3DXpert™

3DPRINTING EXERCISE - 4

Support Templates

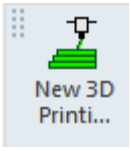
Tutorial_V4 - Updated: 13,0600,1489,1642(SP6)

3D SYSTEMS

The first section of this exercise discusses additional position options and support creation tools. In the second section, we will save and load templates to automate the support creation process and reuse existing supports.

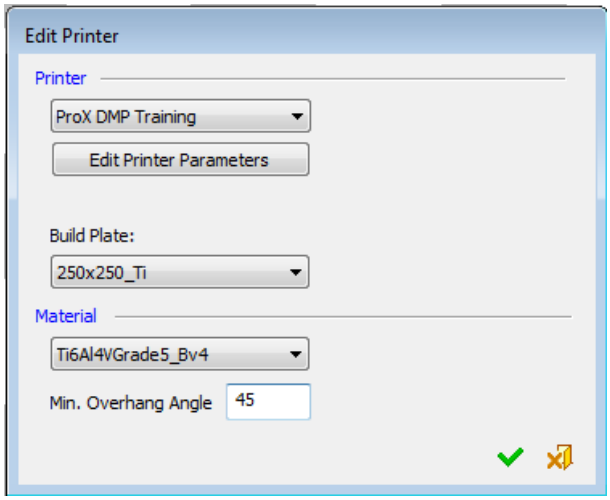
The exercise focuses 3DXPert's 3D printing functionality. Although the various steps to follow are detailed, it is recommended to have a basic knowledge in running the general software tools.

Part 1 - Creating the 3D Printing project and positioning the part

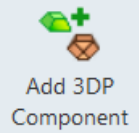
1. Let's open a new 3DPrinting project. From the menu bar press the **New 3DPrinting Project** button. 

2. Save to Define the project's name and check on the Folder Location box.
   Use the Browse button to set where the new folder will be created.

3. Select Edit Printer to set the Printer you are going to work with by selecting it from the list of available printers. Define a **Build Plate** by selecting it from the dropdown list of available plates. The build plate defines the valid printing areas on the tray. Select a Material from the list. The default overhang angle is a technological value, dictated by the printer and the material.
   Set the Min. Overhang Angle to 45 degrees. Press OK to finish the project's setup step.



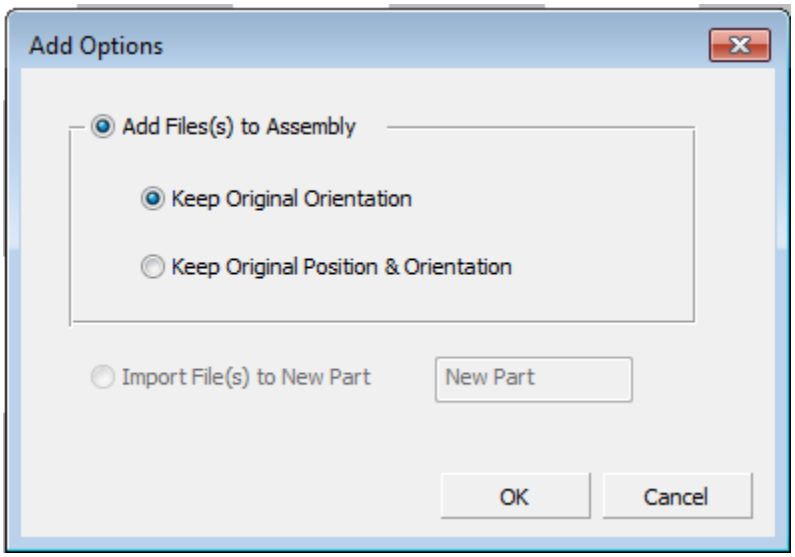
4. Let's add the part we are going to print. Press the Add 3DP Component



.

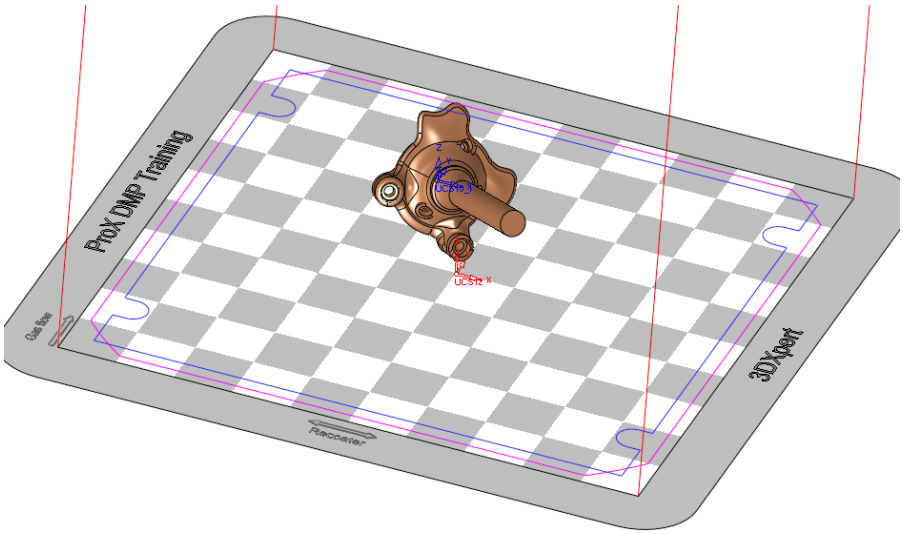
As the 3DXpert explorer opens up, browse and select the file Med.elt. Press 'Select' or double click the file.

Set the option Keep Original Orientation and select OK



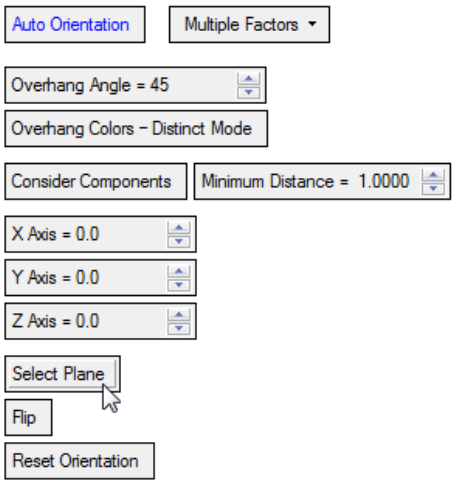
The part has been added to the project. See that it also shows on the tree, below the tray.

5. The part is now placed inside the tray area.

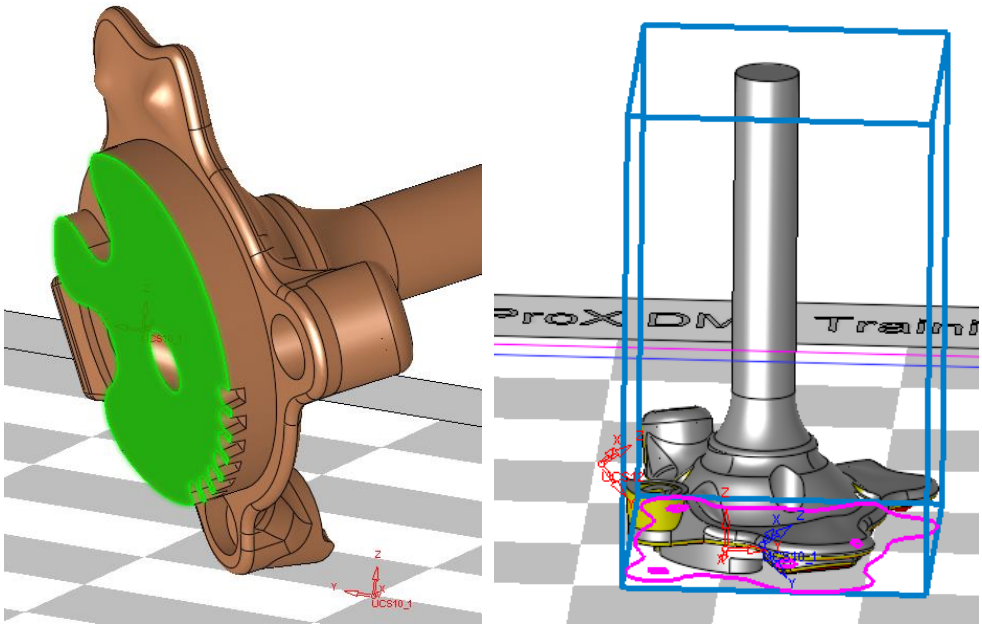


6. The part is positioned in the center of the tray, oriented according to its original design; this may not be the ideal position for printing. To properly position the part inside the tray, press ‘Position Body’ from the Guide Bar .

7. 3DXpert can suggest to the user various orientations (by Auto Orientation). Let’s suppose however that we as users know the part and we want to position it ‘our way’. Click ‘Select Plane’



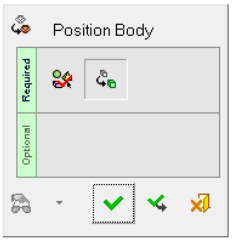
8. Rotate the part and pick its bottom flat face

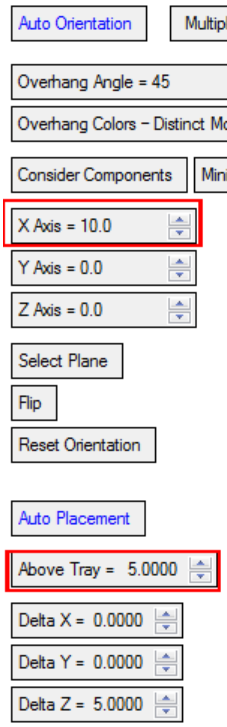


The part is positioned so that the face is now tangent to the tray’s base.

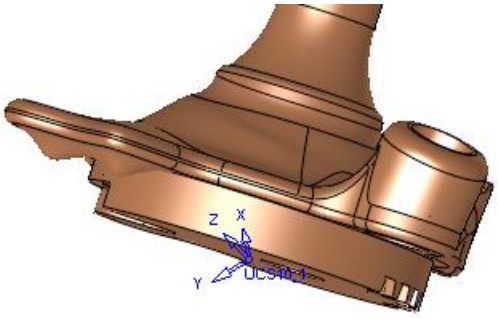
Note: the Flip option helps you to define whether the face you have selected as reference is a top or bottom face.

9. You can pick the part and move it around or fine-tune the existing position. For example, move upwards a little bit by entering a Delta Z value and then rotate it along the X-Axis by 10 degrees.
   Right Mouse click to bring the Feature Guide and press OK.

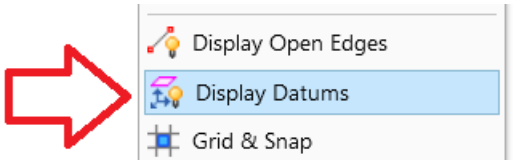




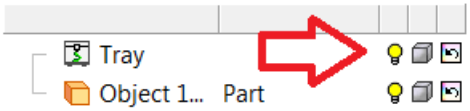
10. A UCS (User Coordinate System) is located at the base of the part.



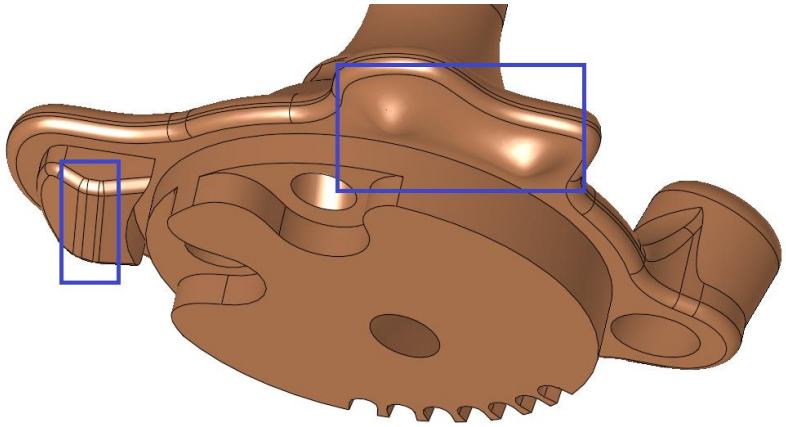
There are several ways to hide it.
One of them is by hiding all the Datums (planes, axes, UCSs).
Press the Right and Middle mouse buttons to bring the display sub menu and switch OFF the 'Display Datums' option:



Also, remember that you can hide the tray by click its bulb on the 3DP Objects tree.



