



CONFORMAL COOLING

3DXpert 15

Tutorial_V1 - 15,0100,1774,705(Official)
Official version

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Introduction

Create complex conformal cooling channels

The system supports mixed/hybrid manufacturing environments with subtractive and additive solutions. A mix of both traditional and conformal cooling capabilities enables efficient design, resulting in shorter injection cycle time and better parts quality due to reduced warpage.

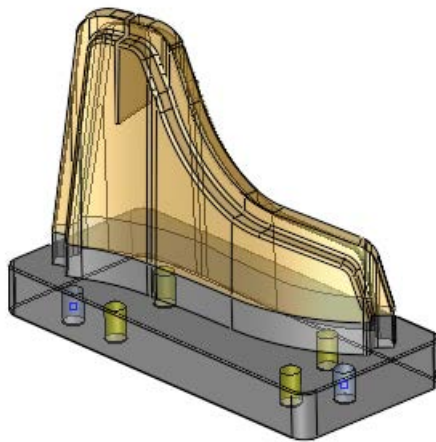
Data required for the exercise:

- ❖ Conformal cooling - Start.elt.
- ❖ Cooling Map.elt.

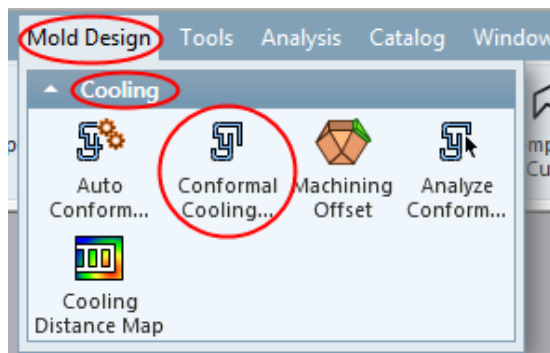
 Notice/ Remember		Left mouse button name is "Click"
		Middle mouse button name is "Exit"
		Right mouse button name is "Right Click"

Part 1 Create Conformal Cooling

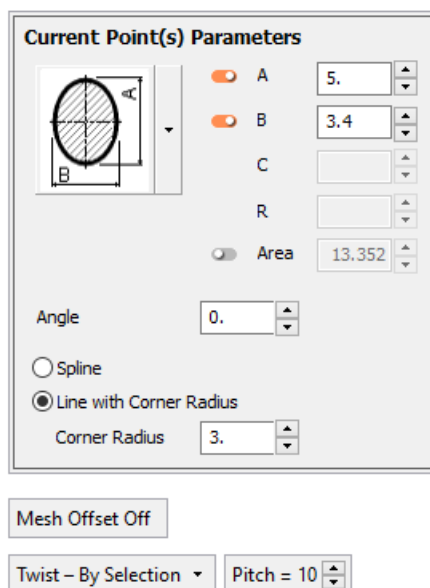
1. Load **Conformal cooling - Start.elt**.



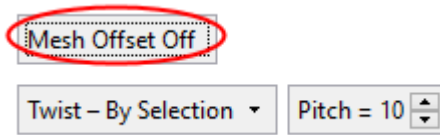
2. Invoke the **Conformal Cooling** function.



Notice the set of parameters that define the cooling channel.

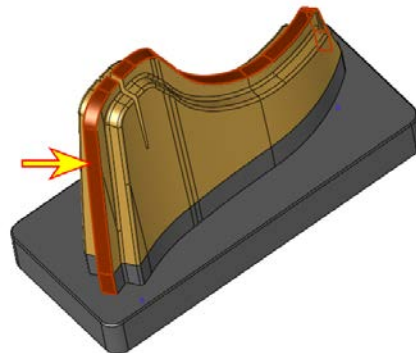
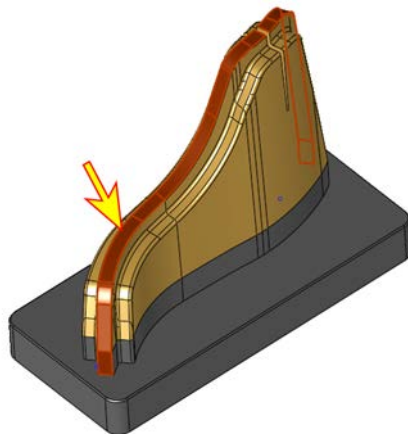


- Set the **Mesh Offset** to 'On', in order to use a mesh offset of faces and to select points on it.

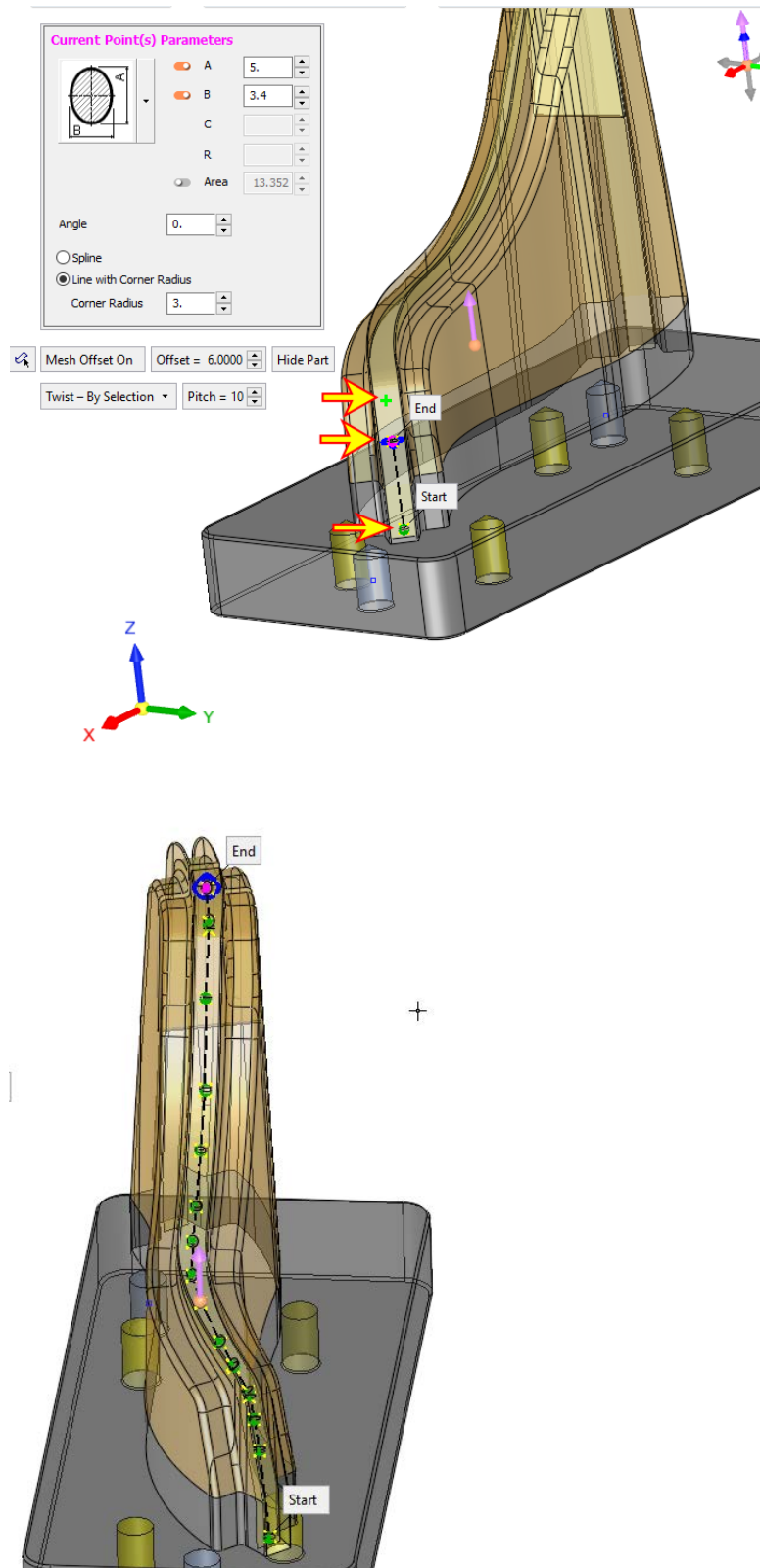


- Select the face icon and then select the top faces of the rib as indicated by the arrow in the picture below and exit.

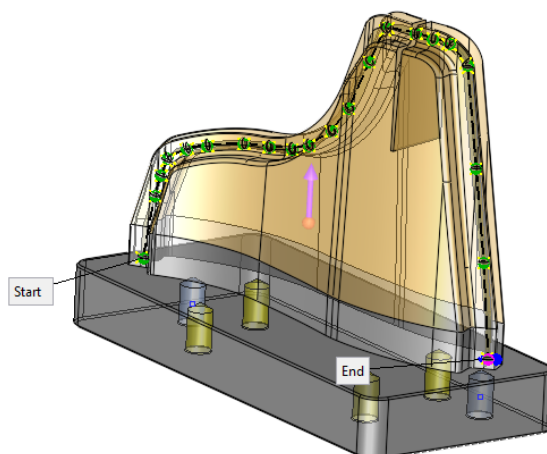
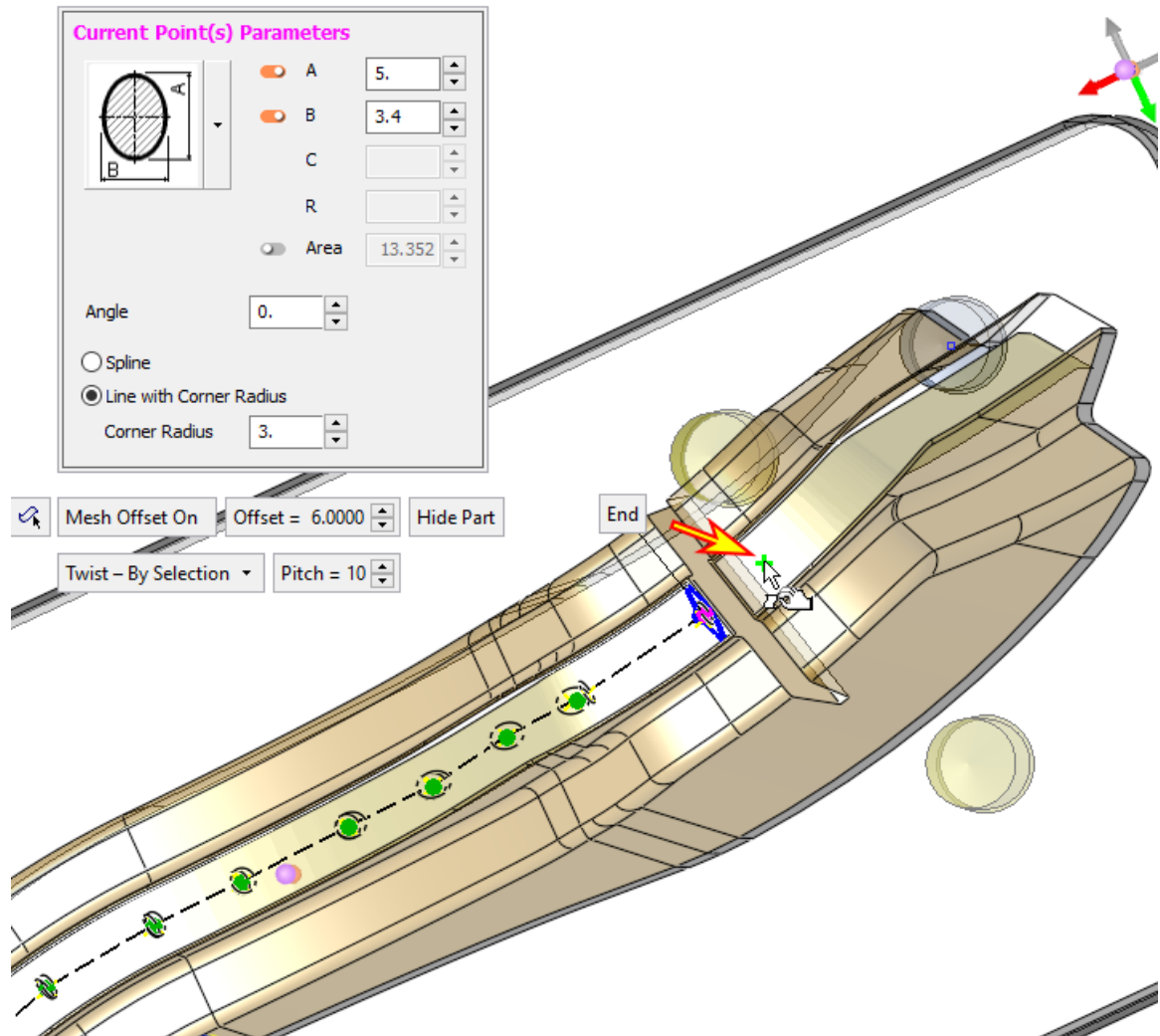
The Mesh Offset is a toggle option Mesh Offset Off / Mesh Offset On that enables you to use a mesh offset of faces and to select points on it.



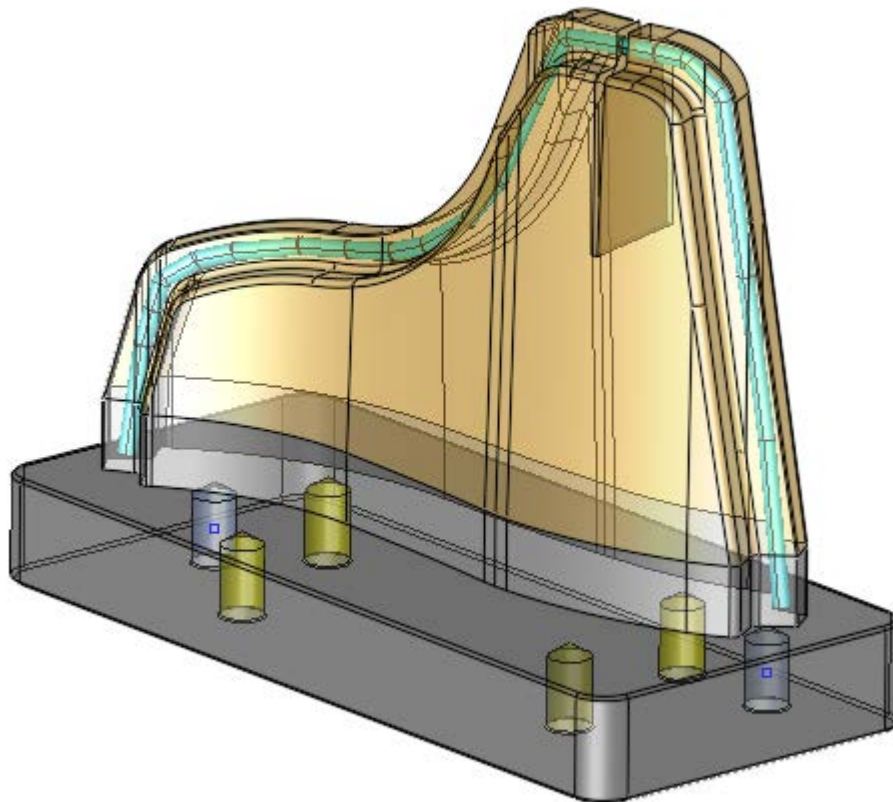
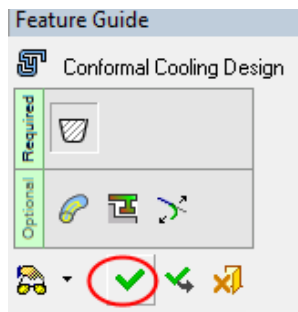
- Set the **Offset** to **6**, and select points along the rib. The parameters are relevant for the selected **current** point and not to the 'next' selected point, as in the previous version. In this way we can see the current point result and make changes if needed.



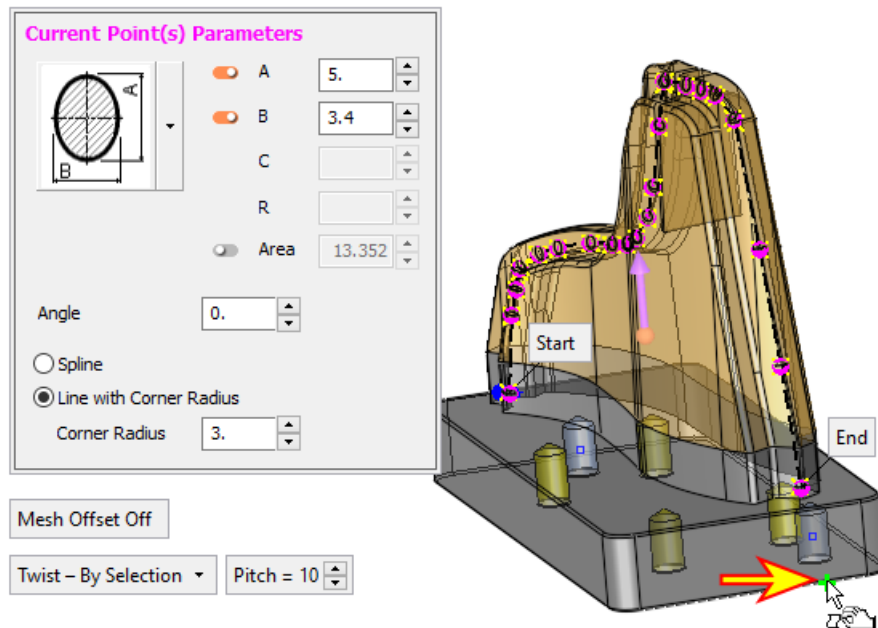
6. Skip the gap between the two parts of the rib.



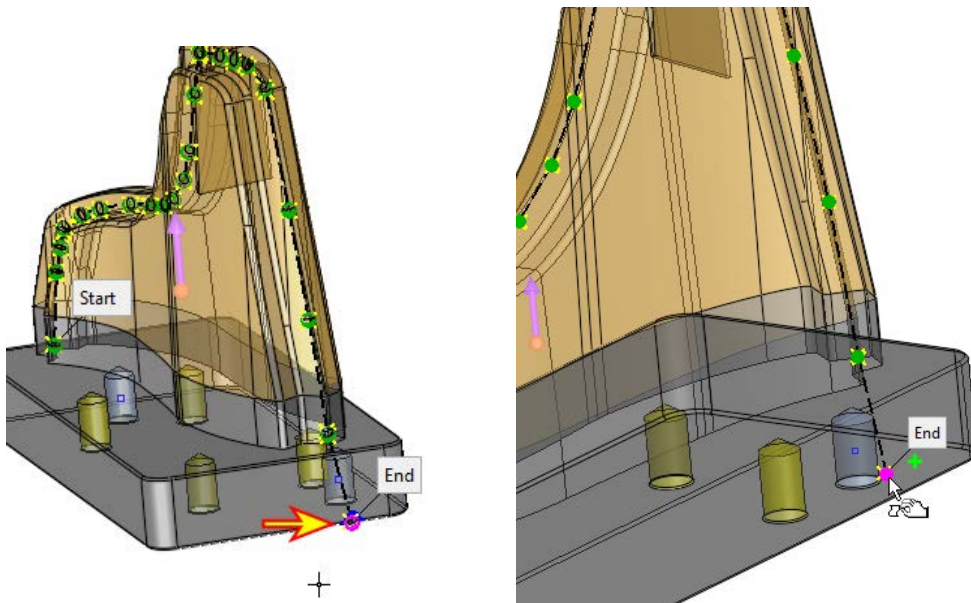
7. Select **OK**.



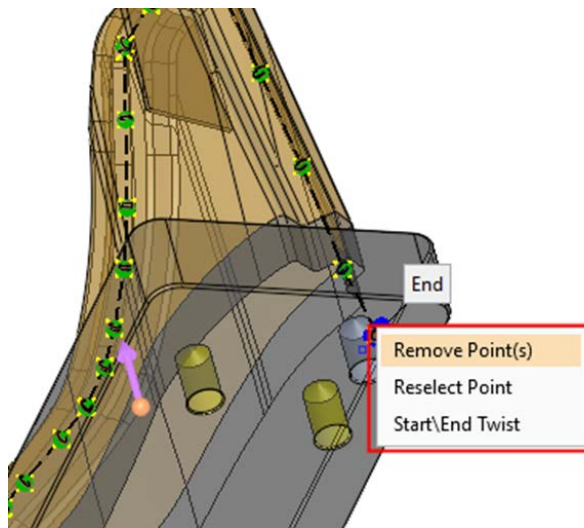
8. Edit the cooling to change the start and end points of the entry and exit points. First select the end point for the 'Exit' as indicated by the arrow in the picture below:



9. Drag the point to the desired location

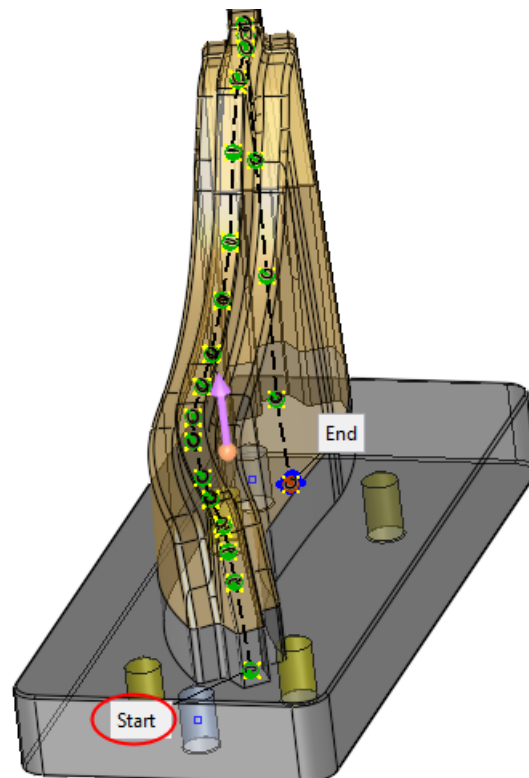


10. Notice that in order to remove, reselect or twist between start/end points, simply right-click the point and select the required option. Do not select any option.

