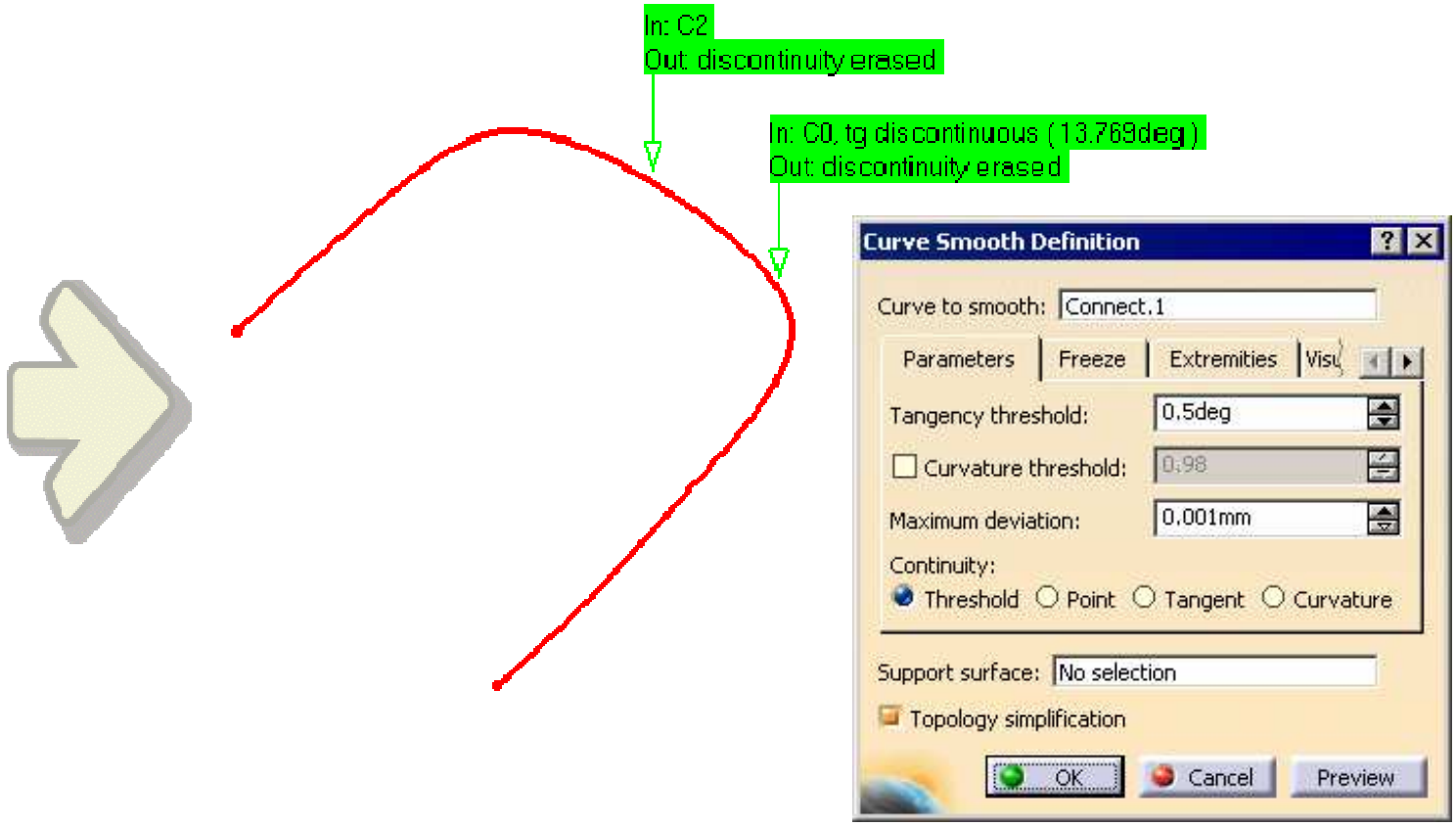
Student Notes:

Smoothing Curves

You will learn how to smooth curves.

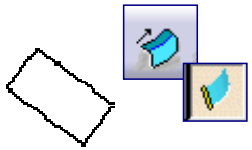


Student Notes:

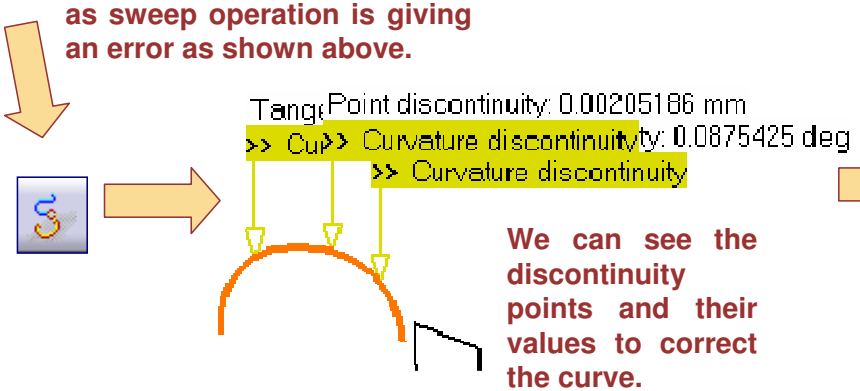
Why Smoothing Curves?

Sometimes when you want to create a sweep for instance, CATIA warns you that the profile curve is not continuous in tangency and that it could not build the geometry as you wish. The Smoothing Curve function allows you to clean these curves from distance,Curvature and tangency discontinuity.

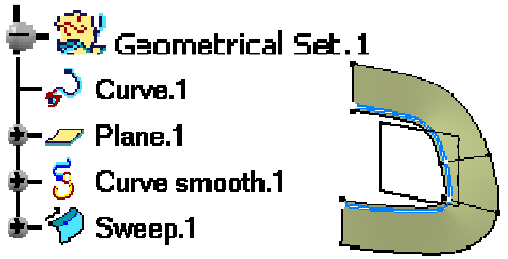
We want to create a Line-type sweep from this curve using the plane as reference surface.



We need to smooth the curve before generating the sweep as sweep operation is giving an error as shown above.



We can see the discontinuity points and their values to correct the curve.



Using the smoothed curve, we can create the swept surface.

Student Notes:

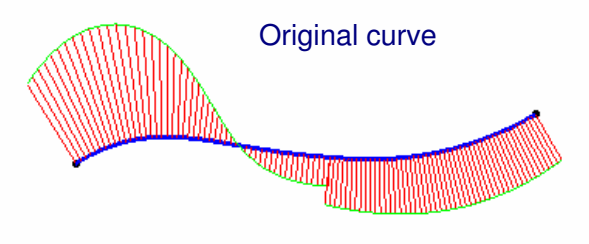
Wireframe Analysis –Recommendations

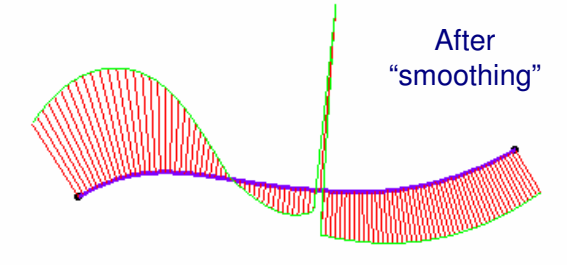
You will learn about specific methods and recommendations concerning the use of wireframe analysis and repair.

Student Notes:

Cautions for using Curve Smooth

Curve Smooth repair internal curve flaws such as:
- Tangent discontinuities
- Curvature discontinuities
by selecting the curve you want to repair.





However, you should always use Porcupine Curvature Analysis after performing the operation as the resultant curve may not be as “smooth” as you would wish.

This is especially true when the “Maximum deviation” value is small. As a general rule, the larger the flaw, the larger the Maximum deviation value.

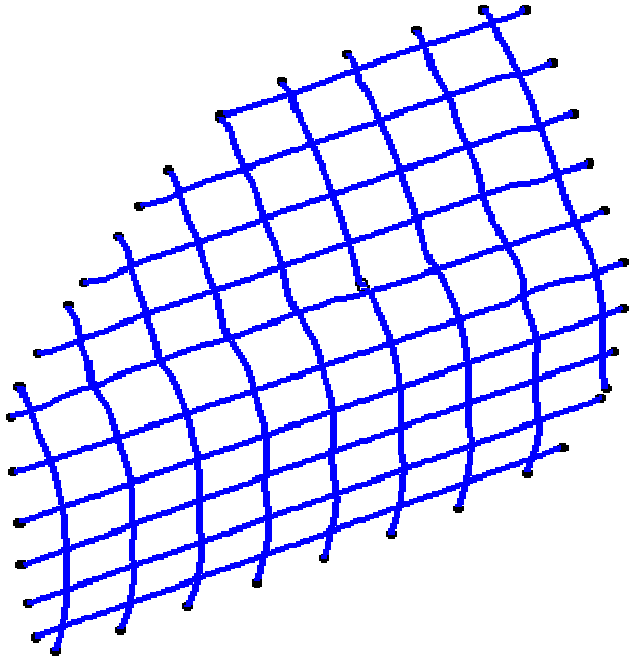
Student Notes:

Wireframe Analysis and Repair

Recap Exercise

10 min

- Perform a Connect Checker Analysis
- Repair the curve using Curve Smooth

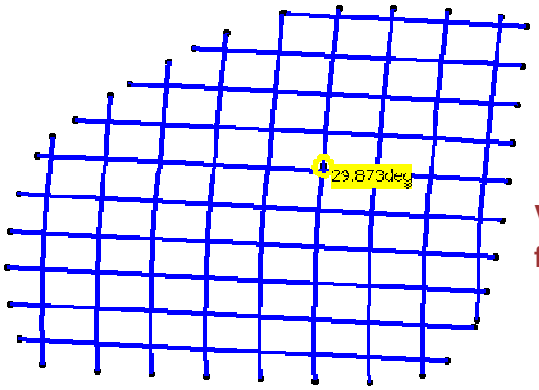


Student Notes:

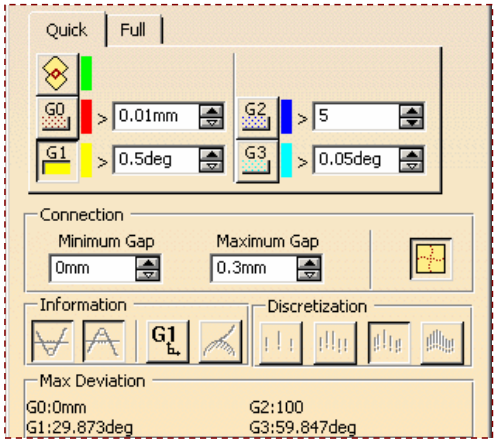
Do It Yourself…

Part used: CATGSD_F_Wireframe_Analysis_Recap.CATPart

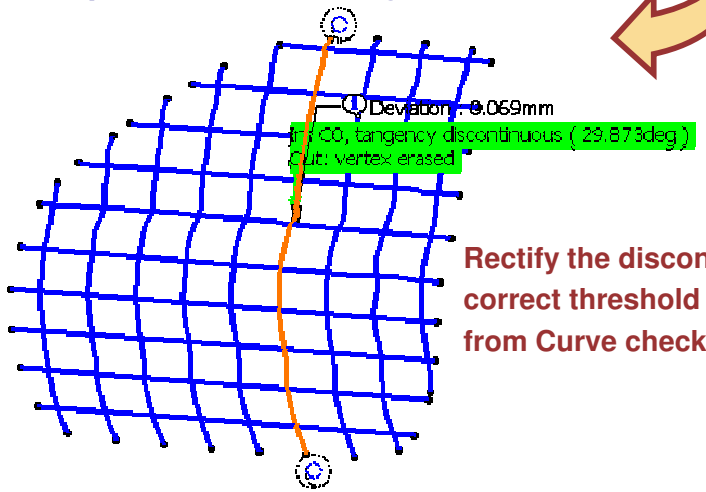
- **Perform a Connect Checker analysis.**