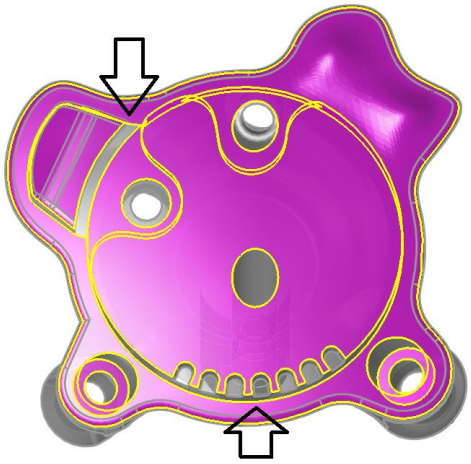
Zoom in on the bottom of the part. If you look closely, you will see that there are two areas where printing starts 'in the air', so although we are printing one part, on these layers the metal being printed is not connected at all to the main part and hence it will require supports that hold it to the ground so that it doesn't "float around".

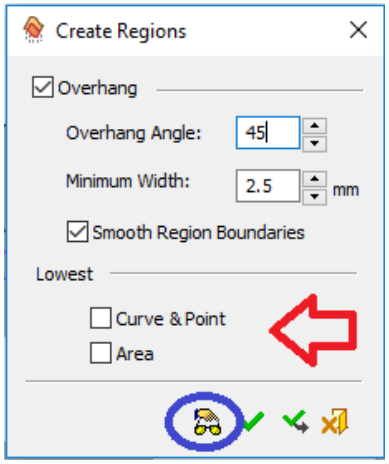


Part 2 – Creating Supports

11. Click the Support Manager button 

from the guide and pick the part.
12. The overhang value is set to 45, as we have set at the beginning of the project. Set the Minimum Width to 2.5mm and uncheck the Lowest options. Press the Preview button.





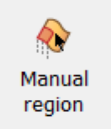
Notice that some of the areas were not included. For example, the analysis did not find the lower areas of each 'tooth'. That's because the Minimum Width value is set too high. Also, the area shown here by the second arrow is not included.

We can set a smaller Min.Width value, however we will see how to add these regions in a different way.

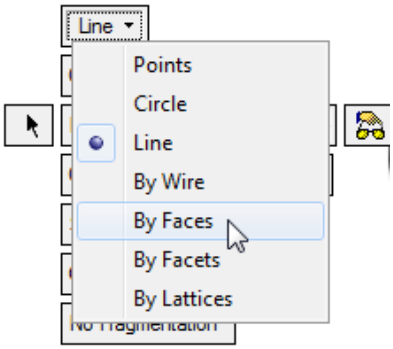
Press OK to create the support regions.

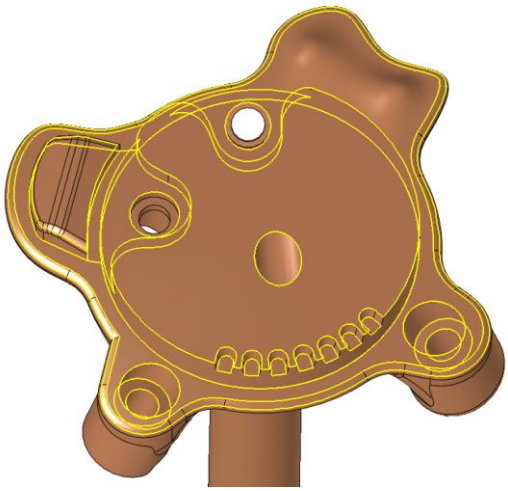
13. Having created the regions, we are now inside the Support Manager.

Press Manual Regions

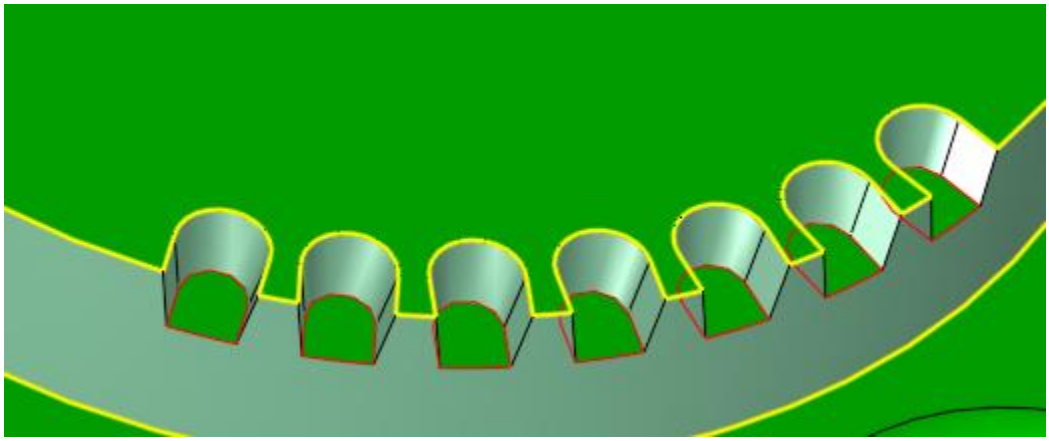


And switch to the option By Faces



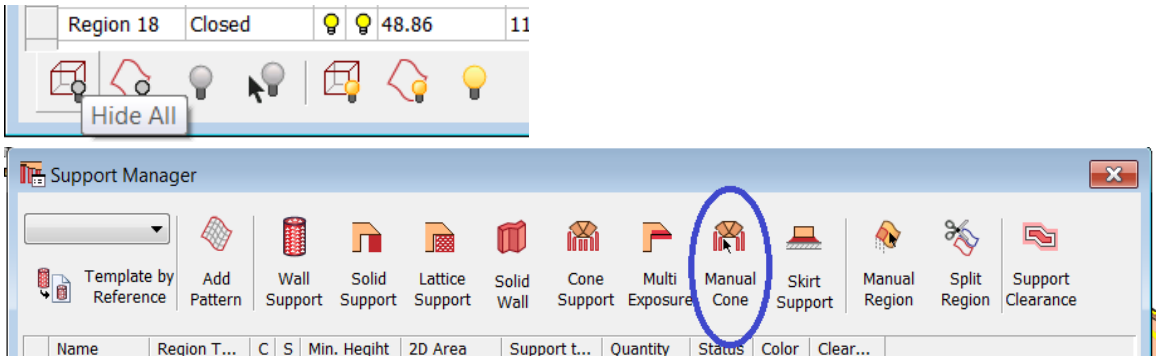


Pick the 7 identical small faces to add as regions

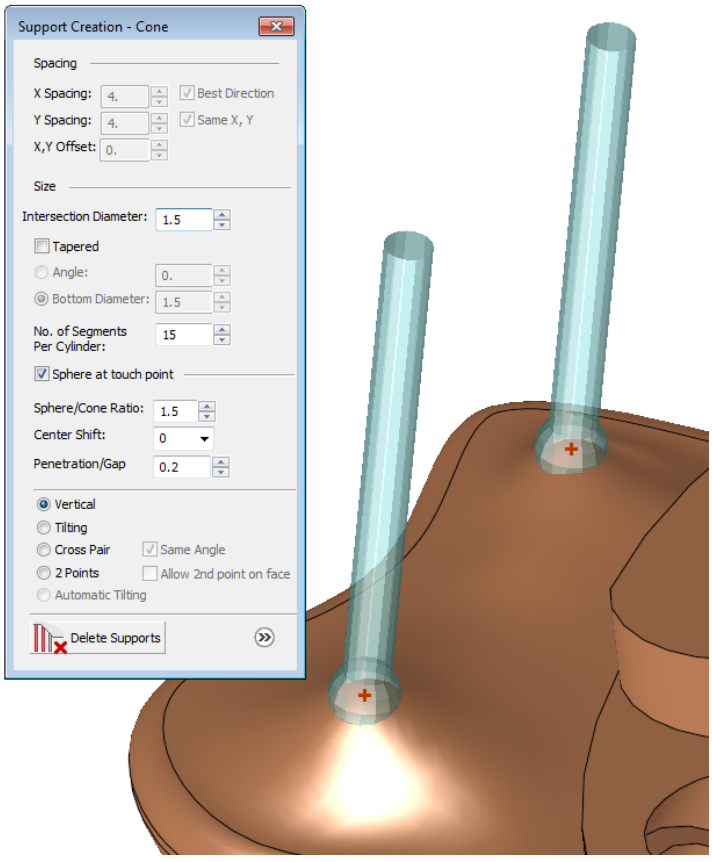


Press OK.

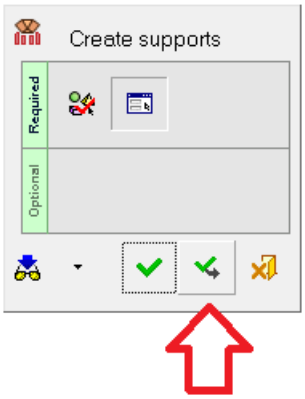
14. We will begin by adding manual cone supports on the special areas we detected in step 10. Press the Hide All button at the bottom of the dialog and click the Manual Cone button:



Pick at the tips of the two small 'hills':
Set a cone diameter as 1.5 and add a sphere at the top.



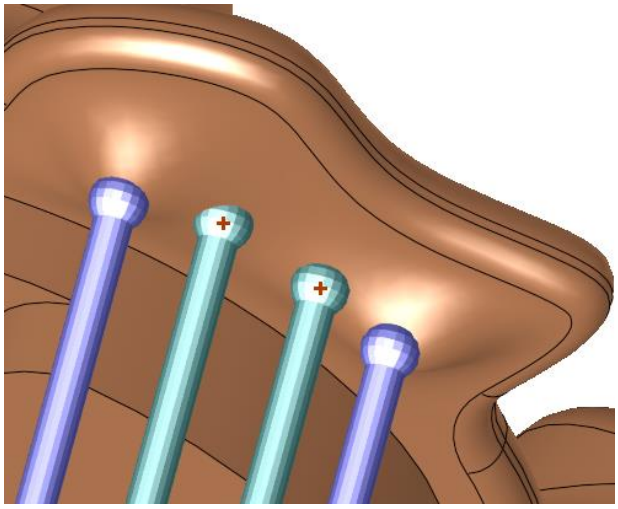
Press Apply in the Feature Guide



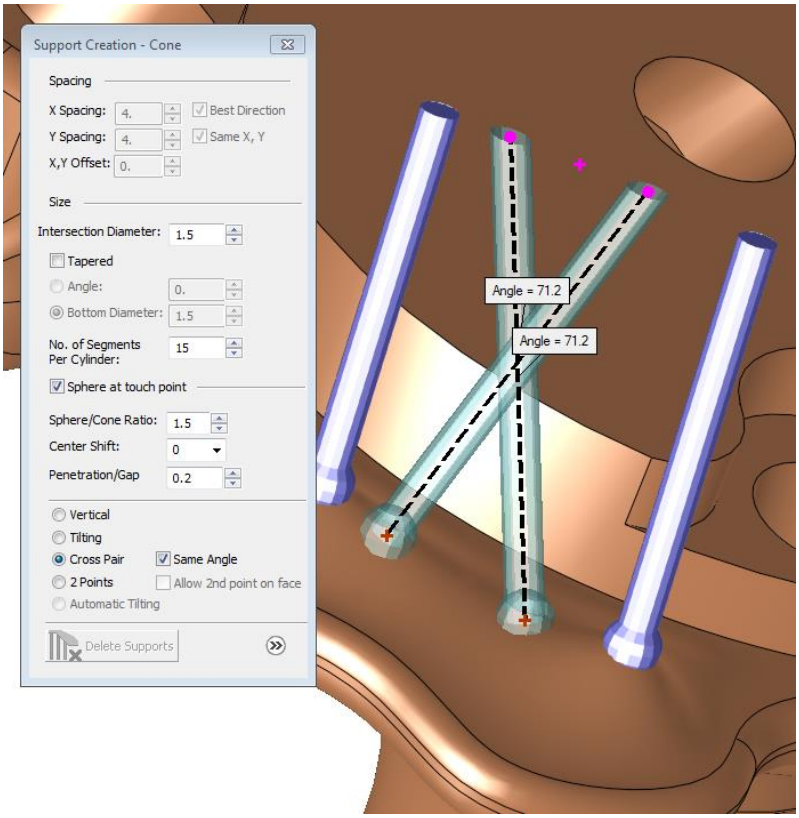
By pressing apply the cones are added but you are still inside the Manual Cones function ready to add more cones.