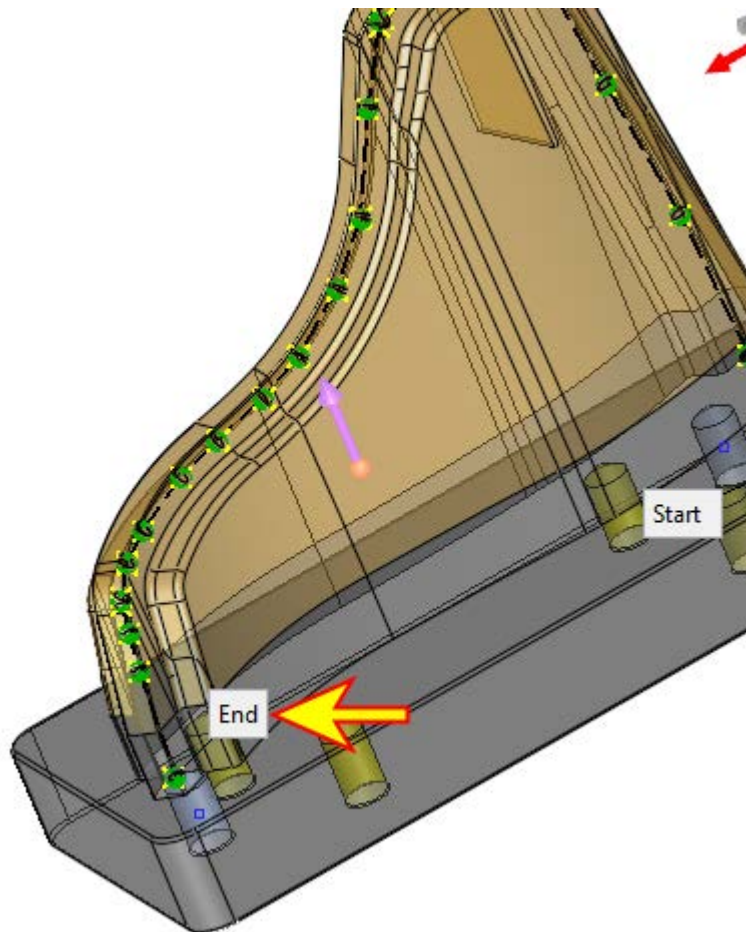


We would now like to add a start point; however, if we select a point on the screen, it will change the end point.

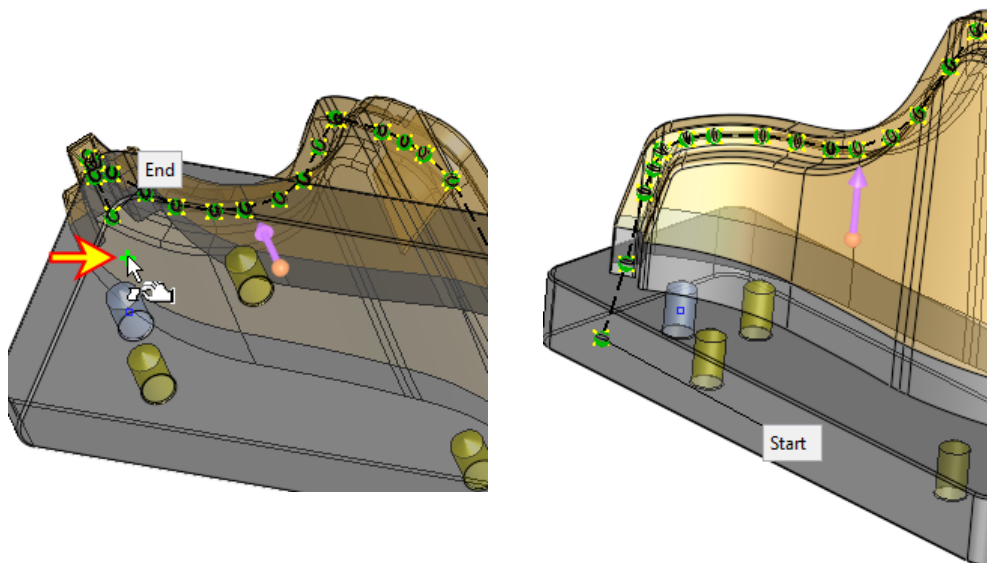
11. In order to select another start point, simply switch the direction of the cooling channel, by pressing the 'Start' SP (screen parameter).



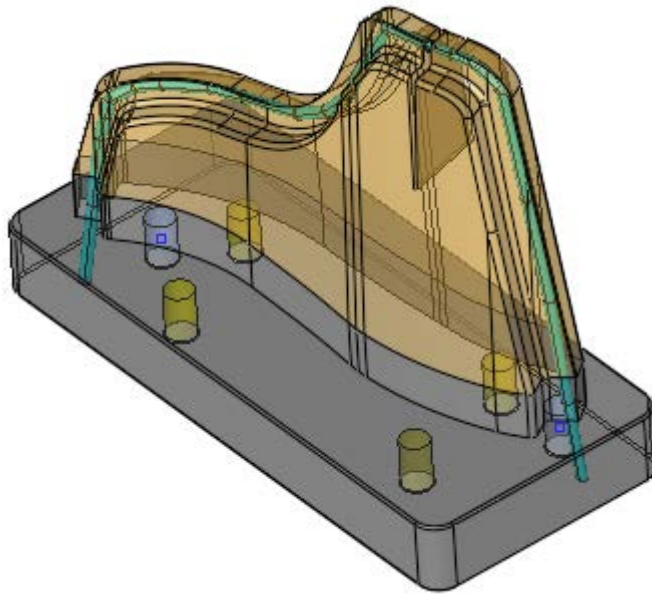
12. Now the start point became the end point and you can add another point to the exit.



13. Select another point for the exit as indicated by the arrow in the pictures below:



14. Select **OK**.

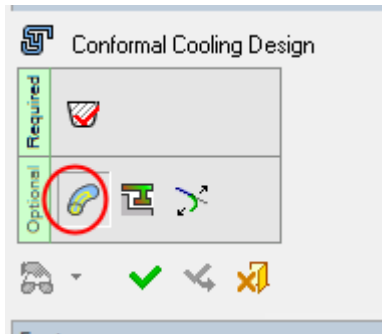


Part 2 Overhang Analysis

We will now practice the overhang analysis to ensure no internal areas within the cooling channels will fail during printing.

An overhang is any part of a structure that has no direct support under it.

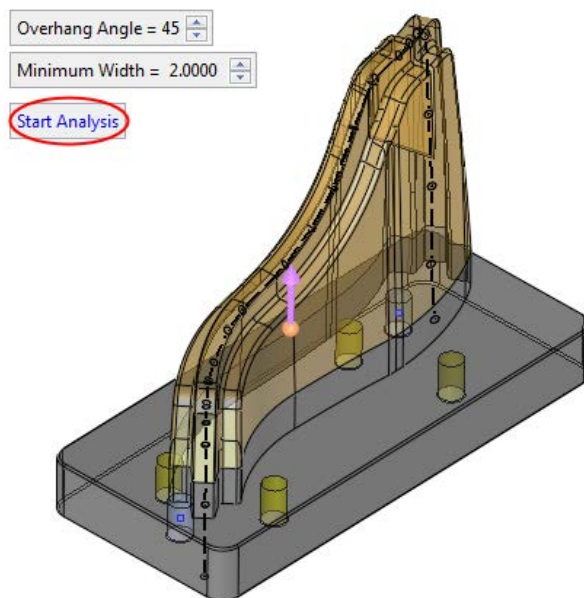
1. Edit the cooling feature in the tree. Enter the first optional step.



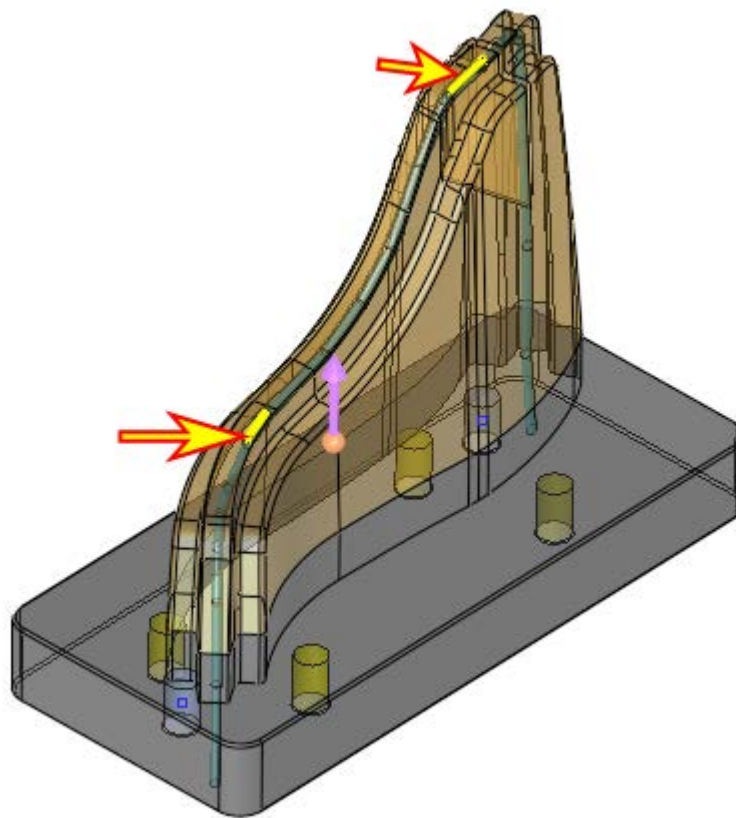
Overhang Angle is the angle that defines the degree of overhang after which some support structure should be added. Defaults are defined by the overhang angle of the selected printer if it exists, or 45° if the printer default is not available.

Minimum Width is the minimum allowed width with no support.

2. Accept the default parameters and start the analysis.



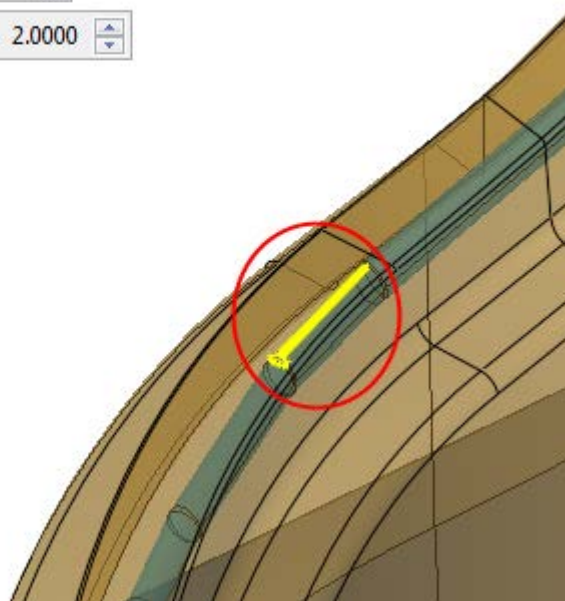
Notice the detected overhang areas, they are displayed in YELLOW.



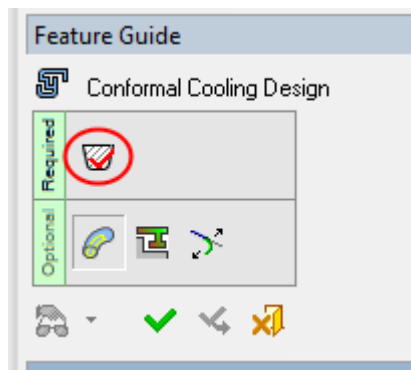
Overhang Angle = 45

Minimum Width = 2.0000

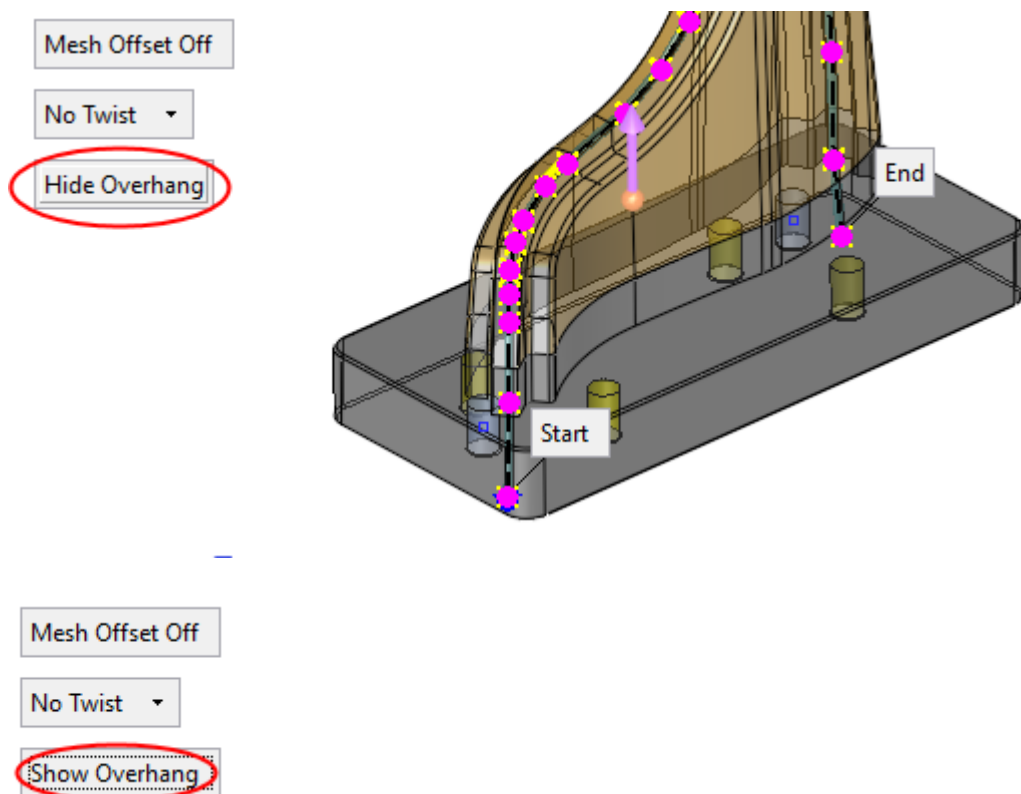
[Start Analysis](#)



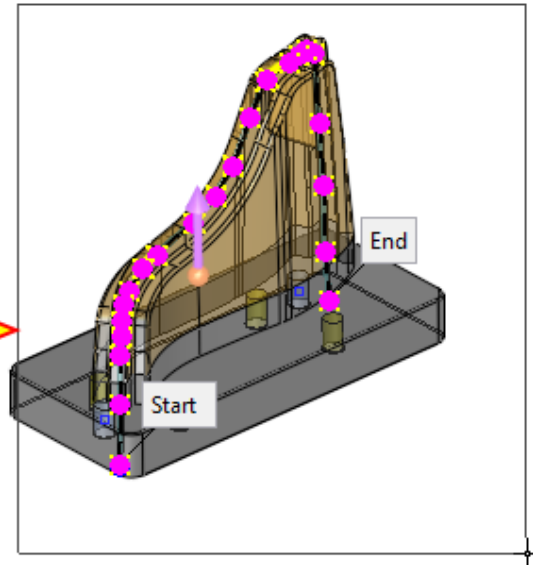
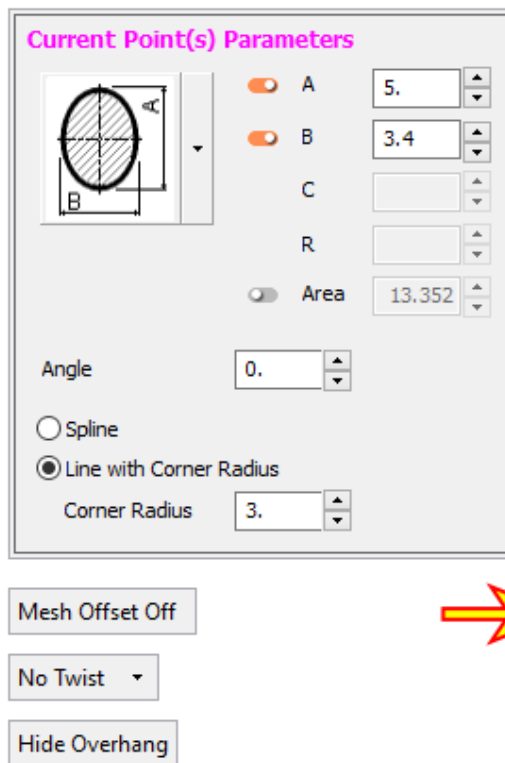
- As we cannot apply supports within cooling channels, enter the first required step to fix these areas.



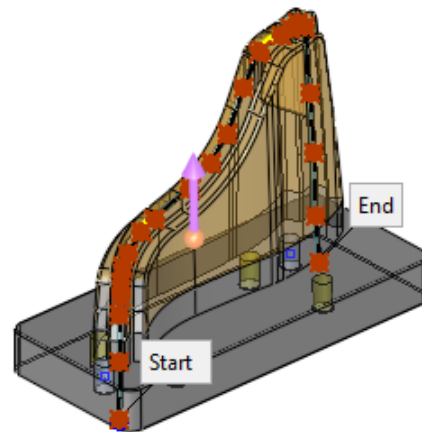
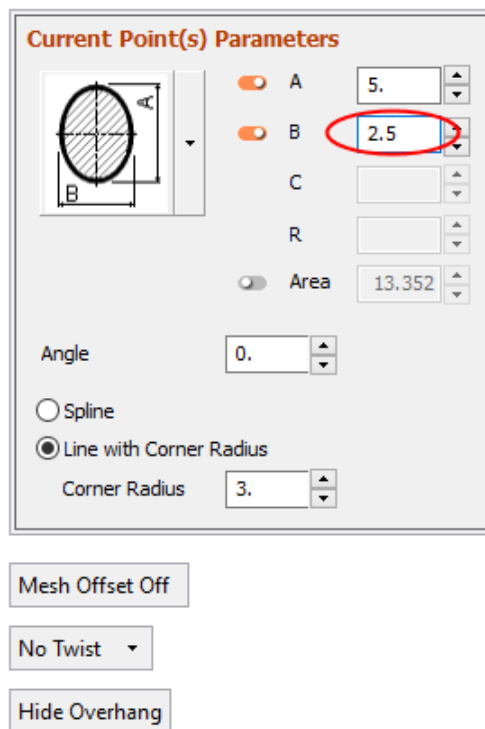
- Use the **Hide/Show Overhang** button to hide/show the 'Overhang areas'.



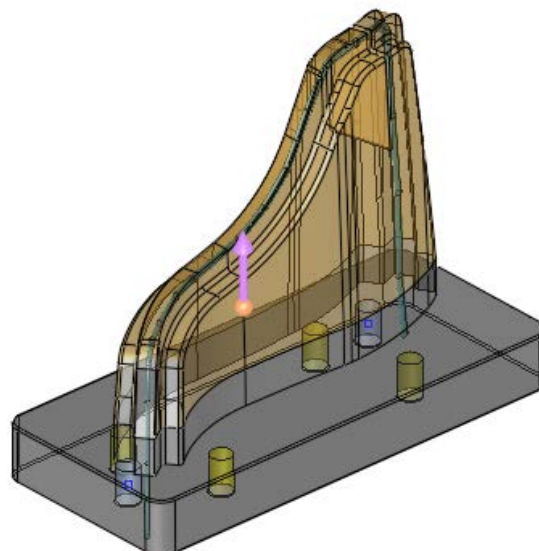
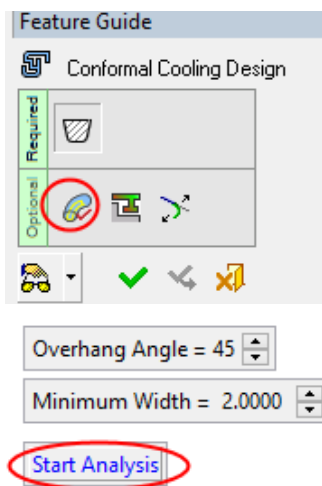
- It is possible to edit multiple points. Select all the points as indicated in the picture below (By Box):



- Apply a smaller size to the channel. Set the **B** size to **2.5**.



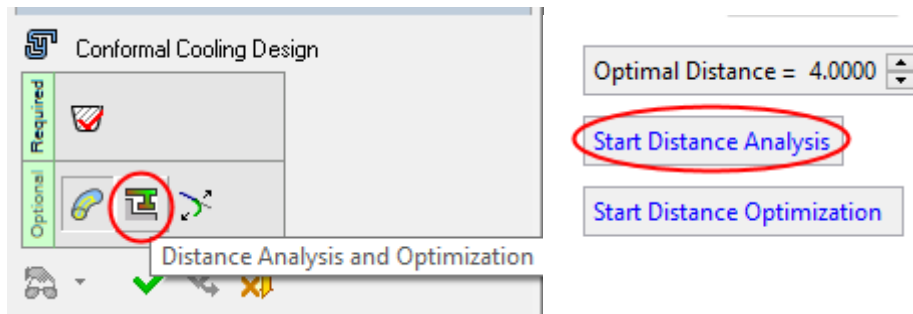
- Enter the first optional step and run the analysis again. This time no 'overhang areas' were detected.



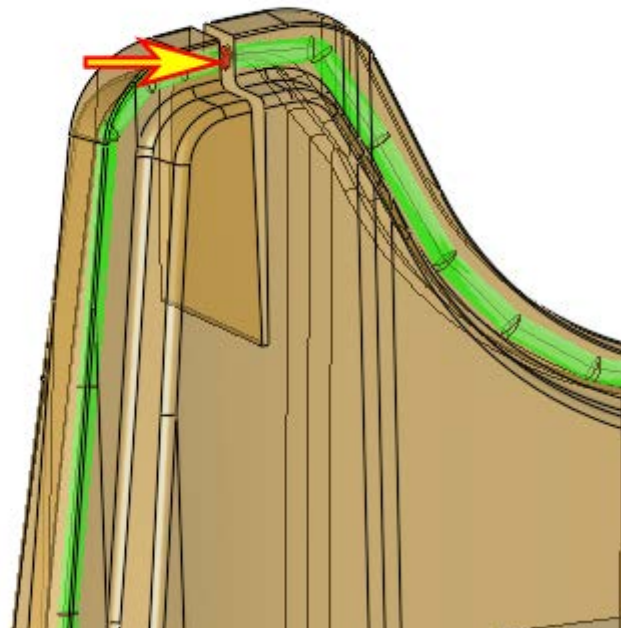
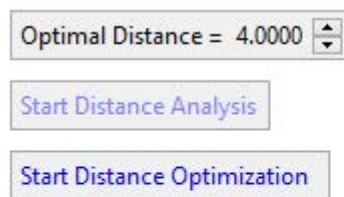
Part 3 Distance Analysis

Perform a distance analysis and optimization to identify areas where the channels may be too close to, or too far from, the walls of the insert and adjust them automatically.

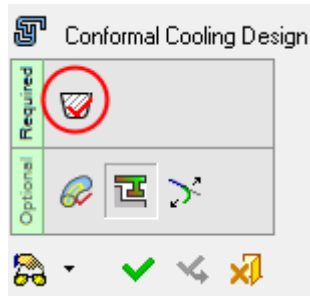
1. Enter the second optional step. Accept the default Optimal Distance which is currently defined as 4 mm.
2. Start the **Distance Analysis**.



