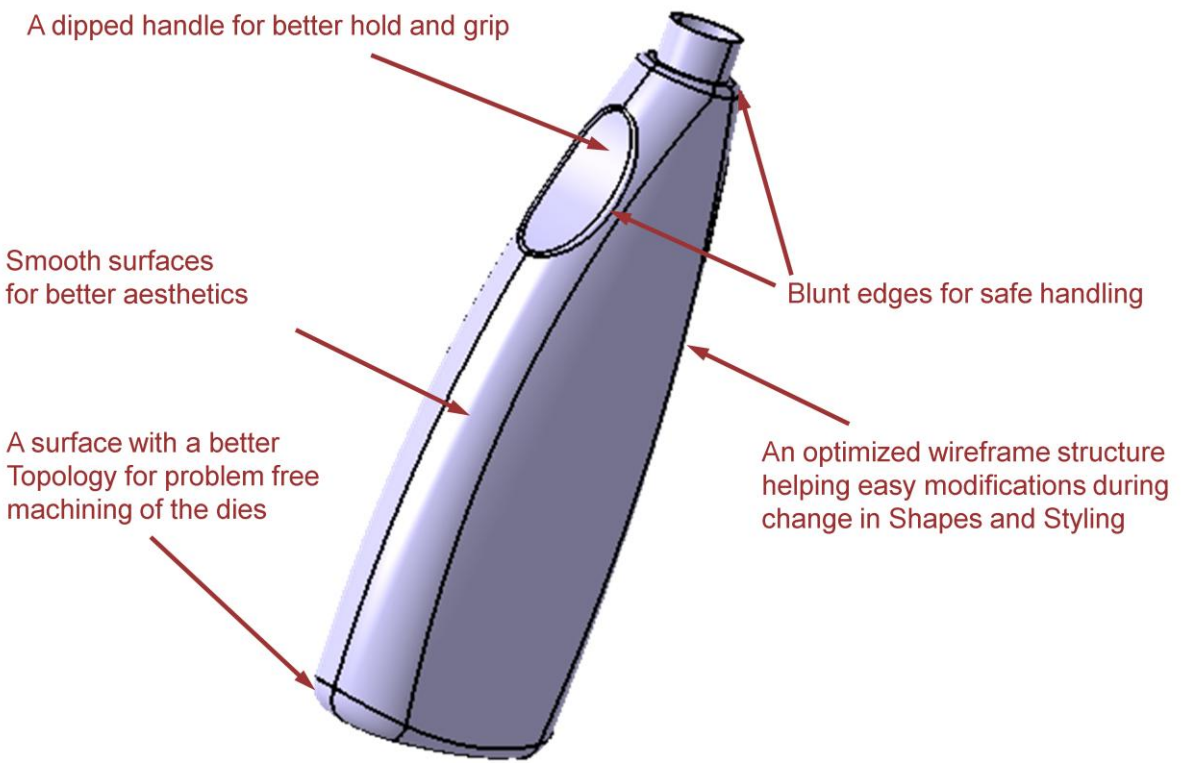
In this exercise you will:

- **Create, analyse and modify the wireframes and surfaces using advance tools of Generative Shape Design**
- **Learn that, high quality surface can be achieved using advance tools of Generative Shape Design**



Student Notes:

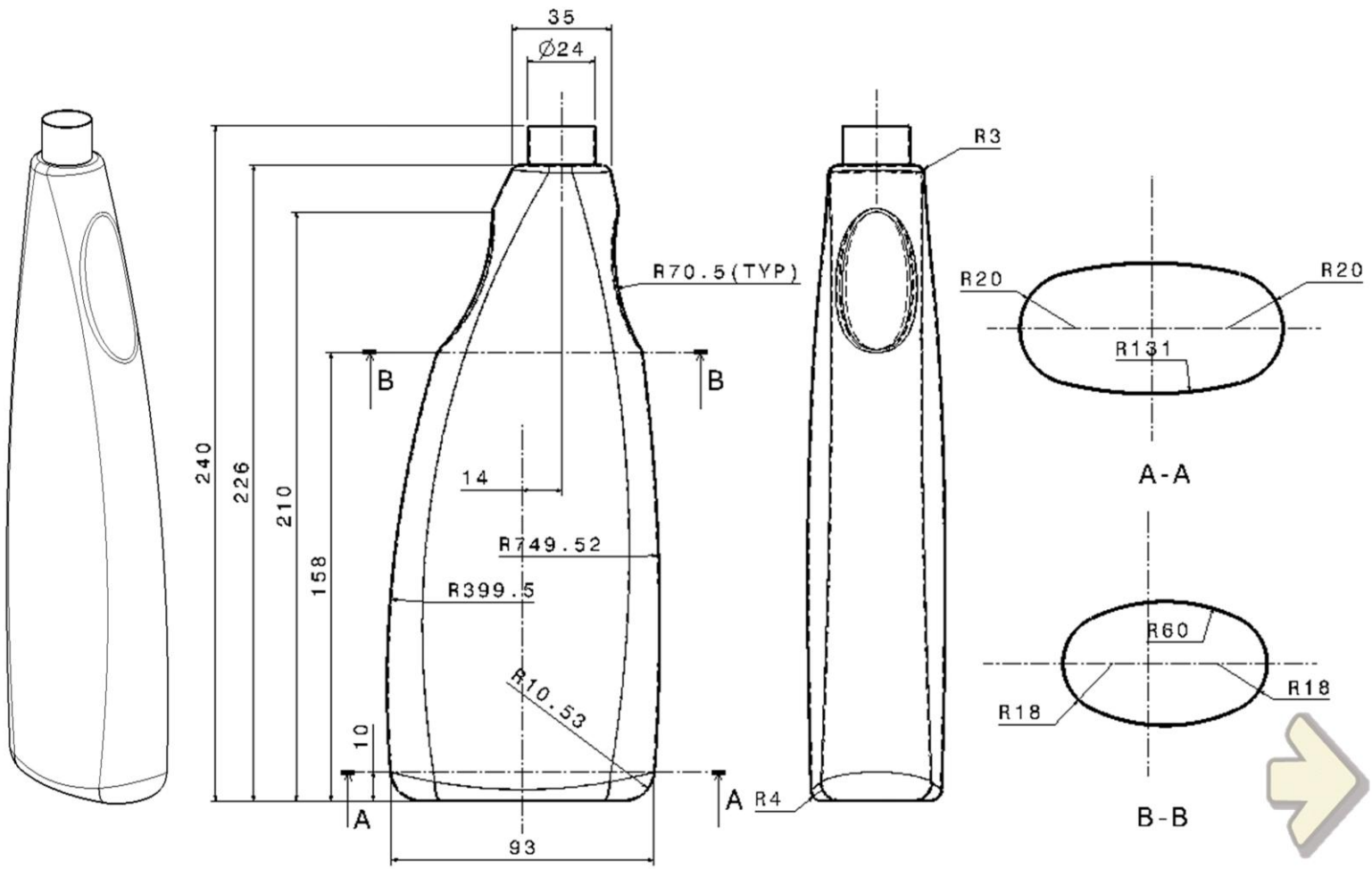
Design Intent: Shampoo Bottle (1/2)



Student Notes:

Design Intent: Shampoo Bottle (2/2)

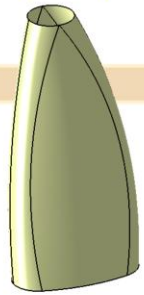
Build the Shampoo Bottle geometry using the shown specifications

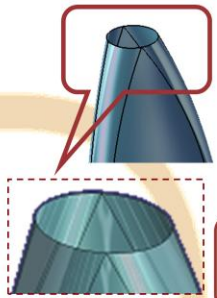


Student Notes:

Design Process: Shampoo Bottle (1/2)

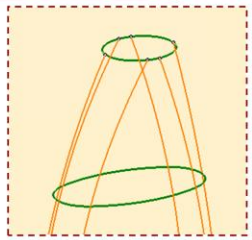
1. Create Basic Multi-Section Surface from given Wireframe



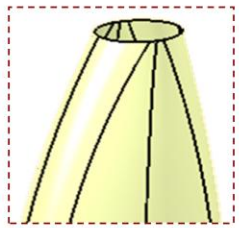


2. Analyze the Surface

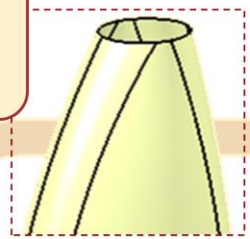
3. Modify the wireframe



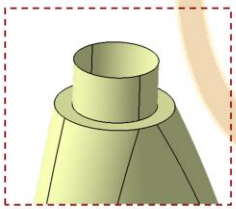
4. Create the Multi-Section surface using the modified wireframe

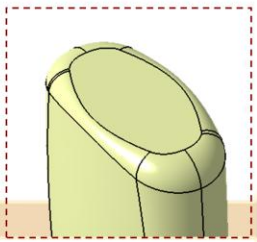


5. Smoothen the Multi-Section surface specifying the Deviation



6. Create the Neck of the bottle



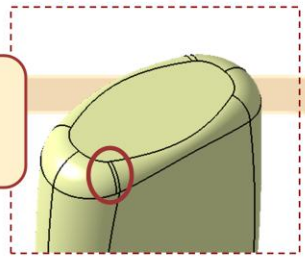


7. Create a Bitangent fillet at the bottom without specifying Hold curve and complete the model

Student Notes:

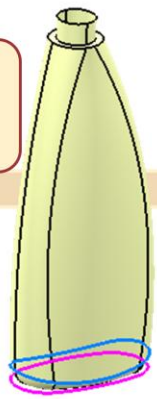
Design Process: Shampoo Bottle (2/2)

8 Analyze the surface for broken fillet at the bottom

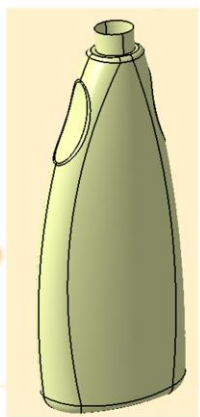


9 Create a 'Hold curve' using 'intersection' and spine using 'curve Smooth'

10 Modify the Bitangent Fillet using Hold curve and spine



11 Create the Bottle Handle

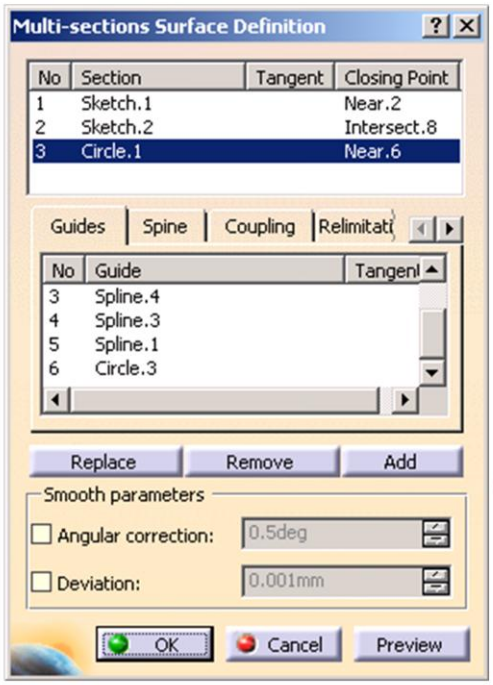


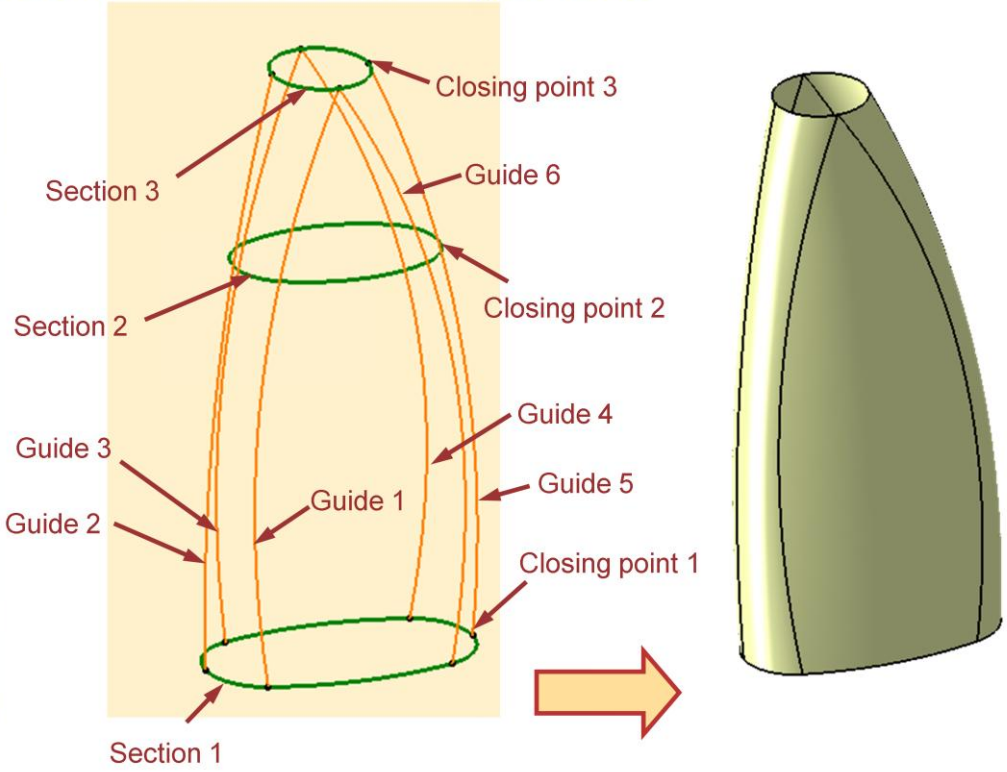
Student Notes:

Do it Yourself (1/11)

Part Used: CATGSD_F_Shampoo Bottle_Start.CatPart

- Create Basic surfaces using the given wireframe. This surface will then be analyzed for quality
  - Create a Multi-Section surface from the given sections and guide curves



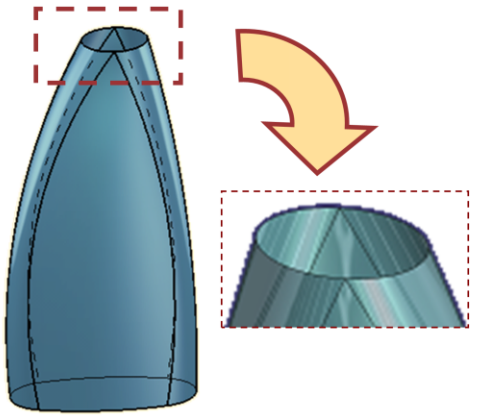


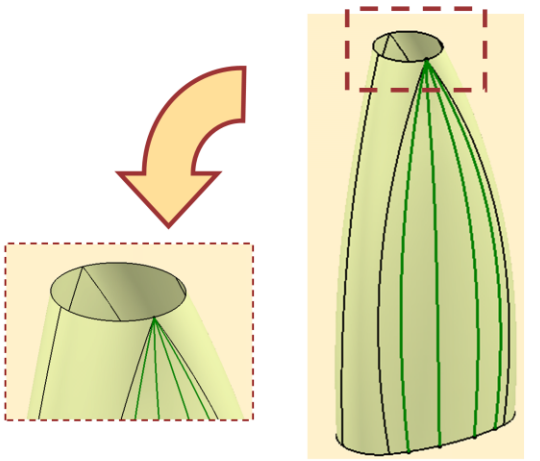
Student Notes:

Do it Yourself (2/11)

- Analyze the surface quality visually
  - Apply the material specifications to the surfaces-
    - DS Light Blue

    You will find the distortion on the surface formed by three edges, at the converging point
  - Change the View to “Shading with Edges” mode.
- You will Create the Isoparametric curves to see the segmentation of the surface
  - Invoke the Isoparametric curves function
    - Insert > Wireframe > Isoparametric curves
  - Select a point on the surface(support) where you would require the curve. Swap U V if required contextually, and confirm OK to create the curve
  - Similarly extract the few more Isoparametric curves.