So now that where the two 'hills' converge, we want to add two additional cones, and these should be positioned in an X shape.
When the two hills are building up, the next point that requires support is where they meet. At this point, there will be a lot of stress, therefore we need very robust supports there. For this purpose, we will use two cone supports in an X shape, as this adds more robustness.

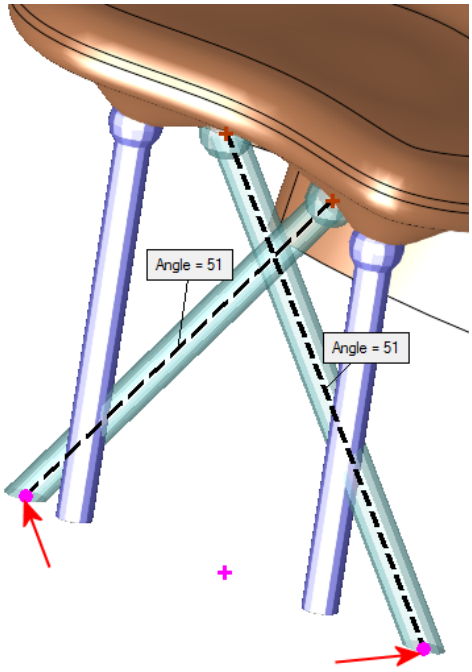
15. Add additional two cones by picking their positions on the part:



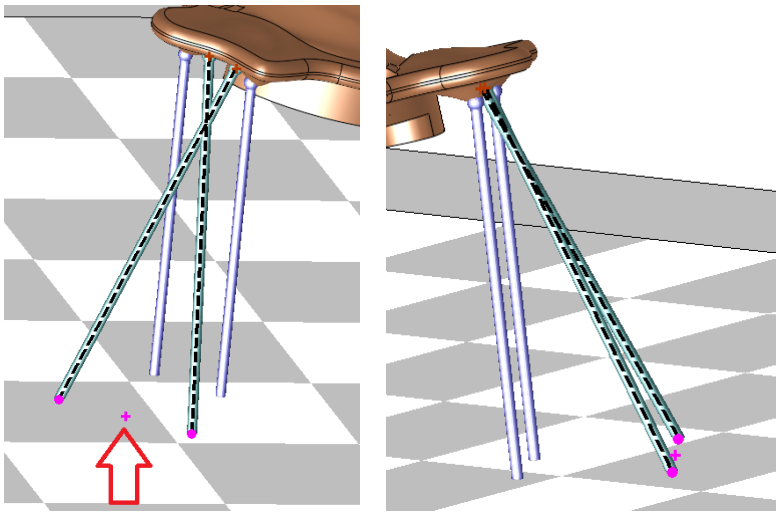
Click the ‘Crossed Pair’ button at the bottom of the Create Supports dialog



Now pick a point at the bottom of the supports to change the angle between them:



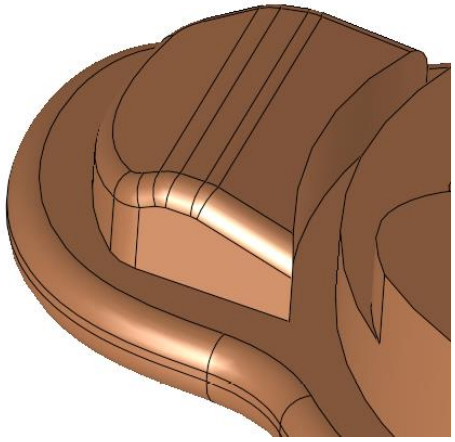
You can also change their inclination by dragging the middle point between them:



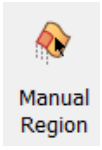
So now we have a set of cones to support this area.
Click OK on the Feature Guide and we are back to the Support Manager.
See that we have two new Manual Cone Regions (remember that we pressed Apply between the two sets of cones). The Region numbers may be different.

Name	Region Type	C	S	Support type	Part Name	Color	Analysi...	Min. Height	2D Area	Clearance	Ease of Remo...
Manual Cone Region 18				Cone	Med		0.0			☐	
Manual Cone Region 19				Cone	Med		0.0			☐	

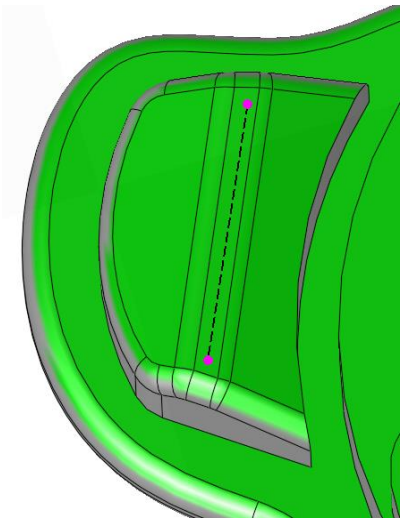
16. As we explained above, there is still one more area that that needs special attention.
    We will now create a thick Solid Wall support on the entire area.



For that, let's create first a Manual Region.

17. In the Support Manager, click the Manual Region button. 

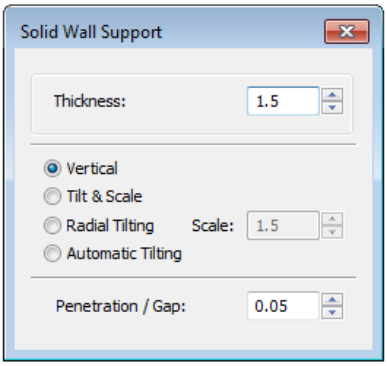
The region will practically be a line. Switch from By Faces to Line and Draw the following line by picking two points:



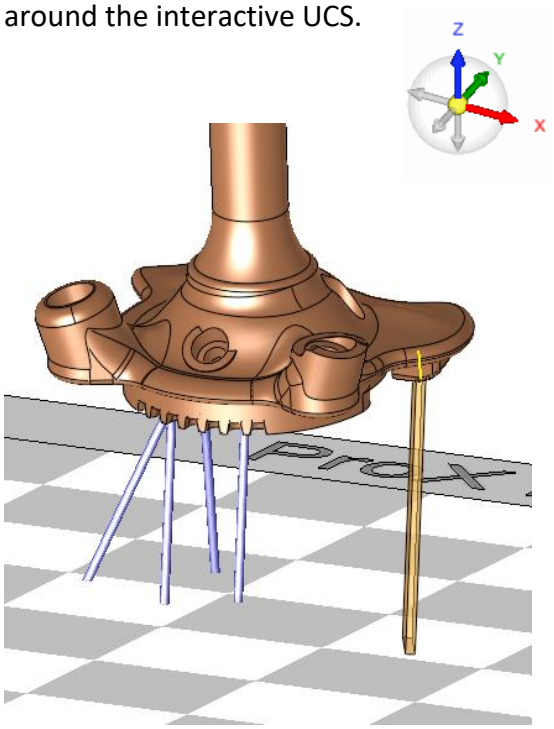
Click the right mouse button to show the Feature Guide and press OK.
A new Manual Region of type Open has been added at the bottom of the regions' table.

18. Pick the region, either by picking the Manual Region from the table or by picking the line from the display area and hit the 'Solid Wall' button from the Support Manager. 

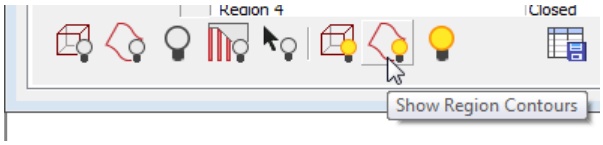
Set the wall thickness as 1.5mm and press OK.



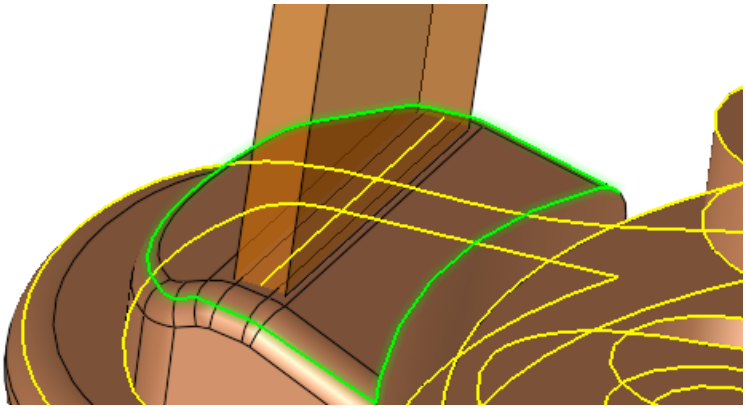
19. The Wall reaches the tray. You can see its height through the Support Manager. For quick isometric view of the model, double click the translucent bubble around the interactive UCS.



20. Let's continue adding more supports to the model. Click the Show regions button in the Support Manager.



Hide the Tray, rotate the part and pick from the display the following contour defining the region marked in green here:

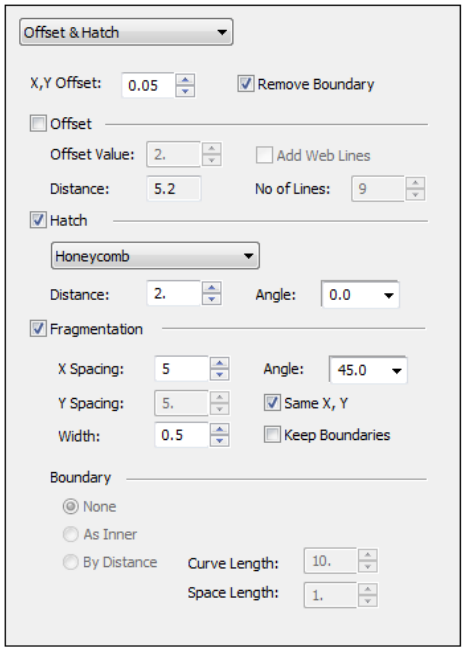


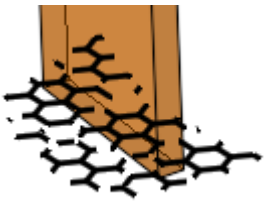
If the region does not follow exactly the shape shown above, remember that you can edit the region manually. Enter Edit Region – 2D and modify the contour using the sketch tools accordingly.

Click Add Pattern.