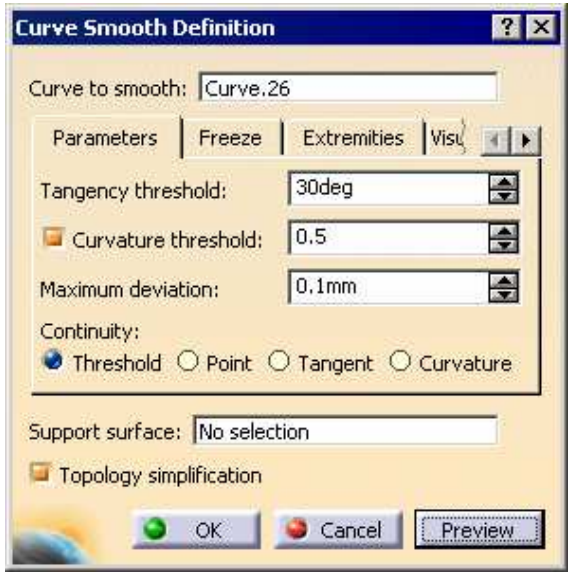
Validate the discontinuity for all the curves



- **Repair the curve using Curve Smooth.**



Rectify the discontinuity Using correct threshold value obtained from Curve checker analysis



Student Notes:

Surface Analysis

This lesson will cover the following Surface Analysis and Repair topics:

- About this Lesson
- Curvature Analysis
- Surface Analysis -Recommendations
- Recap Exercise: Surface Analysis

Student Notes:

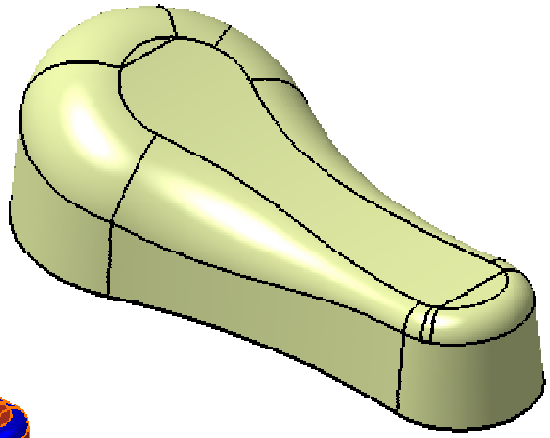
About this Lesson

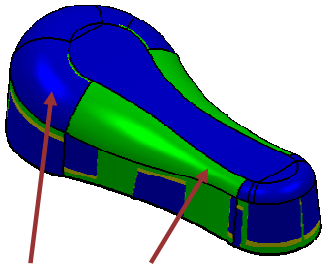
In this lesson you will learn and practice the advance tools of 'Surface Analysis'.

At the end of this Lesson, you will identify and analyze Inflection on surfaces and also find the minimum inside radius on the part.

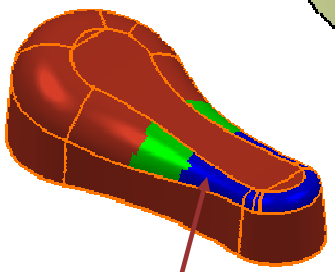
In this lesson you will learn a few functionalities of surface analysis such as,

- Curvature Analysis
  - Measuring mean curvature on a surface
  - Measuring Minimum and Maximum Curvature
  - Checking the inflection area on the Surface





Inflection Analysis on surface



Finding minimum inside radius on the part

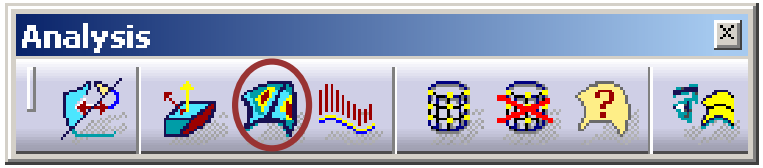
Simple visual inspection of a part will not always uncover surface flaws. Hence the surfaced geometry should always be analyzed using above tools to achieve better quality surfaces.

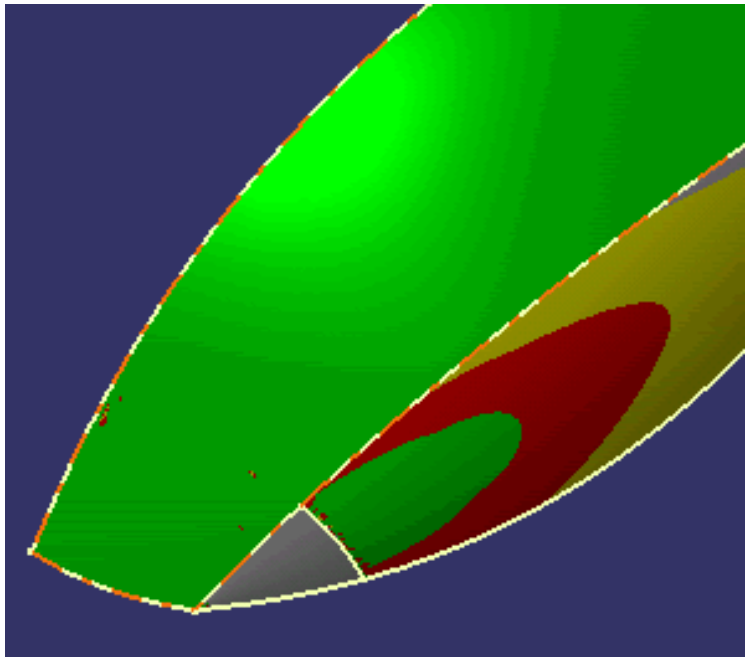
You will also see a few Surface Analysis recommendations at the end of the lesson.

Student Notes:

Curvature Analysis

You will learn how to use the Mapping Analysis tool to analyze surface curvature



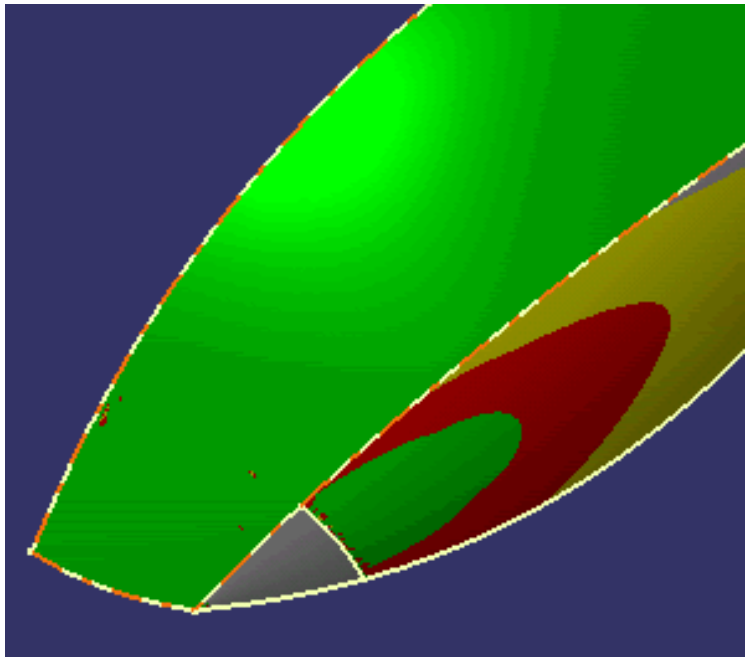


Student Notes:

Why use Curvature Analysis?

Curvature analysis of surfaces are generally used to help model high quality surfaces.

Abrupt changes of curvature on a surface (for example on a car exterior body) can be easily seen by the naked eye and must be smoothed.



Student Notes:

What is a Curvature Analysis? (1/2)

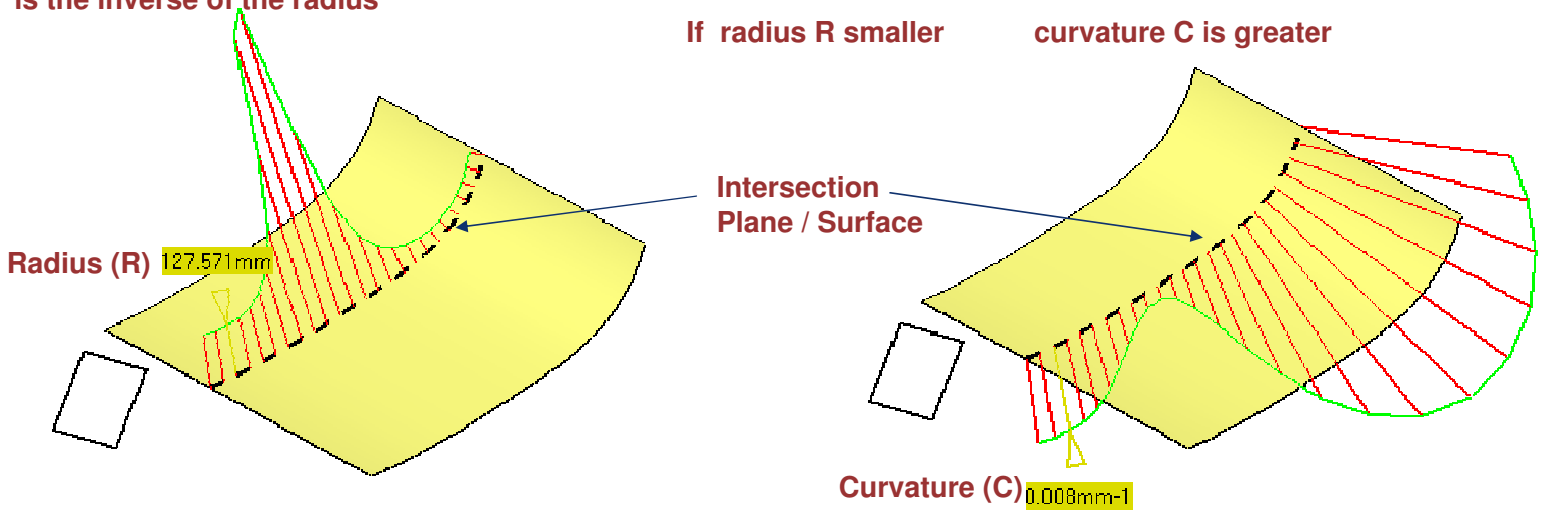
Curvature analysis of surfaces is used to help detect the imperfections on surfaces. Abrupt changes of curvature on a surface can be easily seen by the naked eye and must be smoothened. The curvature analysis measures the curvature on each point of a surface according to the following method :

Curvature radius in one point (R): represents the local convexity of the surface

The curvature in one point (C): C = 1 / R
is the inverse of the radius

If radius R greater curvature C is smaller

If radius R smaller curvature C is greater



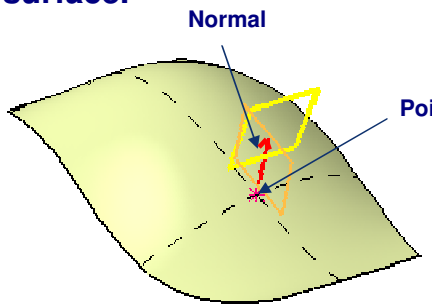
Radius measure of the surface intersection with a cutting plane

Curvature measure of the surface intersection with a cutting plane

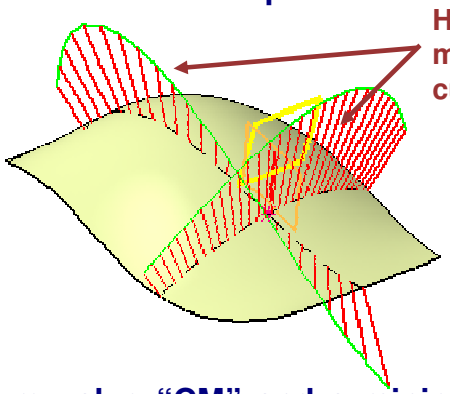
Student Notes:

What is a Curvature Analysis? (2/2)

If we rotate planes around the normal vector on a point of the surface, we can build the intersection of these planes with the surface.