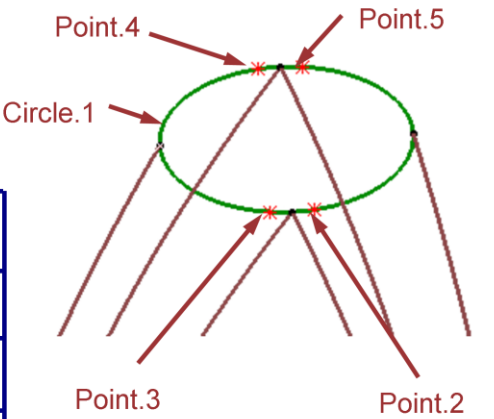
You will observe that the Isoparametric curves intersect each other at the same converging point. This signifies that the surface is NOT of good quality.

Student Notes:

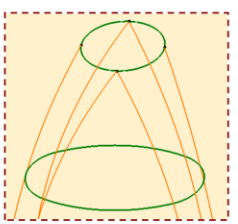
Do it Yourself (3/11)

To improve the surface quality you will improve the quality of wireframe.

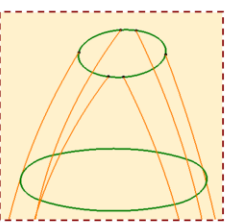
- Modify the wireframe to achieve a good quality surface
  - Deactivate all the Isoparametric curves before modifications
  - Create Four points using “Point on Curve”



Name	Curve	Ref Point	Length
Point 2	Circle 1	Near 3	3 mm
Point 3	Circle 1	Near 3	3 mm
Point 4	Circle 1	Near 4	3 mm
Point 5	Circle 1	Near 4	3 mm



Wireframe with guide curves converging at same point.



Wireframe modified to achieve a good quality surface.

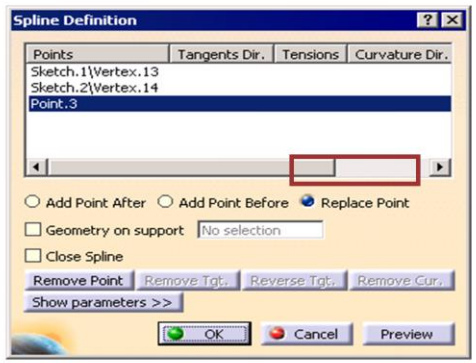
Once you finish the modification of wireframe. You can activate the Isoparametric curves to visualize the changes.Deactivate or delete these curves after your study.

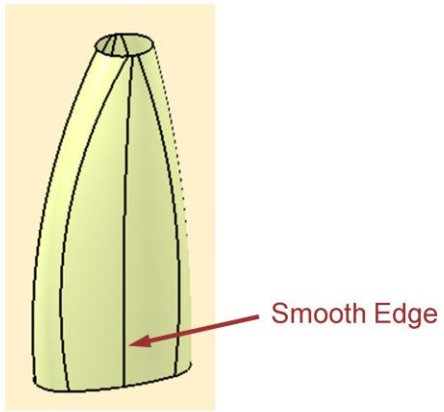
Student Notes:

Do it Yourself (4/11)

- Modify Guide curves using the new points to overcome the problem of point converged surface
  - Replace the end points(Near.3 and Near.4)

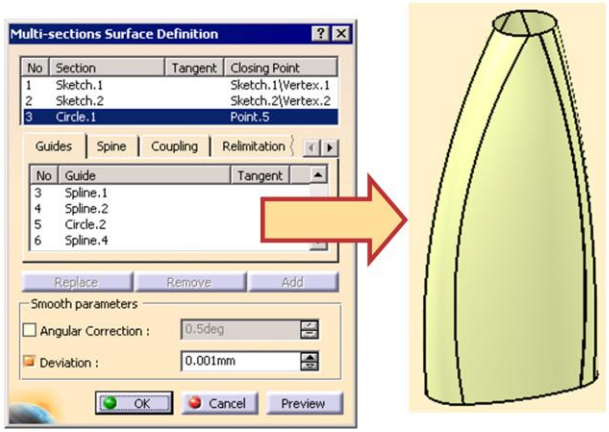
    of Splines 1,2,3 and 4 by new points created





Multi-section surface gets updated according to the modified wireframe. A smooth edge is created on the surface forming two faces which would affect the aesthetics of the bottle.

- Specify deviation value in smooth parameter box to achieve smooth surface
  - Edit Multi-section surface and select the Deviation checkbox in smooth parameters
  - Specify the value as 0.001mm (default value) and click OK

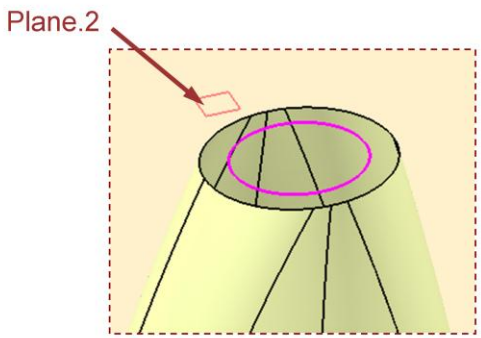


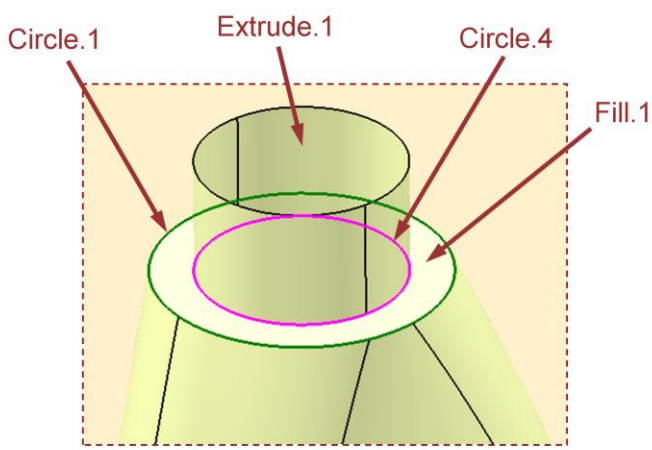
With the smoothing parameters the two faces are converted into a single face. This is achieved by specifying the Deviation parameter.

Student Notes:

Do it Yourself (5/11)

- Create the top portion of the bottle
  - Create Circle.4 of type “Center and Radius”
    - Center: Point.1, Support: Plane. 2
    - Radius: 12mm
  - Create fill.1 by filling Circle.1
  - Extrude Circle.4 to create neck portion of the bottle (Extrude.1)
    - Direction : XY Plane
    - Limit 1 : Up to plane.1

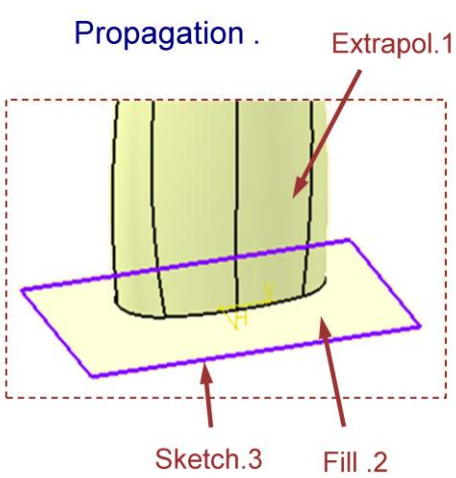


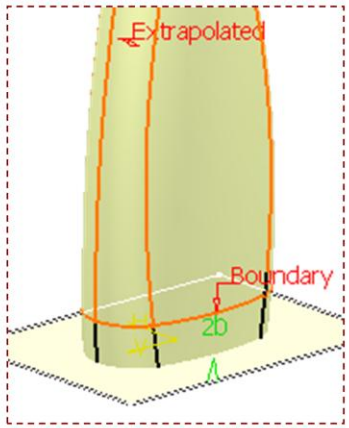


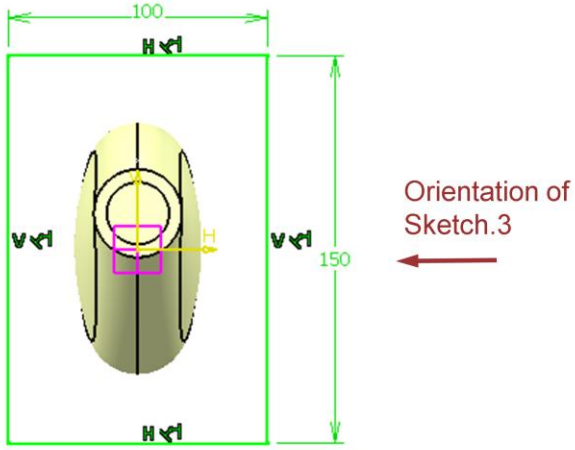
Student Notes:

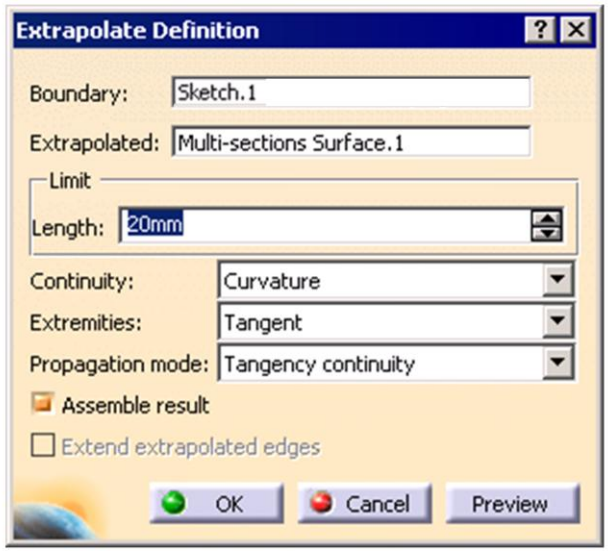
Do it Yourself (6/11)

- Create a fillet at the bottom of the bottle
  - Sketch a Rectangular Profile into Sketch.3 on XY Plane.
    - Profile :100X150mm
  - Create fill.2 by filling Sketch.3
  - Extrapolate Multi-Section Surface.1 up to 20mm using Curvature Continuity and Tangent continuity as Propagation .





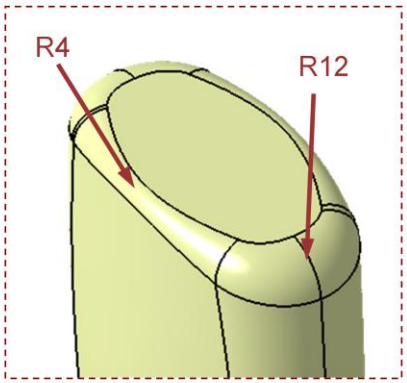


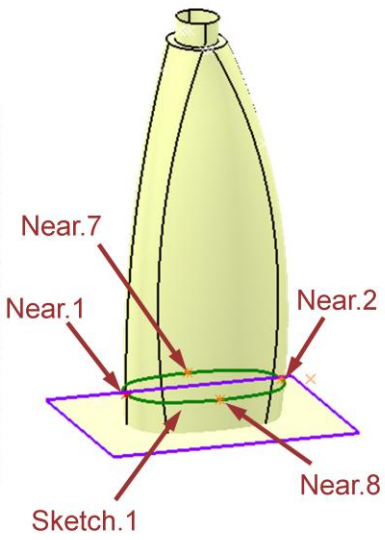


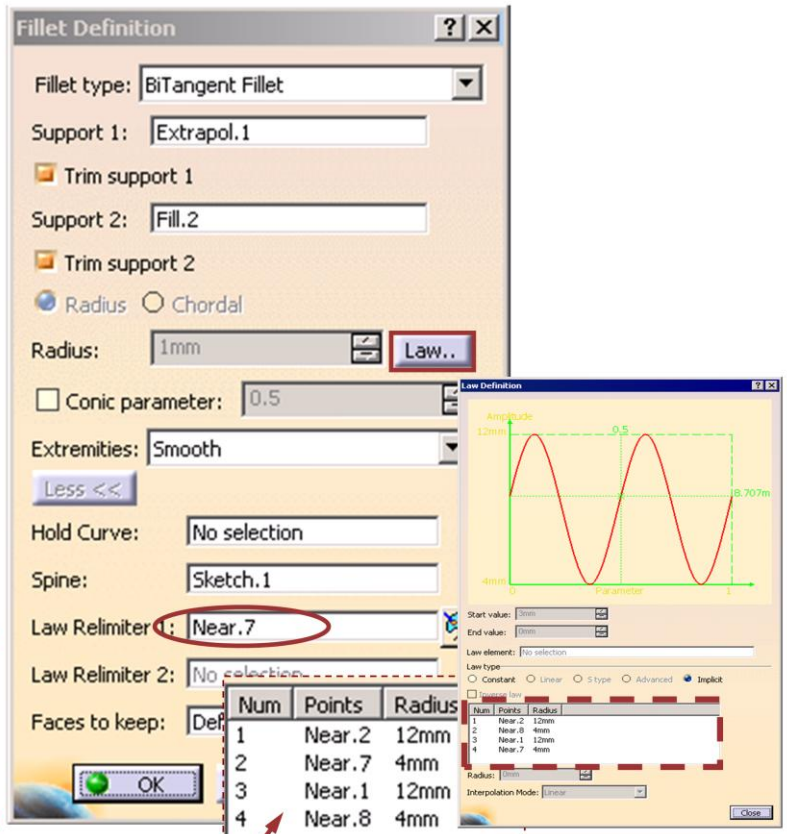
Student Notes:

Do it Yourself (7/11)

- Create Intersection.9 between Sketch.1 and ZX Plane.creating the points Near.7 and Near.8 from Intersection.9. (Use Plane.7 and Plane.8 as reference)
- Create Bitangent Fillet between Fill.2 and Extrapol.1, specify sketch.1 as a Spine. Use Implicit Law to define the radius.