In the Modify Pattern dialog set Hatch type to Honeycomb, distance = 2mm. Add Fragmentation and remove the outer boundary (toggle Keep Boundary to Remove Boundary).

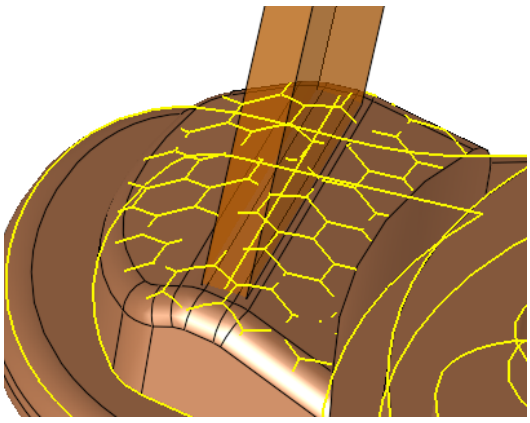
Enter the spacing and width as shown here:





Press OK and the pattern is projected on the model.

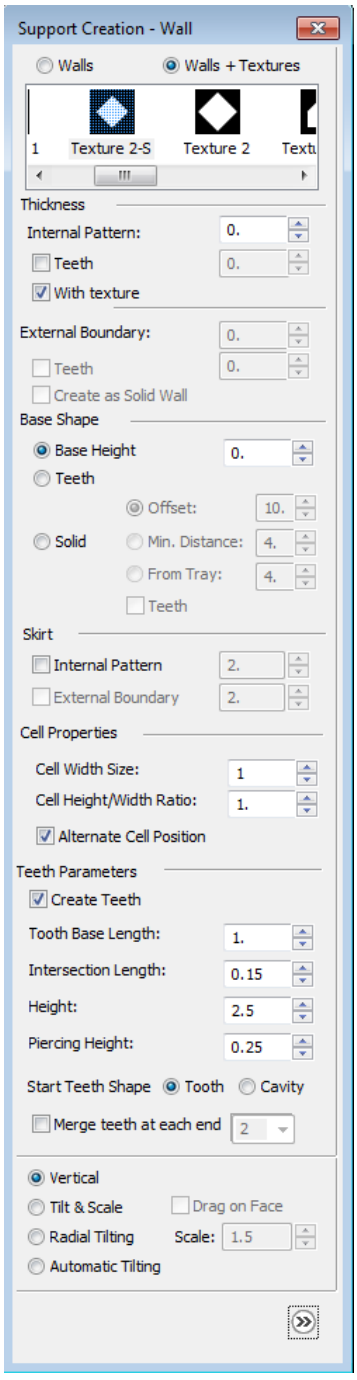
Notice that in the Support Manager, this region is now open:

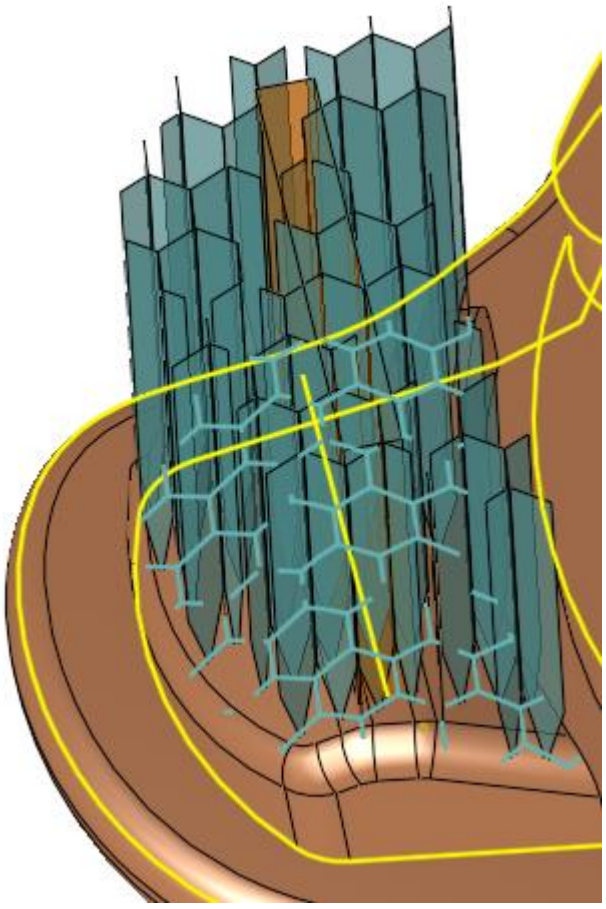


21. Create a Wall Support on this pattern. Click the Pattern and press the Wall Support button. 

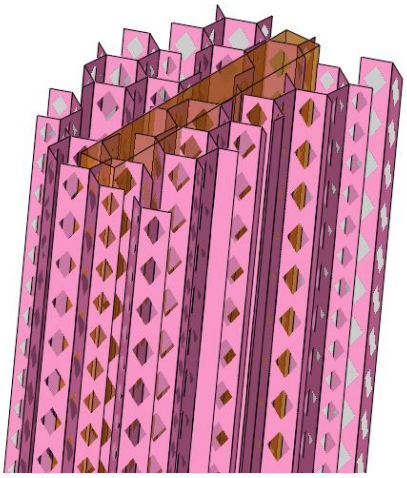
In the Wall Support creation dialog make use Wall+Texture and pick the Texture 2-S.

Set the parameters as follows:





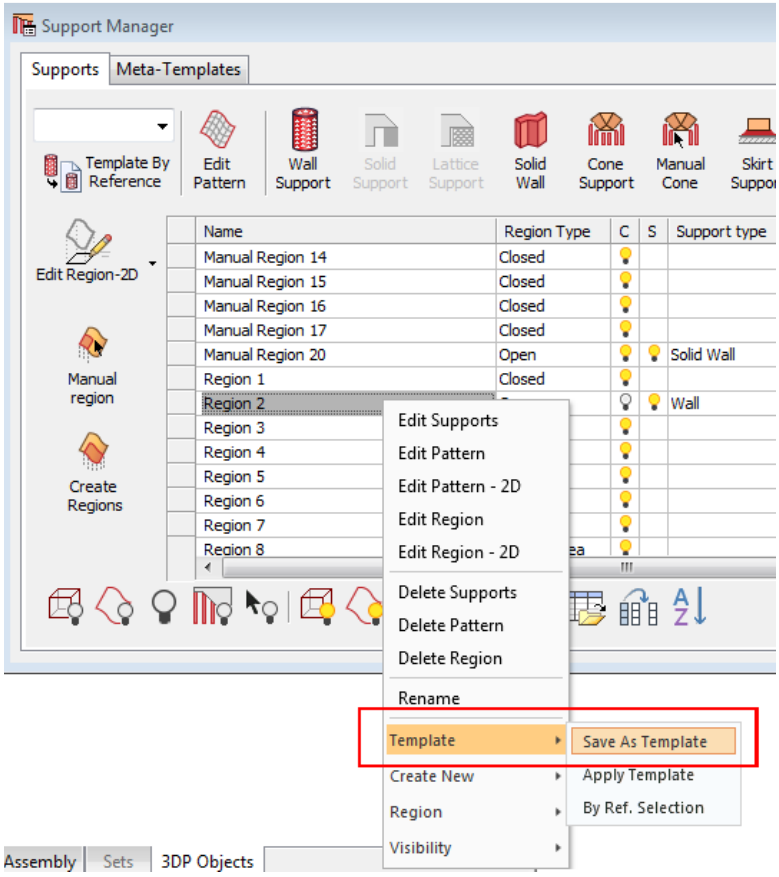
Press OK. You can see the wall support interferes with the solid support created earlier. We will see how to deal with this later on.



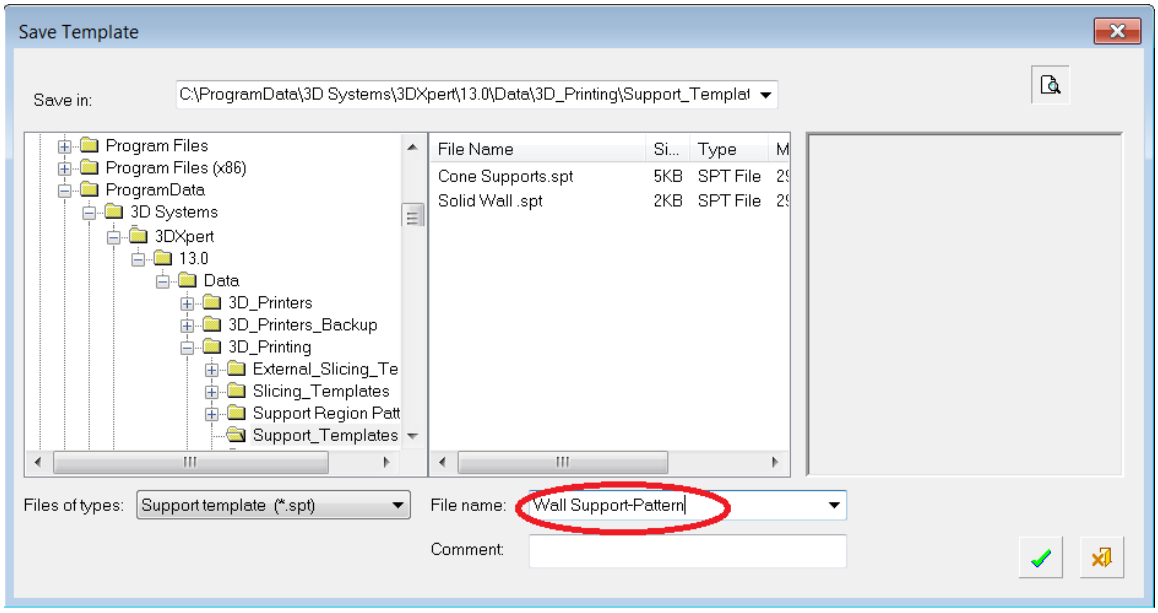
Part 3 – Using Templates for Supports' Creation

As you may have seen, each support type has many parameters (as well as its pattern, when used). If you create a similar support, you do not want to redefine these parameters every time you create a similar support. It would be better to reuse the parameters already defined in a previous support.
Therefore, for that purpose, you can save the support & pattern creation parameters into a template, which you can later apply on other regions.

22. Pick the region from the Support Manager (note again, that the region's number on your project may be different), right mouse click and select from the pop up menu Template→Save As Template

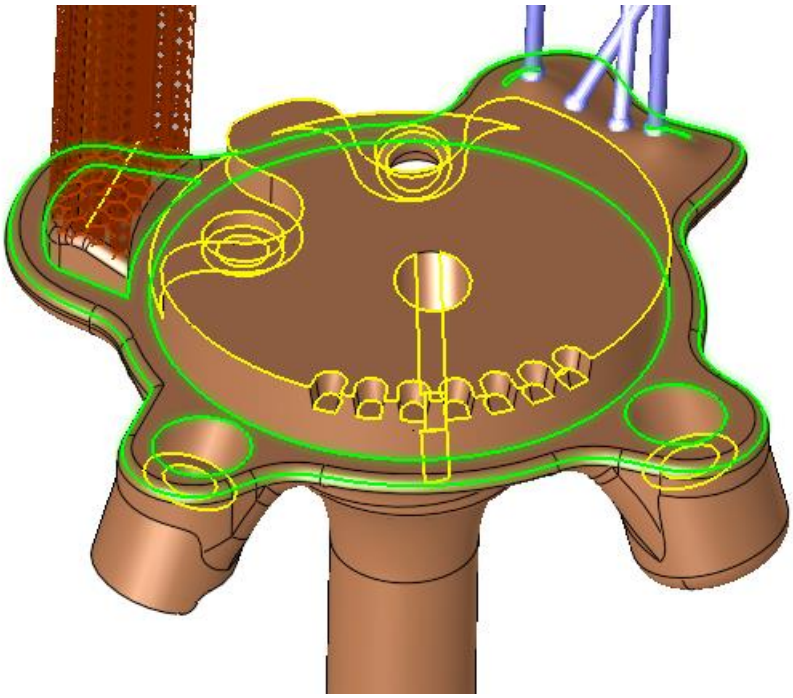


In the Save Template dialog, enter a file name, for example set it as ‘Wall Support-Pattern’ and press the OK button.