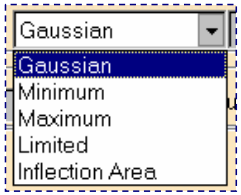


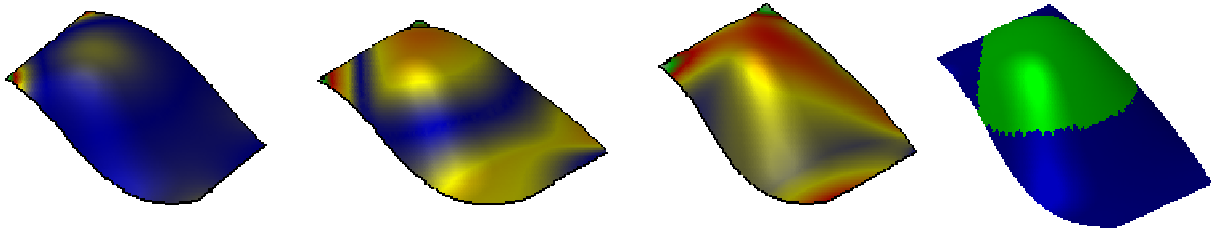
On these intersection curves we can measure an infinite number of curvature values for this point.



At each point we will have a maximum curvature value “CM” and a minimum curvature value “Cm.”

The Mapping analysis tool allows you to measure these minimum and maximum values (Minimum/Maximum analysis), the mean value (Gaussian analysis) and to see the inflection areas.





Gaussian $\sqrt{|C=|}$ CM.Cm

Minimum

Maximum

Inflection area

Student Notes:

Measuring the Mean Curvature on a Surface.

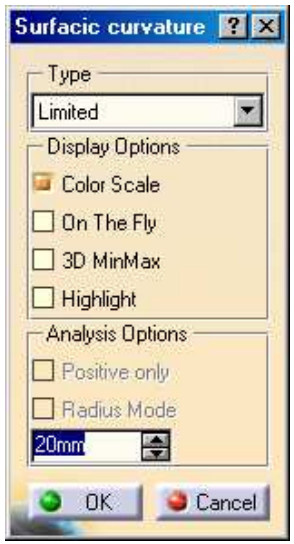
1. Select the customized view render style :

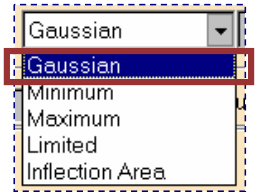
2. 

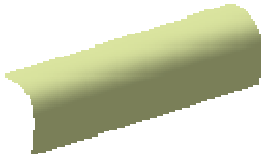
3. Select the surface where you want to examine the curvature:

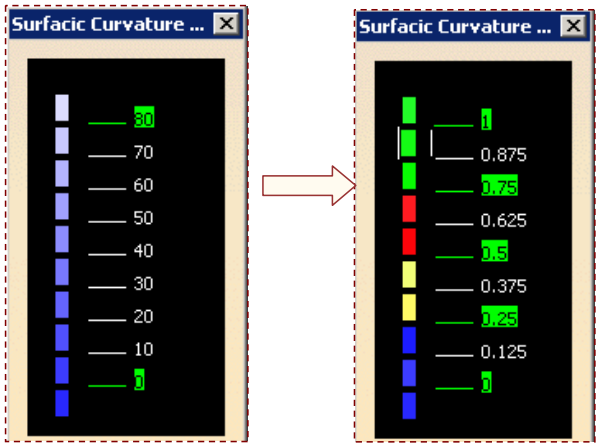
4. Select Gaussian as analysis type :

5. Adjust the color range fields by right clicking on the thresholds values.

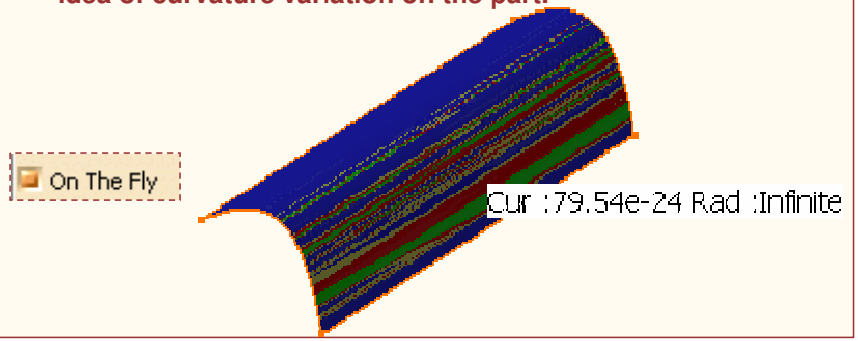








Pass the mouse over the surfaces and read the curvature values shown in order to get a general idea of curvature variation on the part.



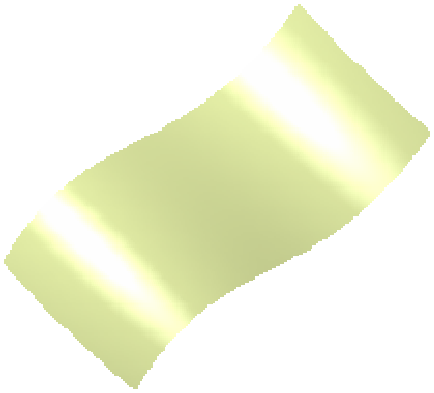
Student Notes:

Measuring the Minimum or Maximum Curvature on a Surface.

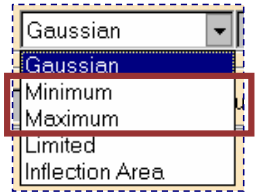
1. Select the customized view render style :

2. 

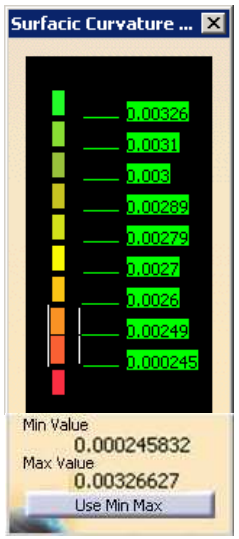
3. Select the surface where you want to examine the curvature:

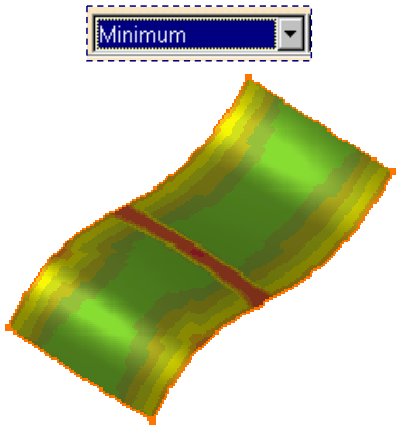


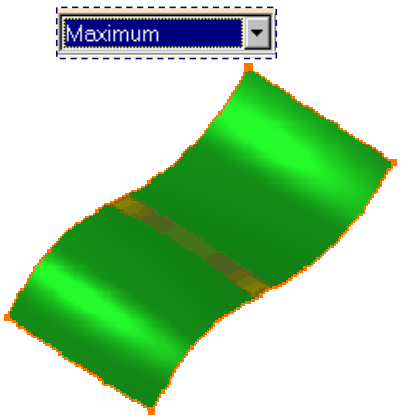
4. Select Minimum or Maximum as analysis type :



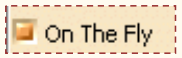
5. Adjust the color range fields right clicking on the thresholds values and on the colours boxes.







Pass the mouse over the surfaces and read the curvature values shown in order to get a general idea of curvature variation on the part.



Student Notes:

Checking a Surface Using the Limited Radius

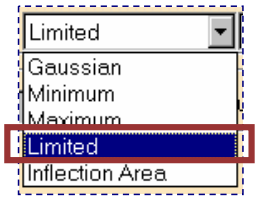
Use the Limited Radius analysis to check if the surface can be offset or to check if a tool (an end mill) with an end radius can mill the part.

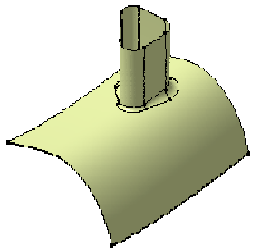
1. Select the customized view render style :

2.

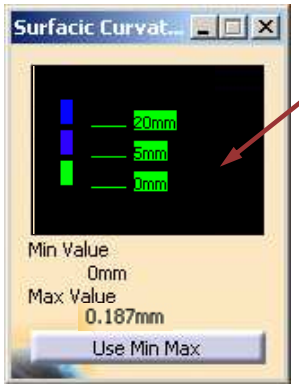
3. Select the surface where you want to examine the curvature:

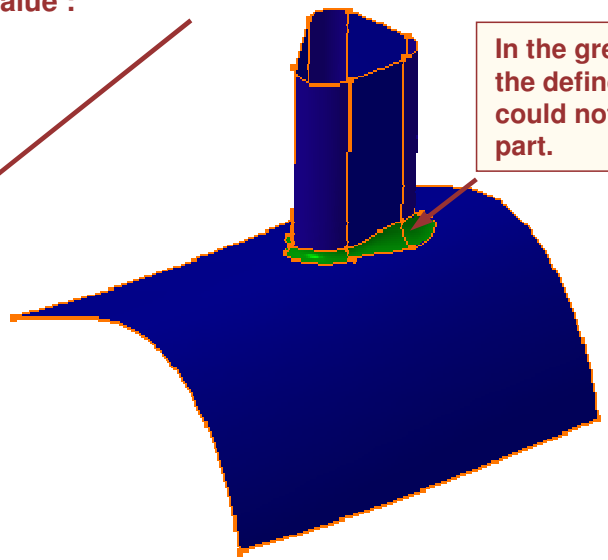
4. Select Limited as analysis type :





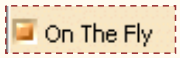
5. Set the limited radius value :





In the green area, the defined tool could not mill the part.

Pass the mouse over the surfaces and read the curvature values shown in order to get a general idea of curvature variation on the part.

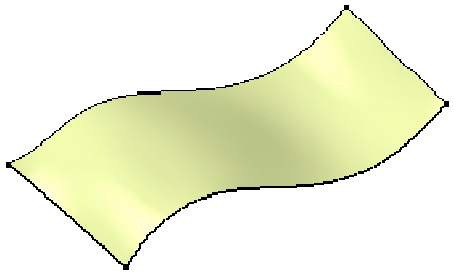


Student Notes:

Checking the Inflection Areas on Surfaces.

Using the Inflection Area analysis type you can see where the curvature sign changes.