Law Parameters as specified

Clear the default selection in the box if any. Select all 4 points manually as specified.

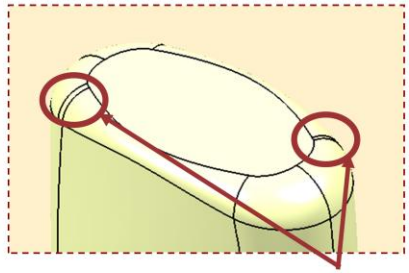
Student Notes:

Do it Yourself (8/11)

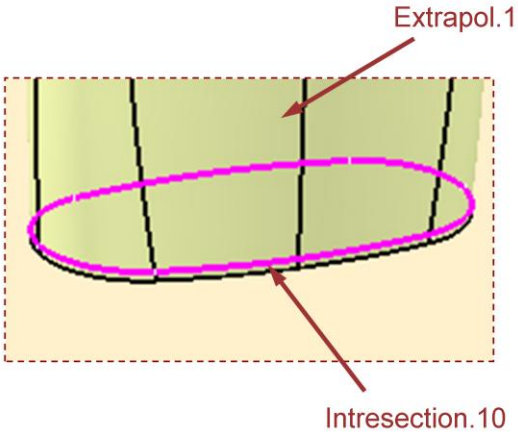
Observe that fillet.1 has a broken faces at few of areas.To overcome this, you will have to use the advance options of Bitangent fillet to achieve a good quality surface.

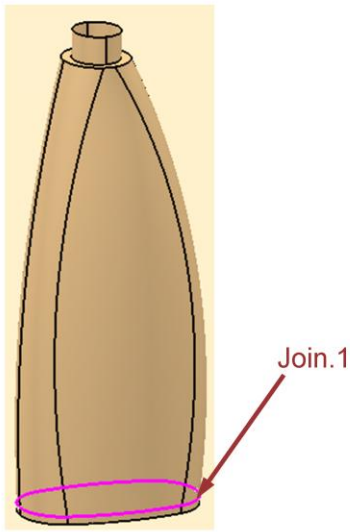
Create a smoother Spine

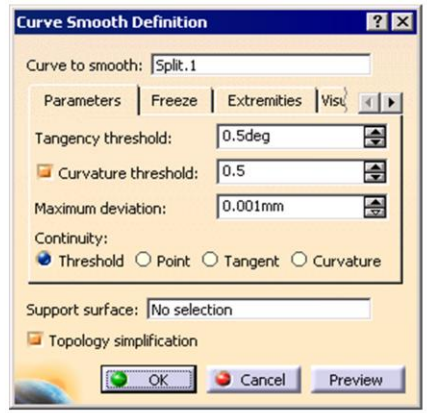
- Create Intersection.10 between Extrapol.1and XY Plane
- Split the Intersection.10 by YZ Plane
- Smooth the resultant curve(Split.1) using 'Curve Smooth'
- Symmetry Curve Smooth.1 about YZ plane
- Join Curve Smooth.1 and Symmetry.1 to form Join.1



Broken faces



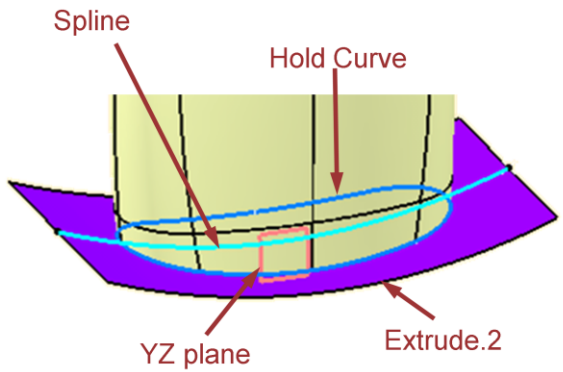




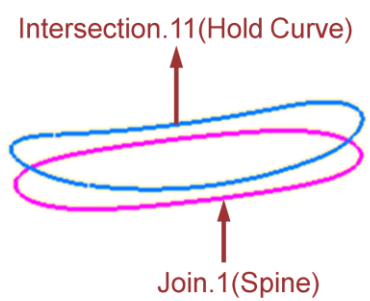
Student Notes:

Do it Yourself (9/11)

- Create a 'Hold Curve'
  - Create a Spline on YZ plane passing through co-ordinates
    - H= 65, V =16
    - H= 0, V = 4
    - H= -65 , V =16
    - Keeping 'origin' as reference point.
  - Using Spline as input curve, create an Extrude(Extrude.2) of length 40mm each side
  - Create an Intersection.11 between Extrude.2 and Extrapol.1



- Modify the Bitangent Fillet.1
  - Replace the spine by Join.1 and select Intersection.11 as a Hold Curve
  - Observe the modified fillet surface getting improved after using advance options

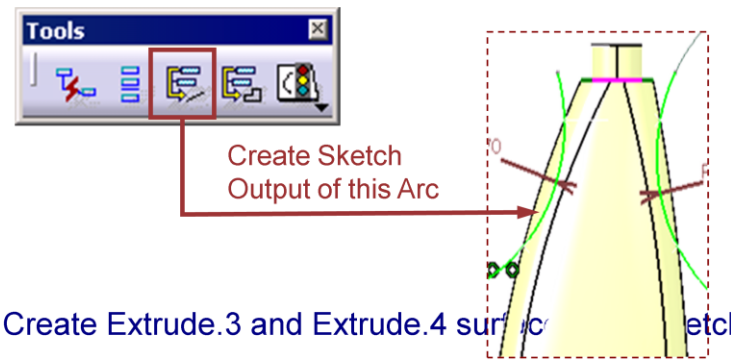


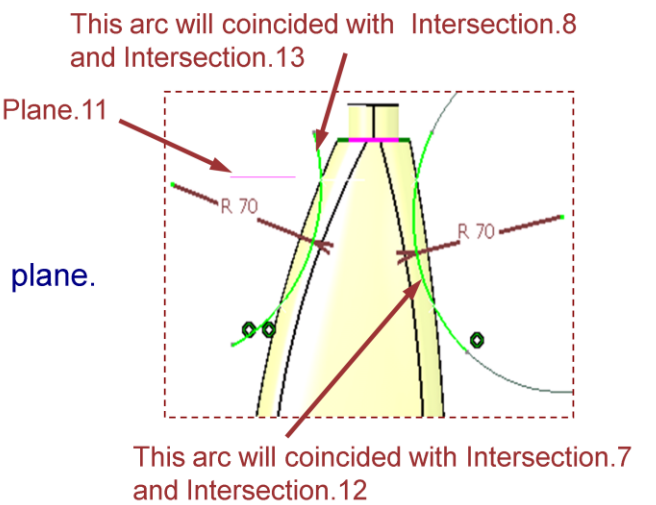
Student Notes:

Do it Yourself (10/11)

- Create the Handle portion of the bottle
  - Create a plane.11 at distance of 210mm from XY Plane using offset Plane function
  - Create an intersection.12 and Intersection.13
    - First Element : Plane.11
    - Second Element : Circle.2 + Circle.3
  - Create two Arcs of Radius 70 mm in Sketch.4 on YZ plane.

Create a sketch output for one of the arcs





- Create Extrude.3 and Extrude.4 sur[illegible]etch.4

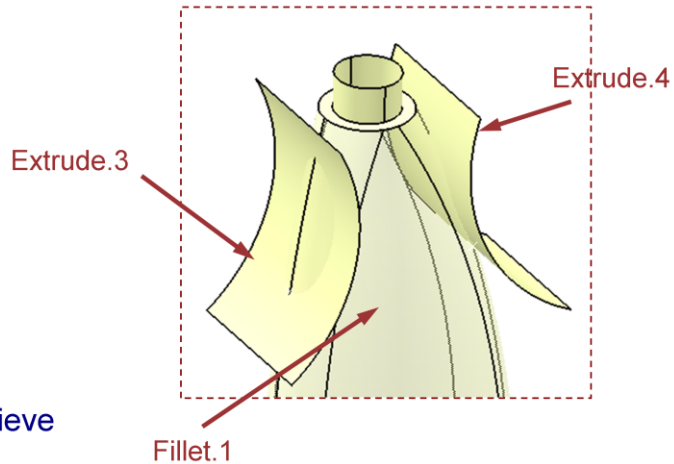
along YZ direction with the length 30mm both sides.

Student Notes:

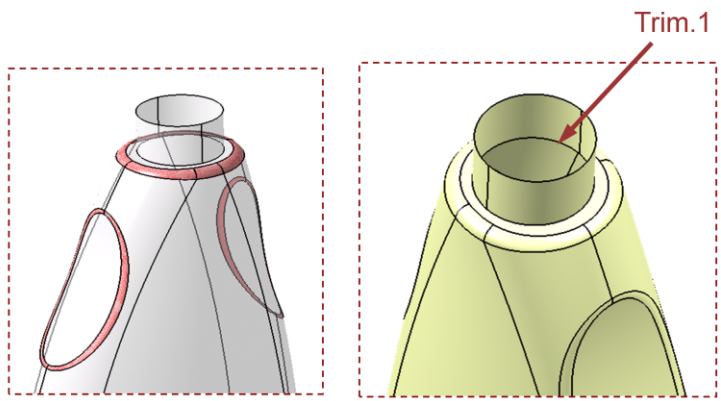
Do it Yourself (11/11)

- Create the Fillets(Blunt Edges) at Handle and neck area of the bottle
  - Create a BiTangent fillet of radius 3 mm between:

First Element	Second Element
Extrude.3	Fillet.1
Extrude.4	Fillet.2
Fillet.3	Fill.1



  - Create a Trim.1 between Fillet.4 and Extrude.1 to achieve hole neck opening



End Part: CATGSD_F_Shampoo_Bottle_End.CATPart

This exercise will demonstrate that surfaces of high quality can be achieved using advance tools of Generative Shape Design

Student Notes:

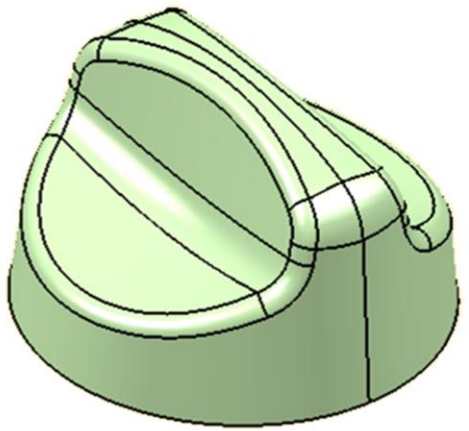
Knob

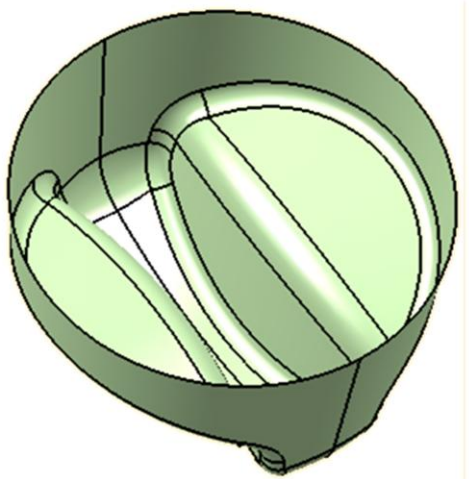
Recap Exercise: Swept Surface

40 min

In this exercise you will:

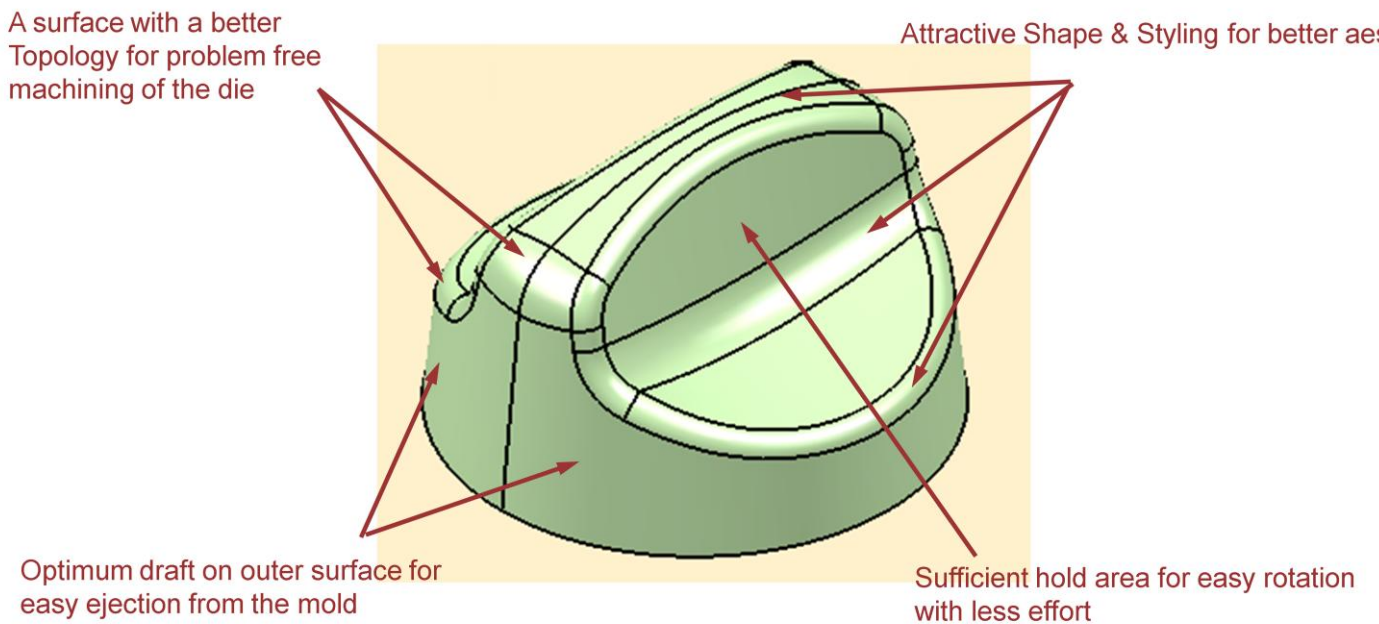
- Build a 'Knob' model using a given wireframe.
- Use Line and Circle Swept Surfaces to generating the 'Knob' shapes.
- Design a law and use it to define the shape of the fillets
- Finally, apply dress up features and complete the model