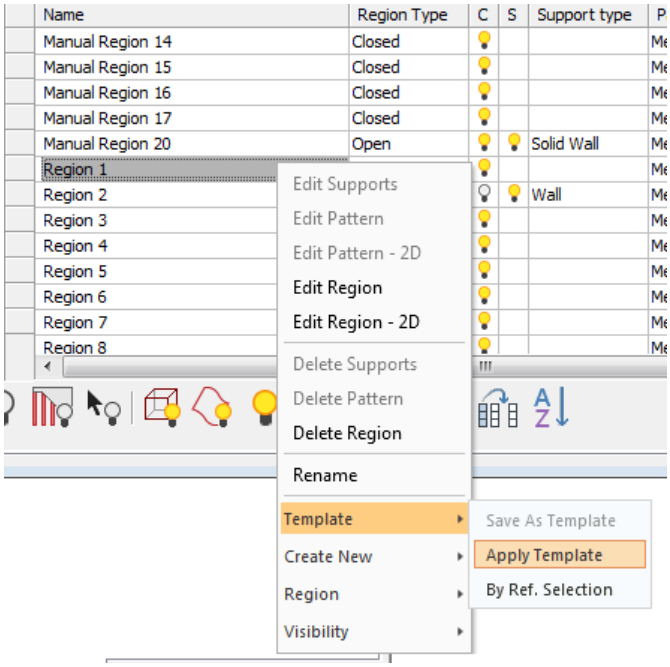
Now that we have saved the support as a template, let’s see how we apply it.

23. Pick the large region from the screen:

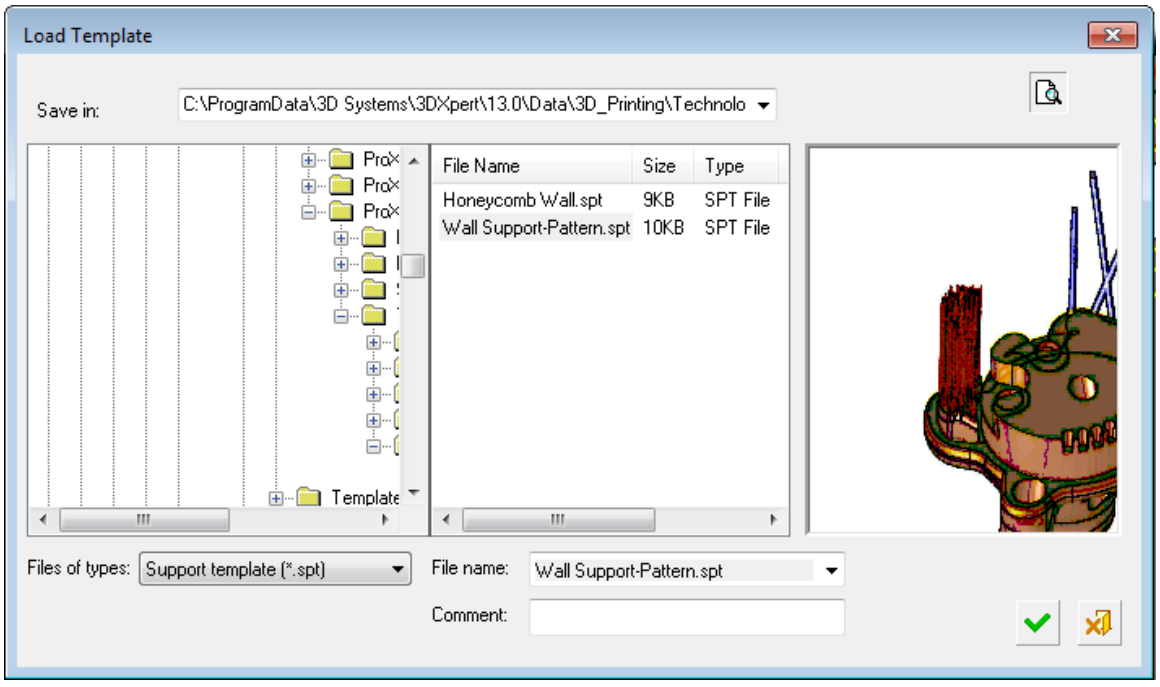


Note: Remember that one region was created automatically and the other was created by Manual Regions. it is possible to apply the same template on several regions in the same operation.

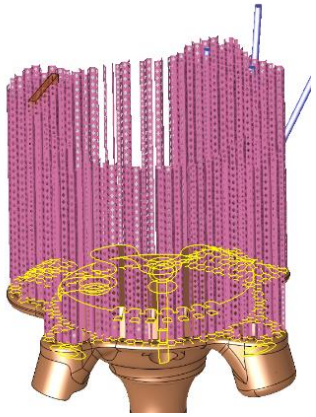
Right mouse click the region and from the pop menu select Template-Apply



From the Load Template dialog, select the template you have just saved

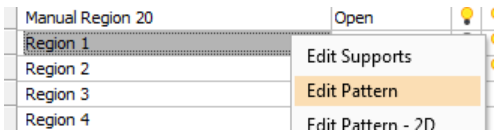


The template's image was captured during the template's save operation.
Double click the template's name or press OK and the template is applied on the selected region or regions.

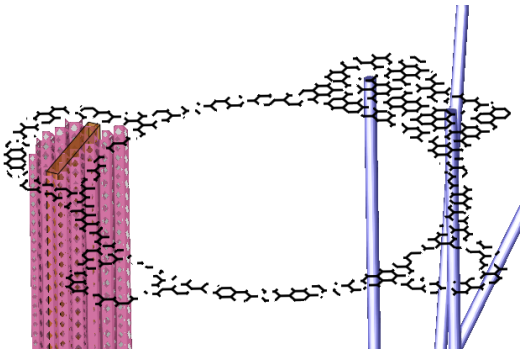


Note: Once a support is created from a template, it is disconnected from it. This means that if we make a change to the reference support from which the template was created, or to the template, it has no effect on supports already created from that template.
Still, a different template can always be applied to regions that already have supports.
There is also an additional, quicker, way to use an existing support like a template without actually saving it into a template. This way called 'By Reference' and we will see it soon. This, however, can only be used within the same project. In order to use a support in a different project, a template must be used.
Before we create a support By Reference, we will edit the existing support, so that it is different than the one created from the template.

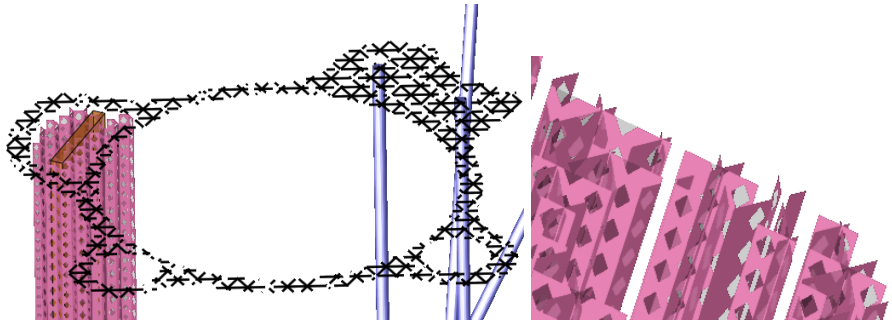
24. So let's say that you want to edit this support. For example, to change the pattern.
Pick the support from screen to highlight its region in the table, right mouse click and select Edit Pattern.



You can see that the pattern currently used for this support is a Honeycomb, as saved into the template.

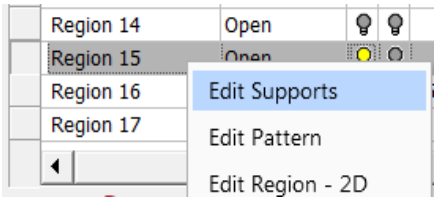


Change it to a different type, for example to something tighter, so pick from the list the type: Triangular Grid



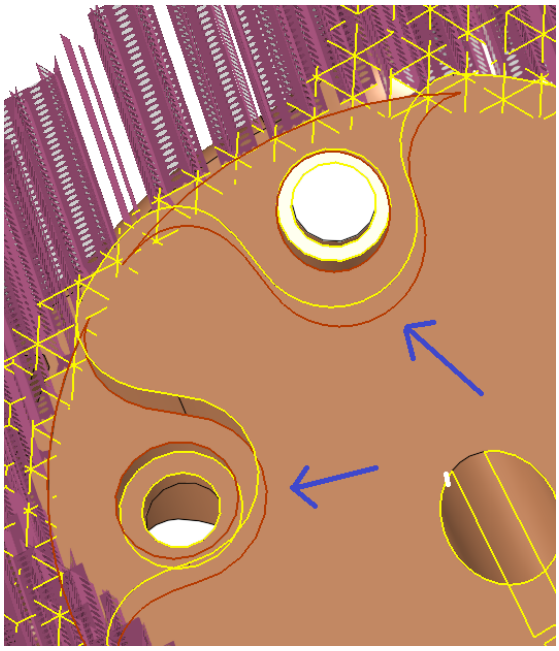
Press OK to update the pattern.

25. You can also change the Wall Support itself.
    Right mouse click the same region and select Edit Supports



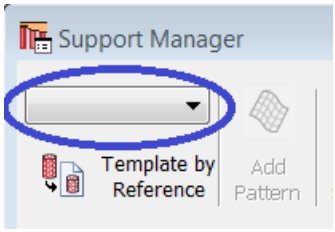
Change the Texture to ‘Texture 1-S’ and press OK.

26. Now let's apply a template to two regions.
    Pick the two regions (contours in red below):

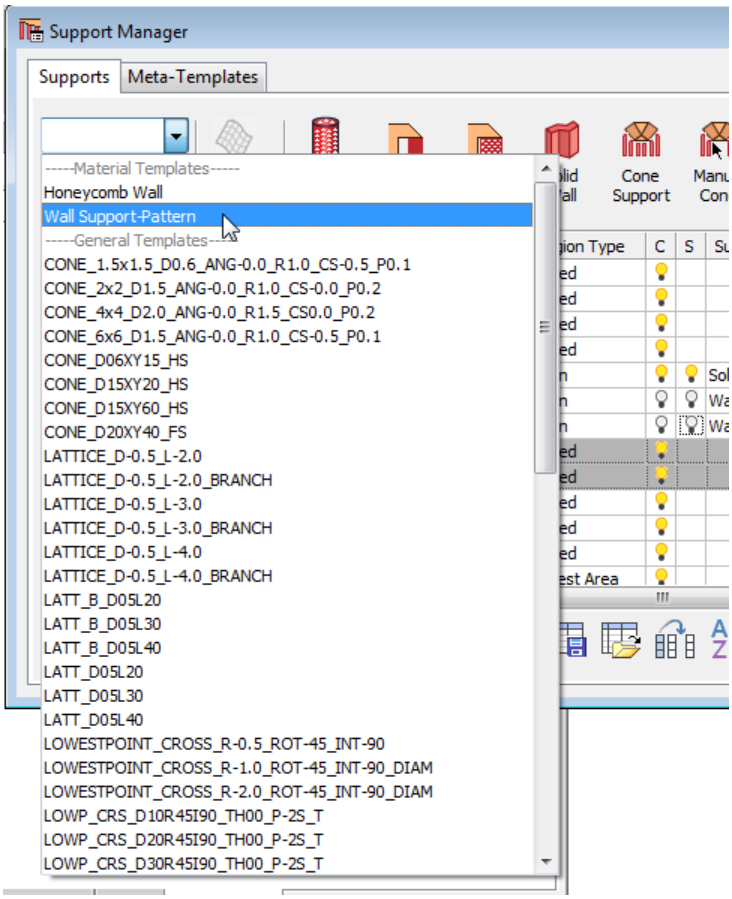


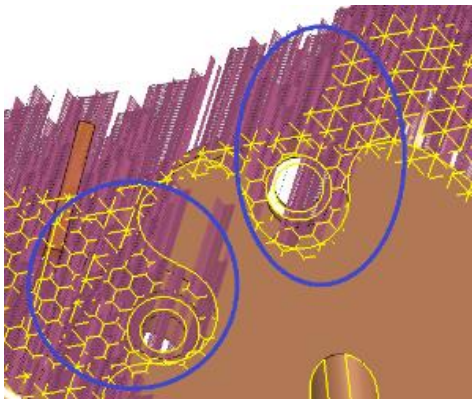
You can again right mouse click any of the regions and press Apply Template, but let's see a quicker way to access the template:

See the dropdown menu at the top left of the Support Manager dialog and list shows all the saved templates.