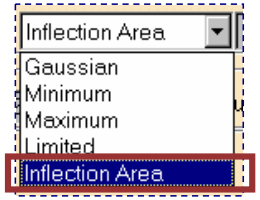
0 Select the customized view render style :

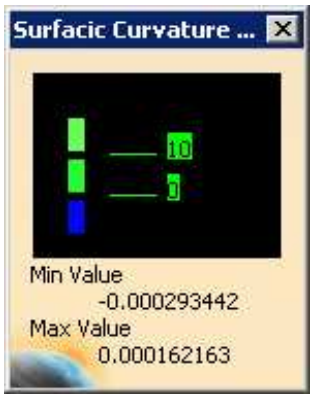


1

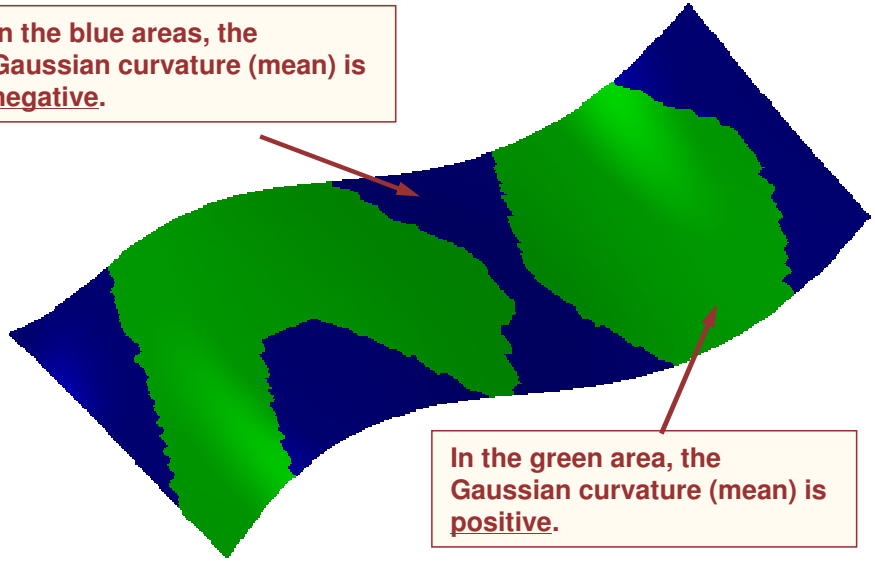
2 Select the surface where you want to examine the curvature:

3 Select Inflection Area as analysis type :





In the blue areas, the Gaussian curvature (mean) is negative.

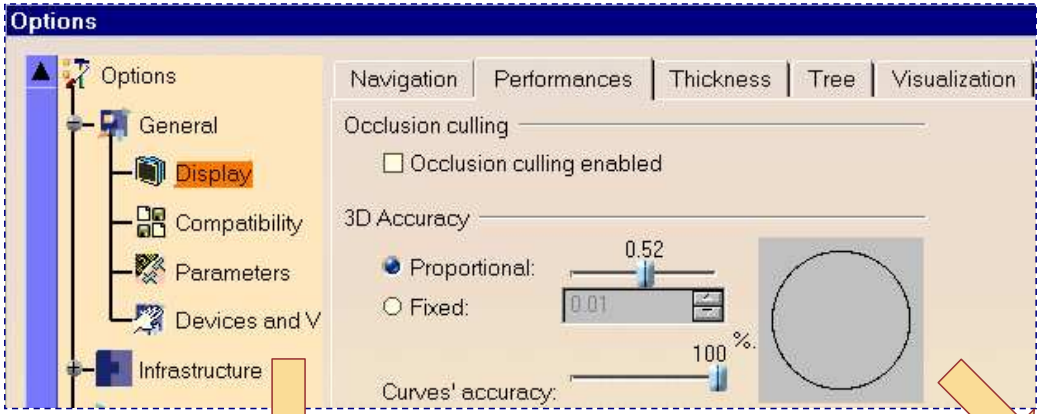


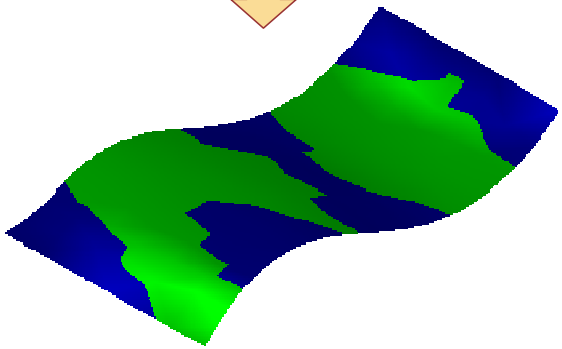
In the green area, the Gaussian curvature (mean) is positive.

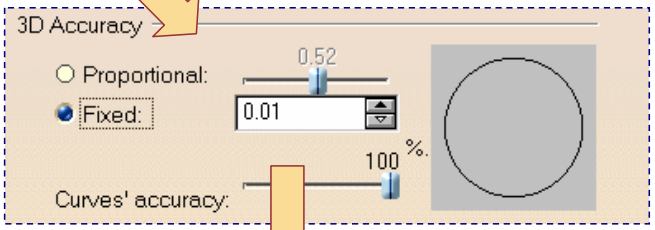
Student Notes:

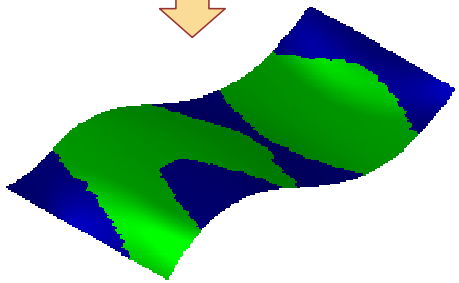
Additional Information on Curvature Analysis

The Analysis is calculated on the mesh used to display the object, the precision of the analysis depends on the display settings.









Fix the 3D Accuracy to the minimum value to have a better analysis rendering.

Student Notes:

Surface Analysis – Recommendations

You will be given specific methods and recommendations concerning Surface Analysis and Repair.

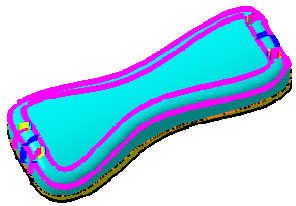
Student Notes:

Tips on performing Surface Analysis

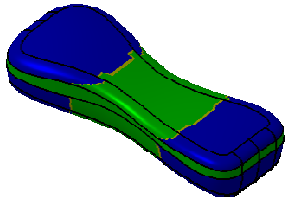
As a general rule of thumb, the following tools of GSD workbench are useful to obtain an initial assessment of the surface quality of a part.

1. **Visual – make sure you place a metallic material on the part and shade in material mode. Also reduce the "Accuracy" values in Tools + Options + General + Display + Performances.**

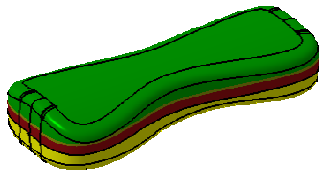
2. **Surface Connect Checker – verify internal connections on the surface. Make sure they conform to specifications.**



3. **Inflection Area Analysis (under Surfacic Curvature Analysis tool) – look for color changes that are not in areas where inflection changes are expected.**



4. **Draft Analysis – make sure the part conforms to all molding or forming criteria.**

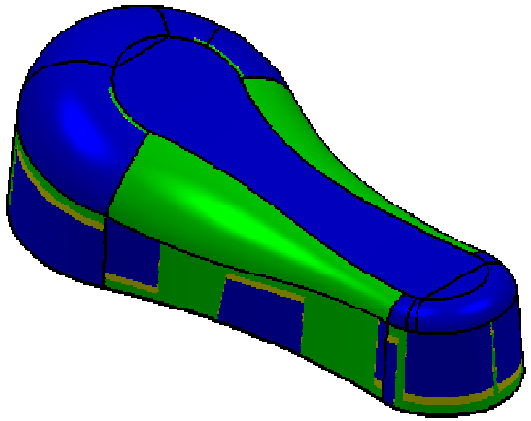


Surface Analysis

Recap Exercise

15 min

- Perform an Inflection Analysis
- Find the minimum inside radius



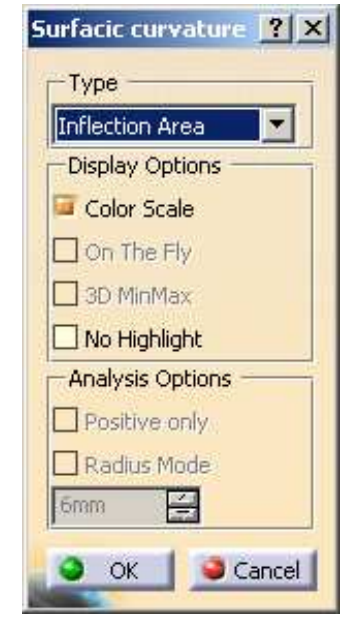
Student Notes:

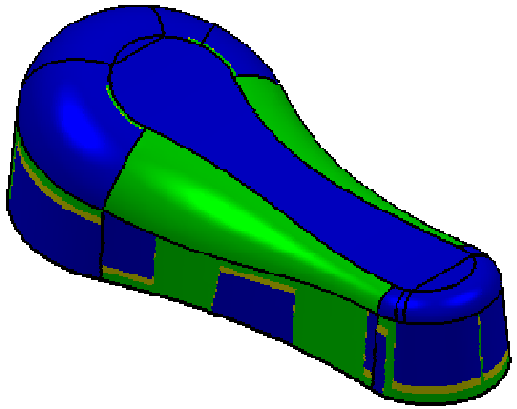
Student Notes:

Do It Yourself (1/2)

Part used: CATGSD_F_Surface_Analysis_Recap.CATPart

- Perform an Inflection Analysis on the part.
  - Click on the Surfacic Curvature Analysis icon.
  - Choose type “Inflection” area.
  - Select the seat surface.





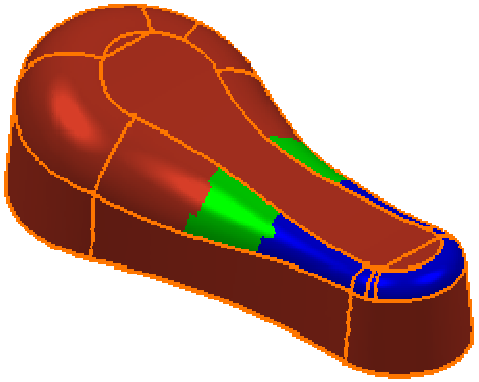
Notice areas of green and blue color. You are looking for is areas of infection that are out of place. On this surface, all the color changes are reasonable

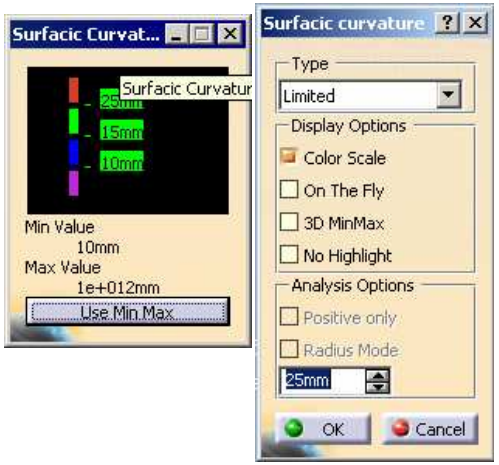
Student Notes:

Do It Yourself (2/2)

- Delete the Inflection Analysis from the specification tree.
- Find the minimum inside radius on the part.
  - Click on the Surfacic Curvature Analysis icon.
  - Choose type “Limited.”
  - Make sure the panels appear as shown.
  - Select the “Whole top surface.”

Notice areas of color indicating minimum radius. Notice the minimum radius in the panel for this surface. This may be critical information for Homologation or for manufacturing.