Student Notes:

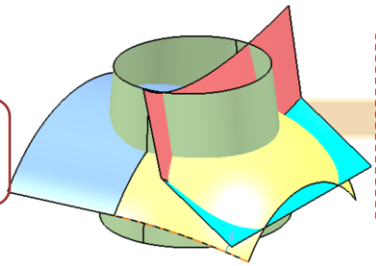
Design Intent: Knob

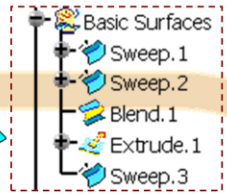


Student Notes:

Design process: Knob

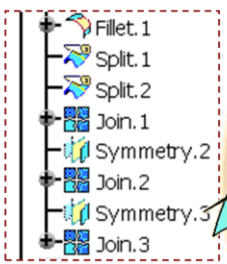
1 Design Basic Surfaces

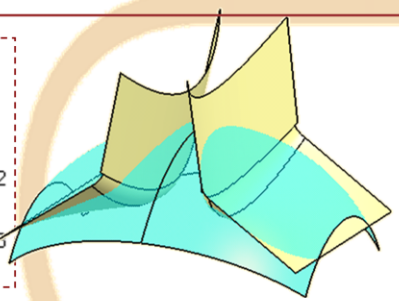


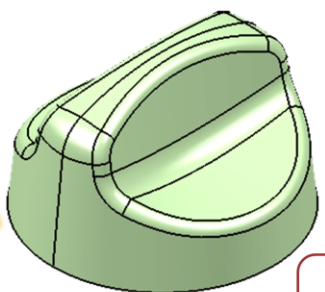


2 Create Laws

3 Design the Intermediate Surfaces







4 Design the Final Surfaces

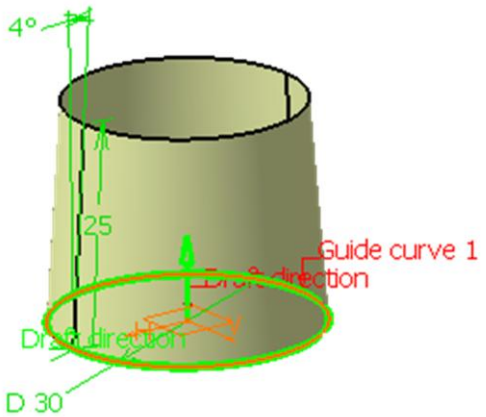
Student Notes:

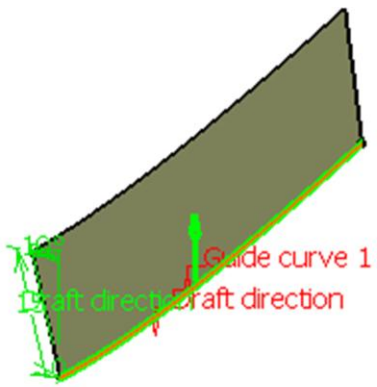
Do It Yourself (1/11)

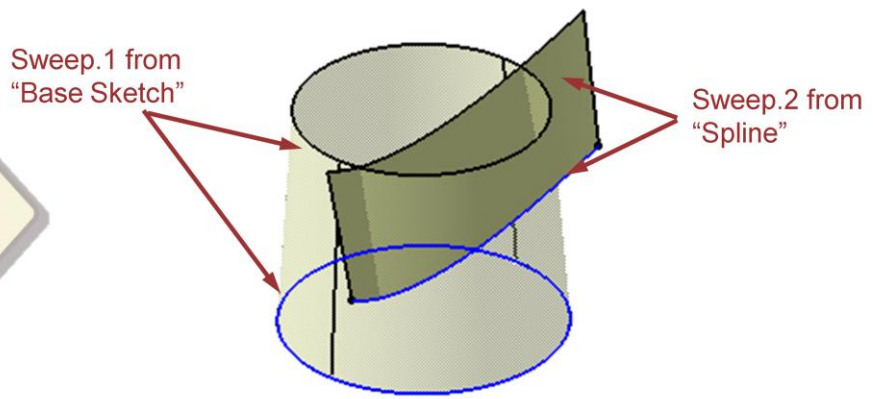
Part Used: CATGSD_F_Knob_Start.Catpart

Create the basic surface of the Knob using the given wireframe

- Create the first swept surface using the “Base sketch”
  - Sweep type “Line” & Subtype “with draft direction”
  - Use “Base sketch” as Guide Curve 1
  - Draft direction “XY Plane”
  - Draft angle “4 deg” and square wholly defined
  - Enter Length.2 as 25 mm
- Create the second swept surface using ‘Spline.1’ as a ‘Guide curve.1’ with the same specifications as the first sweep.
  - Draft angle 10deg
  - Enter Length.2 equal to 15 mm.



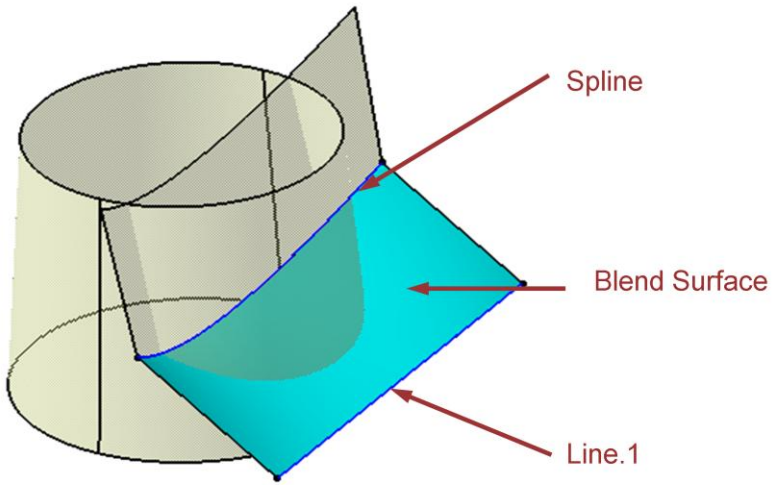




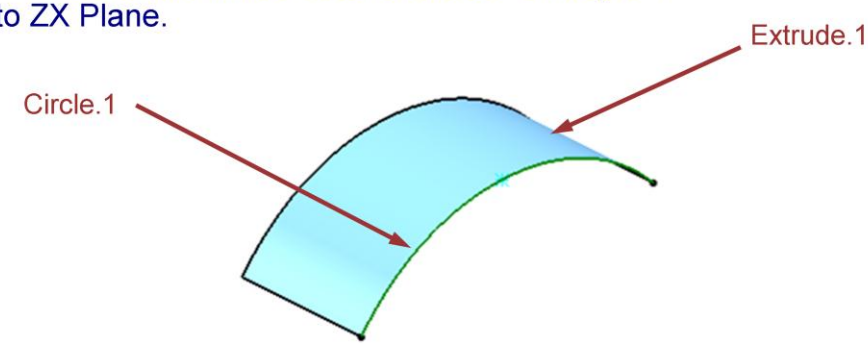
Student Notes:

Do It Yourself (2/11)

- Create a Blend.1 surface between “Spline.1” and “Line.1”



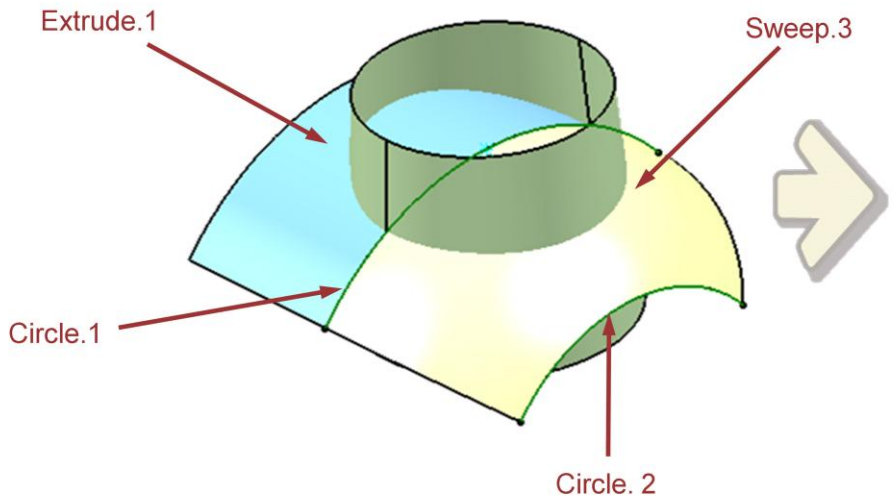
- Create an Extrude from “Circle.1”. This extrude will be used to create “Sweep.3”.
  - Extrude it by 20 mm normal to ZX Plane.

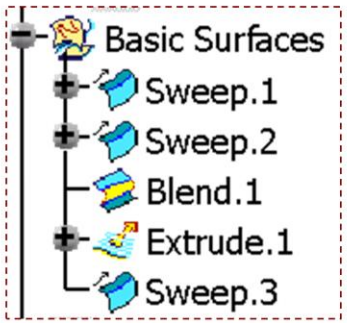


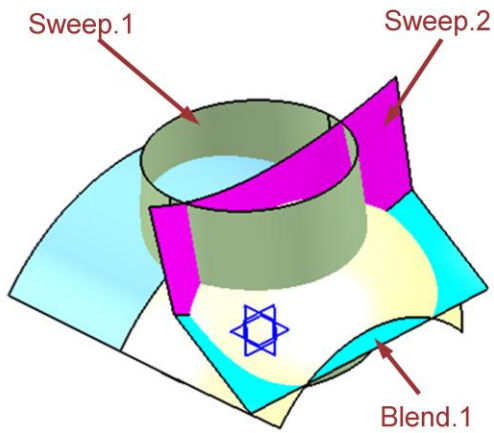
Student Notes:

Do It Yourself (3/11)

- Create a “Sweep.3”. Use previously created extrude to create it.
  - Type: Circle. Sub type: Two guides and tangency surface
  - Limit curve with tangency: Circle.1
  - Tangency surface: Extrude.1
  - Limit curve: Circle.2







Contents of the “Basic Surfaces” Geometrical Set.

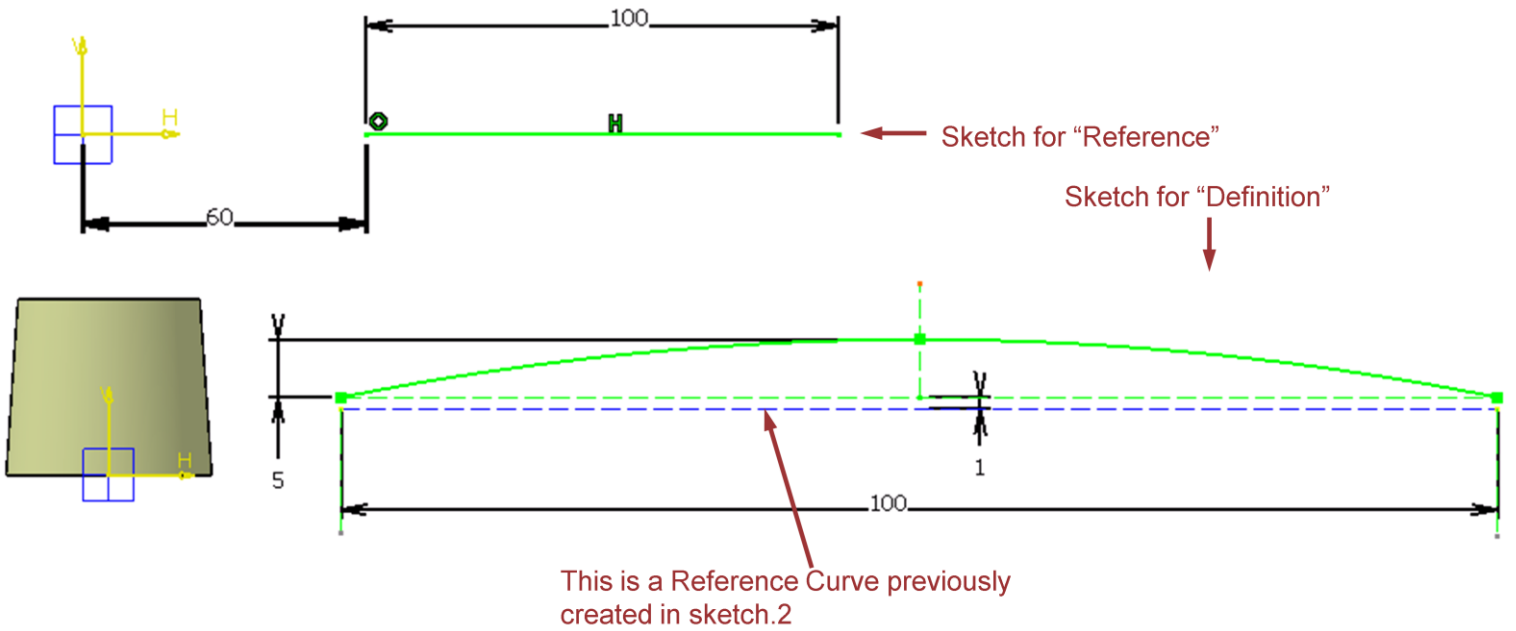
Student Notes:

Do It Yourself (4/11)

Create a law to define the shape of the fillet.