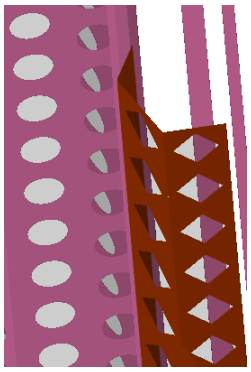
Click the drop down list to select (if there is more than one) the desired template.





Once selecting the template, it is applied to both regions.

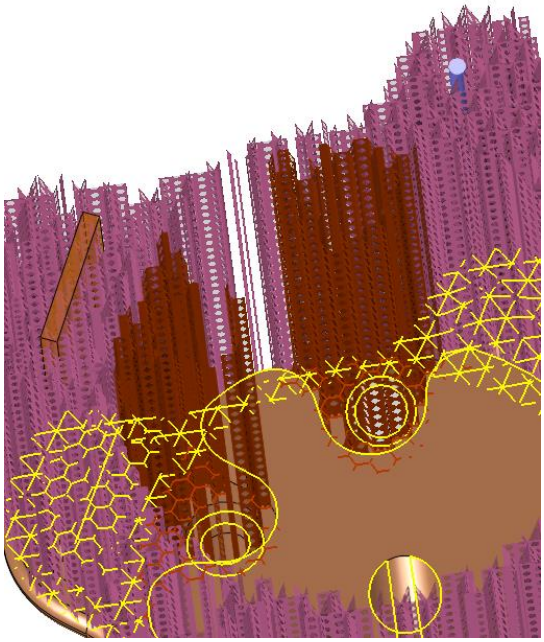
27. Now remember that in steps 24 and 25 of this exercise we modified the support so they now have a different pattern and a different texture (in respect to the saved template.)



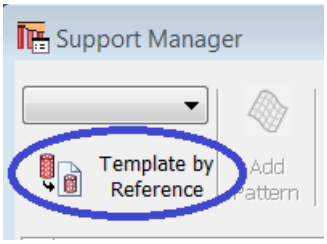
The red support is the original one as applied by the template.
The purple support is the modified .

So let's say that for one of the regions (or both) I want to use the same parameters as in these modified wall support. We will create a support from another reference support, without having a saved template. This is the 'By Reference' way that we mentioned earlier.

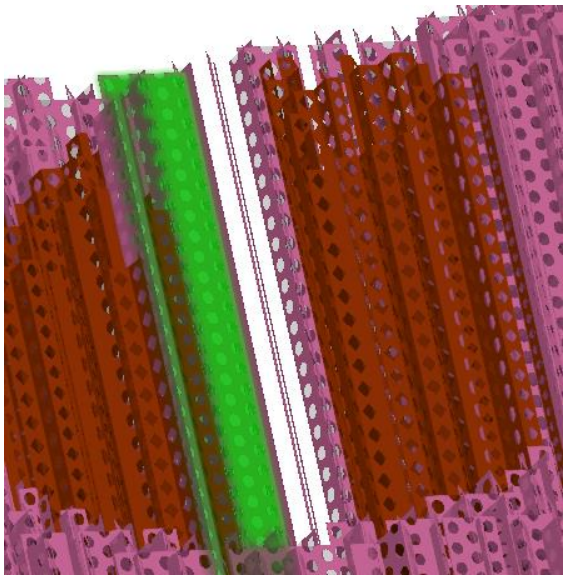
Select the two regions from the screen:



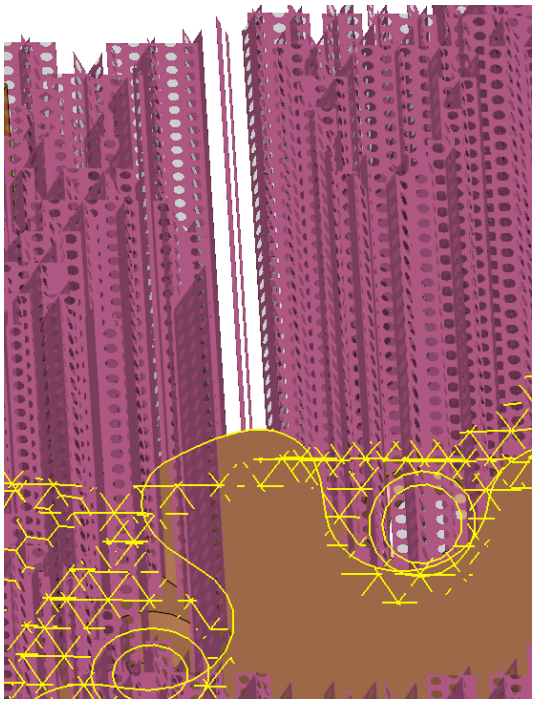
From the Support Manager, hit the Template by Reference button



Now pick the reference support

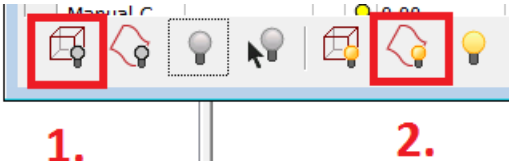


After selection, the supports get the same pattern and support as the reference. See that all supports now have the same pattern and wall texture.

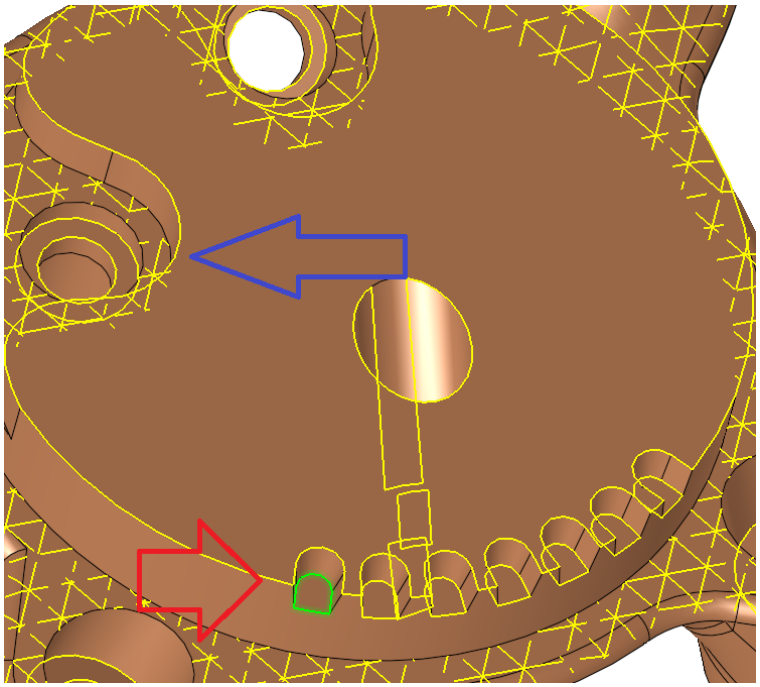


Note: You can also create new supports based on exiting support used as reference, as we will now see.

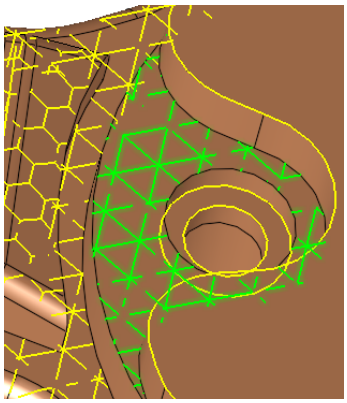
28. Let's show only the regions:



Focus on the region marked in green and a red arrow.

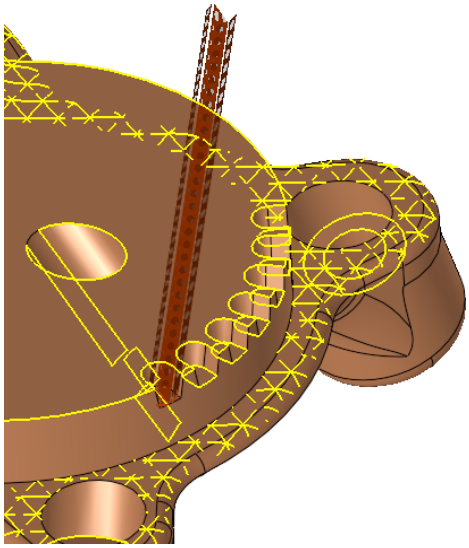


So suppose you want again to use the same wall supports, pick the region, hit 'Template by Reference' and then pick the region marked by the blue arrow.



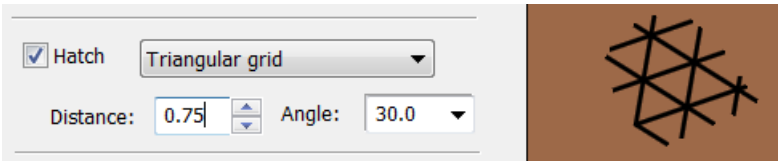
The wall support is created.

29. We will now edit this wall support, so pick it from screen.

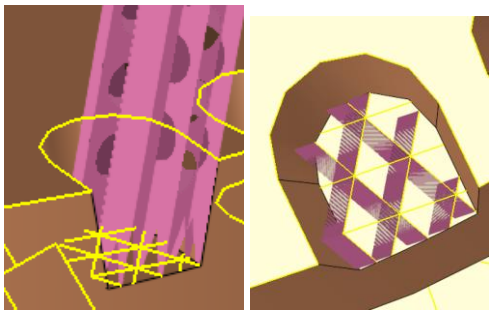


Right mouse click the region and select Edit Pattern. Obviously, we do not need fragmentation for such a small support. Remove the fragmentation by checking it OFF.