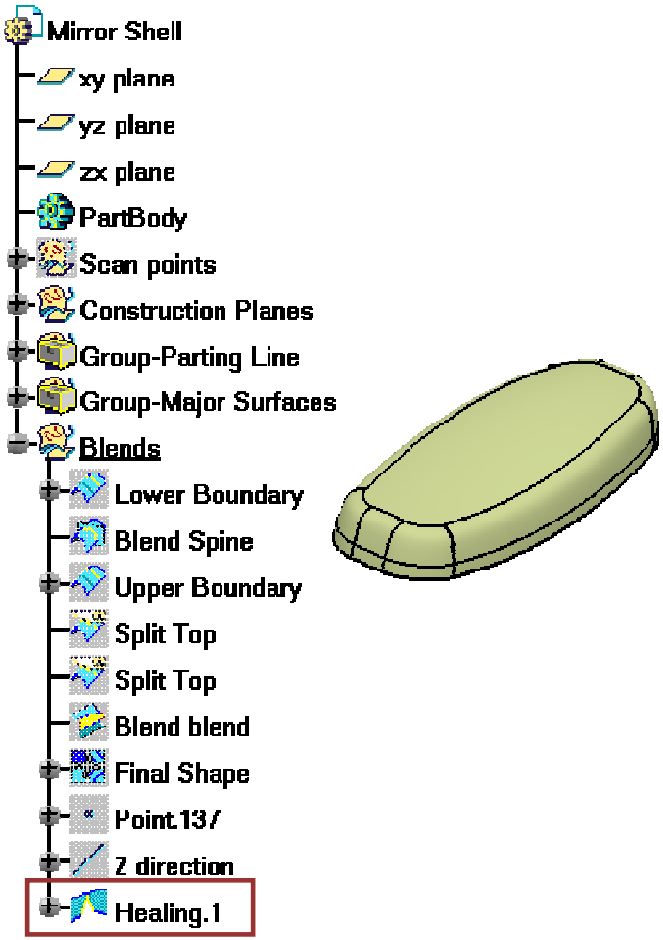




Student Notes:

Healing Surfaces

You will learn about the Healing operation

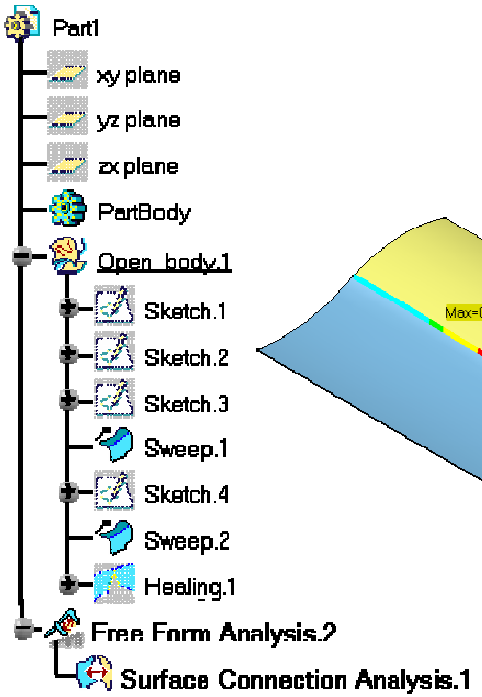


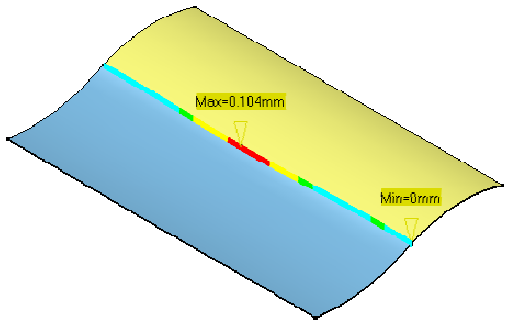
Student Notes:

Why Healing?

While Join is a topological integration of surfaces into one logical surface, HEALING will mathematically deform the shape of surfaces at boundary areas so they smoothly blend into one another.

When physical parts are manufactured from CAD models, the machining is guided by the exact representation of the individual surfaces. Hence, Healing is important to ensure that each one of these surfaces transitions smoothly between one another.

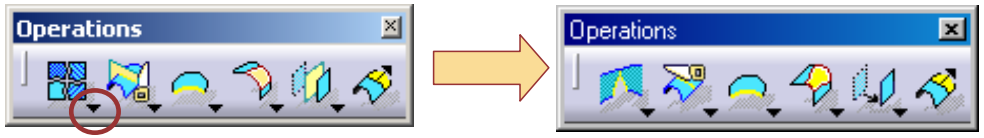




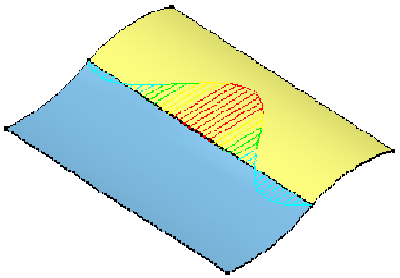
Student Notes:

Healing Surfaces (1/3)

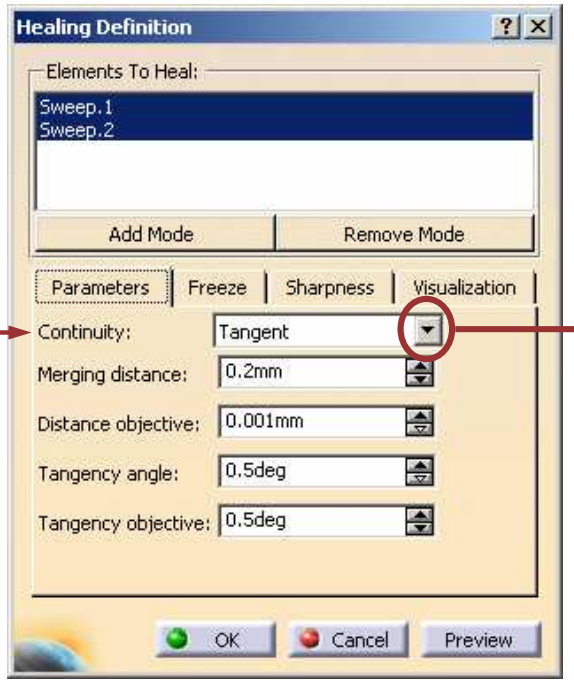
1

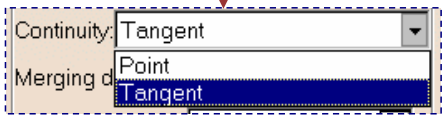


2 Select directly the surfaces to heal.



3 Choose if you want to heal the point discontinuities or the tangency discontinuities.





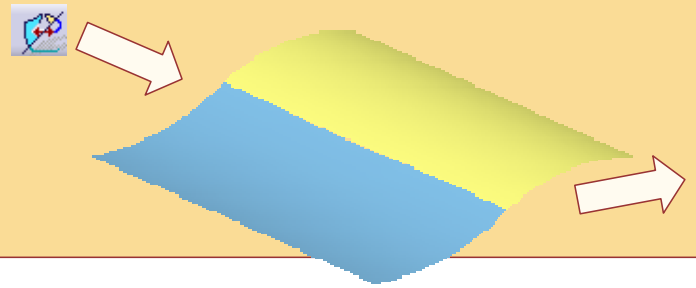
Student Notes:

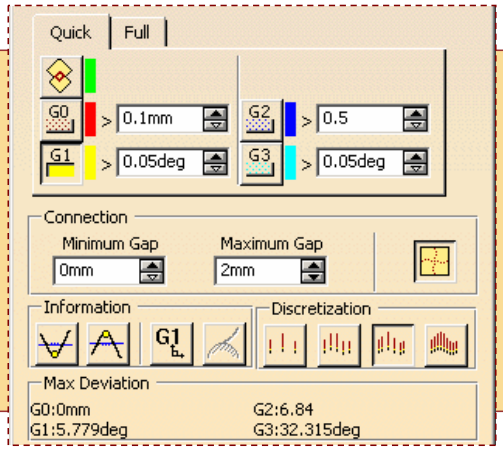
Healing Surfaces (2/3) : Parameters

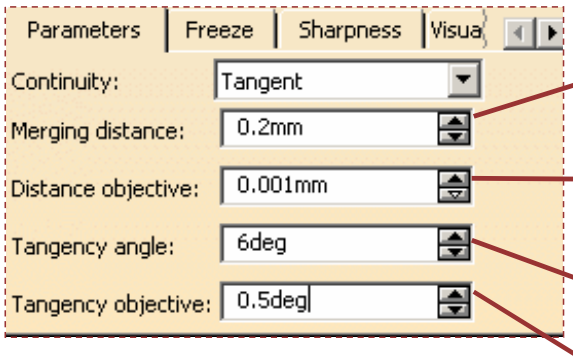
The objective of the parameters is to choose the discontinuities you want to heal or not :

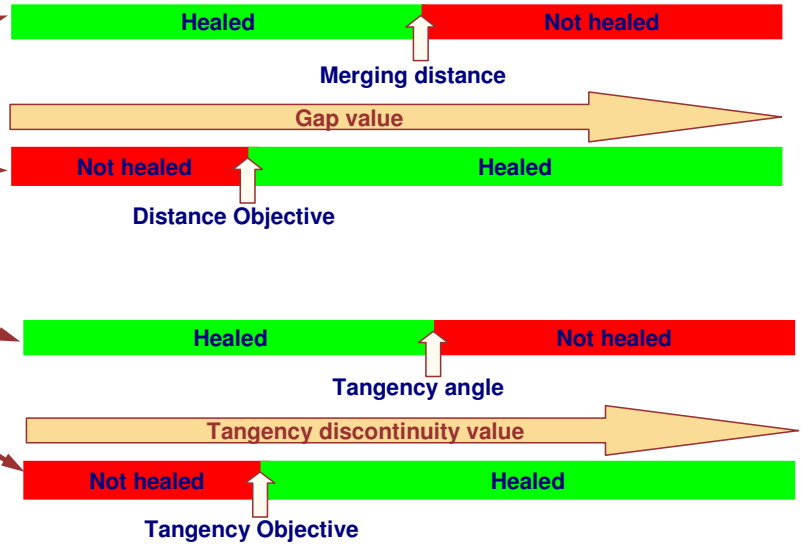
4 **Key in parameters :**

Note : a Connect Checker analysis can help to choose these parameters :







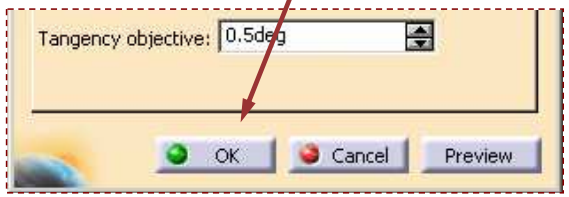


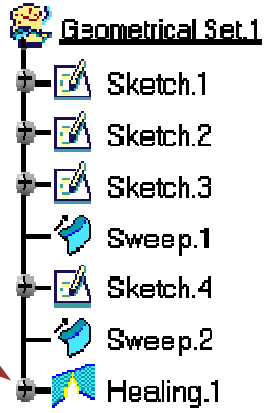
These parameters are thresholds that allows you to:
- define the discontinuities to be healed (Merging distance and Tangency angle).
- define the discontinuities you consider it is not necessary to heal (Distance Objective and Tangency Objective).

Student Notes:

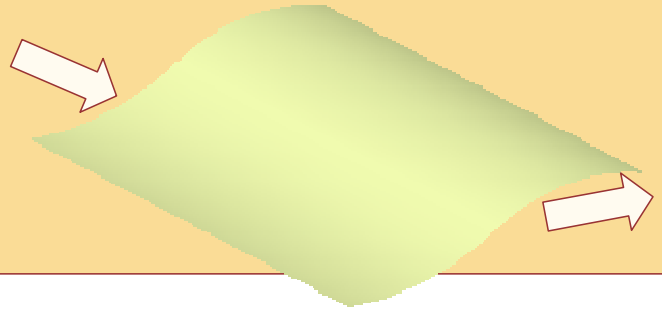
Healing Surfaces (3/3)

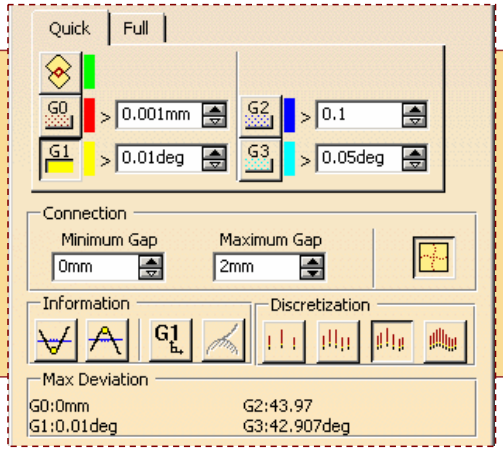
5 Click on OK to confirm the healed surface creation.





