Use Direct Modeling in Fusion 360 to Take Your Models to the Next Level

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Class summary

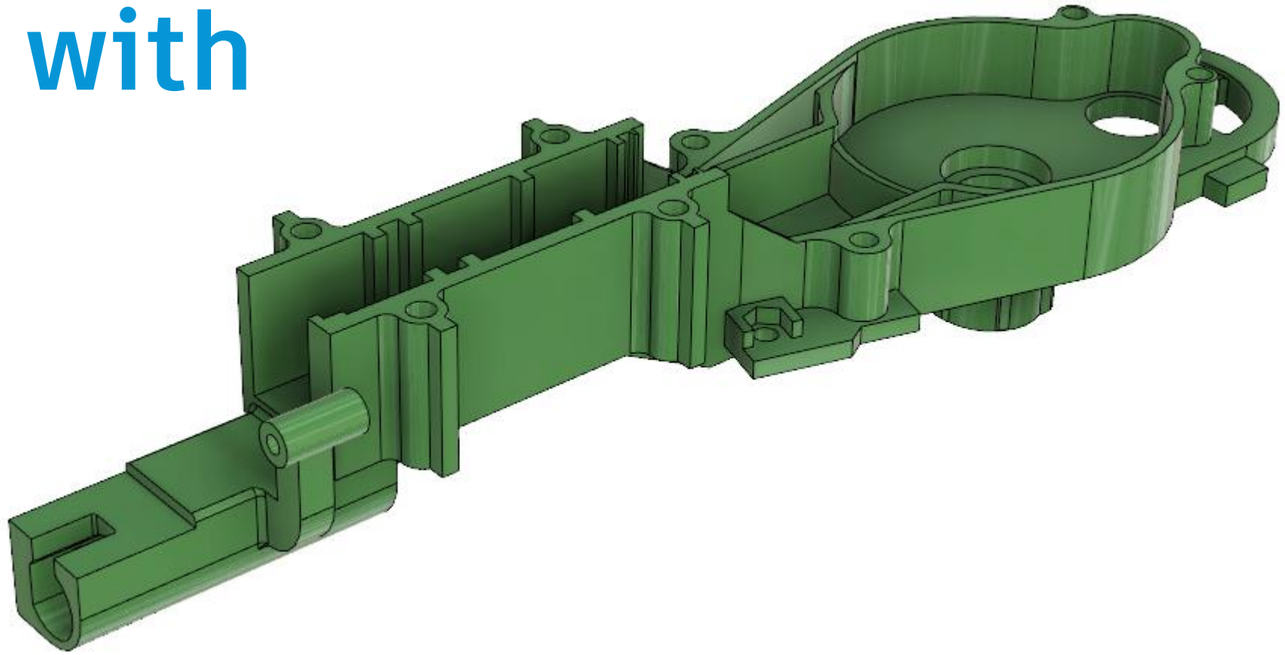
Learn how to use Direct Modeling techniques to make changes to history-based or history-free models, de-feature models, heal corrupt models, and even model “in context” using Direct Modeling techniques.

Key learning objectives

At the end of this class, you will be able to:

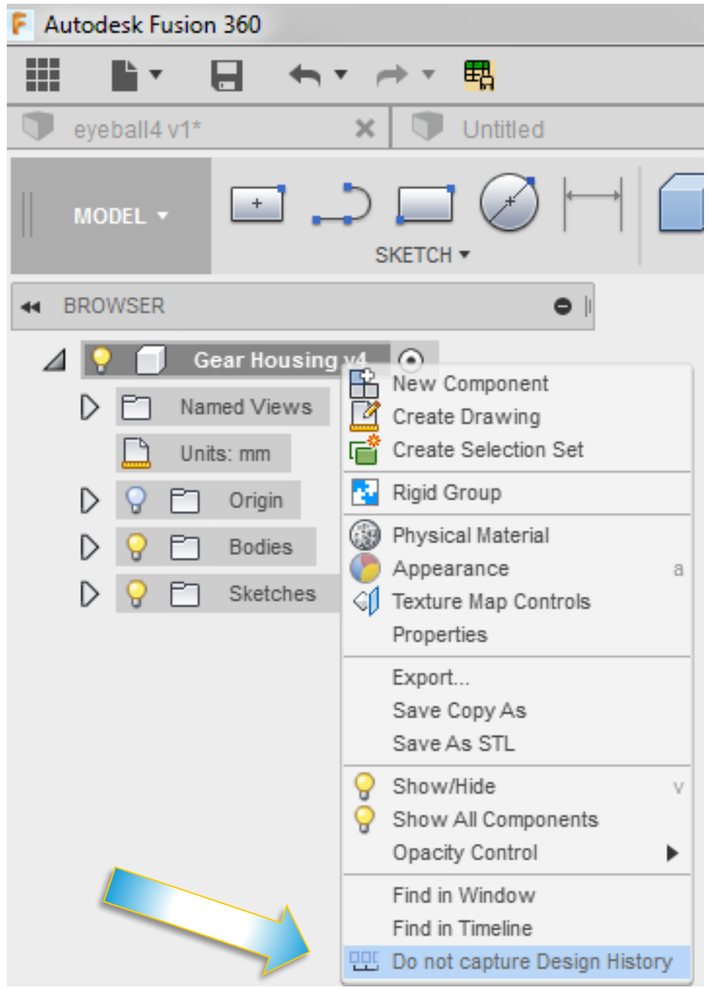
- Use Direct Modeling to move features on a model
- Recognize and remove features off of a model
- Use Direct Modeling techniques to heal corrupt models
- Use Direct Modeling techniques to create in-context designs

Modifying geometry with Direct Modeling



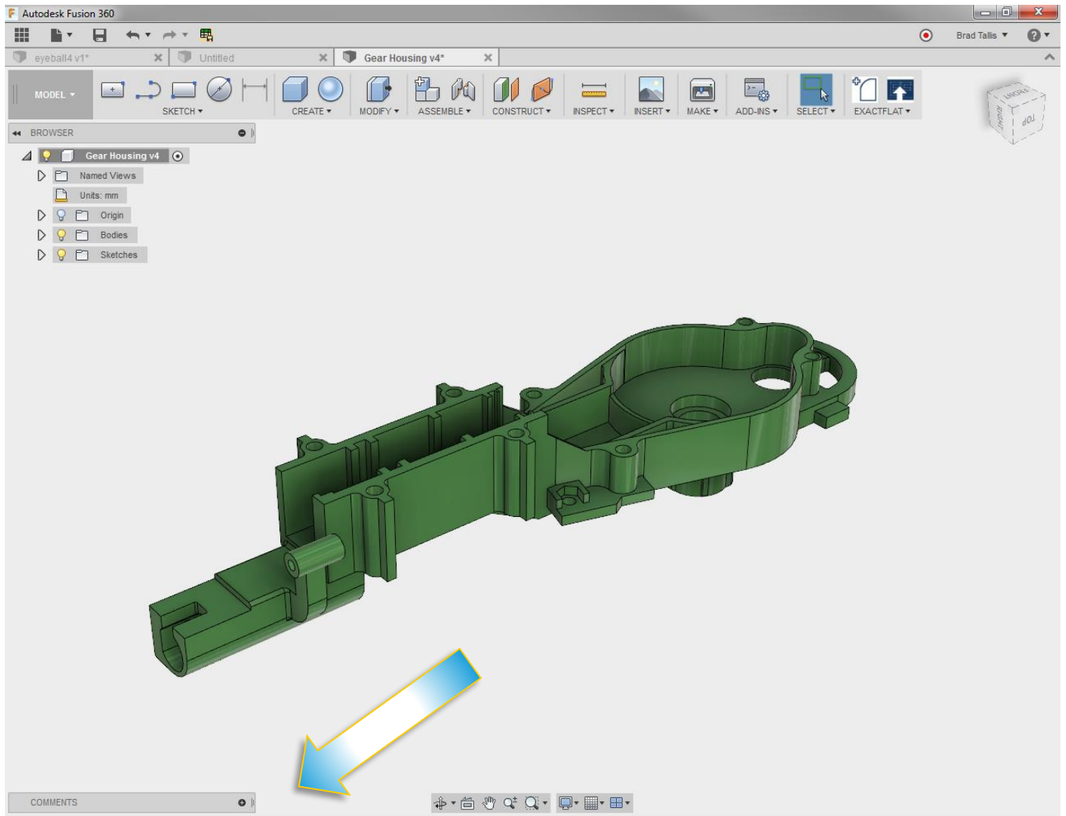
Switch into Direct Modeling Mode

- If working with Fusion 360 data and you want to edit the model with Direct Modeling techniques, you need to first switch into Direct Mode.
- Warning! This will remove all your “history” and it will not come back.
- To switch into Direct mode, right-click on the top-level part or assembly in the browser and select “Do Not Capture Design History”