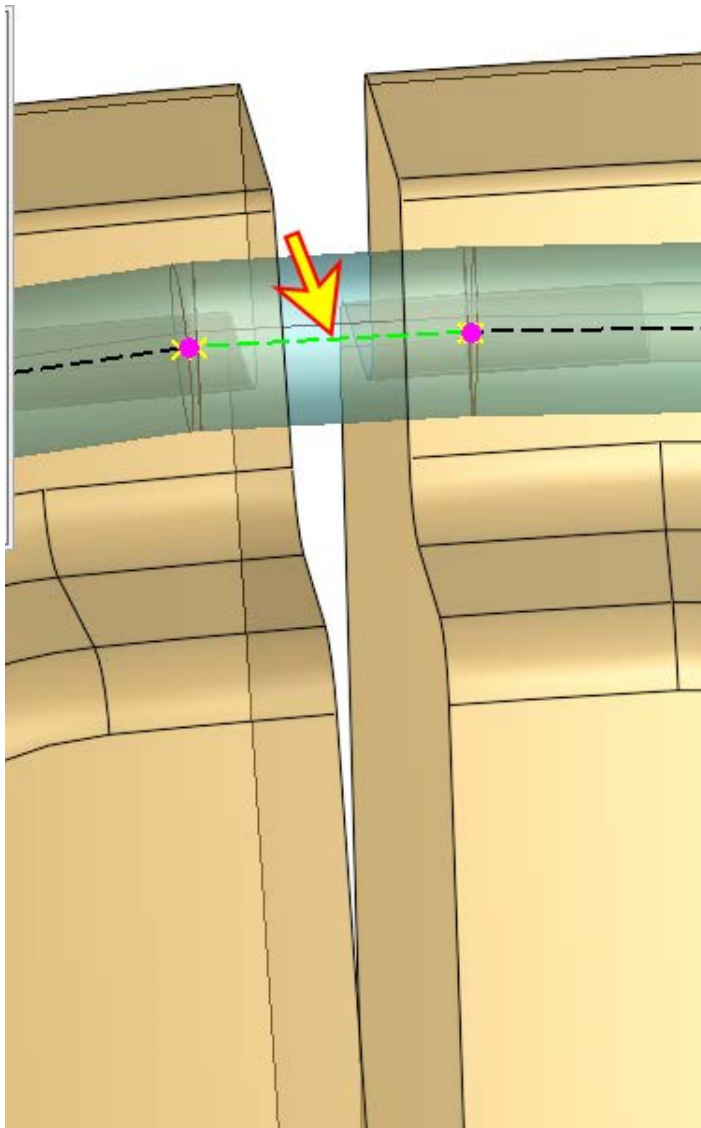
3. As expected, the optimal distance is not kept where the gap exists. (The more we enlarge the Optimal Distance value, more problematic areas will be detected).

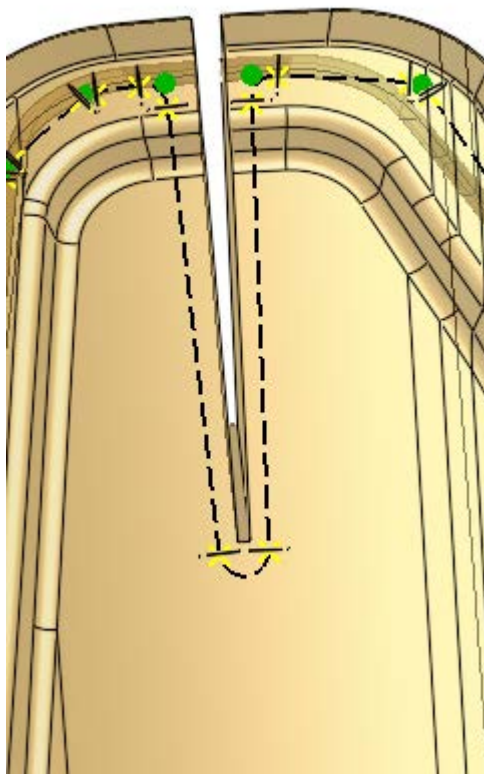
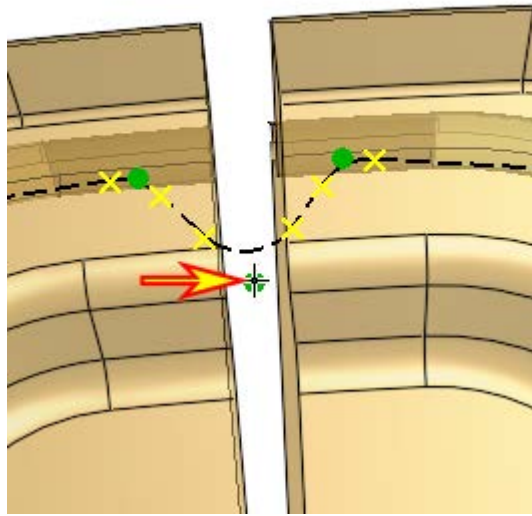


4. Enter the first step.

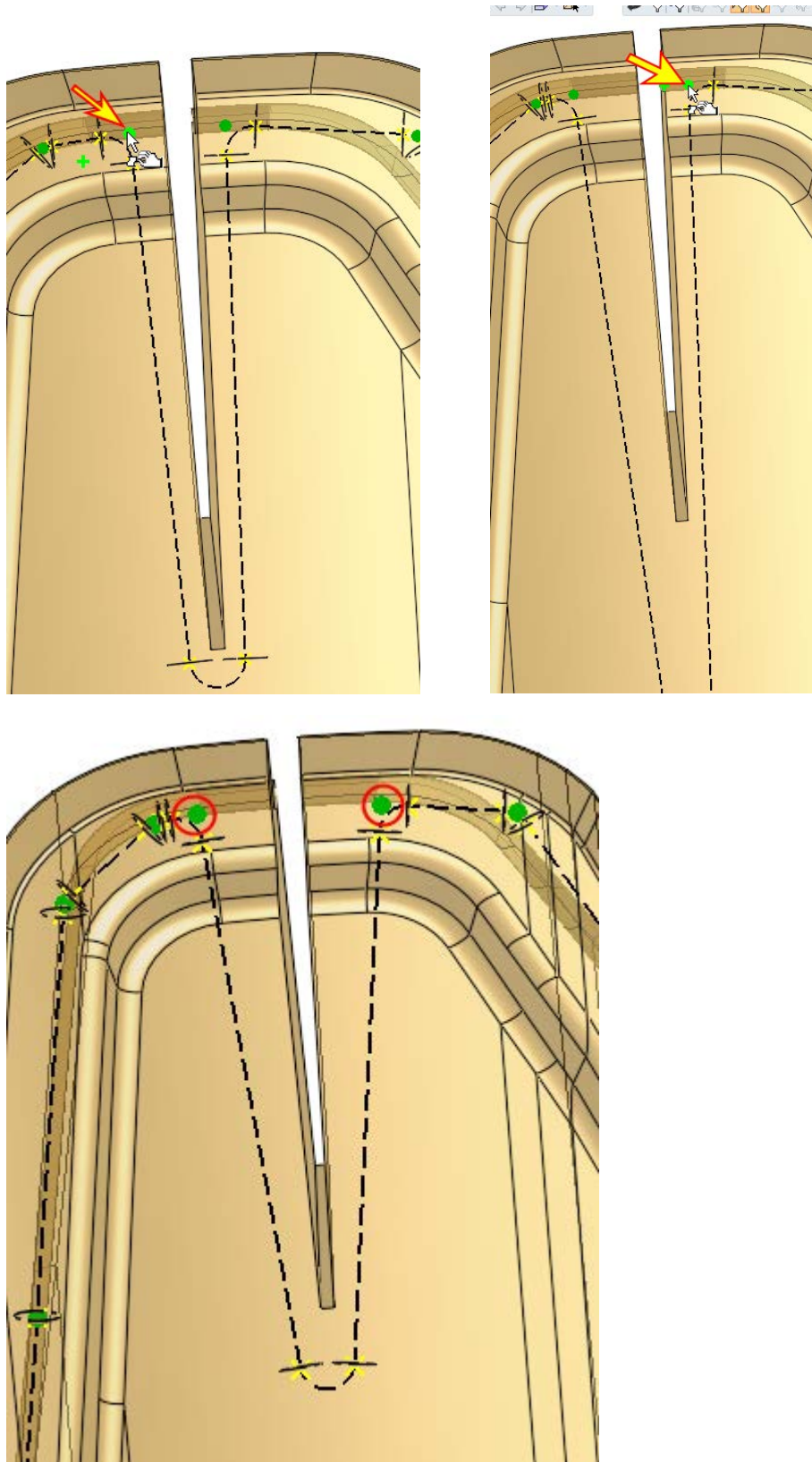


5. Pick the curve as indicated by the arrow in the picture below and drag it below the gap.



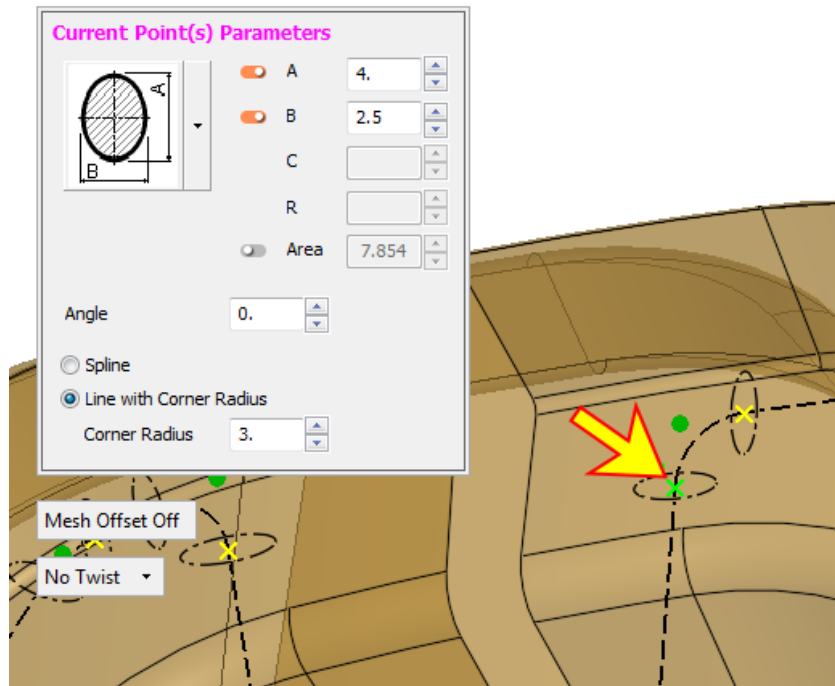


6. Drag the two points next to the gap sideways to get a better result.

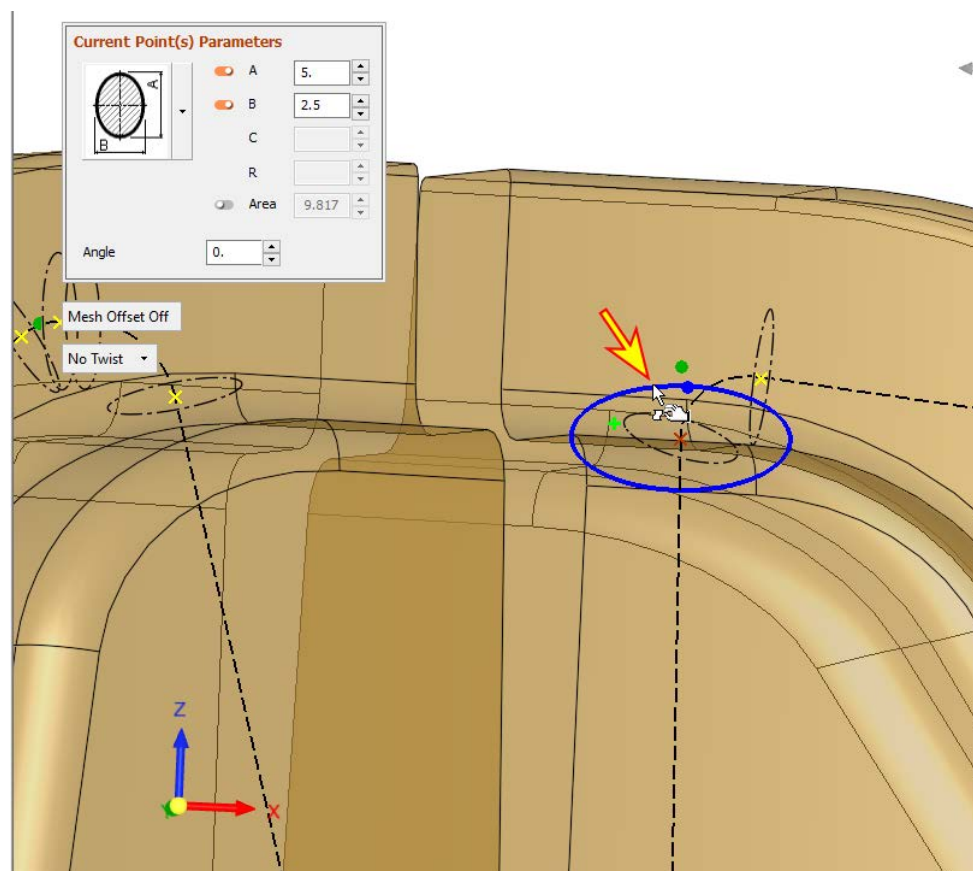


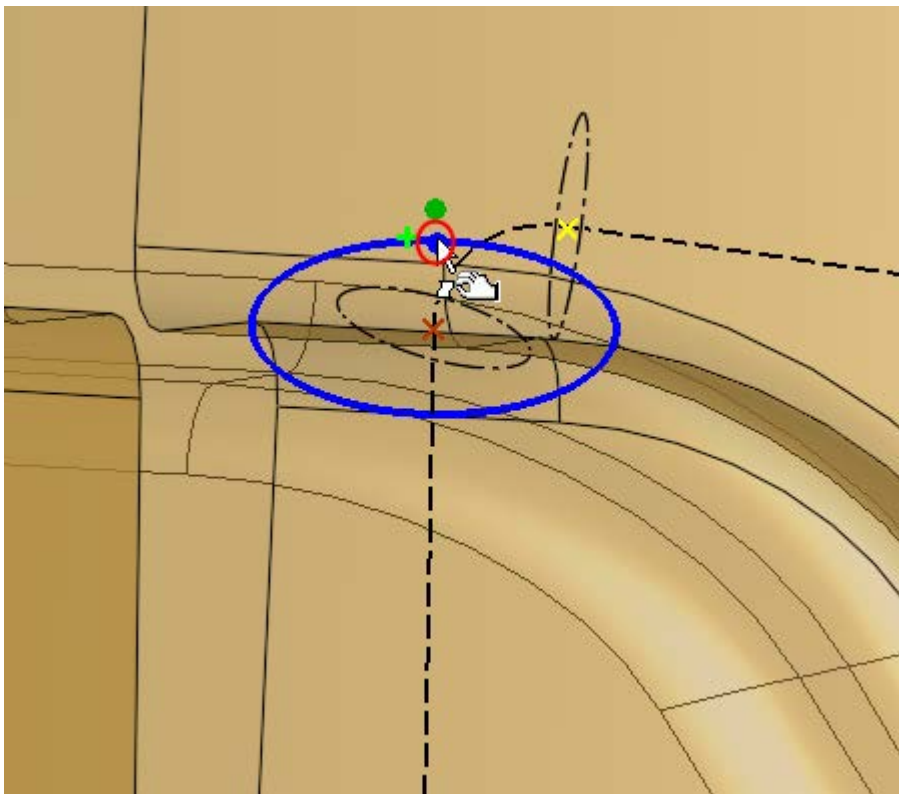
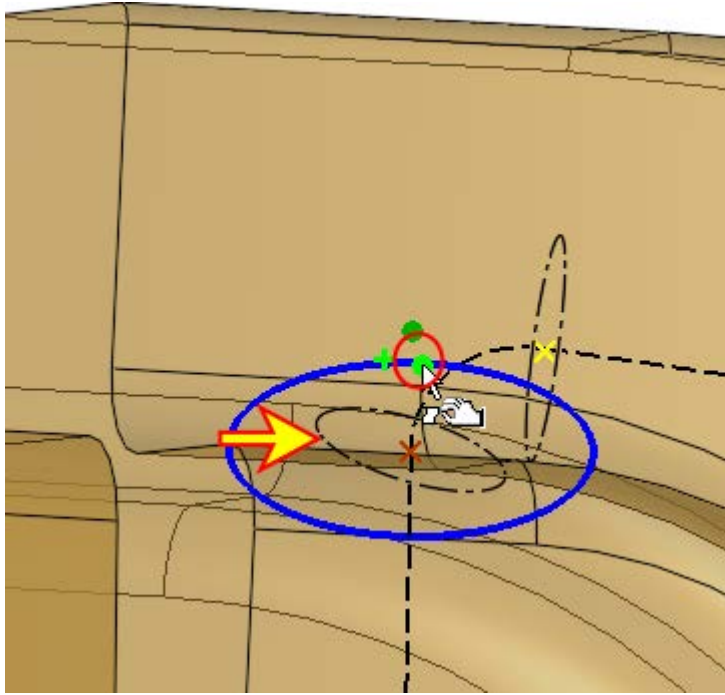
Note that you may change the orientation of each point section.

- Click any point.

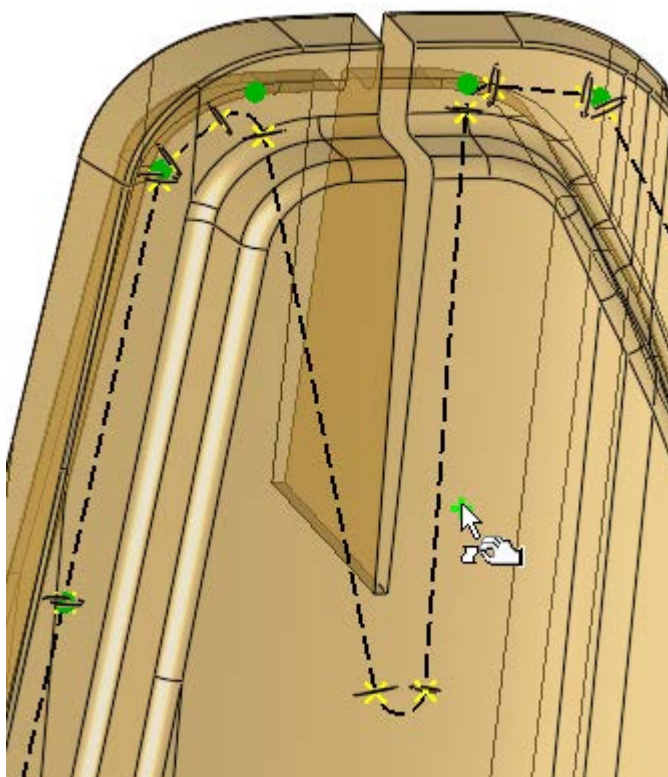
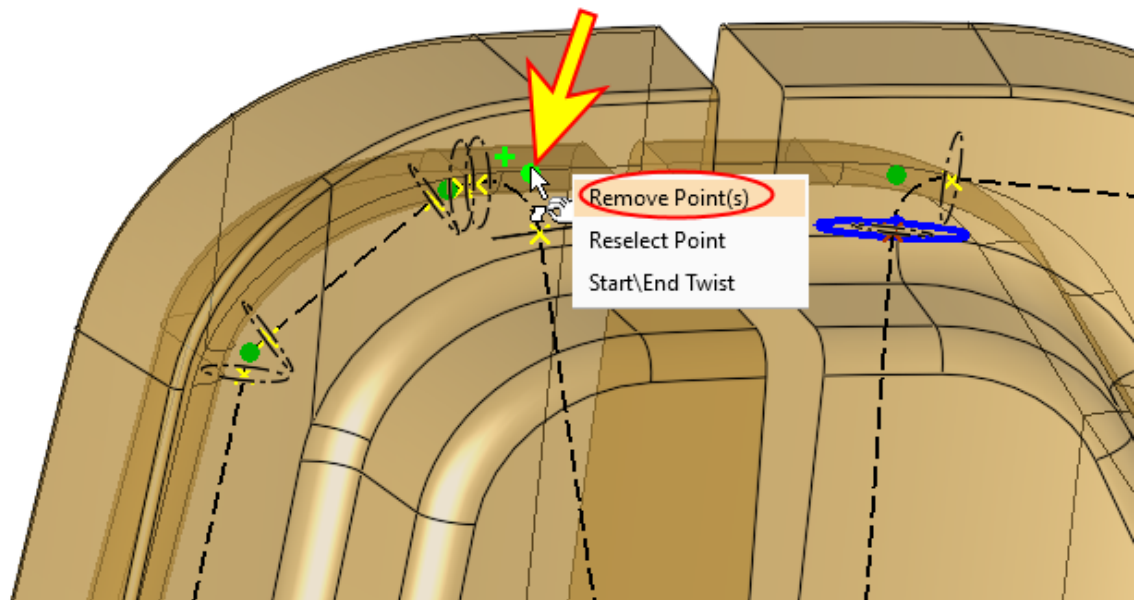


- Click the blue point on the blue section and rotate the section by moving the point to the left and right.