Note : a Connect Checker analysis now shows :



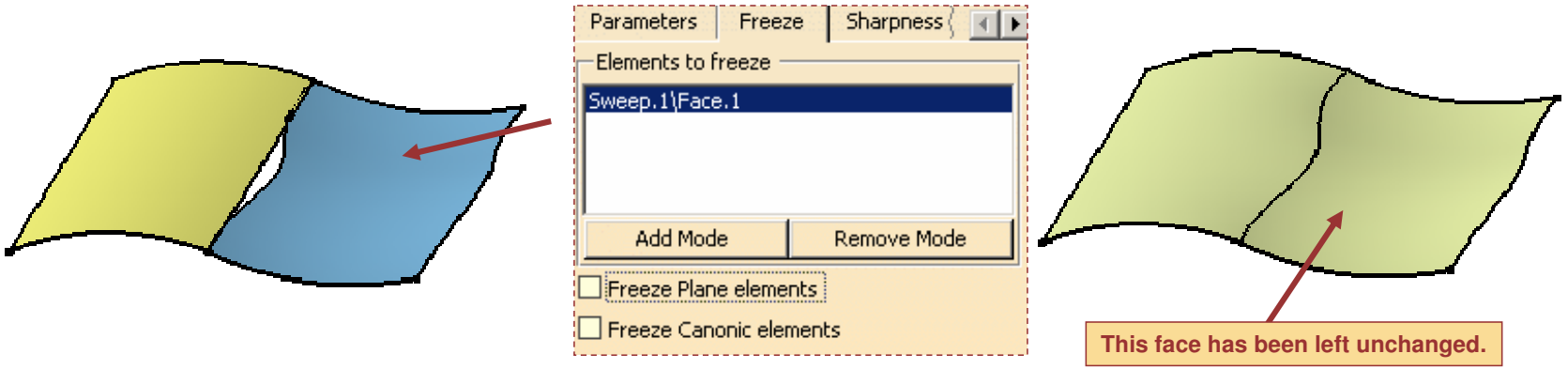


Student Notes:

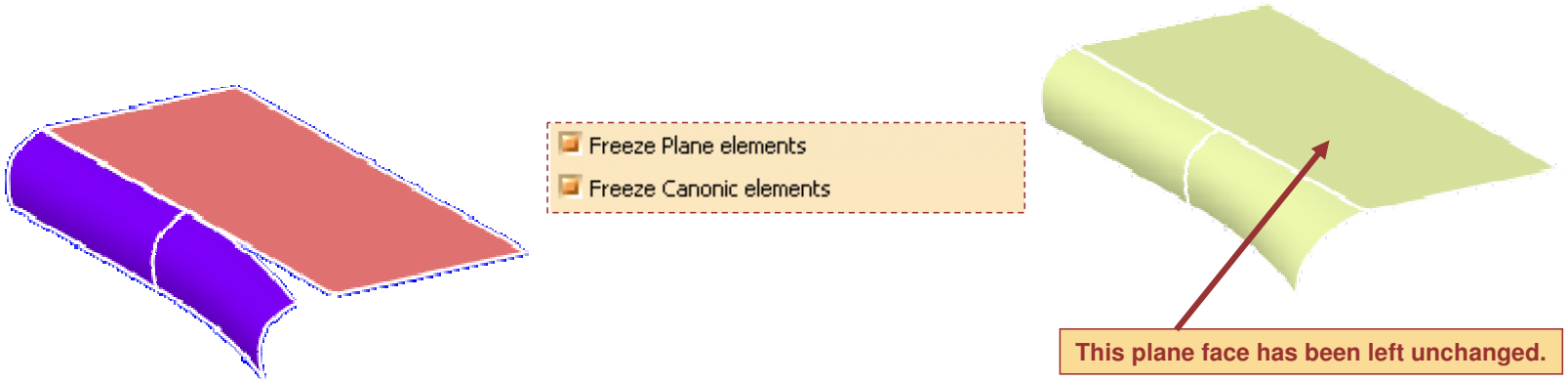
Additional Information on healing (1/2)

While healing surfaces, you can freeze some faces for them not to be modified by the healing operation.

You can choose to freeze any face you want …



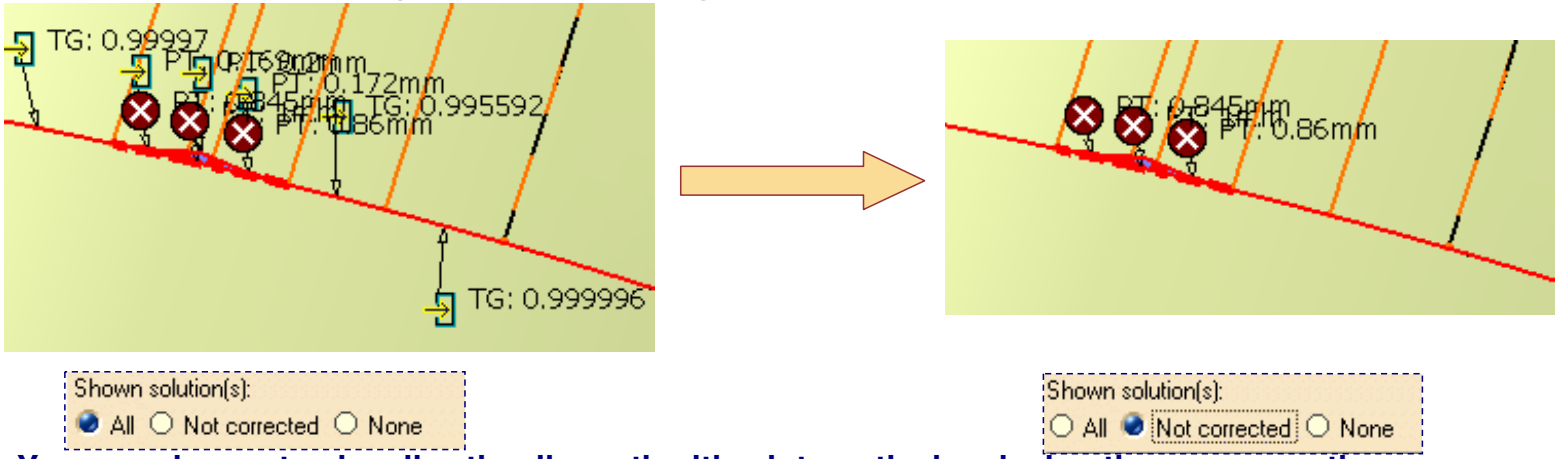
… or choose to freeze plane elements or canonic elements.



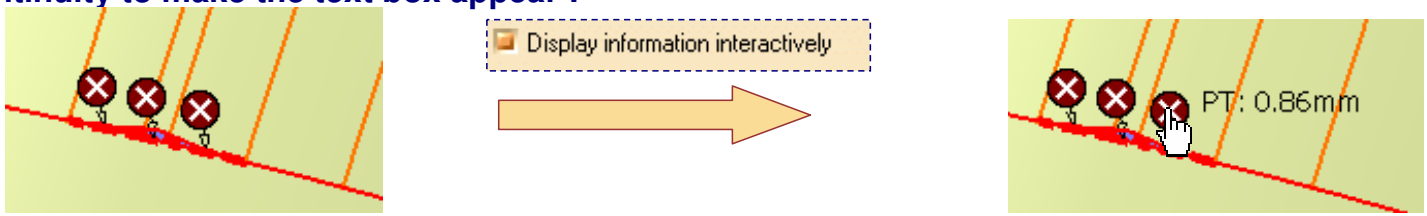
Student Notes:

Additional Information on healing (2/2)

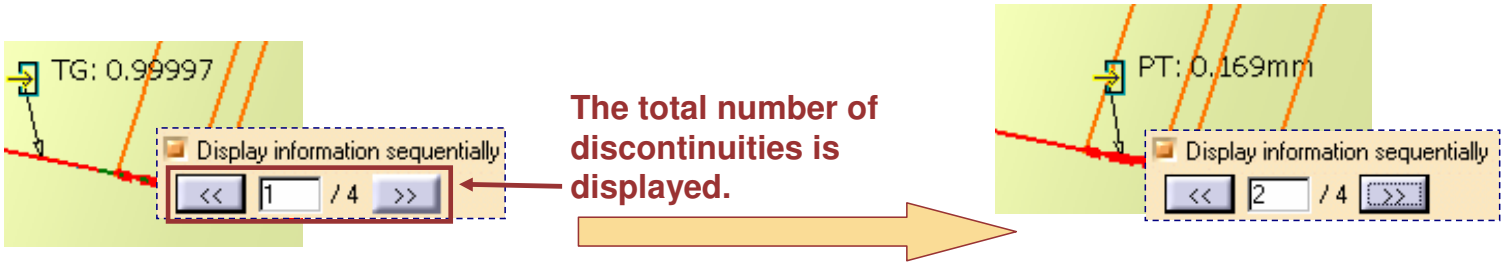
You can visualize a diagnosis while healing surfaces



You can choose to visualize the discontinuities interactively, placing the mouse on the discontinuity to make the text box appear :



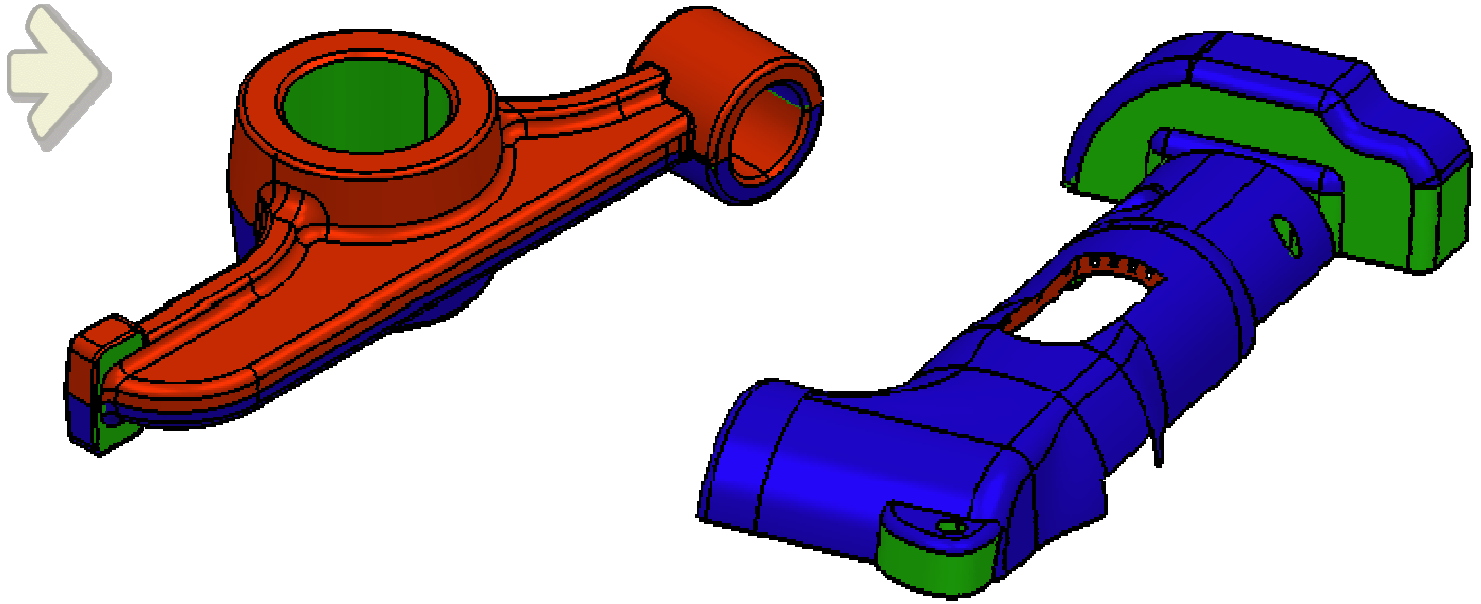
You can also display the information sequentially :