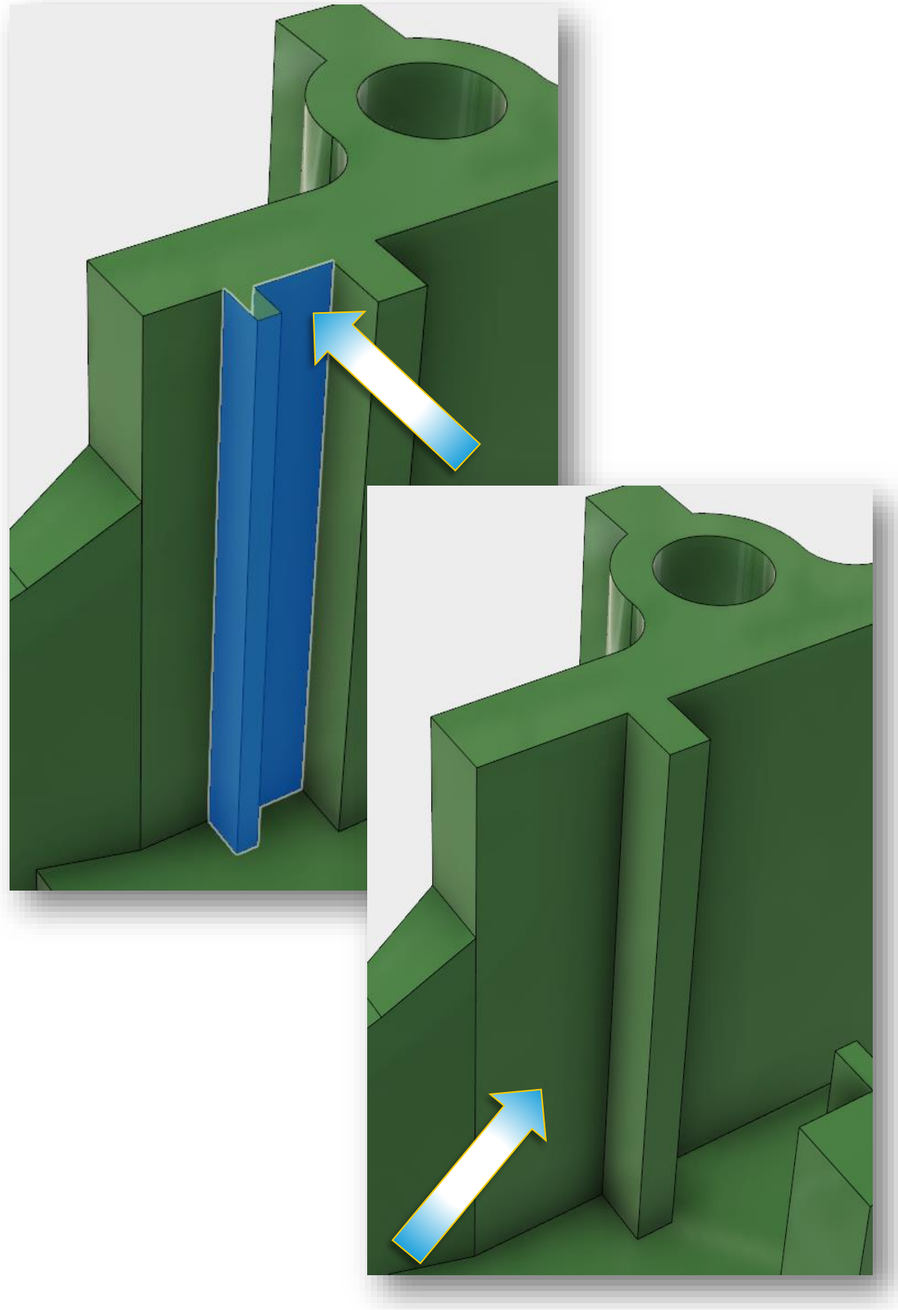
Switch into Direct Modeling Mode

- Now that you are in Direct Mode, notice there is no timeline along the bottom of the screen