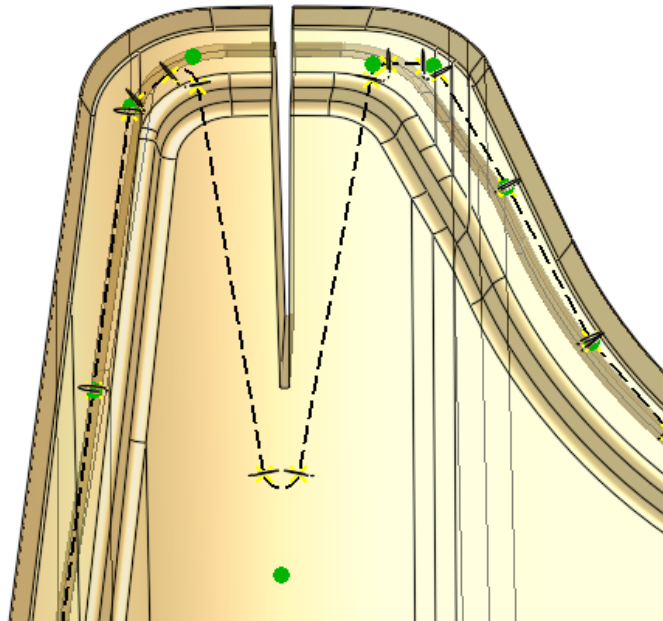




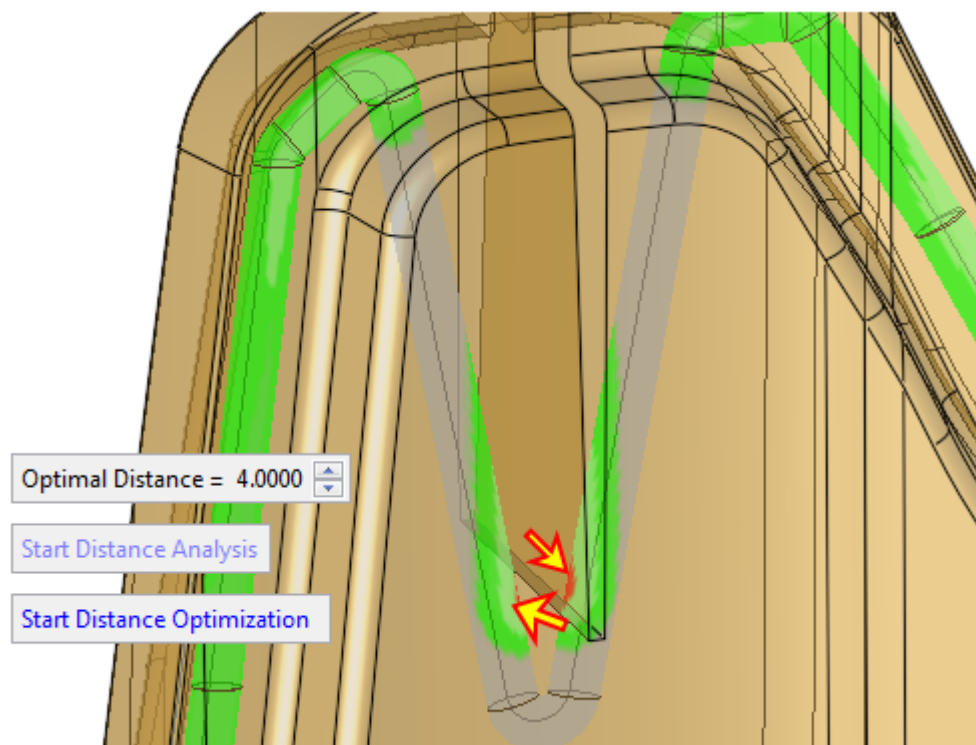
9. You may remove points closer to the gap to get a better result.



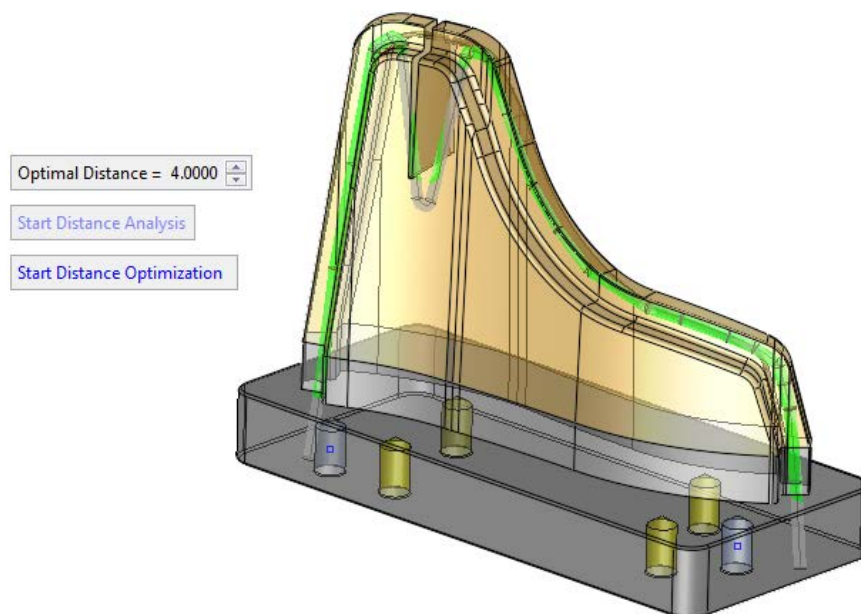
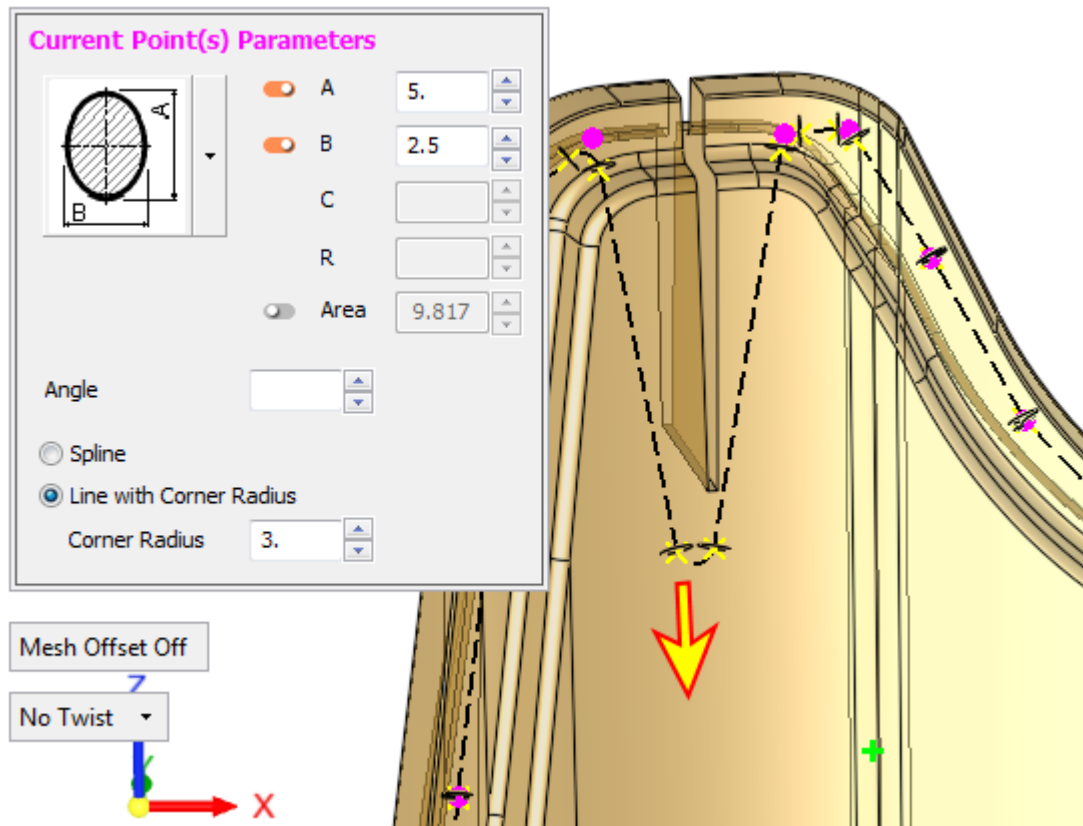
10. The channel should look like in the picture below:



11. Run the Distance Analysis again. If there are the red areas, enter the first stage to fix the points.

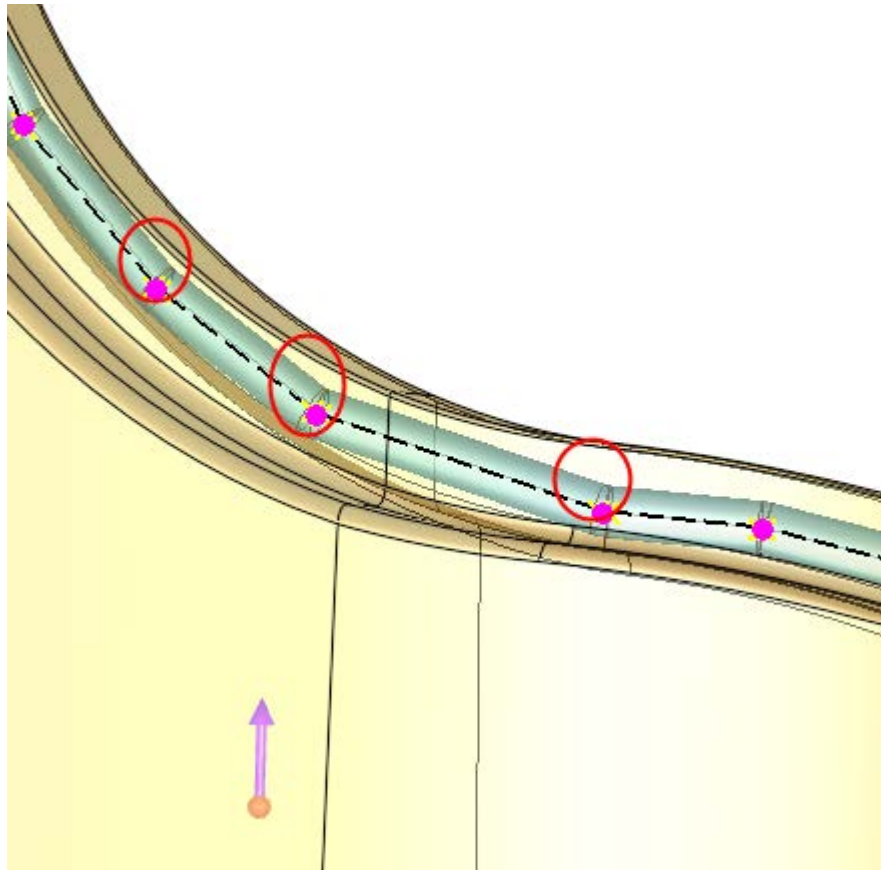


12. For example, drag the point further down and run the analysis once more until no red areas are detected.

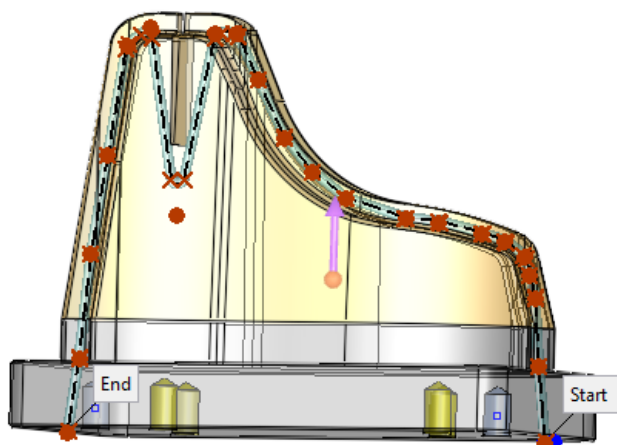


Part 4 Spline Channel

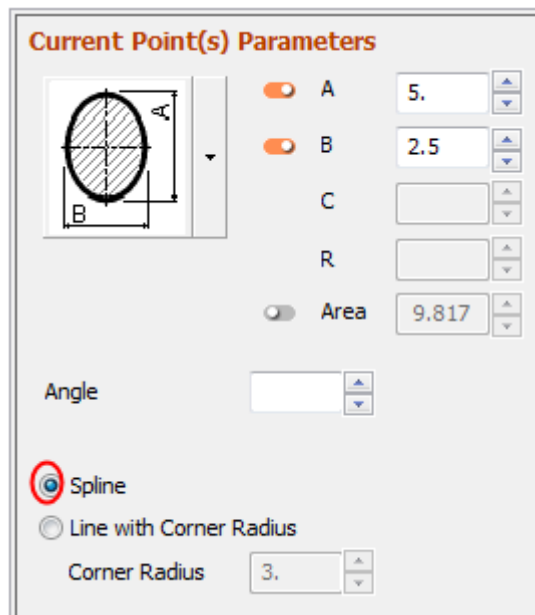
1. Re-enter the first stage to edit the shape of the channel. The current channel looks a bit “broken”.



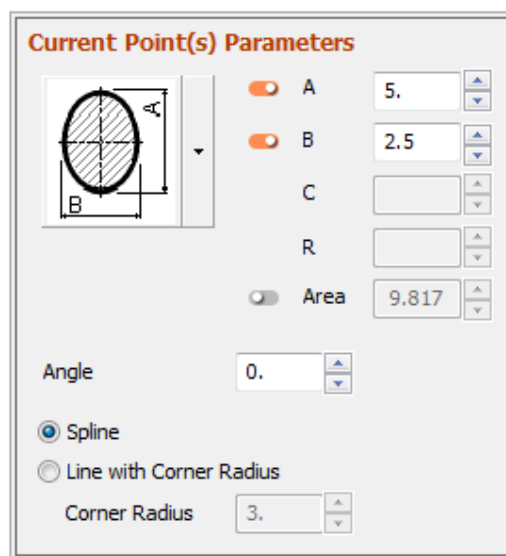
2. One way to fix it is by changing the corner radius of the curve; another way is by turning the curve into a spline. **Select all points.**



3. Select the Spline option in the dialog.

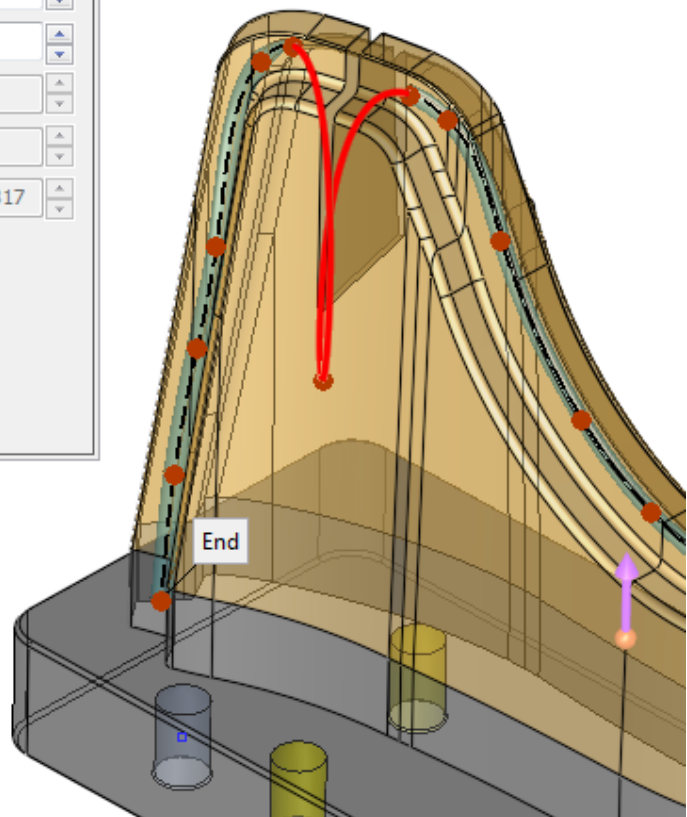


4. Notice the problematic result.

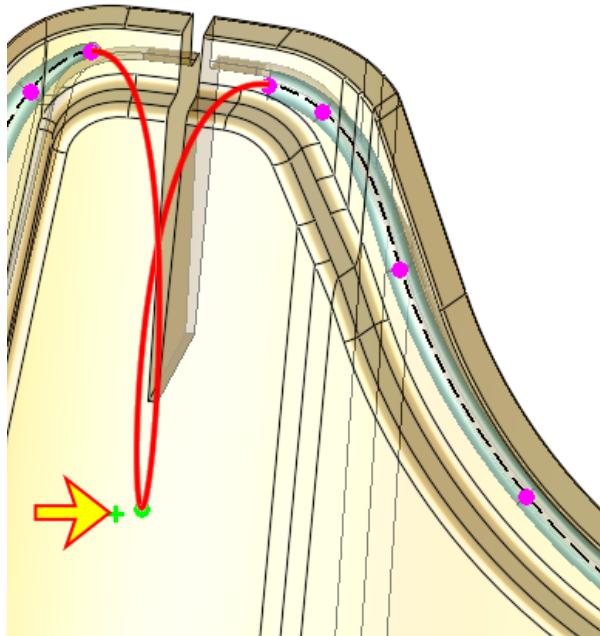


Mesh Offset Off

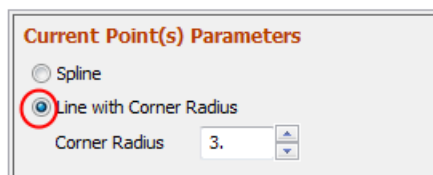
No Twist



- Unselect all points and select only the point that causes the problematic result.

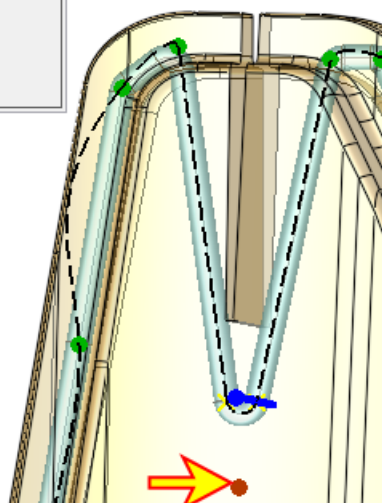


- Change the selected point to create lines with a corner radius.

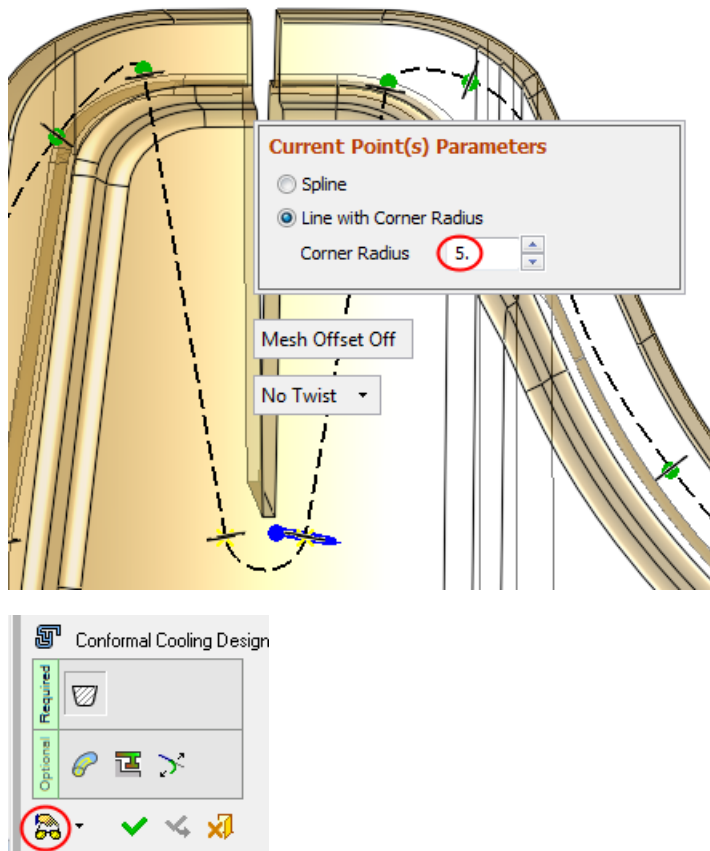


Mesh Offset Off

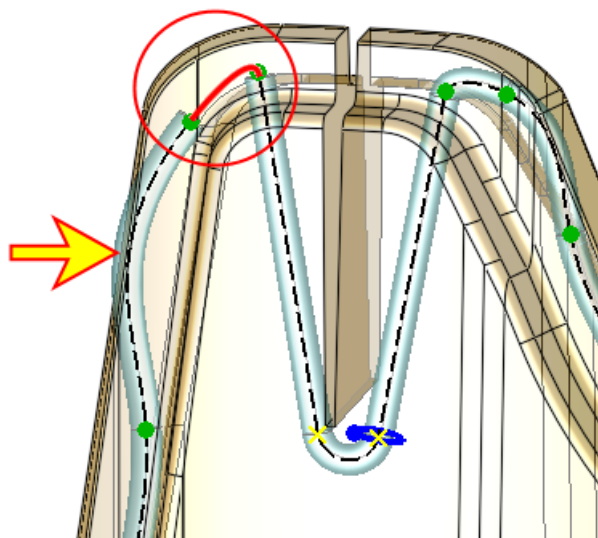
No Twist



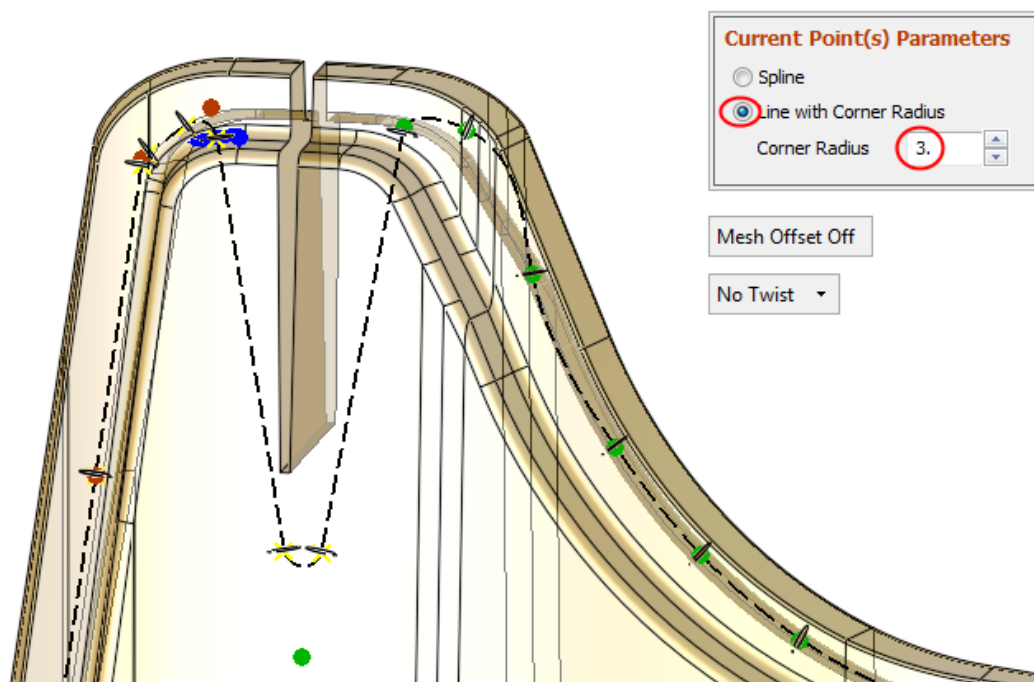
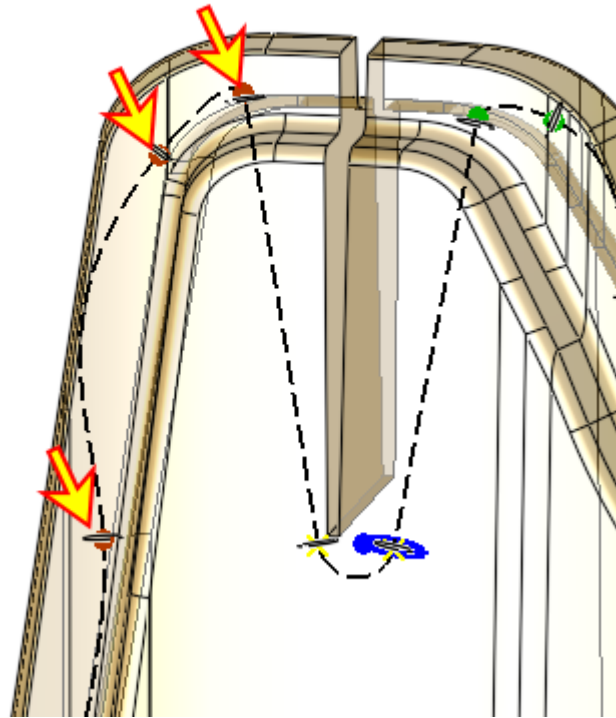
- Set the Corner radius to 5 and preview the result.