Student Notes:

Checking Molded Parts

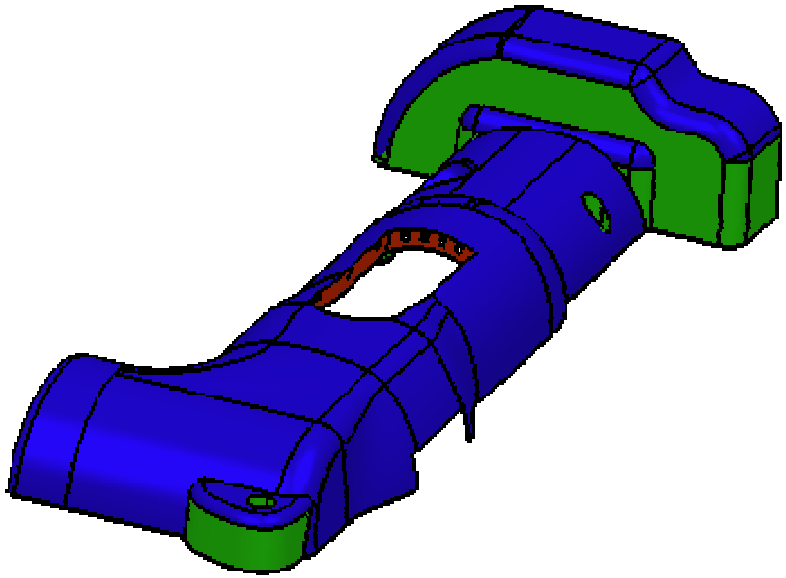
You will learn about tools, commonly used while creating a Molded Parts.



Student Notes:

Draft Analysis

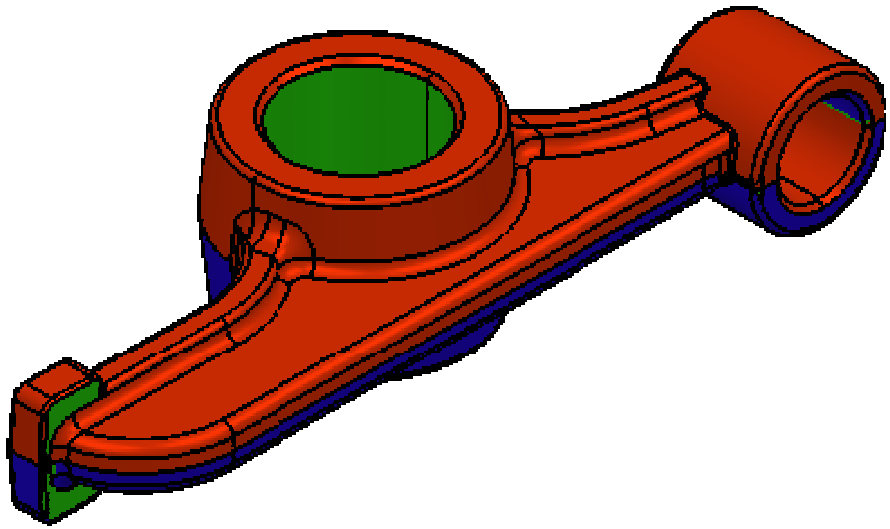
You will learn how to use the Draft Analysis tool to analyze the draft values of surfaces or solids



Why Analyze Draft?

Cast and Forged parts need dies and molds for manufacturing. While doing the die/mold design, draft allowances are required to be given so that the parts can be extracted. Drafts need to be analyzed to determine extractability of the part.

For NC Machining, a part is analyzed to look for negative Draft angles in order to determine if a 5-Axis NC machine will be required to cut the part.



Student Notes:

Student Notes:

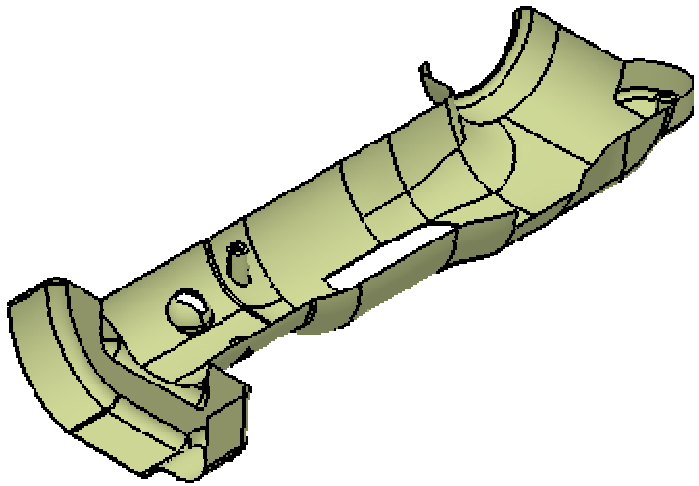
Using the Draft Analysis Tool (1/5)

1 Select the customized view render style : 

2 

Select the Draft Analysis tool

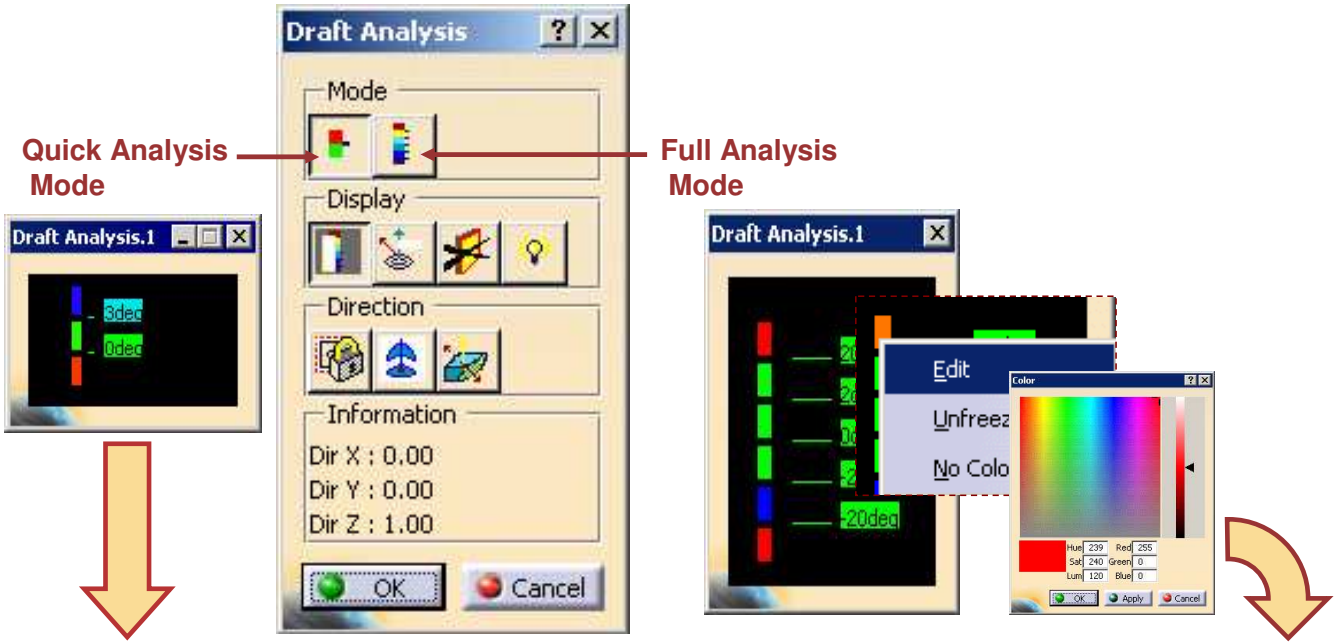
3 Select the surface to be analysed



Student Notes:

Using the Draft Analysis Tool (2/5)

4 Choose the quick analysis mode or the full analysis mode :

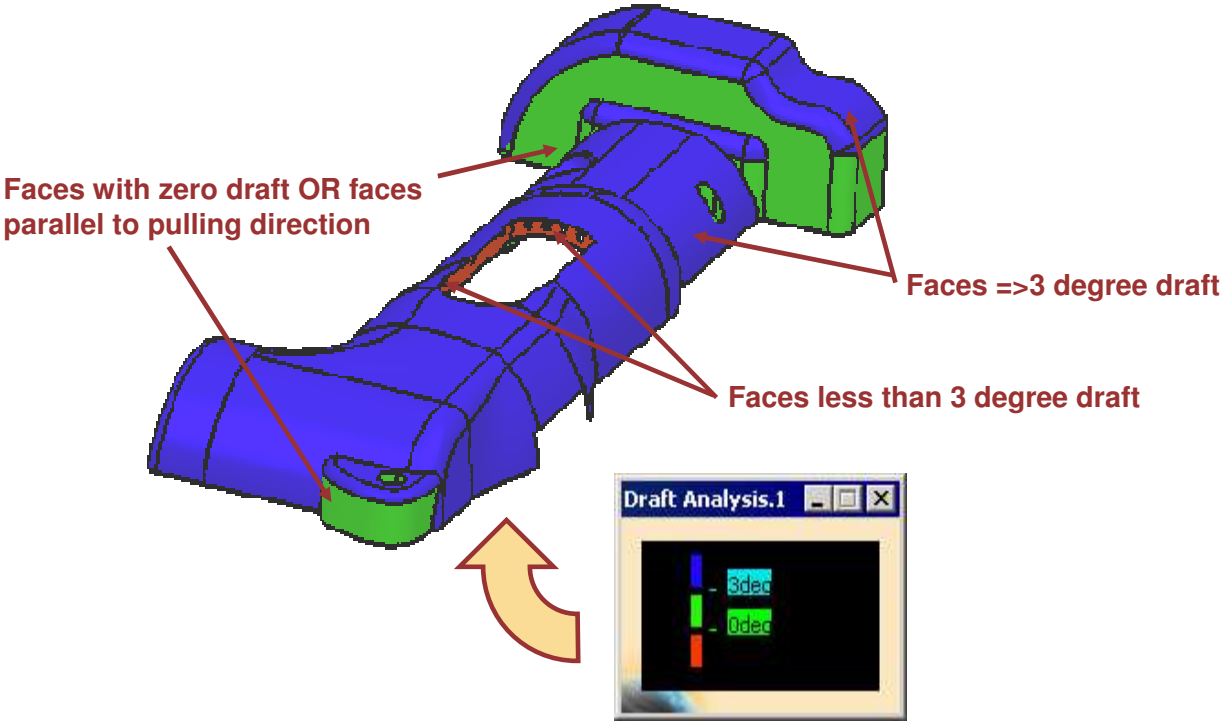


In quick analysis, you can set three parameters showing positive, Negative and zero (neutral) angle and assign the colors to these parameters for a quick view of a draft angle in a part

You can modify the thresholds values and the corresponding colours by right-clicking on them. This way, you can adjust the colour range fields.

Student Notes:

Using the Draft Analysis Tool (3/5)



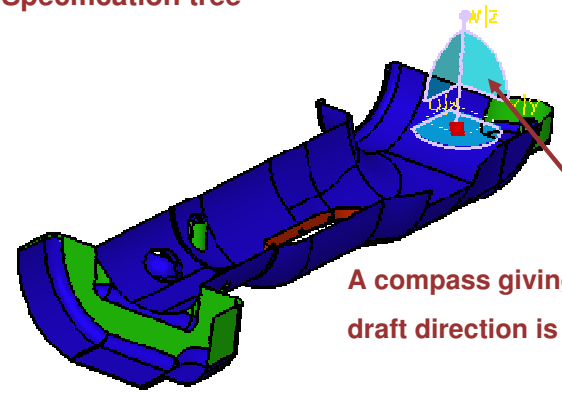
You can Visually analyze the part based on the color assigned with an angle value.A range of colors can be assigned to visualize the varying draft angle.