- To create a Law, you need to specify the “Reference” and “Definition” curves.
  - Make Geometrical set “Laws” Active
  - Sketch the “Reference” for the law in to Positioned Sketch.2 (Law.1Ref).
  - Sketch the “Definition” for the law in to Positioned Sketch.3 (Law.2 Def) as shown in the picture. Use following Inputs for both Sketches:

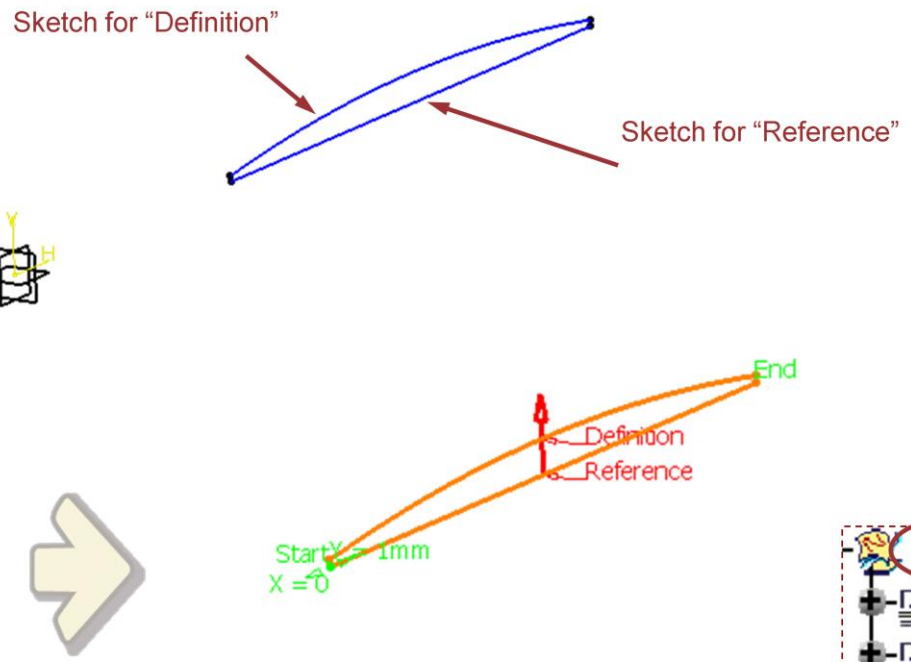
    Origin: Part Origin. Orientation: X axis, Reference:ZX plane.

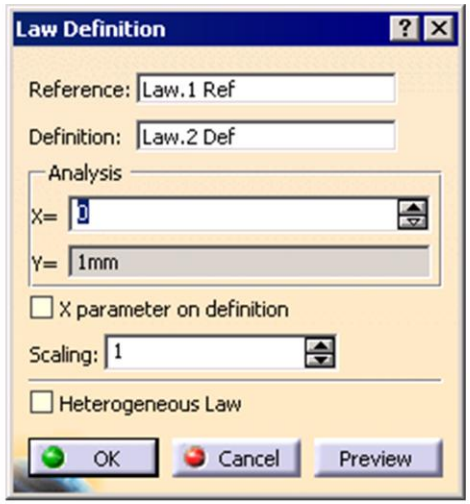


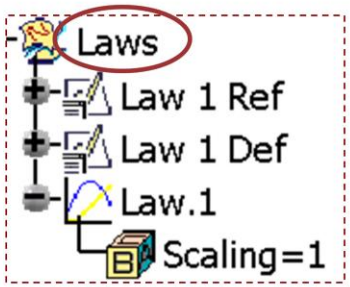
Student Notes:

Do It Yourself (5/11)

- Access the law command to create the law.
- This Law will then be used to define the shape of the fillet





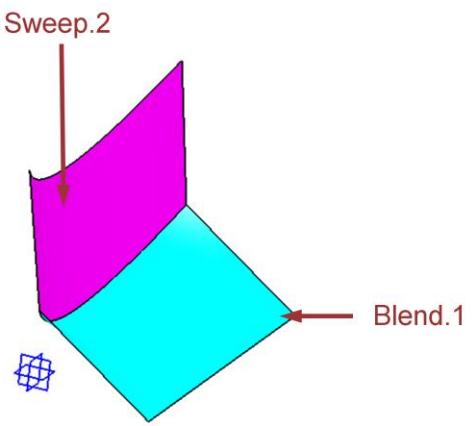


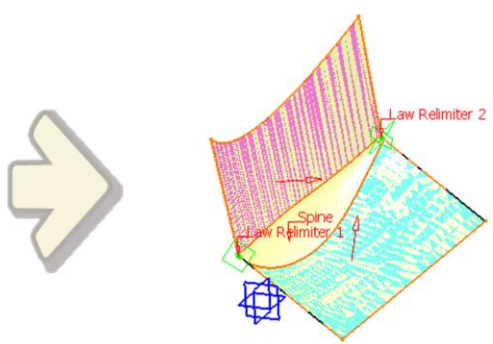
Student Notes:

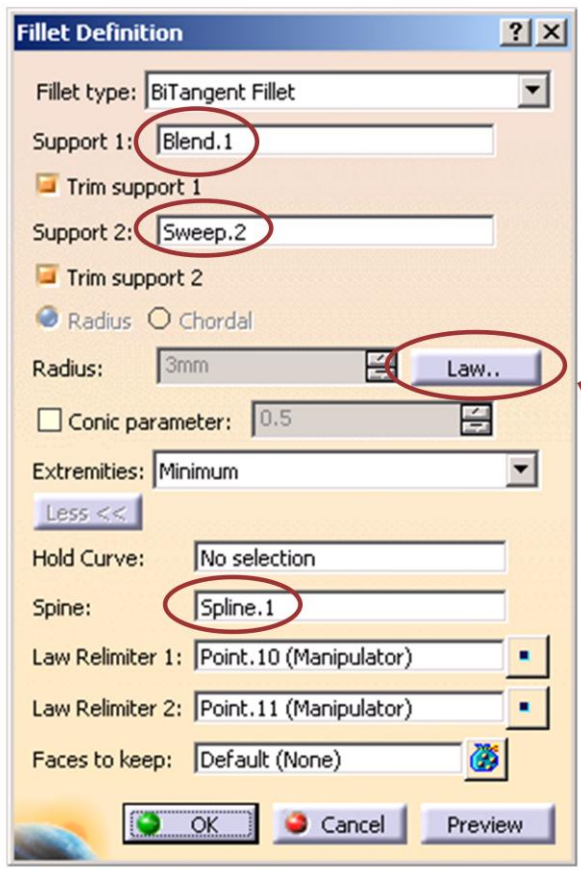
Do It Yourself (6/11)

Create Intermediate surfaces which will be used as inputs to create final Knob
(Work in Object “Intermediate surfaces”)

- Create a Bitangent Shape fillet between Blend.1 and Sweep.2





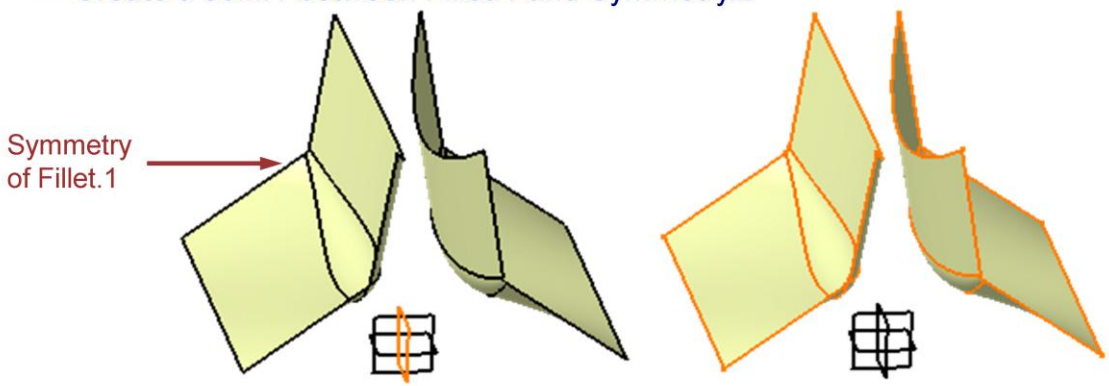


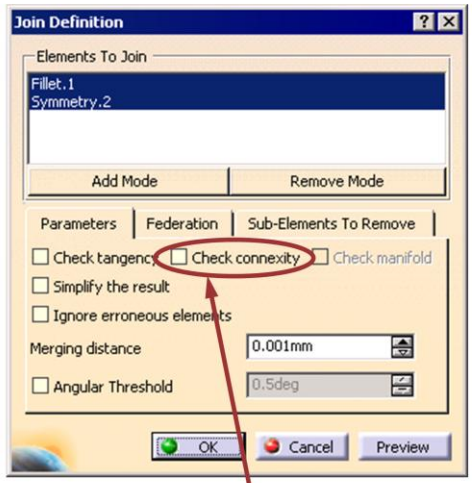
Specify the law you created here

Student Notes:

Do It Yourself (7/11)

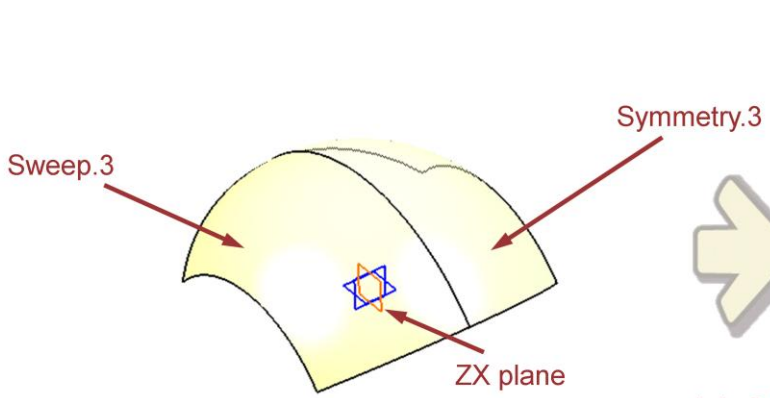
- Create a Symmetry.2 of this Fillet.1 about ZX Plane.
- Create a Join.1 between Fillet.1 and Symmetry.2

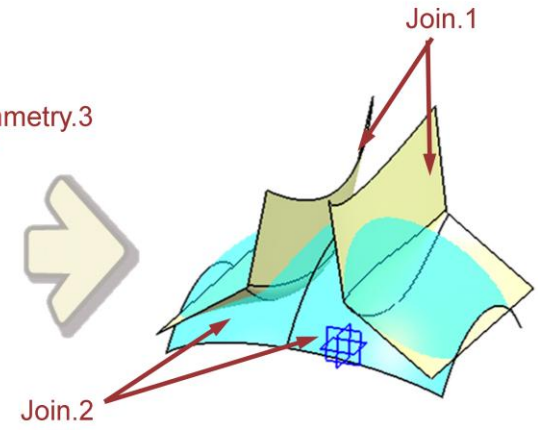


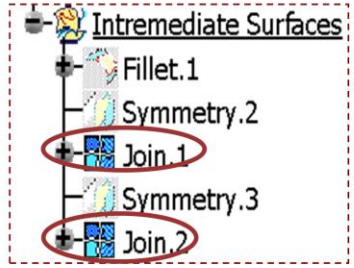


- Create a Symmetry(Symmetry.3) of Sweep.3 about ZX plane.
- Create a Join.2 between Sweep.3 & and Symmetry.3

Check connexity off







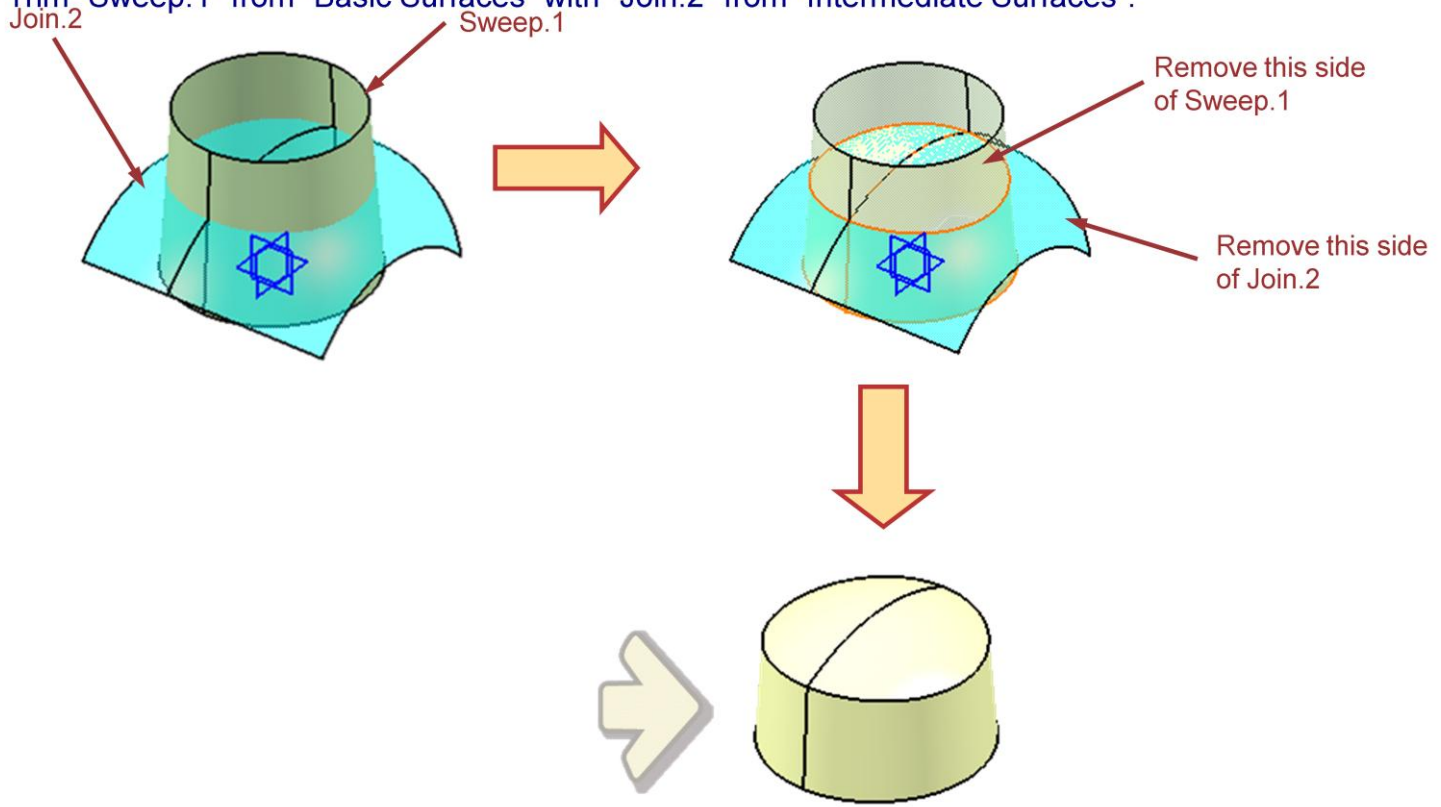
Student Notes:

Do It Yourself (8/11)

Create the final Knob using the Basic surfaces and the Intermediate surfaces.