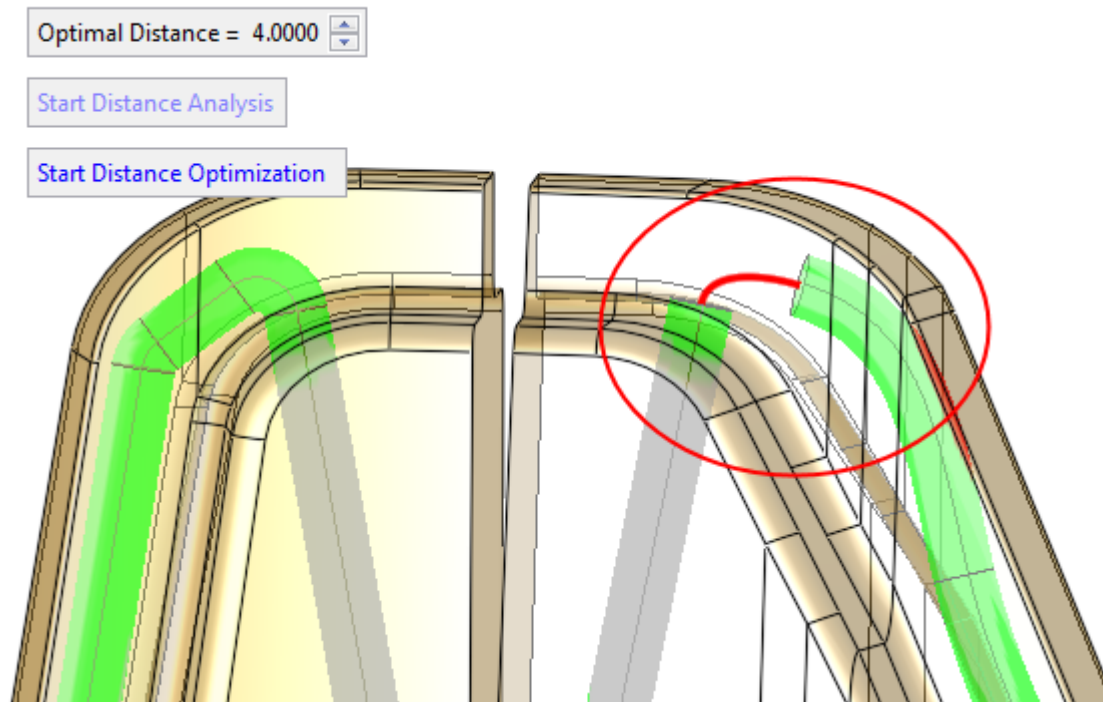
- Notice the problematic area (red curve) and also the exaggerated shape indicated by the arrow.



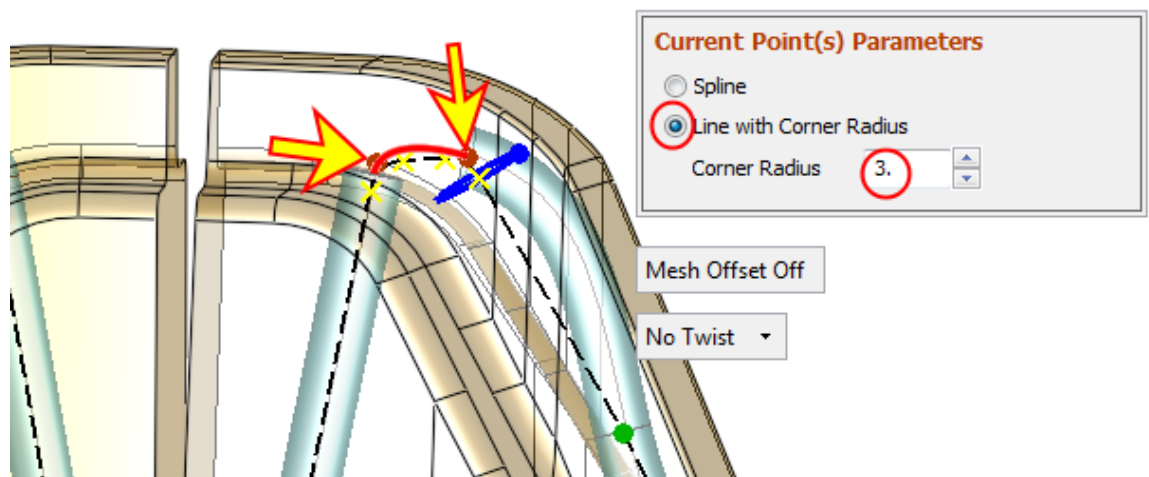
9. Enter the first stage, select the points of the problematic area and toggle the **Spline** option to **Line with Corner Radius**. **Corner Radius = 3**.

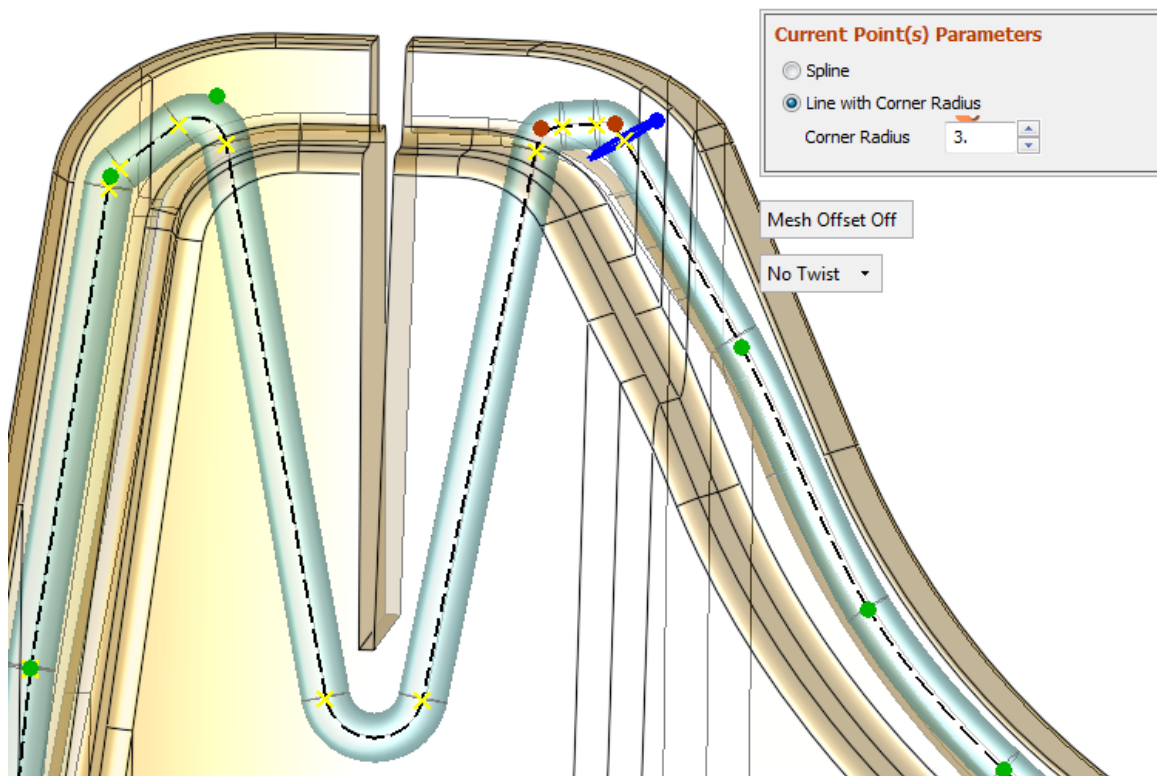


10. Preview the results.

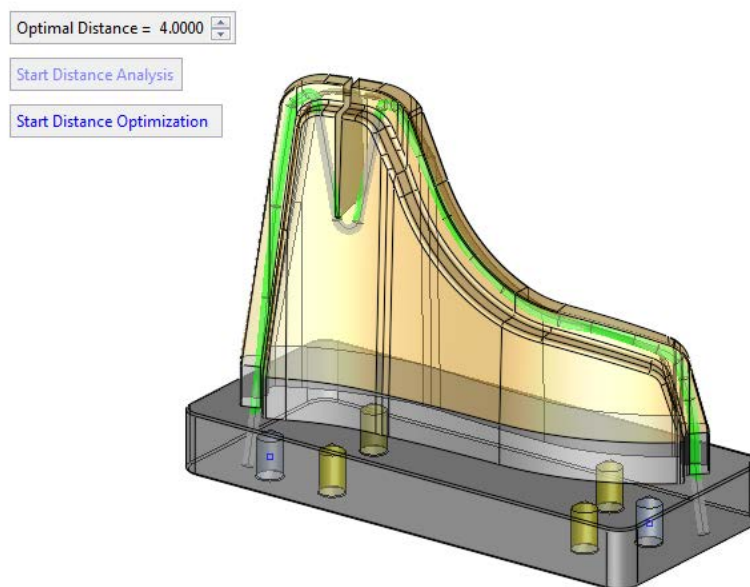


11. Fix the points if needed, using the same method as before.





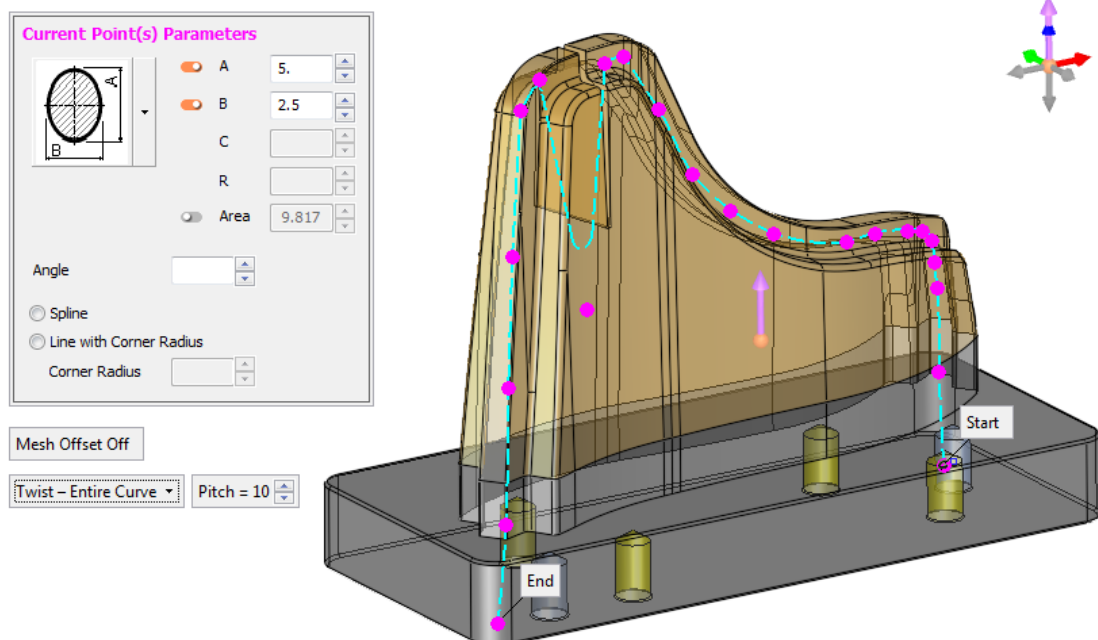
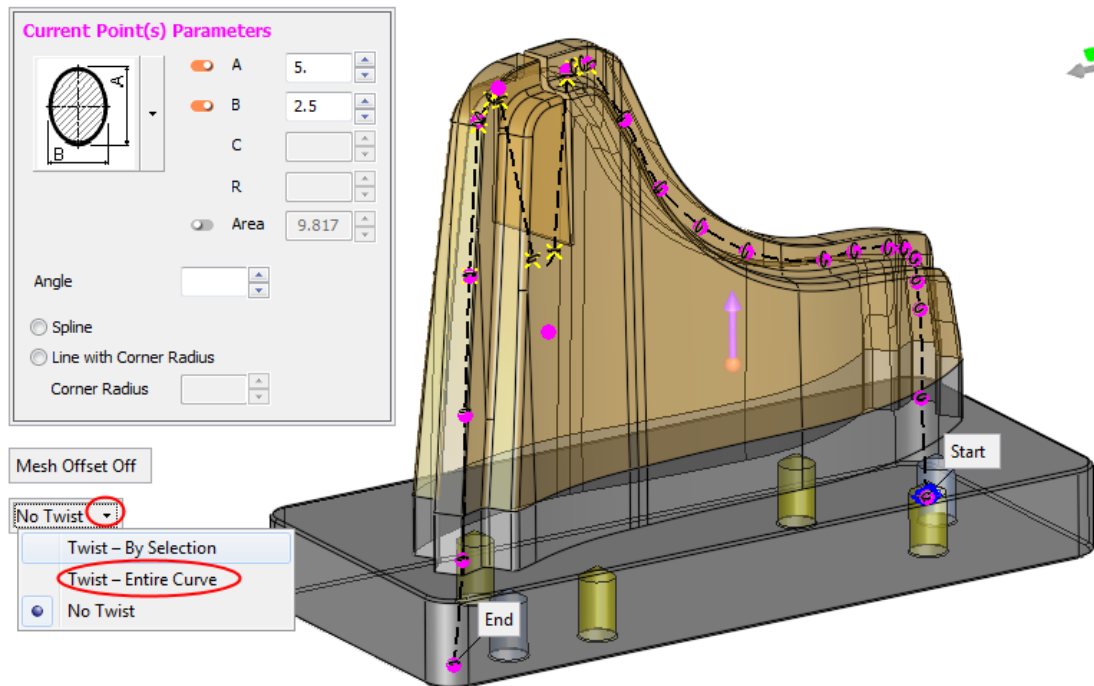
12. Preview the result.



Part 5 Twist

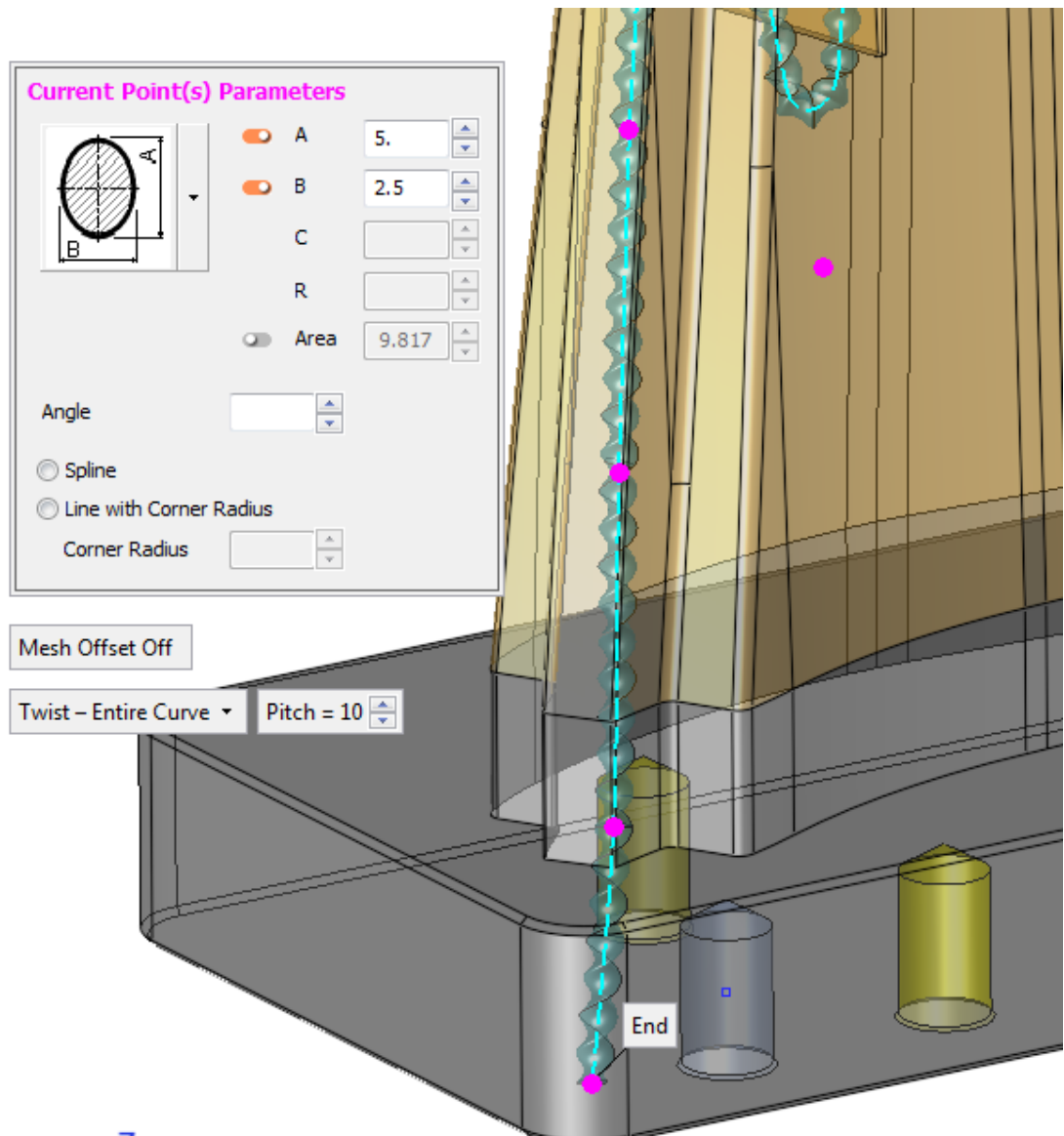
Add a section swirl in areas that will enhance turbulence and cooling efficiency.

1. Re-enter the first stage select the drop down menu next to the **Twist – By Selection** option and select **Twist – Entire Curve**.

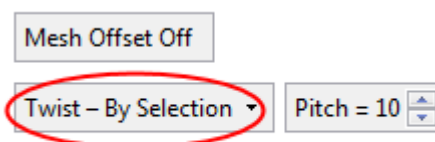


2. Accept the default pitch, and Preview the result.

- Twisting the Entire Curve marks the entire curve as twisted. The preview of the twisted area of the curve is marked in CYAN.

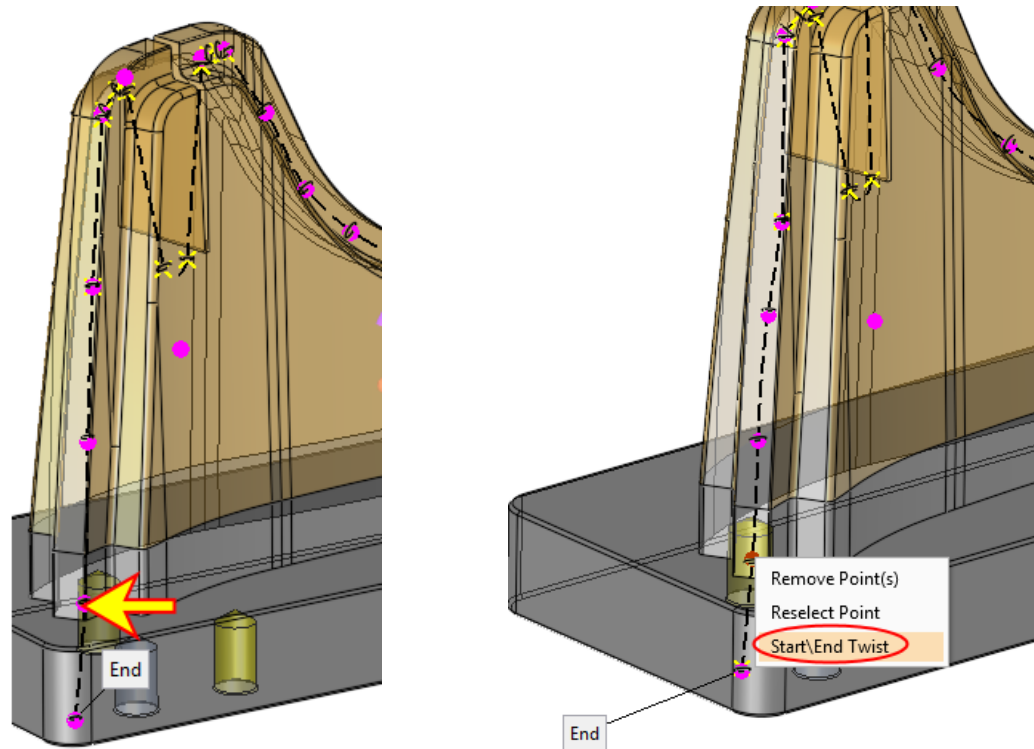


- Set the Twist option to **Twist – By Selection**.