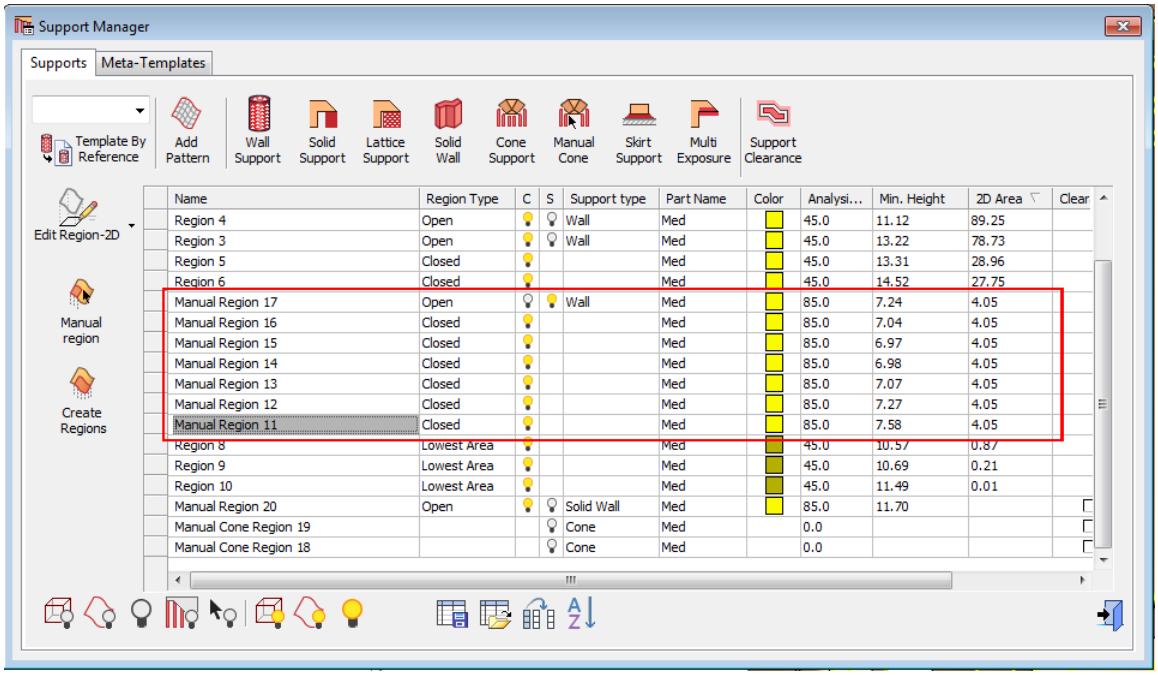
Also, set a smaller distance and change the angle:



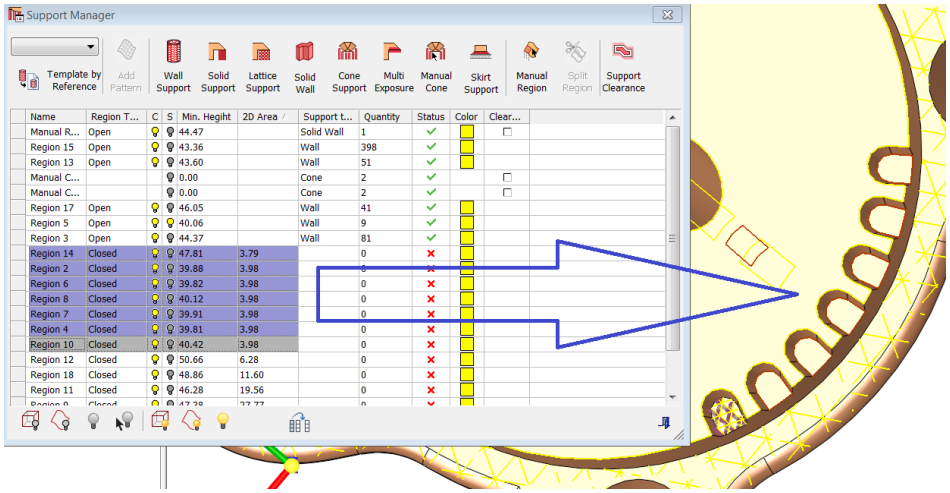
Press OK. Now we have a nice support for this region



30. As you can see on the model, there are additional six similar regions, which we would like to apply the same support. There are several ways to find them on the Support Manager table.
    The first option is to pick the regions from the display. This will highlight each row in the table.
    Another option is to sort the table column. Sort it by the'2D Area' column and pick from the display one of the regions.



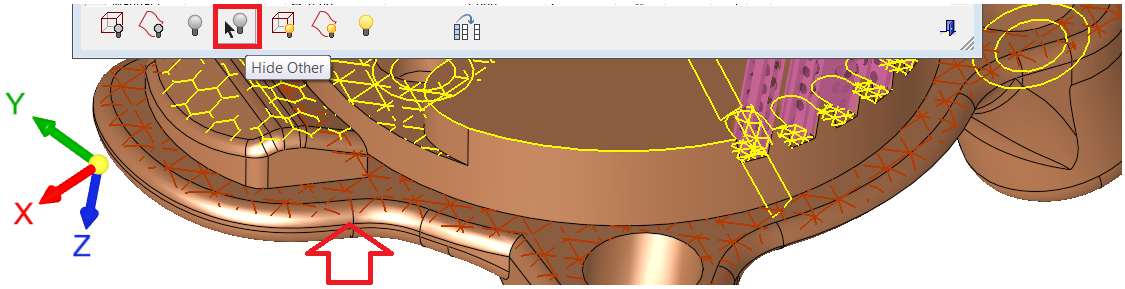
Multi Select them all from the table and see that the correct regions are picked on screen.



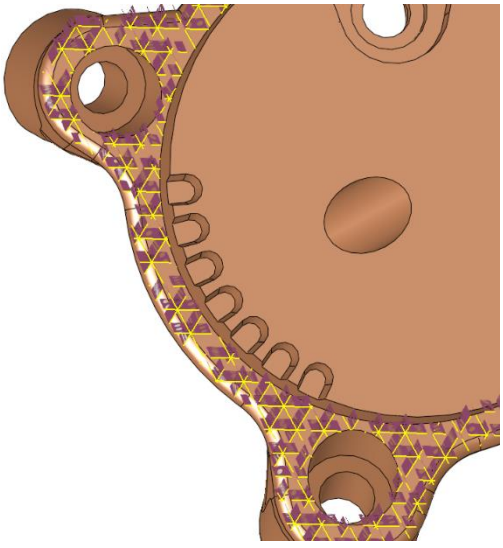
Now press the Template by Reference button and pick the wall support you have just created.

All of the supports were create at once.

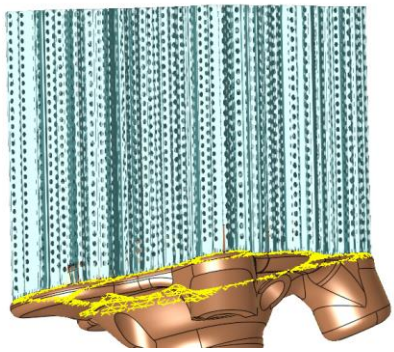
31. Now we want to take a closer look at this bigger region, so we want to hide everything else. Pick the region and click the Hide Other button.



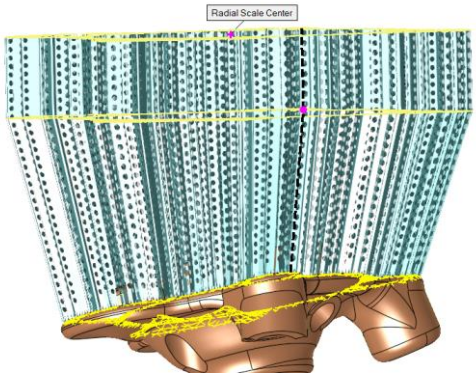
What we see here is that the support is situated very close to the model.
This will make it harder to remove the support.



Right mouse click the region and select Edit Support from the pop up menu.
In the bottom of the dialog switch from Vertical to radial Tilting.

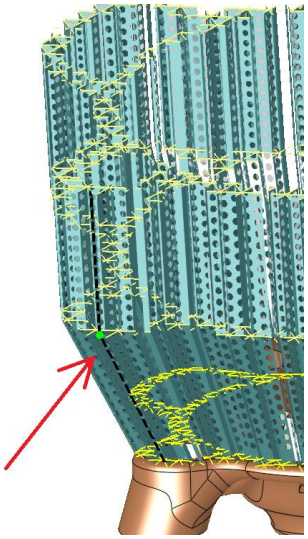


Vertical Support

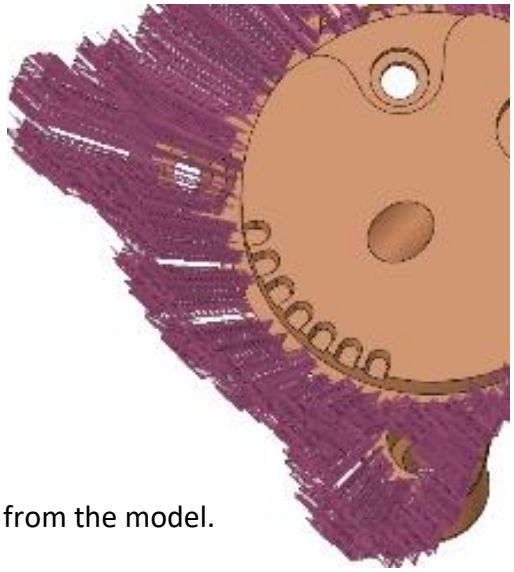


Radial Titling

Set the scaling factor as 1.3.
You can adjust the height defining where the scaling is done. Drag the black line downwards.



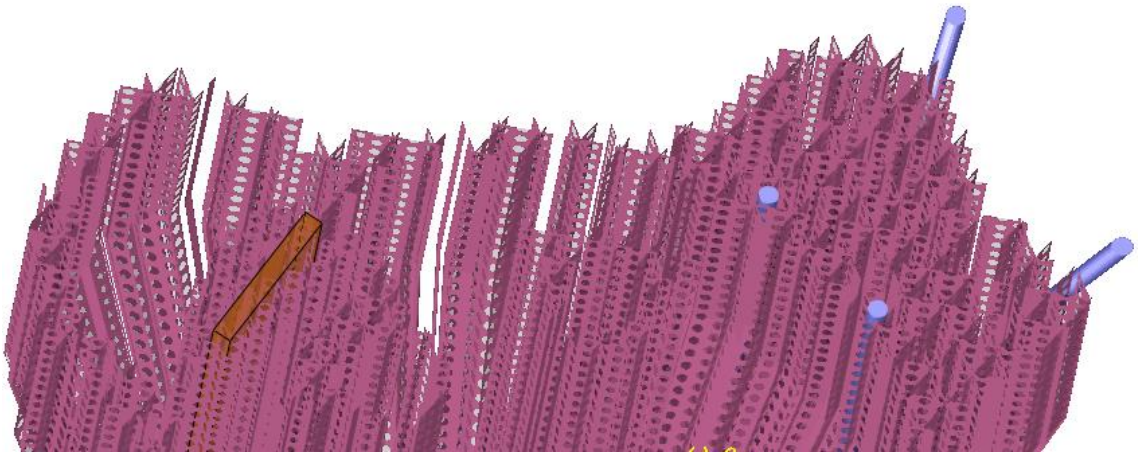
Press OK & hide the region itself. 



You can see now that the support is away from the model.

Note: Tilting of any kind is not kept with the template, as it is not very likely it will be suitable in other location.

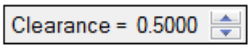
32. The last thing that we want to deal with is the interference between the wall and cone support and the other supports: the solid wall and the cones.



This interference is not wanted when you remove the wall supports – the X shaped cones and the wall support bind a few fragmented clusters together making it hard to remove them. What we want to do is to add a clearance between the wall and cone support and the other supports.