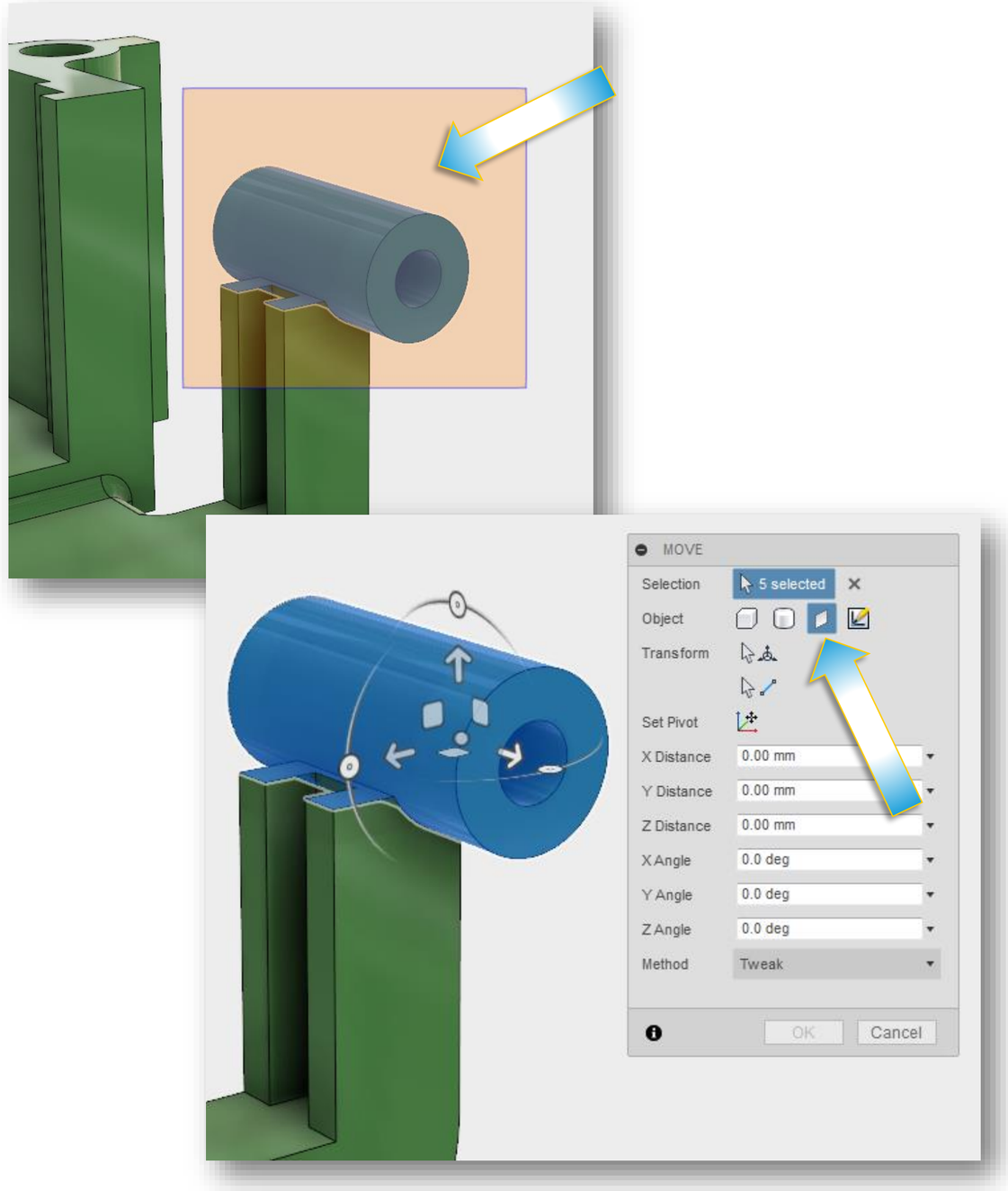
Delete faces

- We want to remove the small ribs
- Select the highlighted faces (4 in total) in the image and press the Delete Key on your keyboard
- Notice that we also had to select the larger horizontal face (highlighted by the arrow). This is because we want the existing horizontal green face to “grow” to the larger rib
- Repeat the same on the other rib