(Work in Object “Final surfaces”)

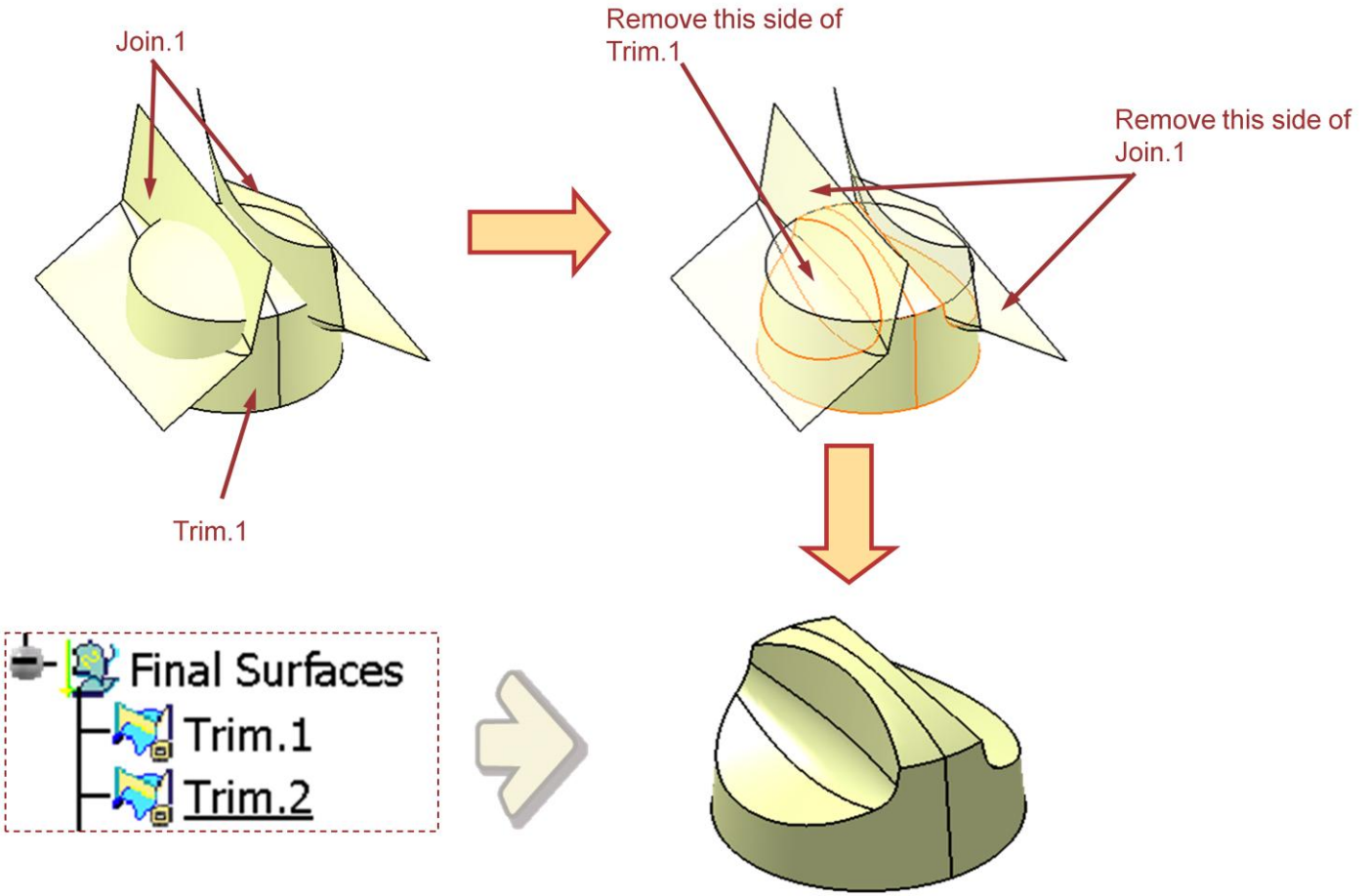
- Trim “Sweep.1” from “Basic Surfaces” with “Join.2” from “Intermediate Surfaces”.



Student Notes:

Do It Yourself (9/11)

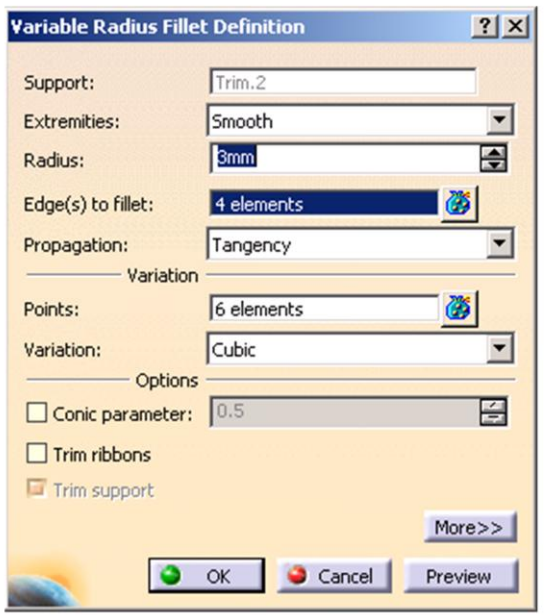
- Show “Join.1”.
- Trim Join.1 with previously created Trim.1

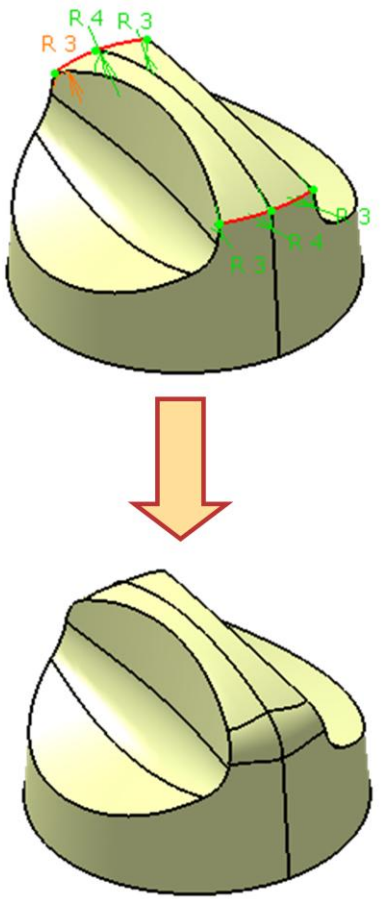


Student Notes:

Do It Yourself (10/11)

- Apply Variable radius fillet to the edge shown. The radius value at the ends is 3mm and at the middle is 4mm.

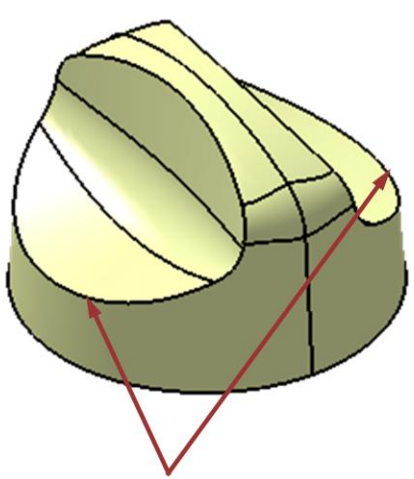


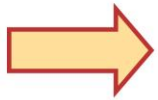


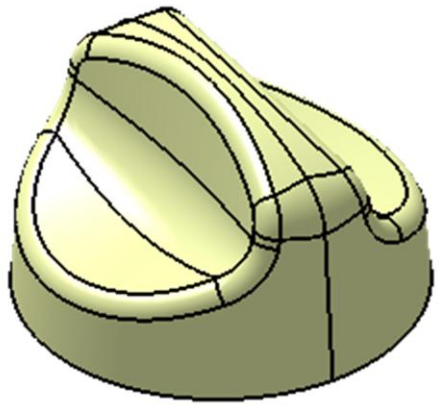
Student Notes:

Do It Yourself (11/11)

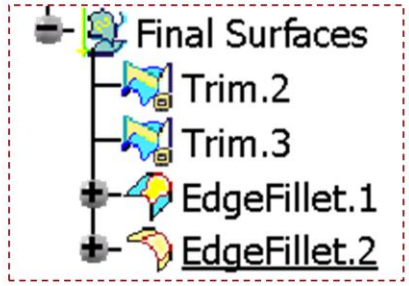
- Apply Edge fillet of 1.5mm radius to the edge shown.







Apply Edge fillet to the two Edges.



End part: CATGSD_F_Knob_End.CATPart

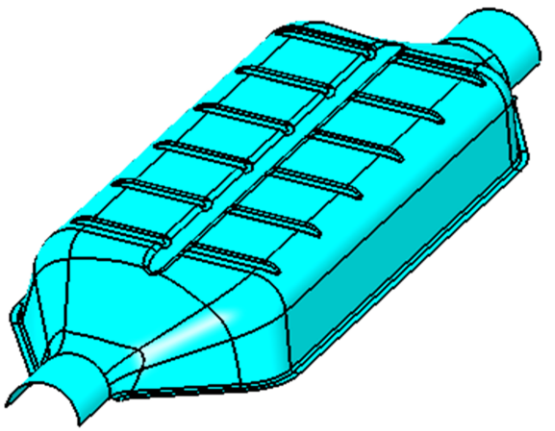
Student Notes:

Housing

Recap Exercise: Adaptive Swept Surface

30 min

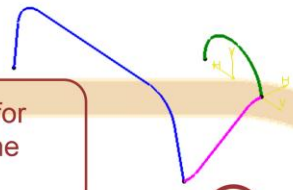
In this exercise you will Create a part (Housing) in which you will be practicing Adaptive Swept surface.



Student Notes:

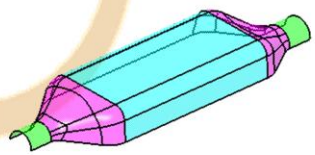
Design process: Housing

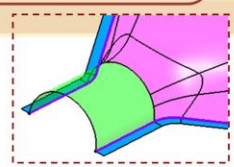
1. Design Basic surfaces for building main body of the housing



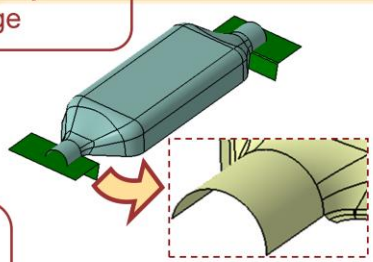
2. Create the main body of the housing using Adaptive swept surface and extrude

3. Extract the boundaries of the main body and create flange surfaces

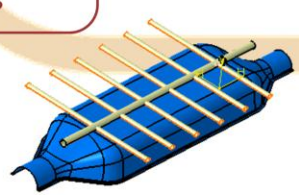


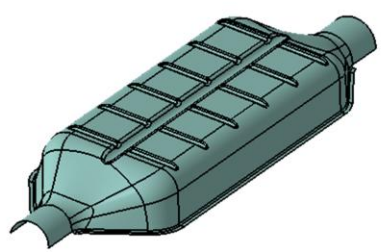


4. Create flange surface and split it from the main body to form the trimmed flange



5. Create tubular serrations on the main body and fillet the sharp edges





Student Notes:

Do It Yourself (1/11)

Part Used: CATGSD_F_Adaptive_Sweep_Start.CatPart

Create the basic surface of the Housing using the given wireframe

- Create an Extrude.1 from Sketch.1 up to Plane .2

  in the ZX direction

- Create an Extrude.2 from Sketch.2 up to distance 50mm

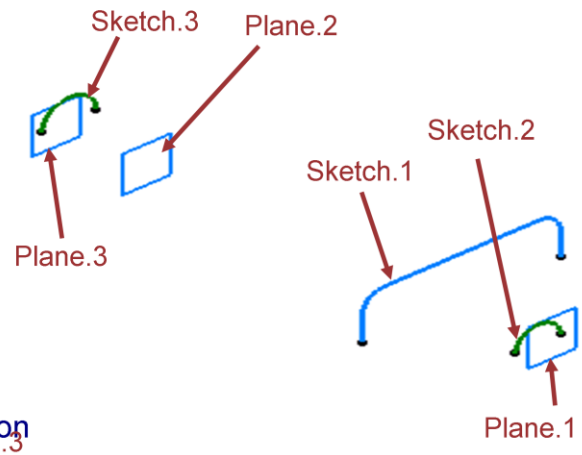
  in the ZX direction

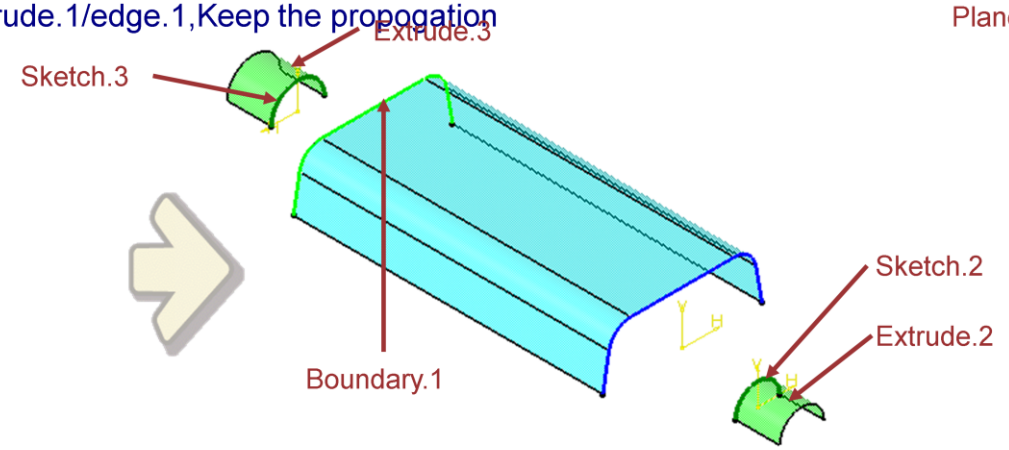
- Create an Extrude.3 from Sketch.3 up to distance 50mm

  in the ZX direction

- Extract a Boundary.1 of Extrude.1/edge.1,Keep the propogation

  Tangent Continuity.