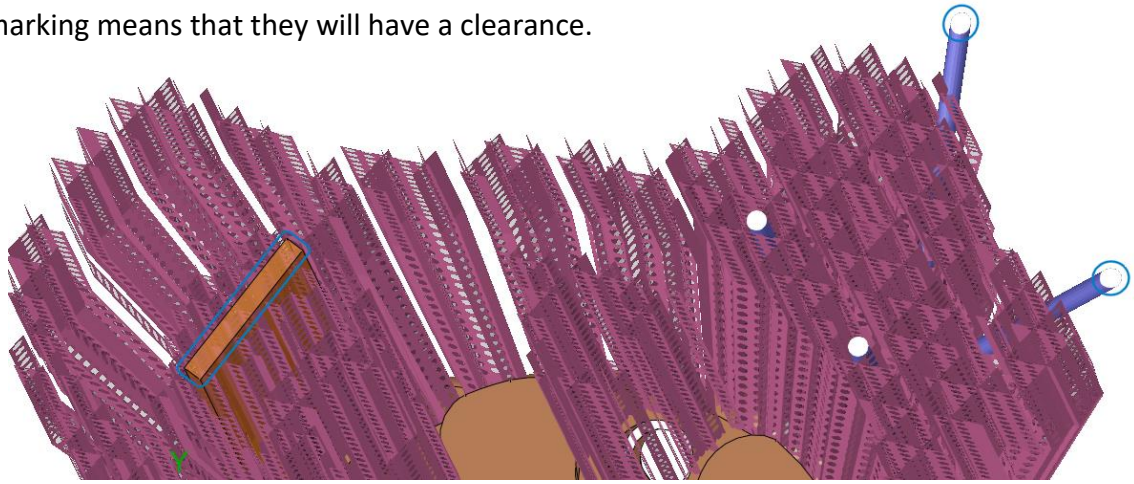
For this purpose, 3DXpert includes the 'Support Clearance' function. From the Support Manager, hit the Support Clearance button.

See that clearance is currently set as 0.5 mm



Pick from screen the solid wall and the two outer cone support and see that the system added a marking around them. We intentionally keep the inner cones without a marking. Press Ok.

This marking means that they will have a clearance.



Note: You do not see the clearance on screen, other than this marking.

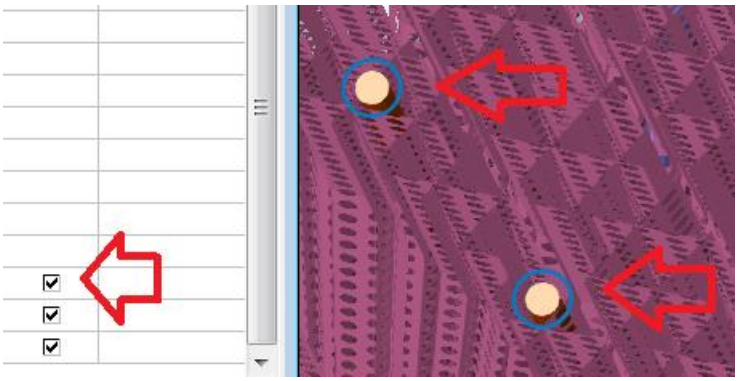
When the Slicer reads the data, it will consider the clearance for each support that has a marking around it and will create an area around it where no supports are printed.

Open the Support Manager and look for the last column - Clearance.

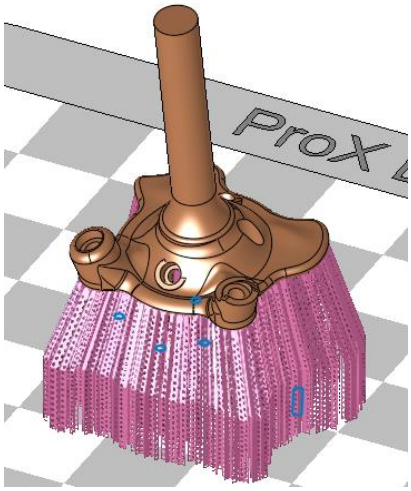
See that one of the Manual Cones regions and the Manual Region for the solid wall have a clearance checkbox set to ON.

Manual Cone Region 19			Cone	Med		0.0			☑
Manual Region 20	Open		Solid Wall	Med		85.0	11.70		☑

Now check ON the box for the remaining Manual Cone Region and see that markings were added to the region's two cone supports:



After the support creation, it is time now to send the model with support to slicing.

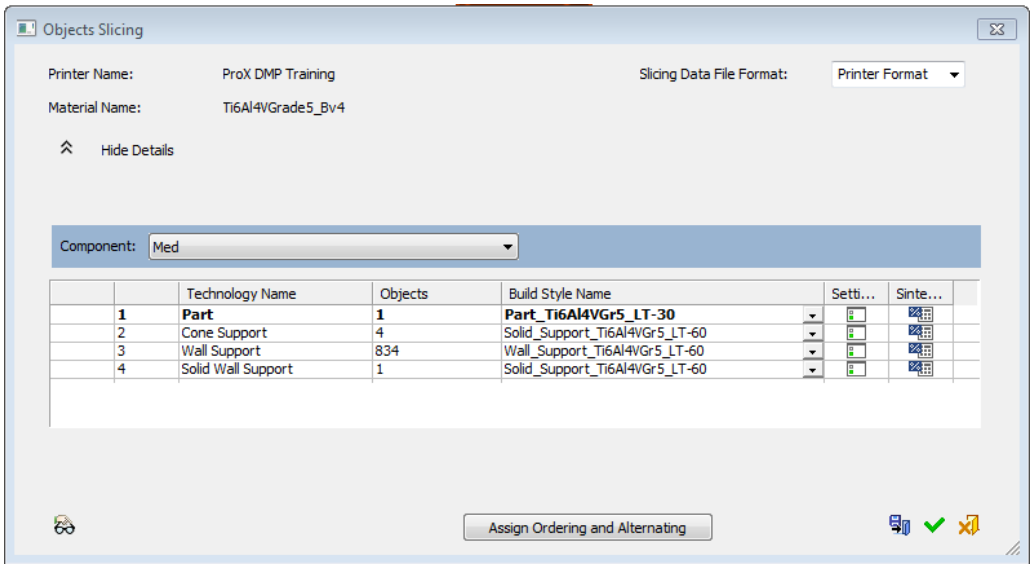


Part 4 – Slicing

33. In the Guide bar, press the Calculate Slices button.

Select everything by box and press the middle mouse button to bring the Slicing dialog.

You can see that we have one part, four cone supports, one solid wall and more than 8 hundred wall supports (the exact number of wall supports may vary depending on the wall pattern type and parameters you have used.

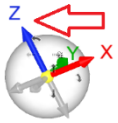


Press OK to calculate. It takes between 1-2 minutes.

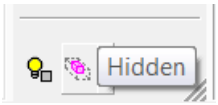
34. After calculation ends, press the Slicer Viewer button from the Guide Bar.

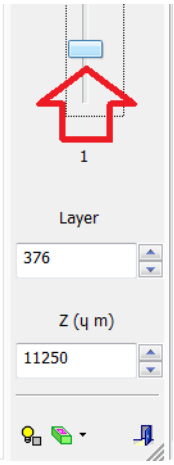
Let's take a look at the slicing of this model.
Move the Slice Viewer navigation bar upwards to see the layers.

Click the Z Axes to switch to Top view.



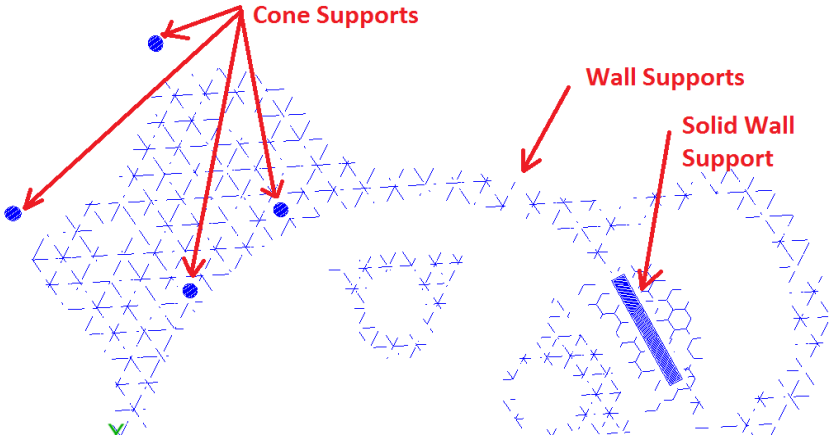
To see only the hatching, press the visibility switch at the bottom of the dialog to Hidden mode





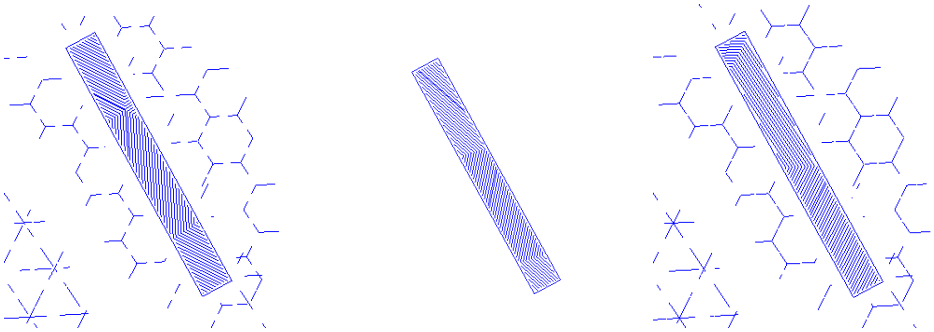
Note: Once moving the bar, you can also move up and down by using the mouse wheel.

In each layer you can see the various supports (or the model, in the relevant layers) being printed according to its own Technology settings.
The Technology settings are pre-defined. What we see here is the result. We will focus here on the supports that we have created in this exercise.



Every time you click the arrows next to the Layer counter, you move one slice up or down.
So move upwards by clicking the arrows and see that the solid wall is printed every three slices, so for example go to Layer 43 and see the hatching for the solid wall (see image above) move one layer up , up again and then to Layer 46 – and the hatching for the solid wall shows up again.

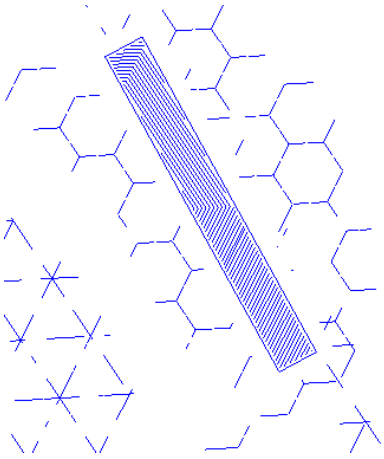
If you observe the hatching pattern in each slice of the solid wall, you will see that it is rotated in respect to the previous solid wall hatching.
This ensures we don't print the exact same hatch lines over and over again:



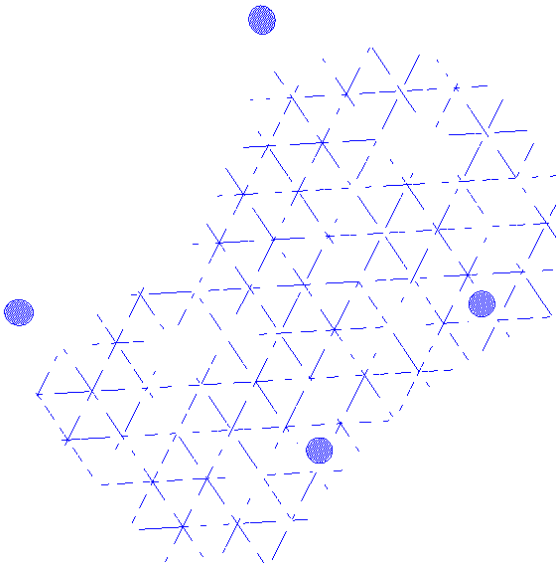
Layer 43 Layer 46 Layer 49

In the same manner you can see that the Wall Supports are printed every two slices,
so the hatching for both the solid wall support and the wall supports do not meet in each layer, but rather once every six layers.

When the hatching of the solid wall support and the wall supports meet, you can see the offset around the solid wall support, as you have defined earlier:



The cone supports are printed every two slices, so they meet the wall supports every two slices. Also here, in each layer you can see that there is an offset around the cone supports.



Press the Slice Viewer Exit button. Save the file.

End of Exercise