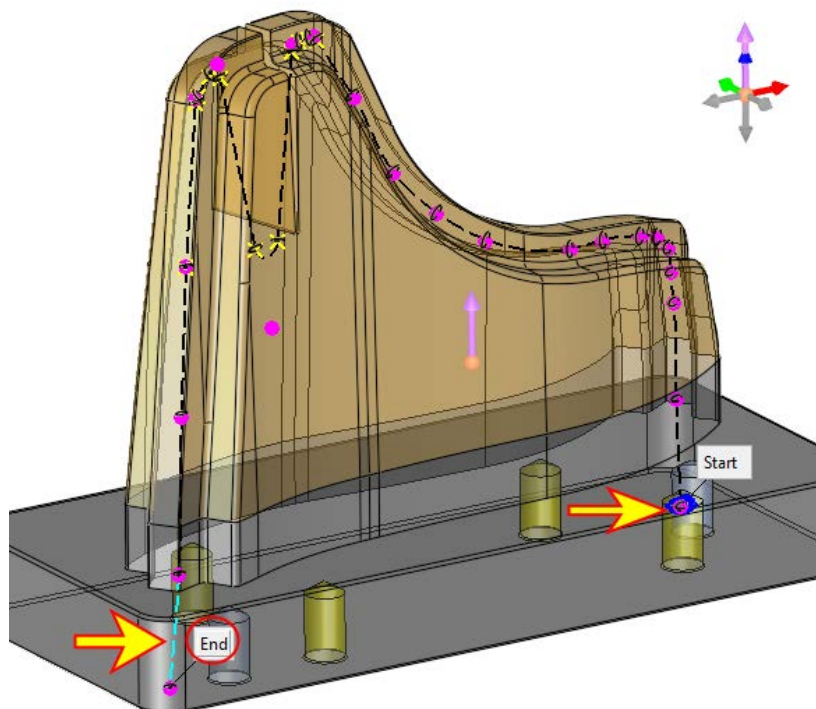


Twist by Selection allows you to right click any point and define it as the start/end point of the twist. The twist will start from that point until it reaches another point that is marked as ON, and then will stop. This takes into account the direction of the curve, and if the direction is changed – so does the behavior. While in preview mode, the twisted section is colored CYAN.

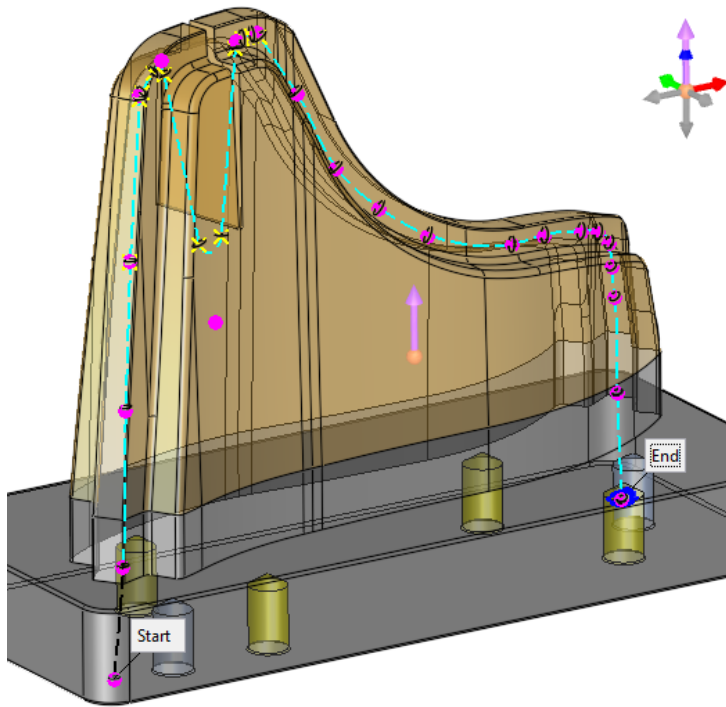
- Right-click the point indicated by the arrow in the picture below and select the option Start/End Twist: This is the start point of the twist.



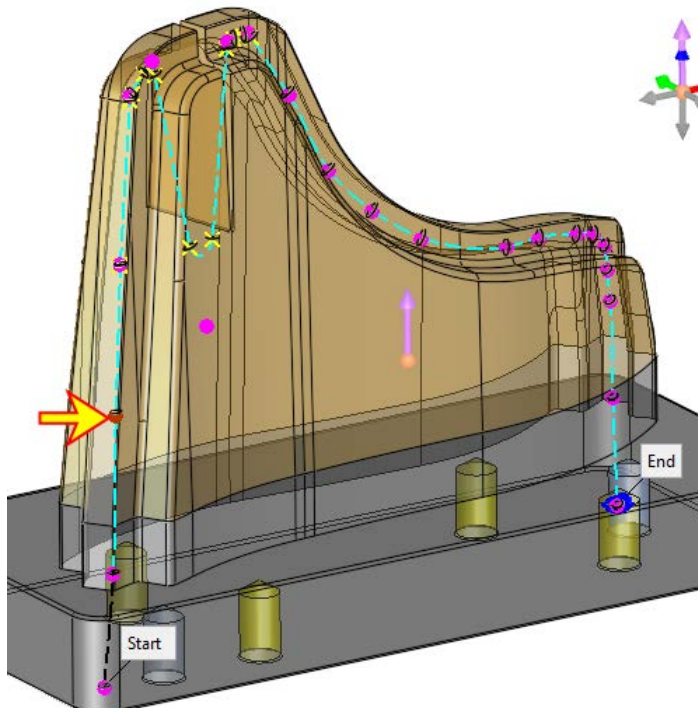
- To change the direction of the curve click the End icon.

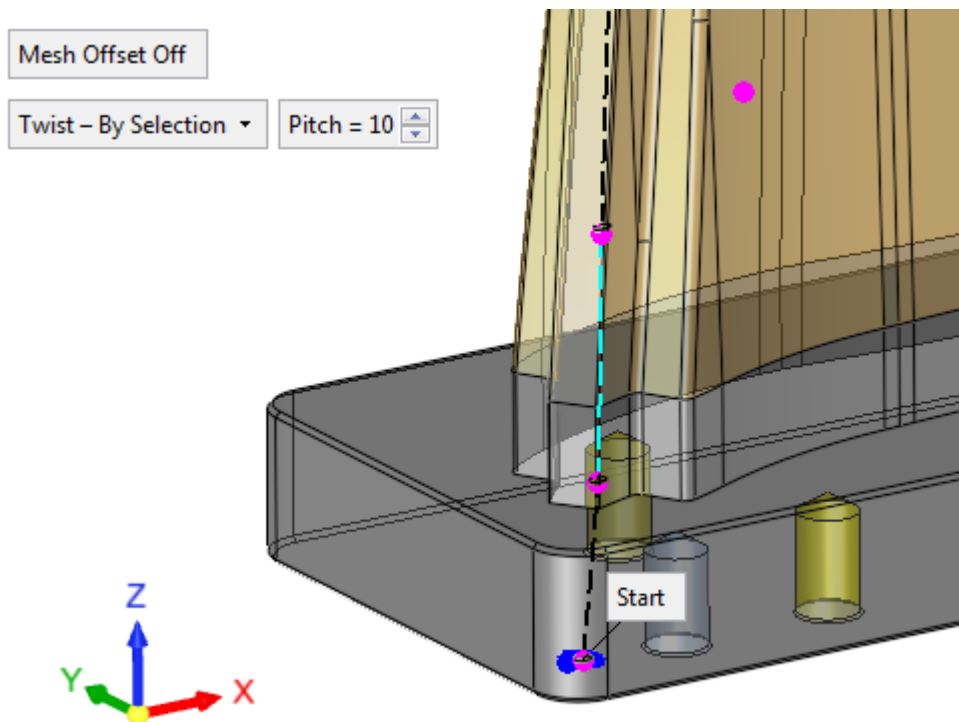
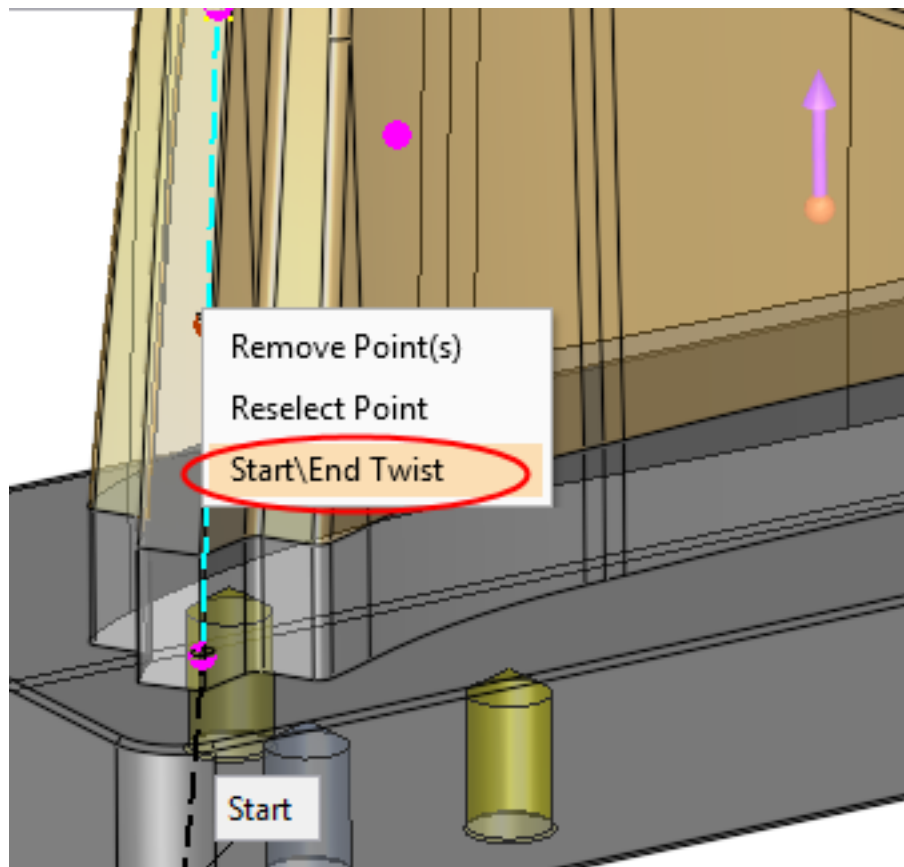


7. The direction affects the behavior of the curves. The other curves will be twisted.

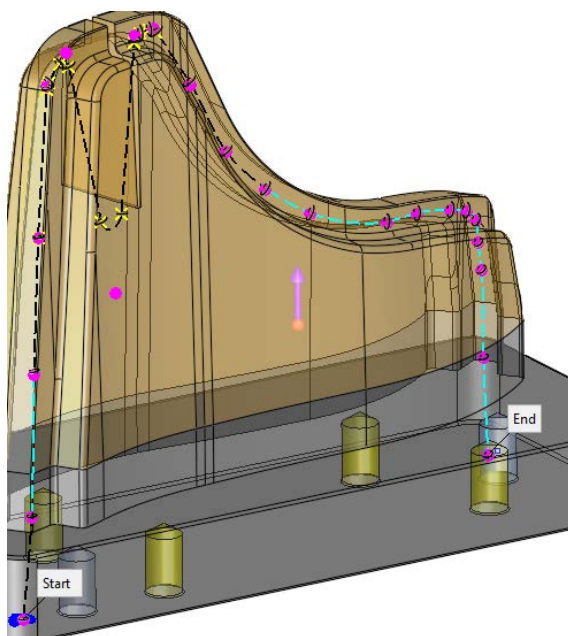
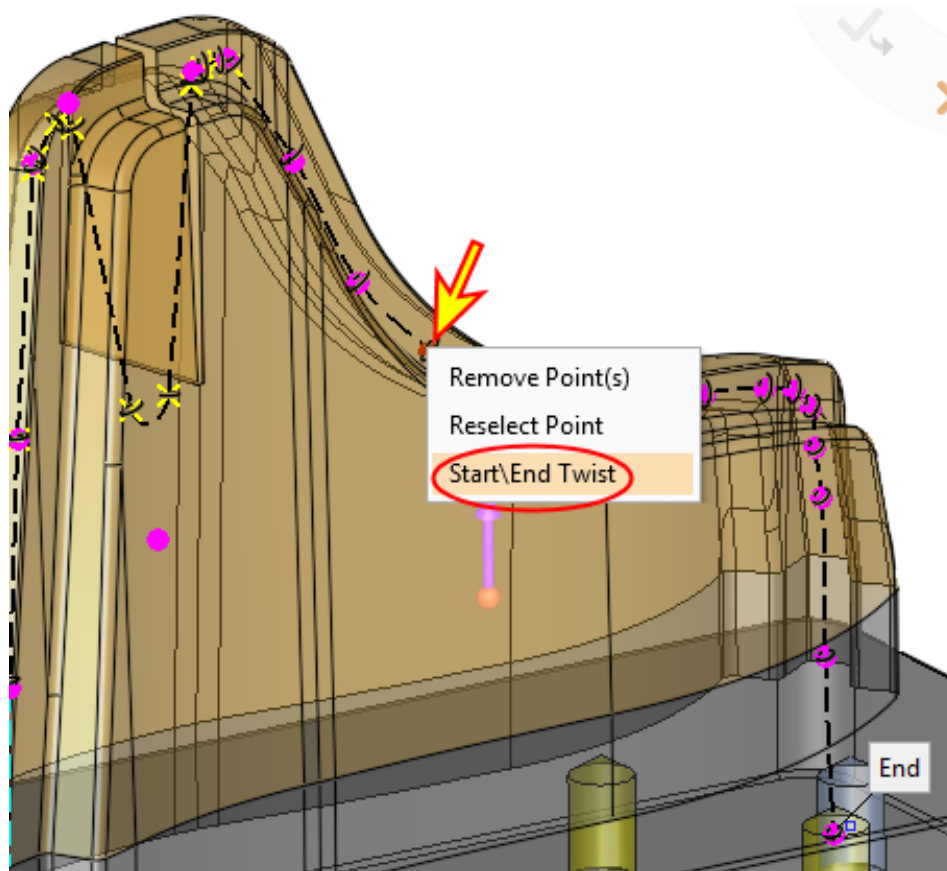


8. Right-click the point indicated by the arrow in the picture below and select it to be the end point of the twist.

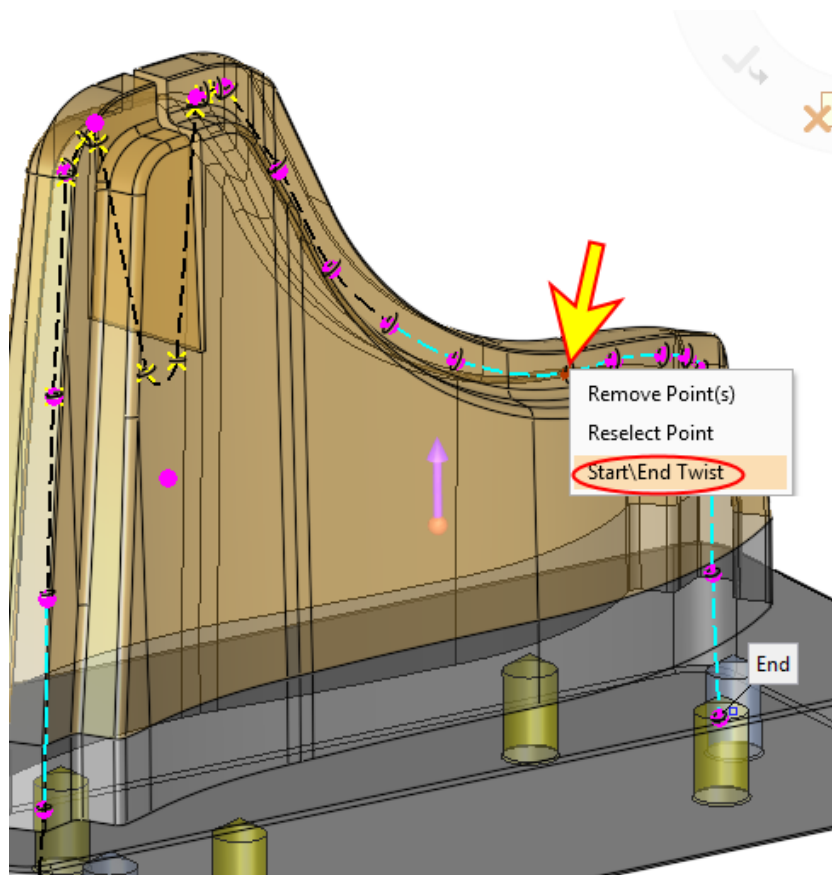




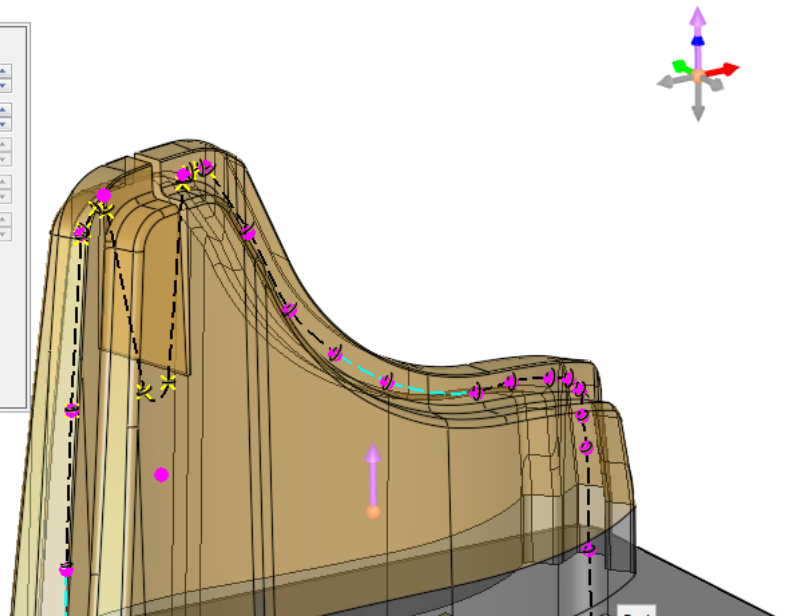
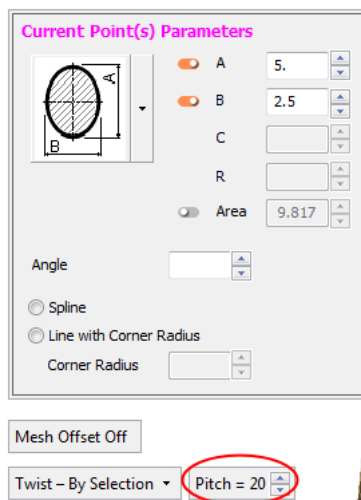
9. Right-click another point on the channel and select Start/End Twist to start another chain of twisted curves.



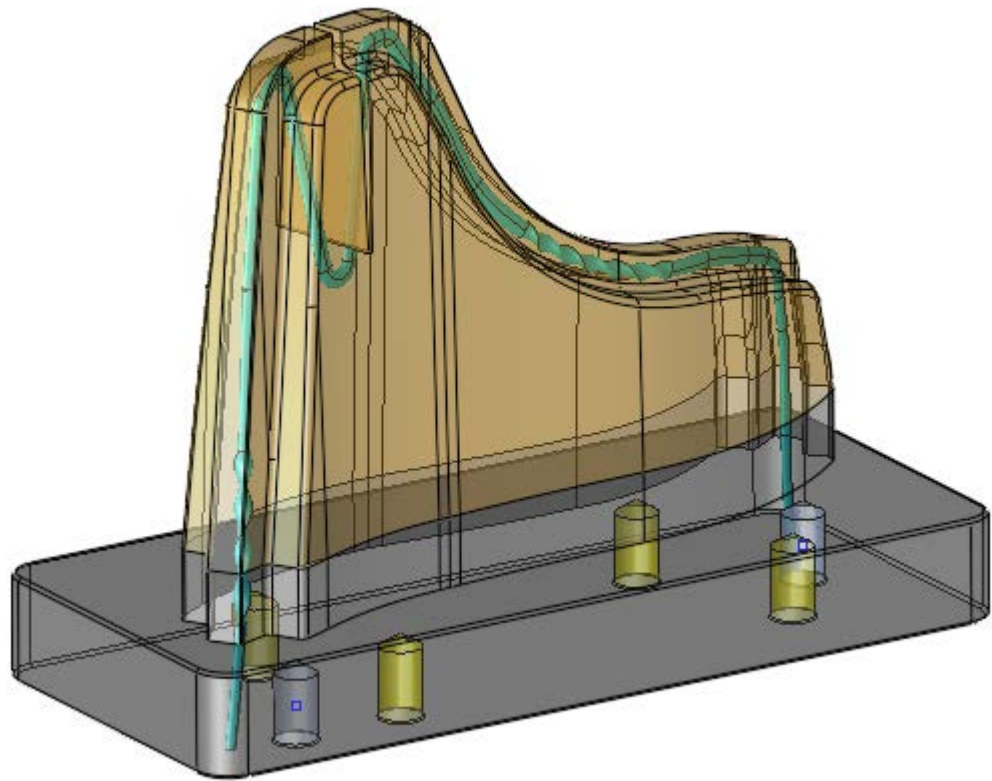
10. To change the end point of the second chain, simply right-click another point and select it as the end point of the Twist.



11. Set the **Pitch** to 20.



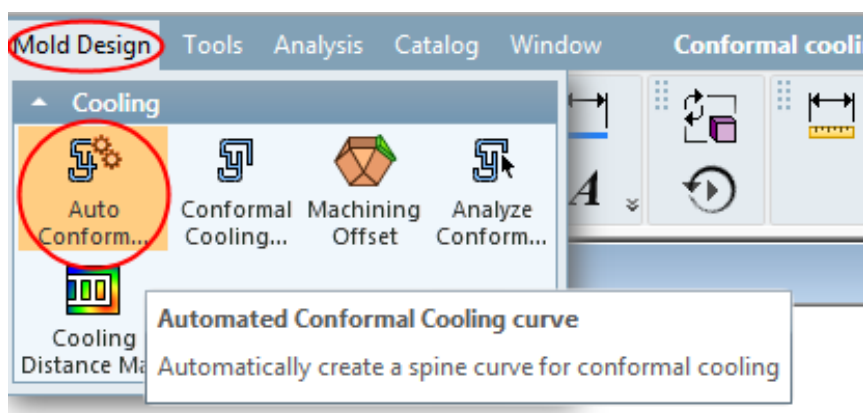
12. Select **OK**.



Part 6 Automatic Conformal Cooling

Automatically create conformal cooling curves by analyzing the part's geometry.