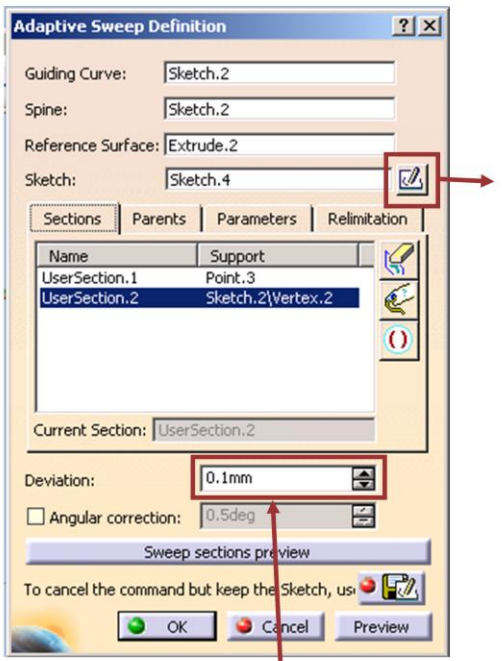




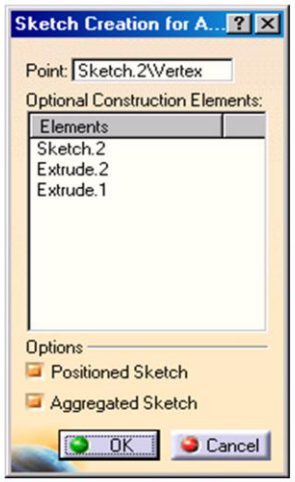
Student Notes:

Do It Yourself (2/11)

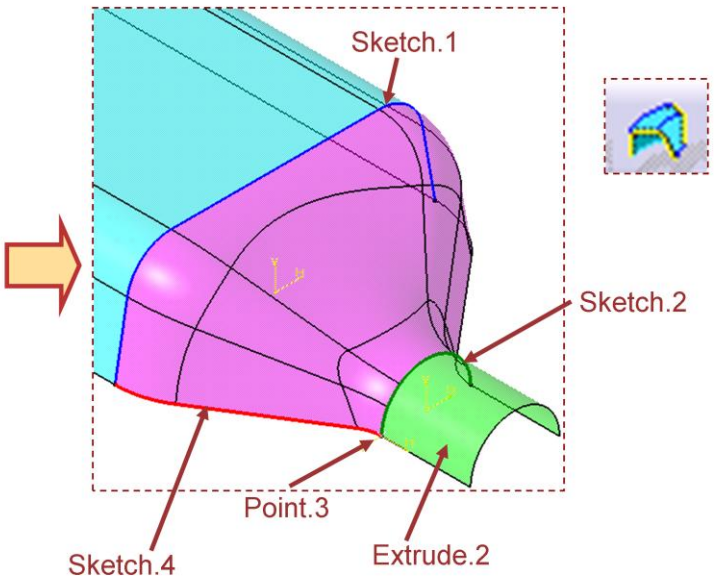
- Create an Adaptive swept surface(Adaptive sweep.1) as per the parameters shown:



Modify the Deviation to 0.01mm



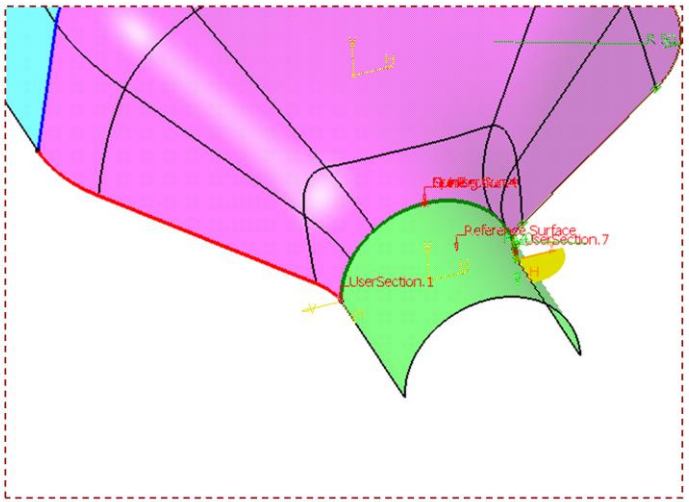
Sketch creation Box



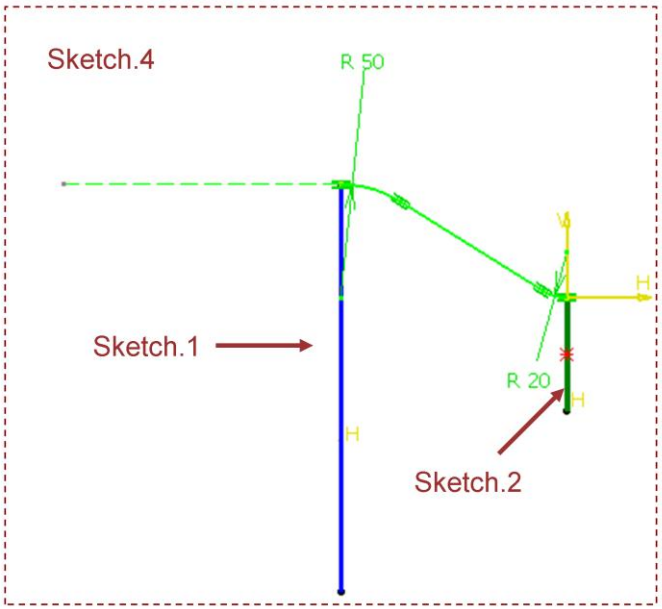
1. Refer to the next slide for detail Sketch and Dimensions.
2. Point.3 is to be created at the extremity of Sketch.2 using contextual menu.

Student Notes:

Do It Yourself (3/11)



Create a Sketch.4 as shown below



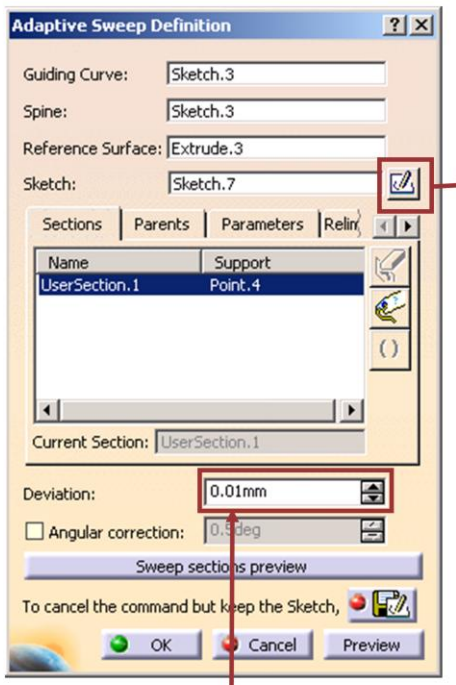
It is recommended that the sketch.4 used for creating Adaptive swept surface is to be created contextually by 'sketch creation box' in Adaptive swept panel

Hide the surfaces and Sketches for convenience while creating the profile in the Sketcher

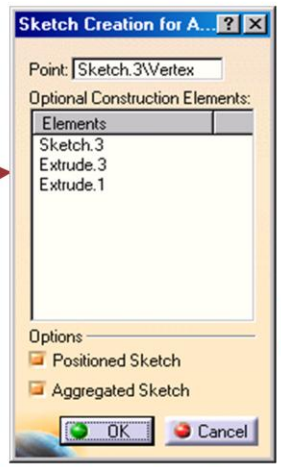
Student Notes:

Do It Yourself (4/11)

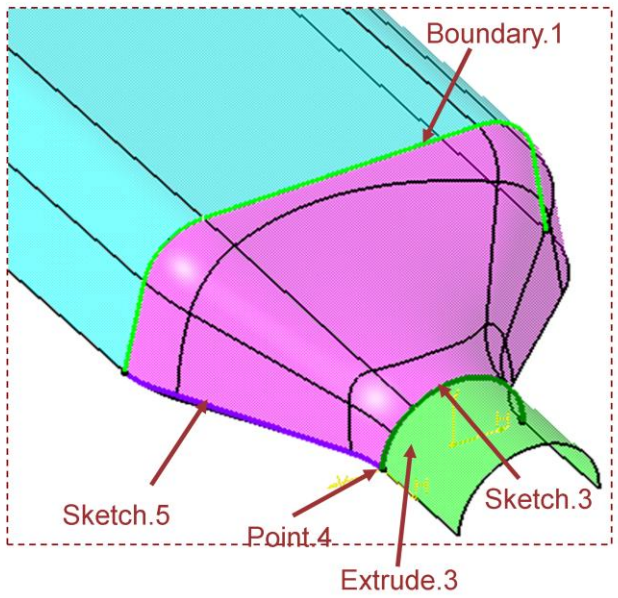
- Create an Adaptive swept surface(Adaptive sweep.2) as per the parameters shown:



Modify the Deviation to 0.01mm



Sketch creation Box

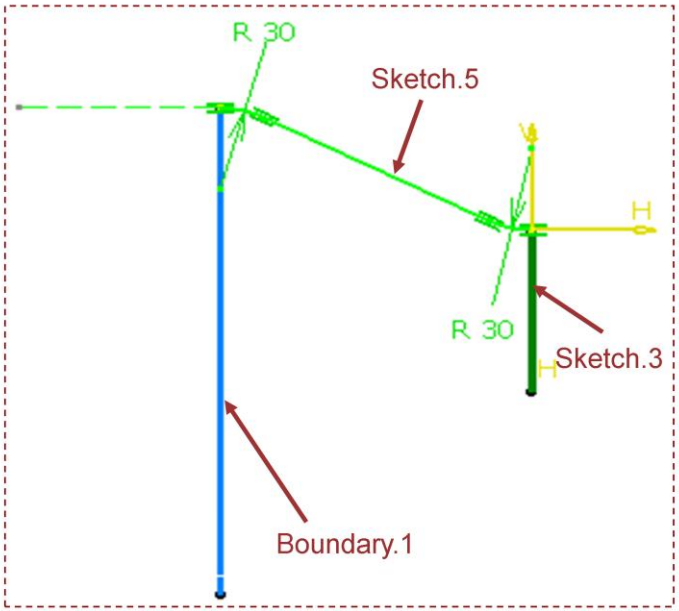


1. Refer to the next slide for detail Sketch and Dimensions.
2. Point.4 is to be created at the extremity of Sketch.3 using contextual menu.

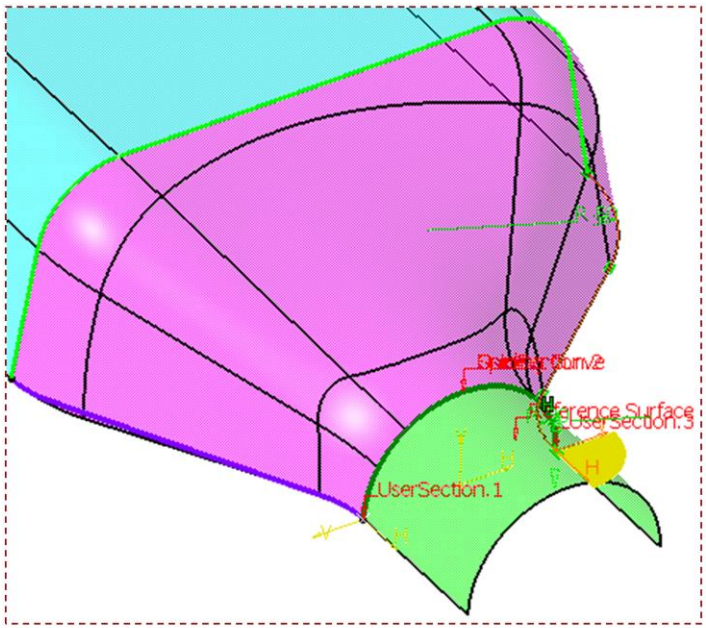
Student Notes:

Do It Yourself (5/11)

Create a Sketch.5 as shown below



It is recommended that the sketch.5 used for creating Adaptive swept surface is to be created contextually by 'sketch creation box' in Adaptive swept panel

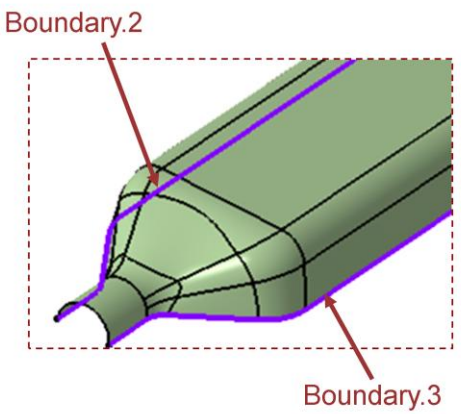


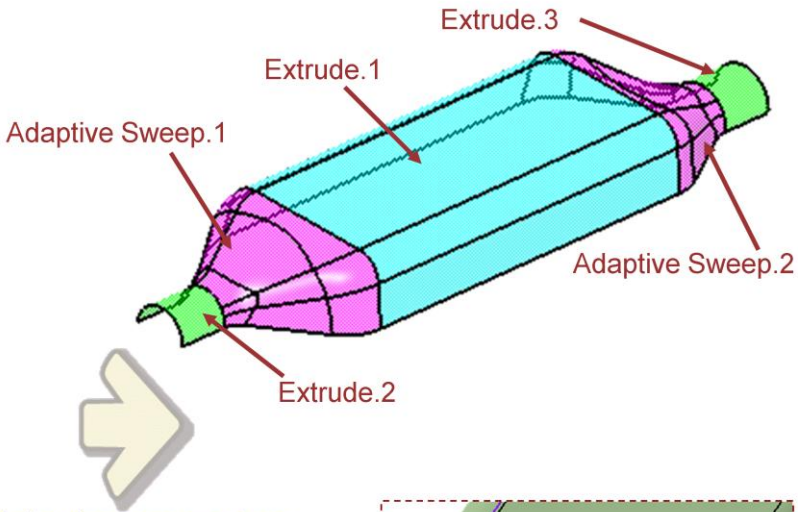
Hide the surfaces and Sketches for convenience while creating the profile in the Sketcher