Student Notes:

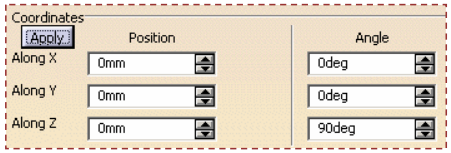
Using the Draft Analysis Tool (4/5)

5 You have now to adjust the draft direction. In the dialog box,select 

6 Select OK to keep the history of the analysis in to the Specification tree



A compass giving the current draft direction is displayed.



You can edit the compass proprieties to precisely define the draft direction.

Lock or unlock draft direction

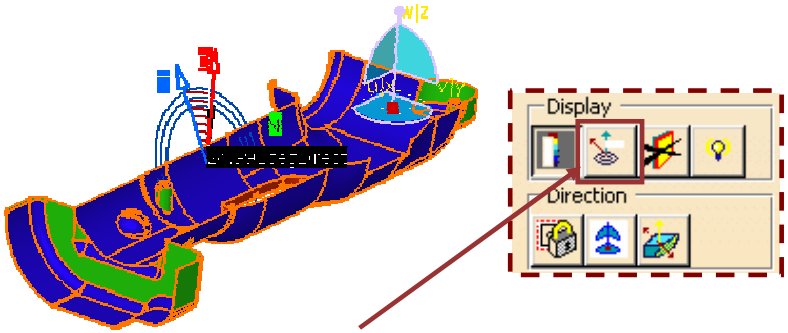
Set the compass to draft direction

The Blue plane is the plane tangent to the analyzed surface at this point..

Arrows are displayed under the pointer.

Green arrow is the direction normal to the surface, the Red arrow represent draft direction.

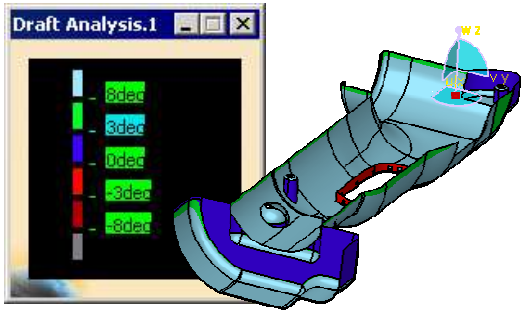
The displayed value indicates the angle between the draft direction and the normal vector to the surface at the current point.



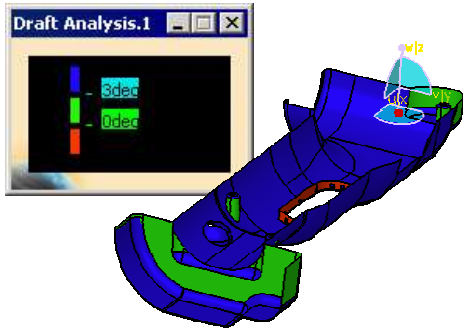
Analyses under the running point, so you can navigate with the pointer over the surface

Using the Draft Analysis Tool (5/5)

Student Notes:



Results of full Draft analysis

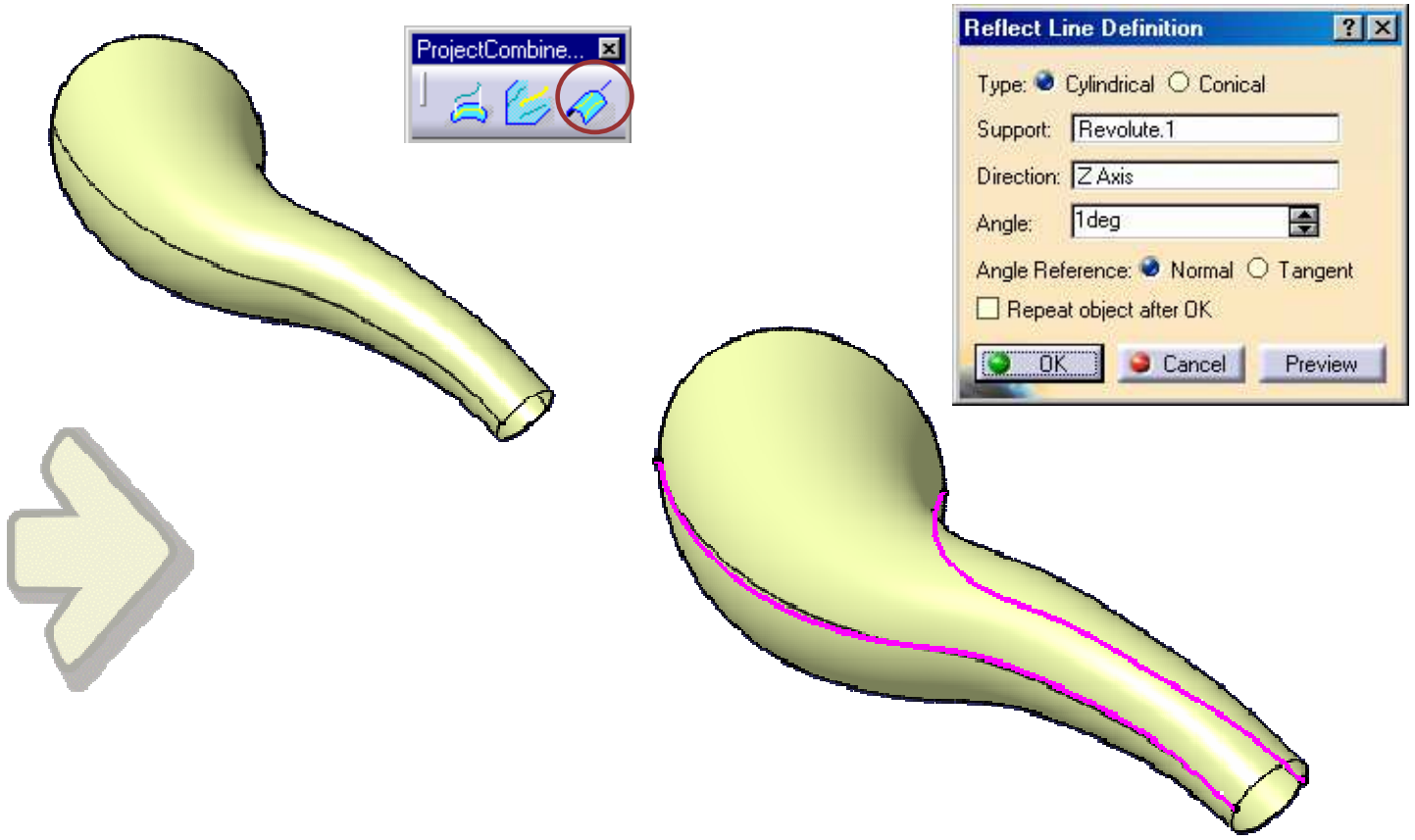


Results of Quick Draft analysis

Student Notes:

Reflect Line

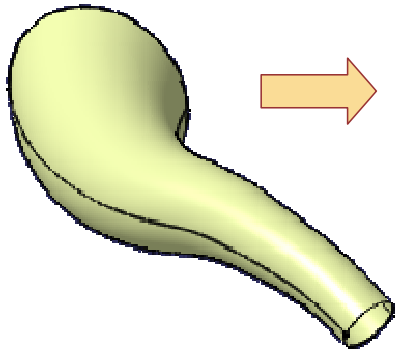
You will learn what a Reflect Line is and how to create it.



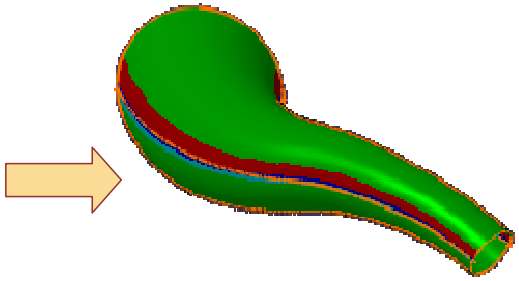
Student Notes:

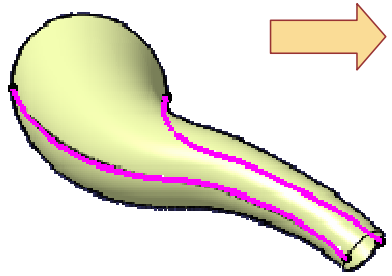
What is a Reflect Line

Reflect lines are curves for which the normal to the support surface in each point presents the same angle with a specified direction. It is very useful to find the parting plane of a complex surface.

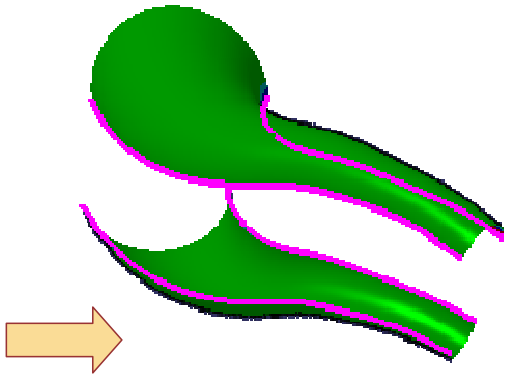


If we perform a Draft analysis on this part, we can see, thanks to the red areas that the part is non extractible.





Thanks to the Reflect Line curve, we can cut the part in two extractible parts.

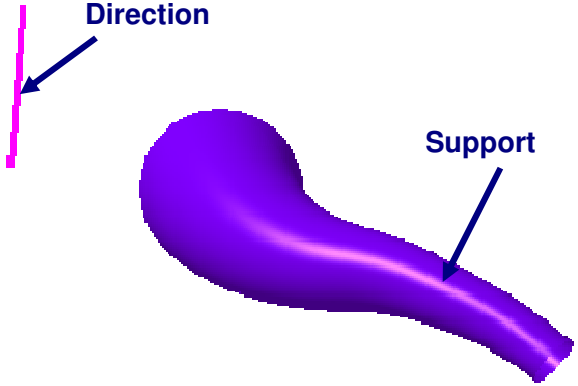


Student Notes:

Creating a Reflect Line

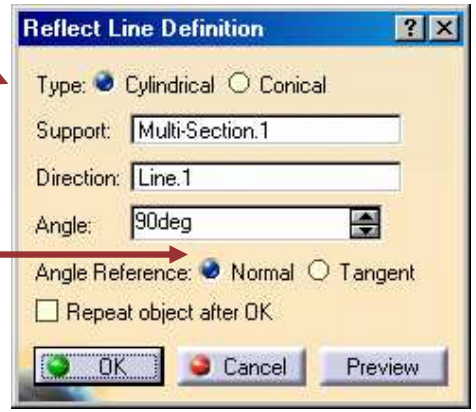
1

2 Select a support surface and a direction.

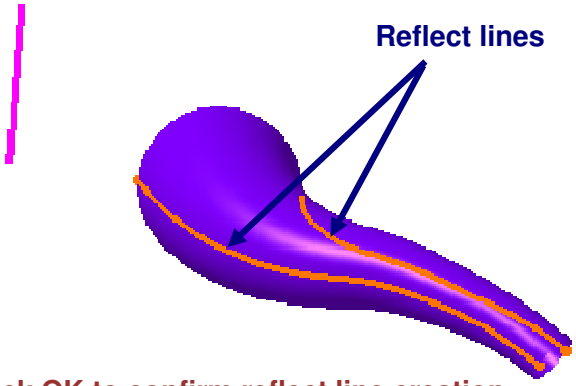


You can define one of the X,Y or Z axis by opening a contextual menu in the Direction field.

3 Key in an angle representing the value between the selected direction and the normal to the surface.



You can select the Normal option for the angle to be computed between the normal to the support and the direction.



4 Click OK to confirm reflect line creation