1. From the **Mold Design** menu, select **Automatic Conformal Cooling**.

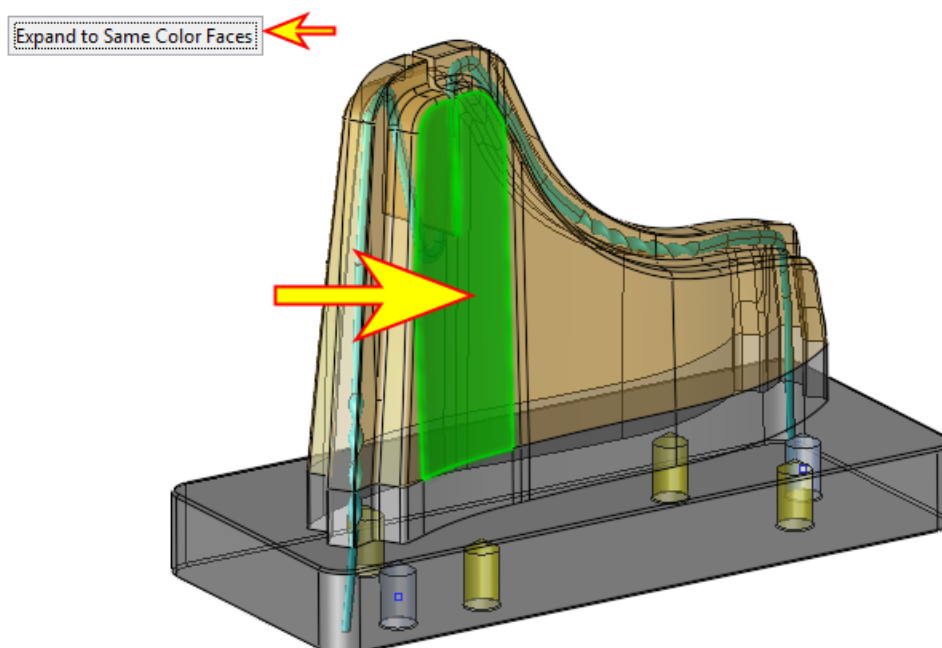


2. Toggle the option **Do not Expand** to **Expand to Same Color Faces**. The **Expand to Same Color Faces** enables the selection of faces to be expanded to those of the same color as the first selected face.

Do not Expand

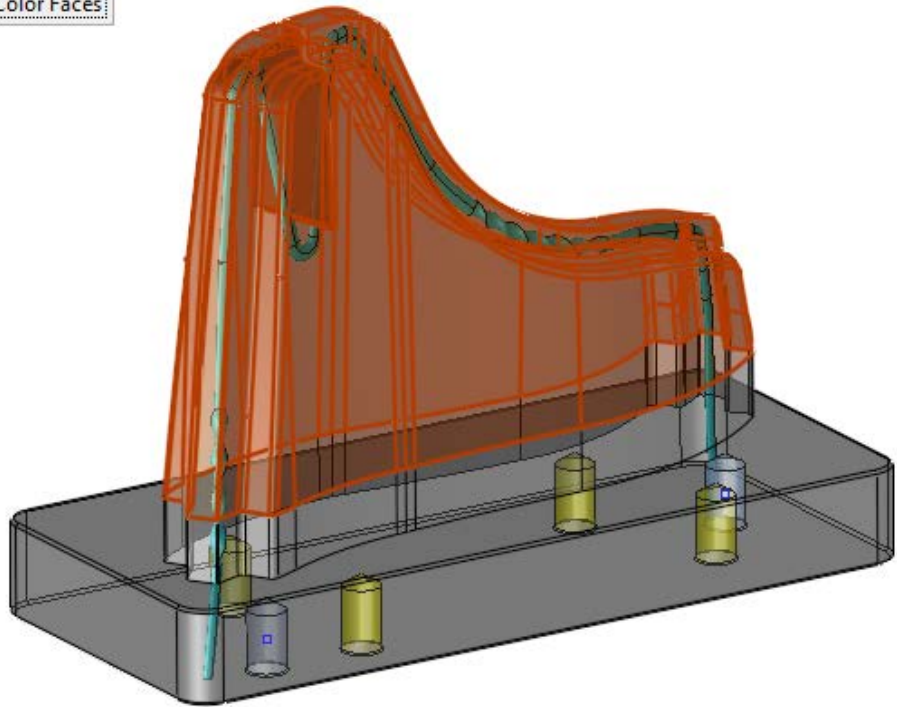
Expand to Same Color Faces

3. Select the face as indicated by the arrow in the picture below:

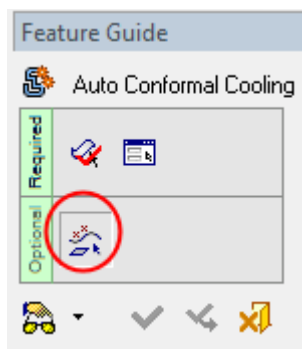


4. All the faces of the insert were selected. **Exit**.

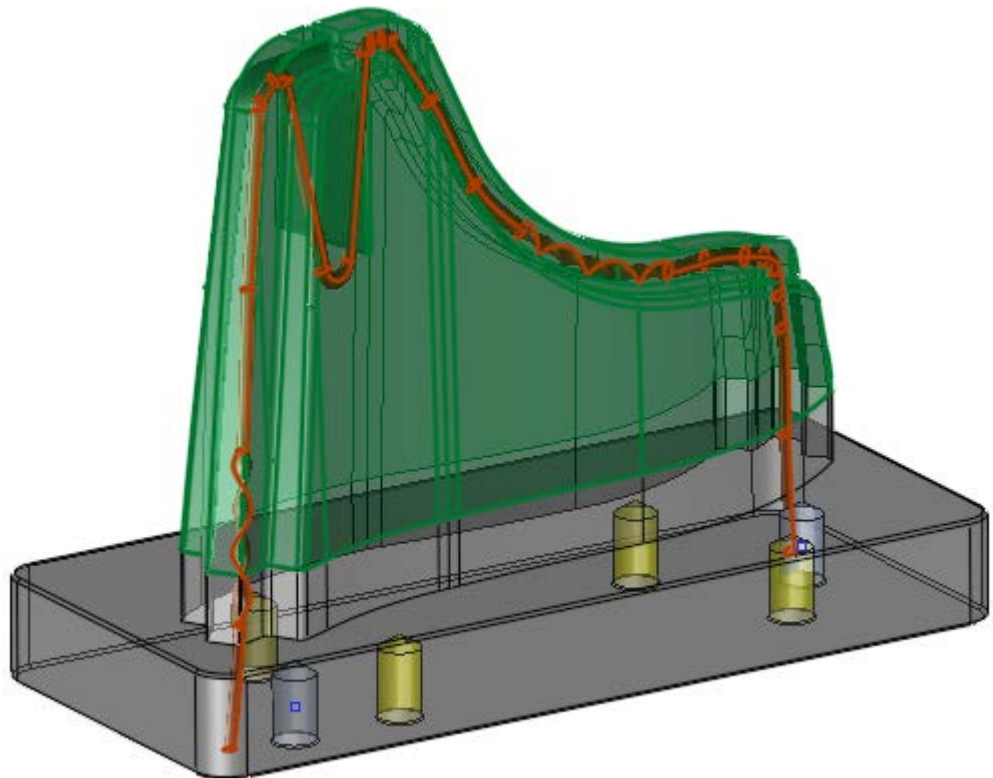
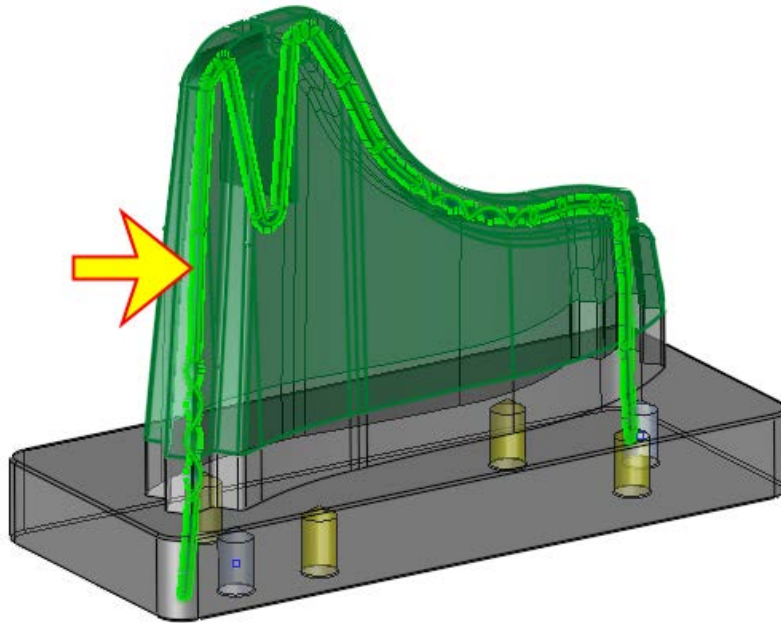
Expand to Same Color Faces



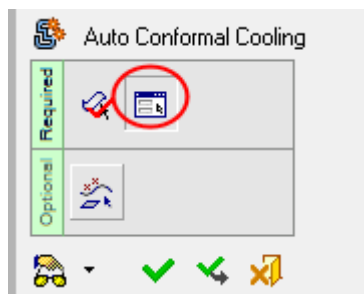
5. Enter the first optional stage. In this stage, you may select additional closed object(s), such as cooling channels (even if they were not yet cut with the part), to make sure that the created cooling curve circuit stays further away from them.



6. Select the cooling object as indicated by the arrow in the picture below:



- Enter the second required step to set the cooling parameters.

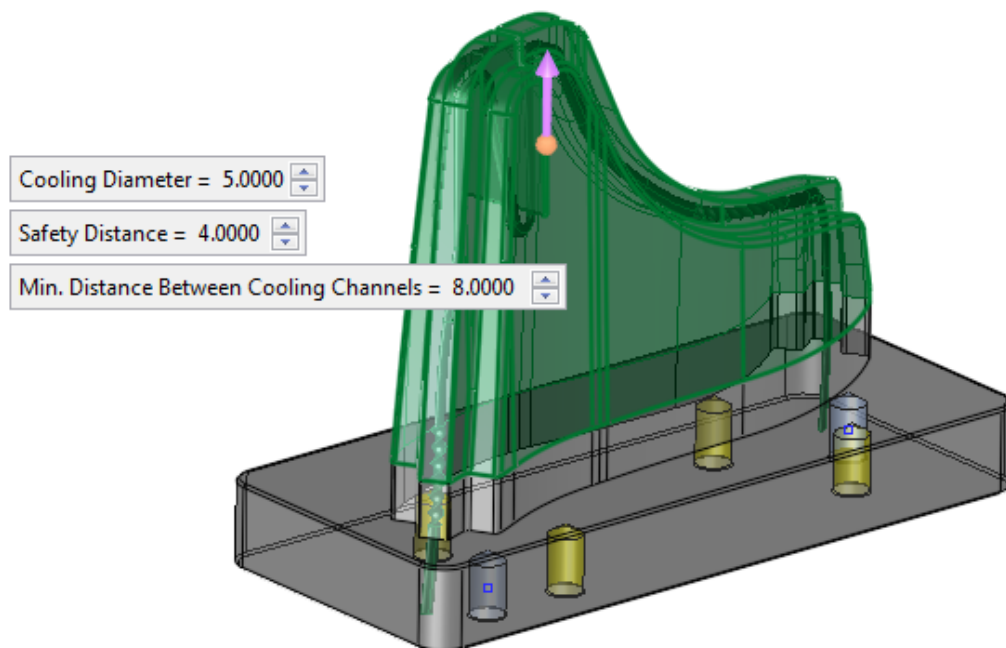


The following parameters are displayed:

Cooling Diameter enables to pre-set the required diameter of the cooling channels that are to be created using the Conformal Cooling Design function (the bounding circle of the section). The last entered value is remembered.
Default = 5 mm (0.2 inch). Minimum = 0.1 mm. Maximum = 100 mm.

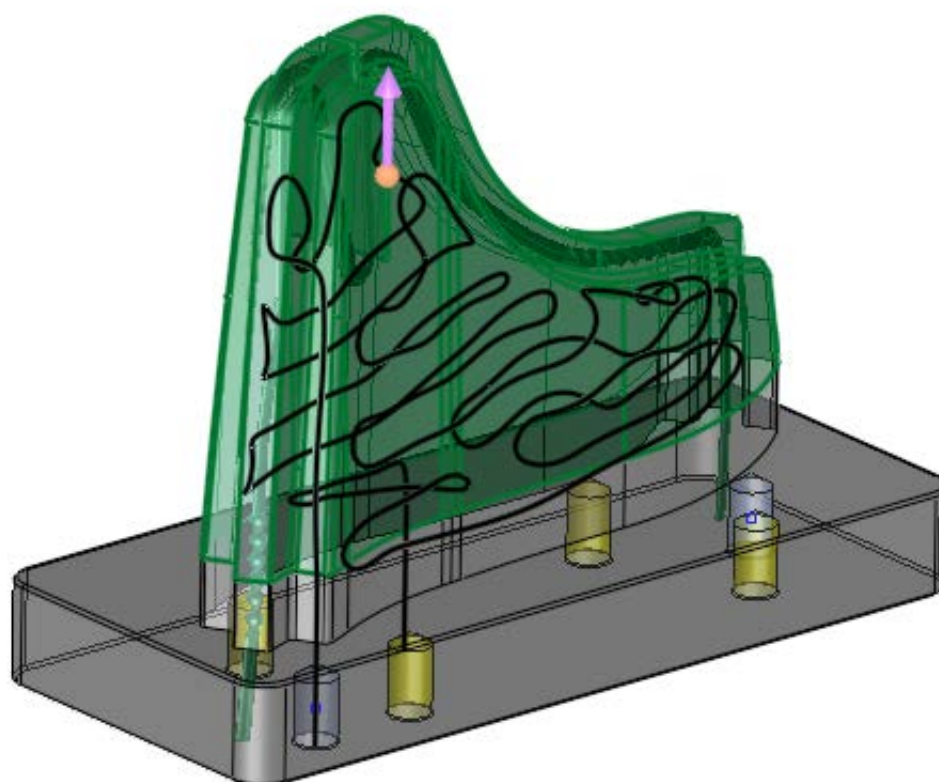
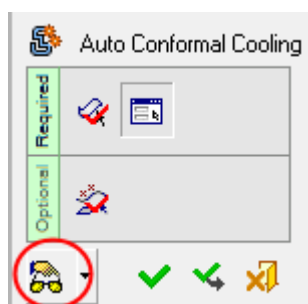
Safety Distance enables to pre-set the required safety distance from walls.

Min. Dist. Between Cooling enables to pre-set the minimum required distance from other cooling lines.



Notice that the required distance between the automatic created cooling and the previously created cooling (Min. Dist. Between Cooling), is double the size of the required distance from the wall (Safety Distance). We need to define a greater value for the distance as the erosion we are going to have is doubled from both sides.

8. Press the Preview button.

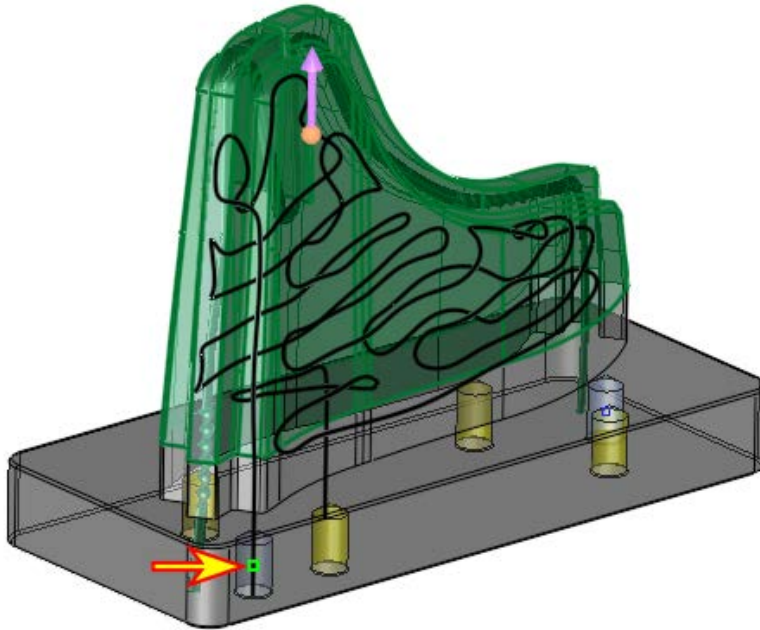


Notice the instructions in the Prompt/Status Bar, displayed at the bottom of the system window:

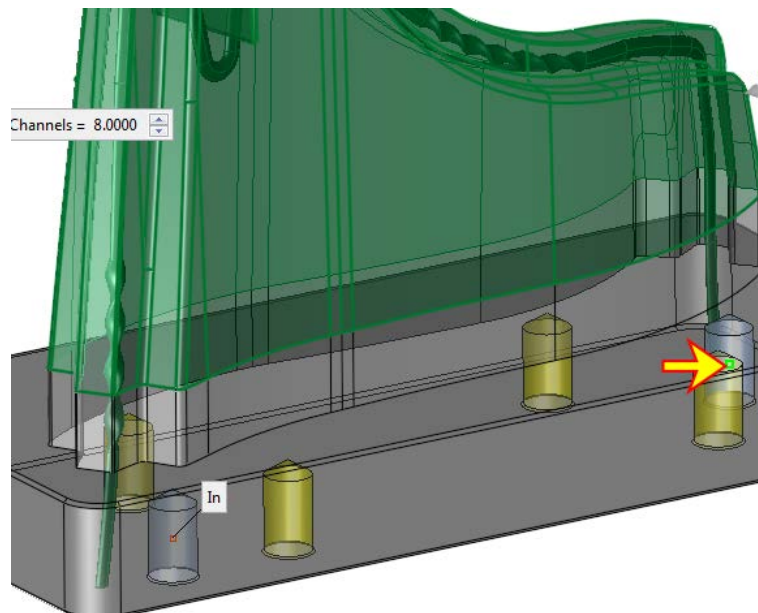
Set cooling parameters and pick In/Out points if needed.

You are requested to pick two points for the cooling circuit which will be labeled as Origin and Destination; these are the in and out points respectively, for the cooling circuit.

9. Pick the “in” point as indicated by the arrow in the picture below:



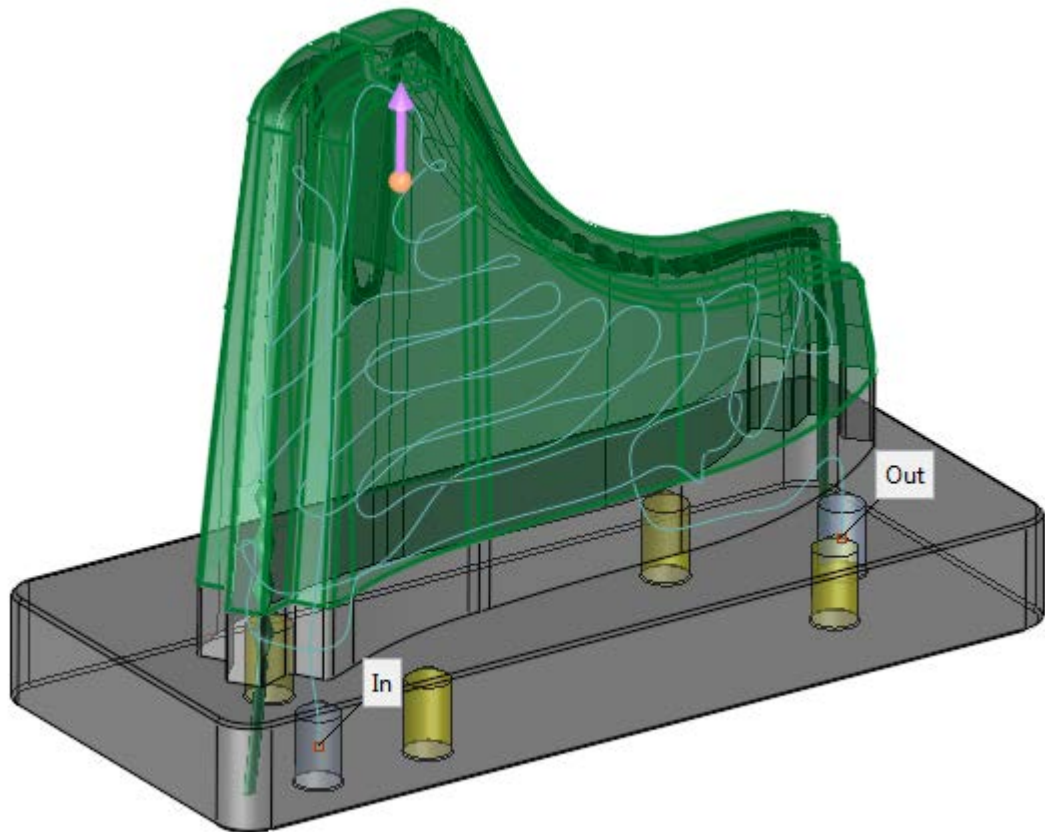
10. Pick the “out” point as indicated by the arrow in the picture below:



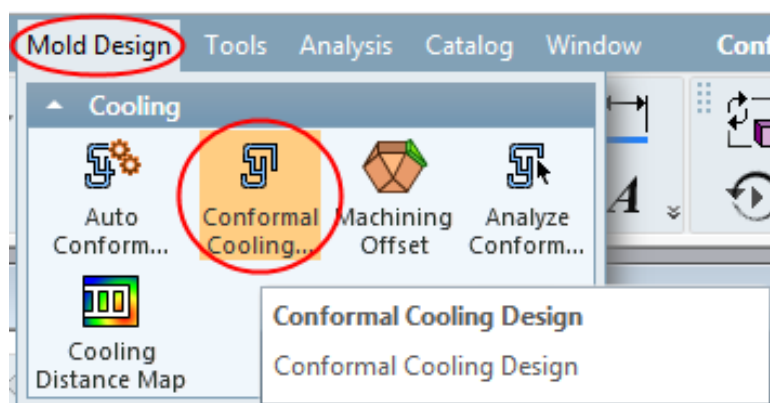
11. Preview the result :



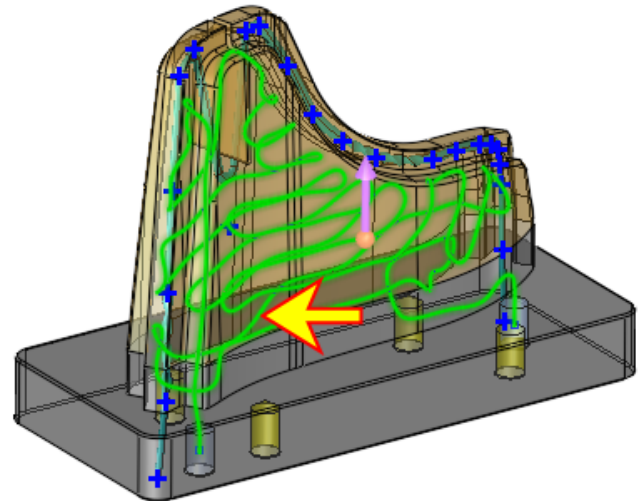
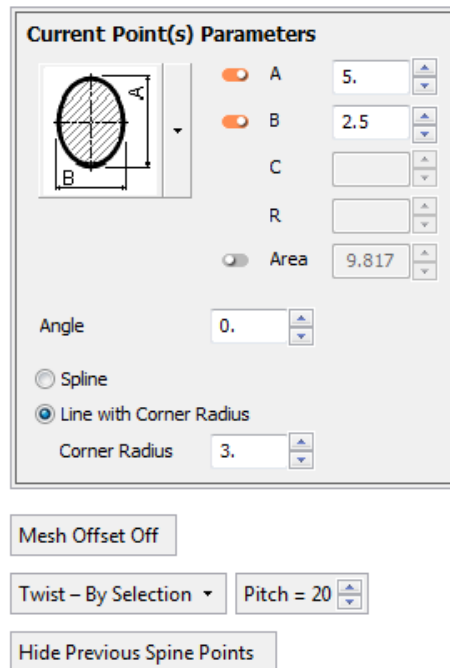
12. Select **OK**.