Student Notes:

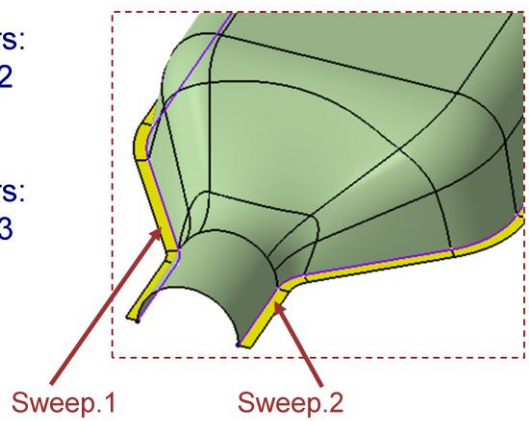
Do It Yourself (6/11)

- Create a Join.1 between Extrude.1,Extrude.2, Extrude.3, Adaptive sweep.1 and Adaptive sweep.2
- Extract Boundary.2 and Boundary.3 of join.1





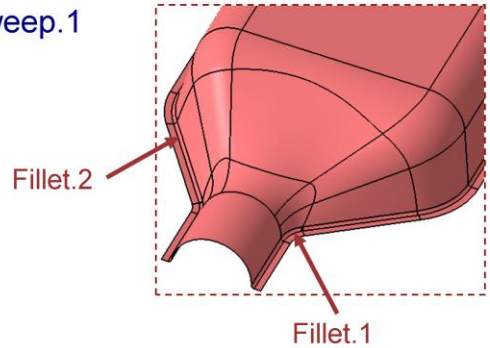
- Create a Line swept surface(Sweep.1) from the following parameters:
  - Sweep subtype:With Draft Direction, Guide Curve 1:Boundary.2 Direction:XY plane, Angle:90deg, Length 1= 6mm
- Create a Line swept surface(Sweep.2) from the following parameters:
  - Sweep subtype:With Draft Direction, Guide Curve 1:Boundary.3 Direction:XY plane, Angle:90deg, Length 1: 6mm

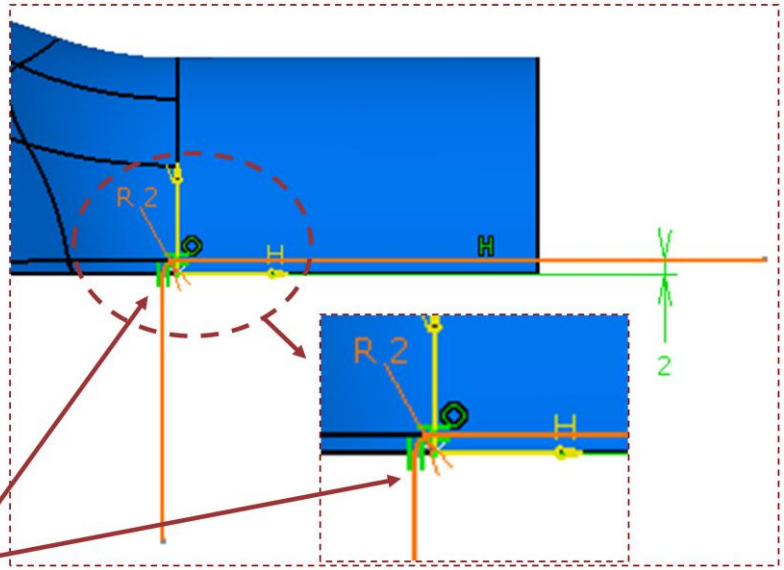


Student Notes:

Do It Yourself (7/11)

- Create a Bi-tangent fillet (Fillet.1) between Sweep.2 and Join.1
  - Radius:R 2.0mm
- Create a Bi-tangent fillet (Fillet.2) between Fillet.1 and Sweep.1
  - Radius:R 2.0mm
- Create a Point.5 and Point.6 as shown:
  - Point.5: On Plane.3, H=0, V=0
  - Point.6: On Plane.1, H=0, V=0
- Create a Positioned Sketch.6 on YZ Plane, Projection point:Point.5, orientation: Y axis
- Create a Positioned Sketch.7 on YZ Plane, Projection point:Point.6, orientation: Y axis



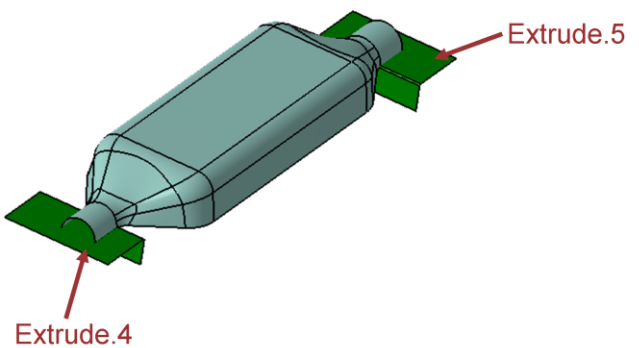


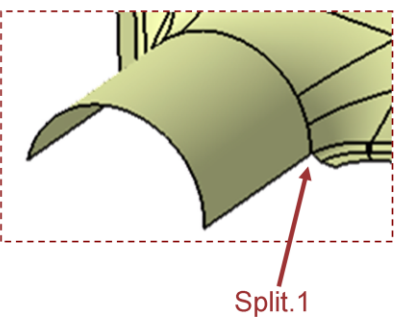
Student Notes:

Do It Yourself (8/11)

- Create Extrude.4 and Extrude.5 from Sketch.6 and Sketch.7 respectively
  - Direction :YZ plane
  - Distance : 75mm on both side

- Split(Split..1) fillet.2. Specify Extrude.4 and Extrude.5 as cutting elements

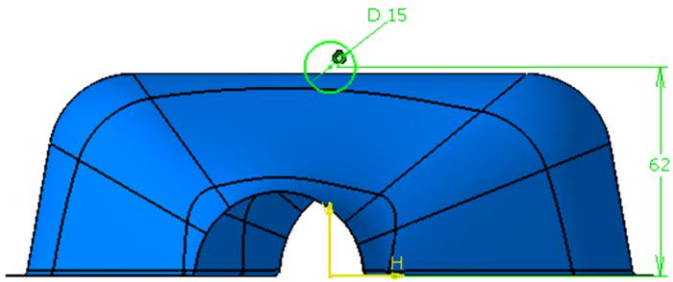


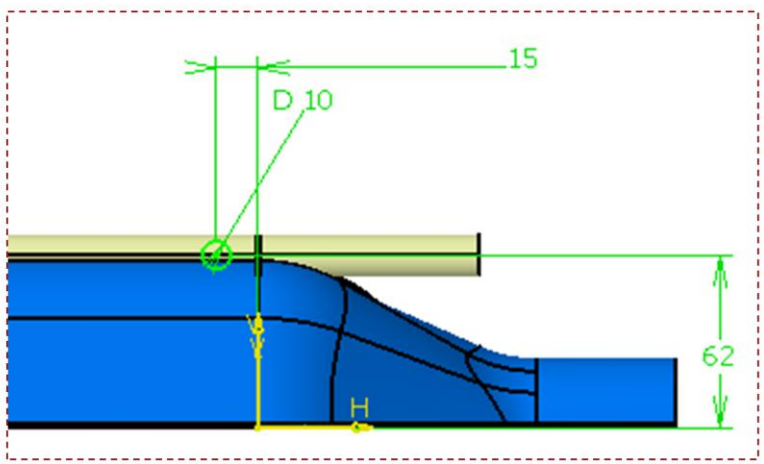


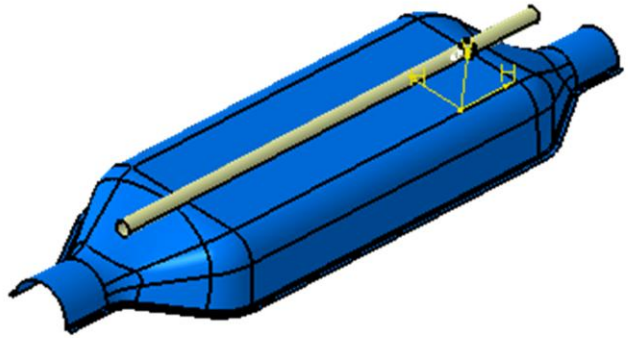
Student Notes:

Do It Yourself (9/11)

- Create a Positioned Sketch.8 on ZX Plane,
  Projection point:Part origin, orientation: Implicit
- Create an Extrude.6 from sketch.8 in the ZX direction
  - Limit 1:80mm
  - Limit 2:425mm
- Create a Positioned Sketch.9 on YZ Plane,
  Projection point:Part origin, orientation: Implicit



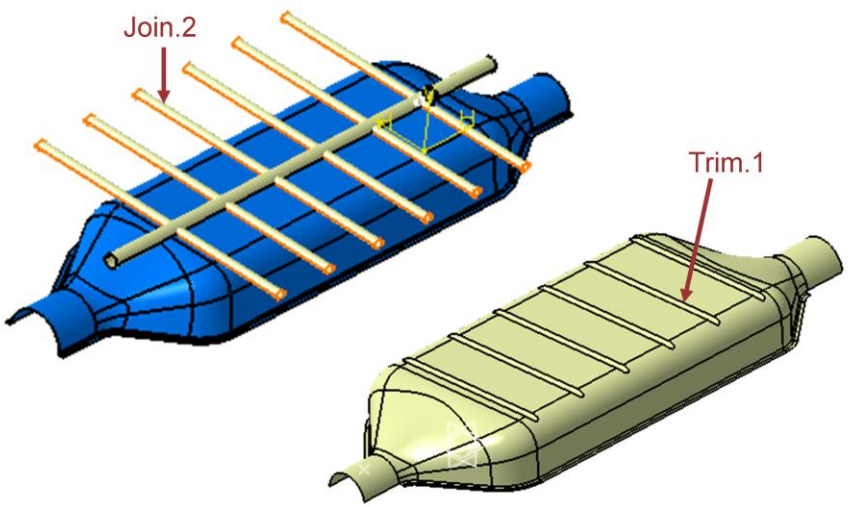


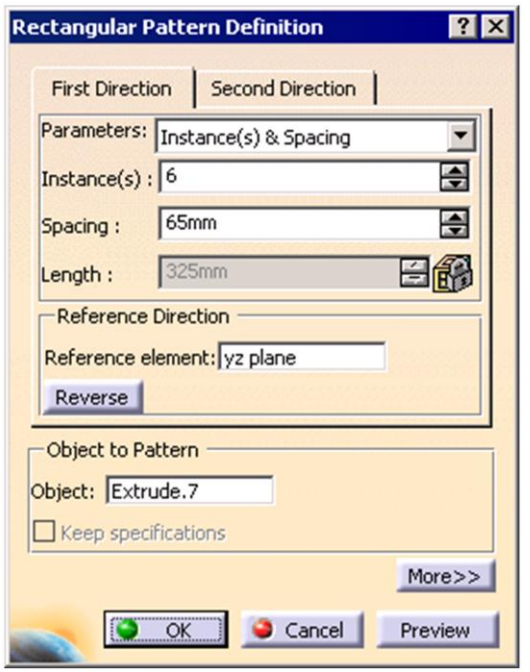


Student Notes:

Do It Yourself (10/11)

- Create an Extrude.7 from sketch.9 in the YZ direction
  - Limit 1:120mm
  - Limit 2:120mm
- Rectangular Pattern(Rectpattern.1) Extrude.7 as shown.
- Create a Join.2 between Extrude.7 and Rectpattern.1(Check Connexity box off)
- Trim (Trim.1) Join.2 and Split.1

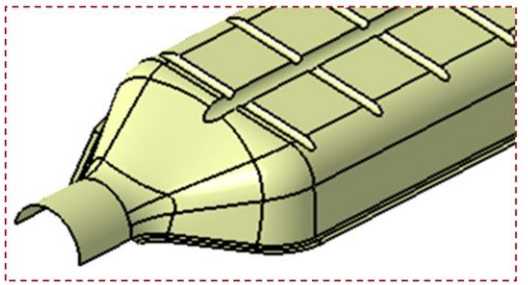


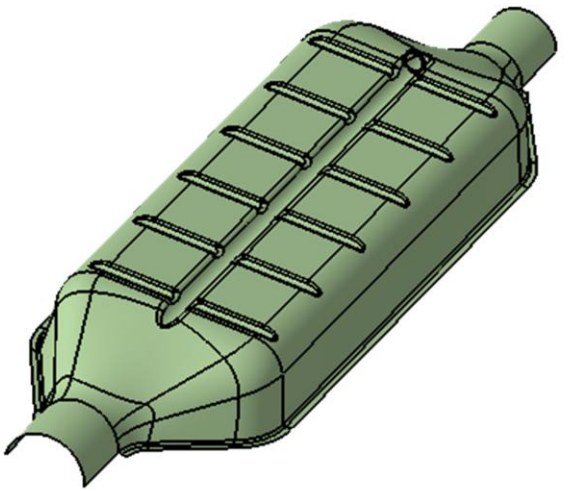


Student Notes:

Do It Yourself (11/11)

- Trim (Trim.2) Trim.1 and Extrude.6
- Apply edge fillet(Edgefillet.1) of radius 5mm to Trim.2/Face.1
- Apply edge fillet(Edgefillet.2) of radius 3mm to Edgefillet.1/Face.2





End Part: CATGSD_F_Adaptive_Sweep_End.CatPart