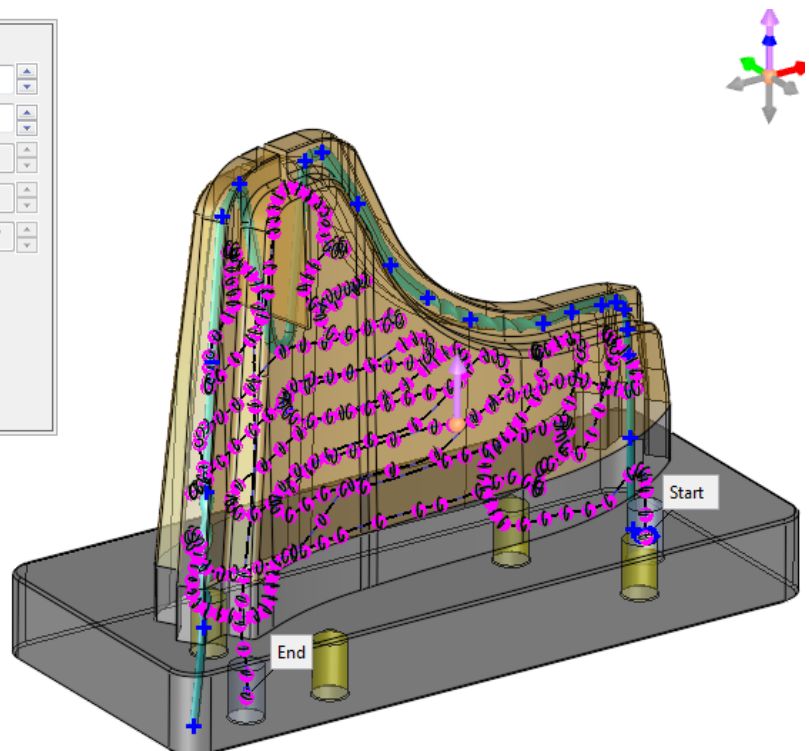
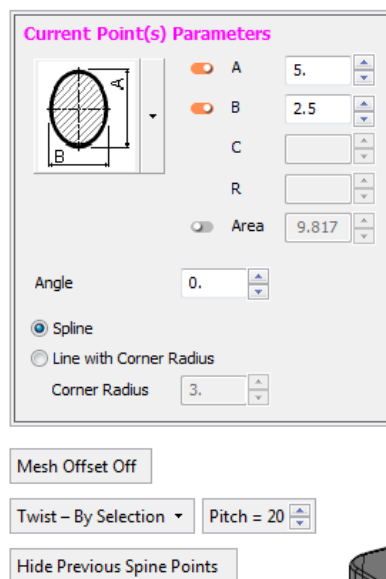
13. To create the cooling object from the automatically created channel, enter the Conformal Cooling Design function from the menu.



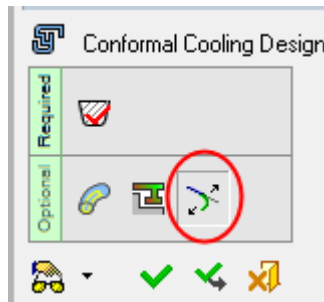
14. Select the channel previously created automatically.



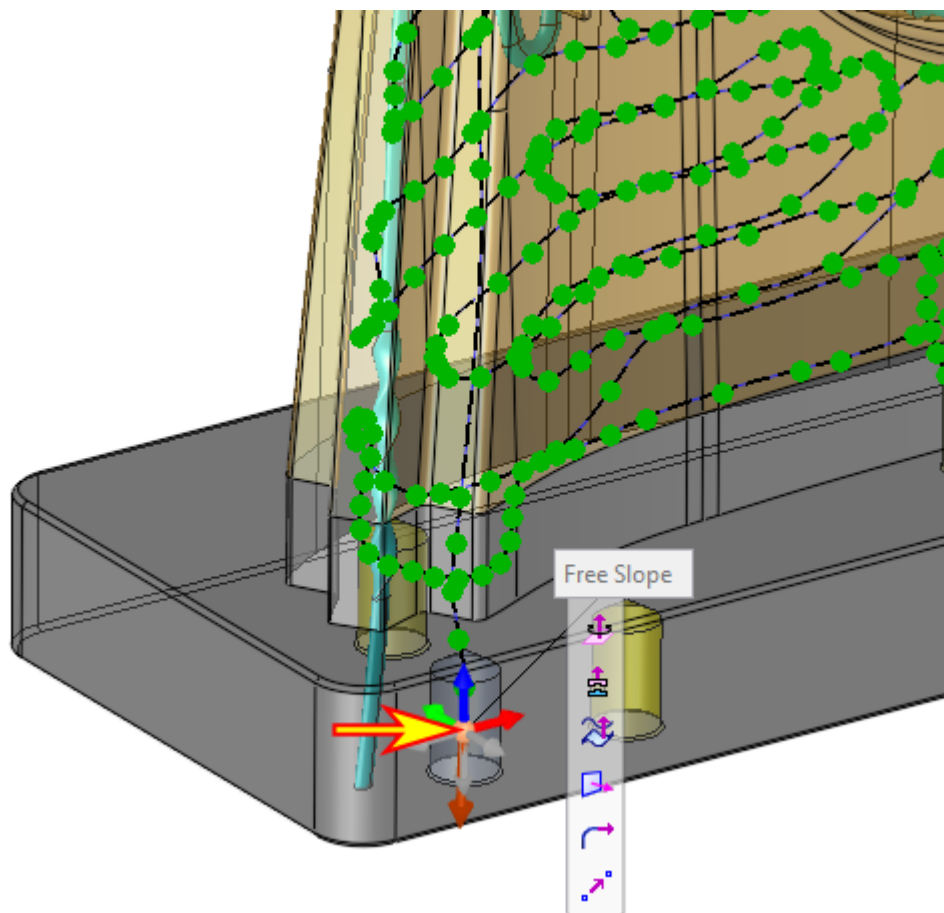
The sections of the object are displayed and may be manipulated as required.



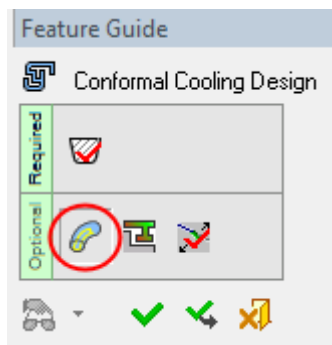
- Enter the 3rd optional step to control the slope direction of the curve at the start and end points.



- You may change the direction of the slopes by clicking the end points and selecting a different direction, however do not change the default direction of the slopes.



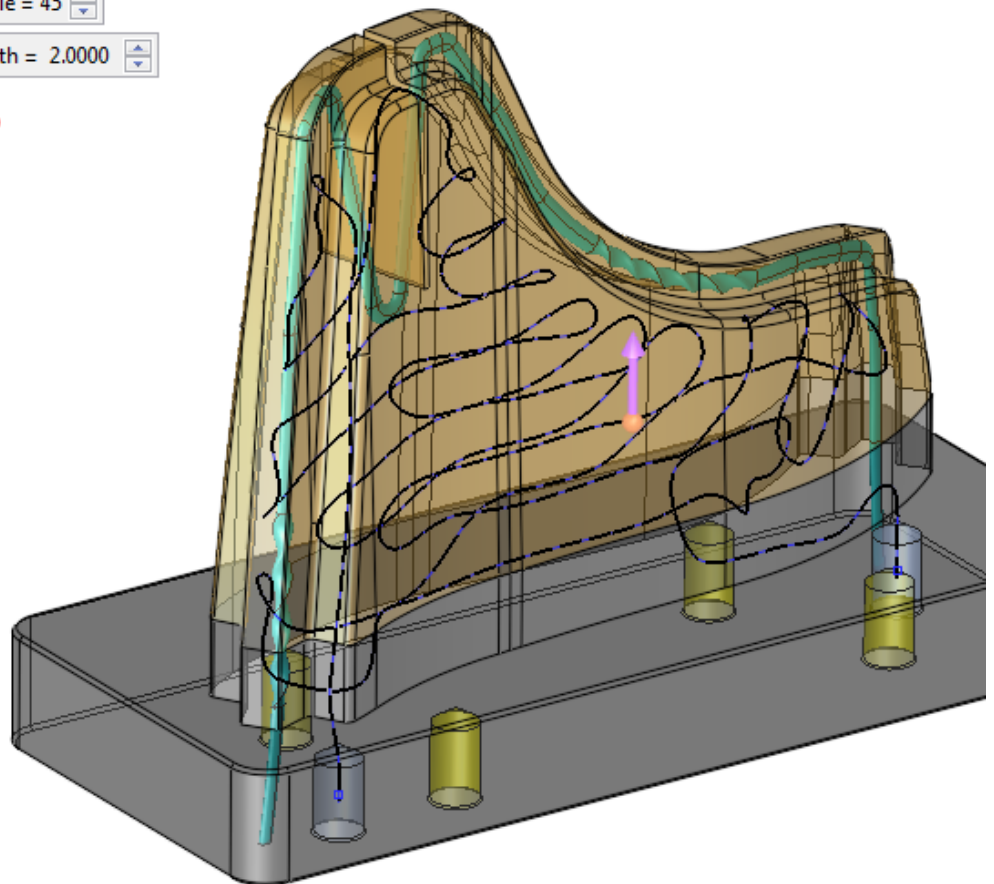
17. Enter the overhang analysis, and click to start the analysis.



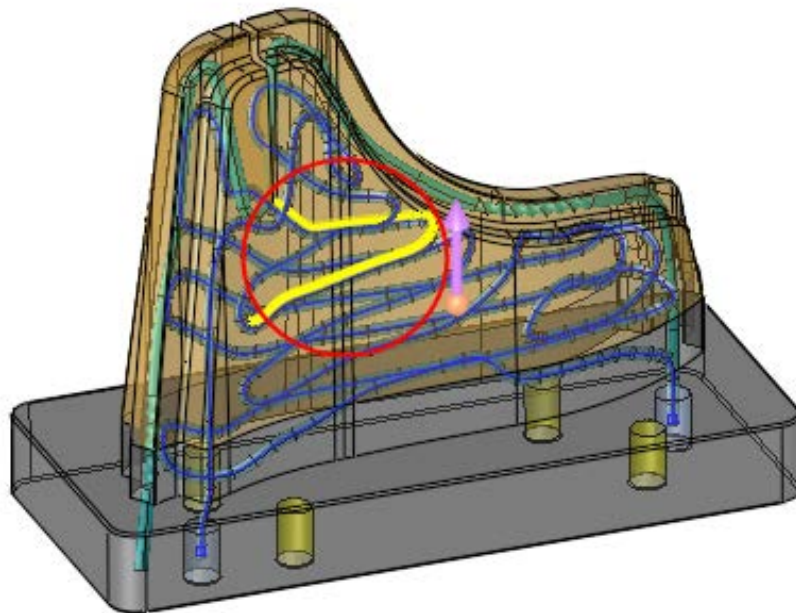
Overhang Angle = 45

Minimum Width = 2.0000

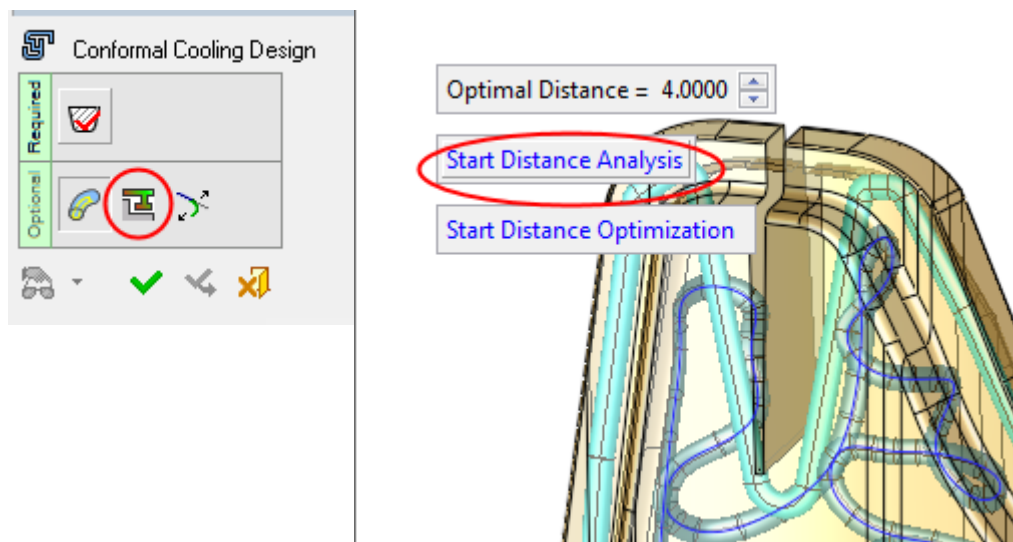
Start Analysis




18. If any area is detected, fix it as previously explained in the exercise.



19. Enter the 2nd optional step to perform a distance analysis. Click the **Start Distance Analysis** button. Naturally, there aren't any detected areas, as we defined the pre-set distance to avoid them.

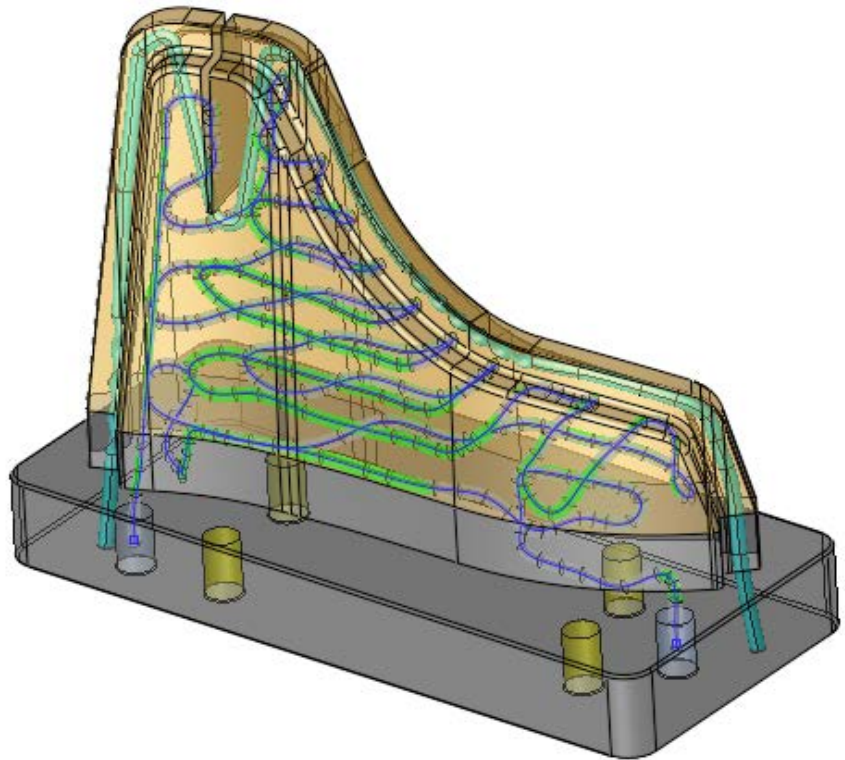


20. Select **OK** to complete the cooling creation.

Optimal Distance = 4.0000 

[Start Distance Analysis](#)

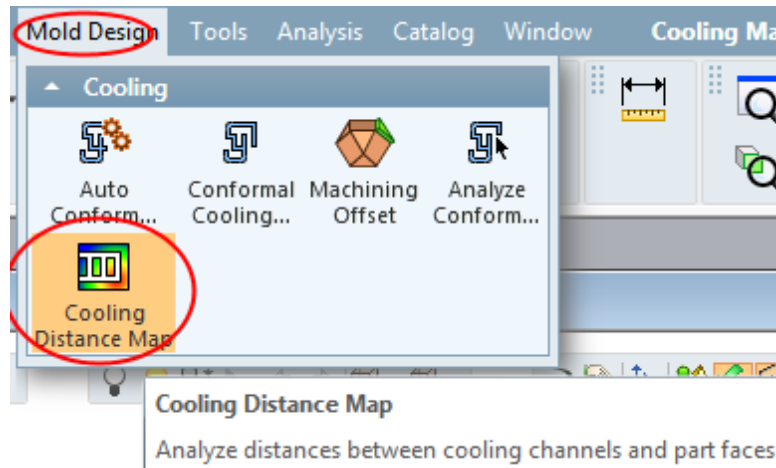
[Start Distance Optimization](#)



Part 7 Analyze Distance Between Faces and Cooling Lines

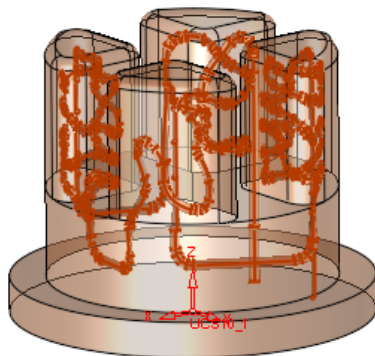
Create a color map of distances between cooling lines and faces.

1. Load the part **Cooling Map.elt**.
2. Enter '**Cooling Distance Map**'.



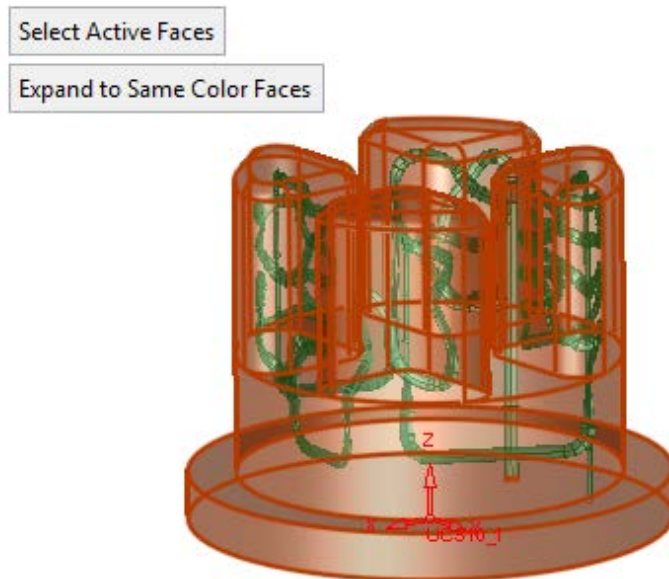
3. Select the cooling channels (in this part they are automatically selected).

At this stage you are requested to pick/unpick the cooling channels to be analyzed. By default, the system selects all visible cooling lines from the entire assembly, including conformal cooling (faces are recognized as cooling lines if they were created with a cooling function, or the Analyze Conformal Cooling Circuit was used to recognize them). You may add or subtract faces from this selection.

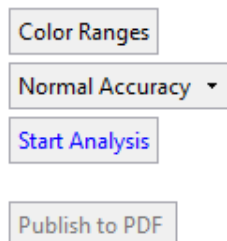


4. Exit to move to the second step.

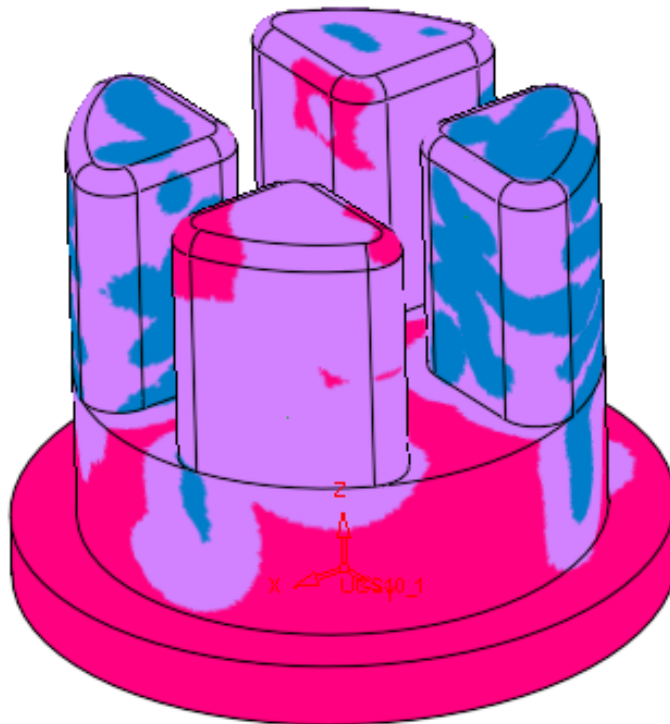
5. Select one of the part faces; (usually active faces - faces that touch the plastic) use the option '**Expand to Same Color Faces**'.



6. On the 3rd step select '**Start Analysis**'. The analysis produces a color map of distances between the active faces and the closest cooling line, to assess cooling efficiency. Tweak the color map by changing color ranges and, if required, export the results to a 3D PDF report.



7. See the result:



Color and ranges can be customized via the **Color Ranges** tab.

A progress bar is displayed during the analysis. The result is a distance color map on the selected faces only (not on the cooling channels) of the minimum distance between each point on the faces and the cooling channels. Move the cursor over the analysis to display a tooltip showing the relevant distance. All faces that do not participate in the analysis are displayed as 100% transparent.

You may also create 3D PDF files that include parts and assemblies from Cimatron. When the **Publish to PDF** button is pressed, a dialog is displayed giving you additional controls before the selected entities are exported to PDF.

The **Publish to PDF** button is available after an analysis is run (**Start Analysis**) and enables you to print the results of the analysis.

End of Exercise