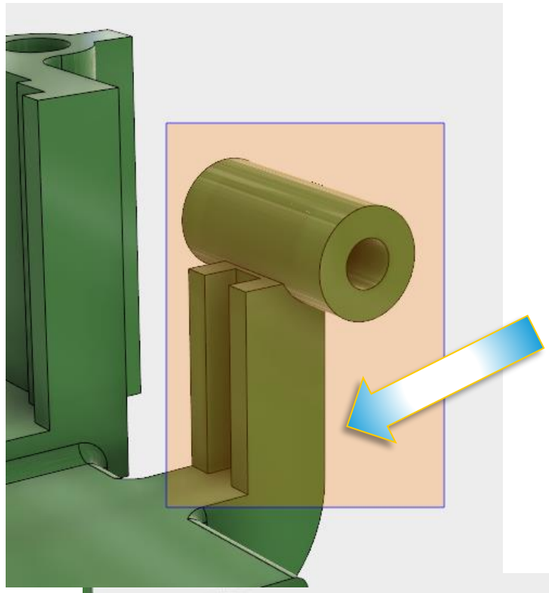
Move faces

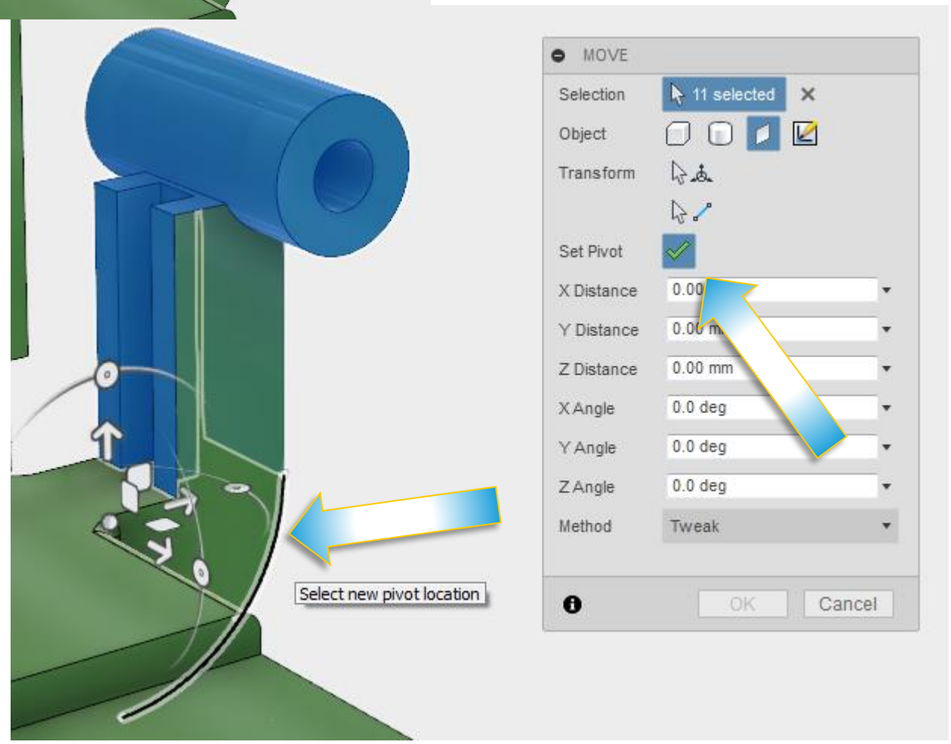
- Draw a selection box around the cylindrical faces as shown
- Right-mouse-click and select **Move**
- Make sure that Faces is selected in the object section of the move menu
- Drag the vertical move arrow down and watch how all the cylindrical geometry moves down



Rotate faces

- Draw a selection box around the cylindrical faces and vertical faces as shown
- Right-mouse-click and select **Move**
- Select **Set Pivot** and select the curved edge as shown in the picture
- Make sure you un-check Set Pivot once you have selected the edge

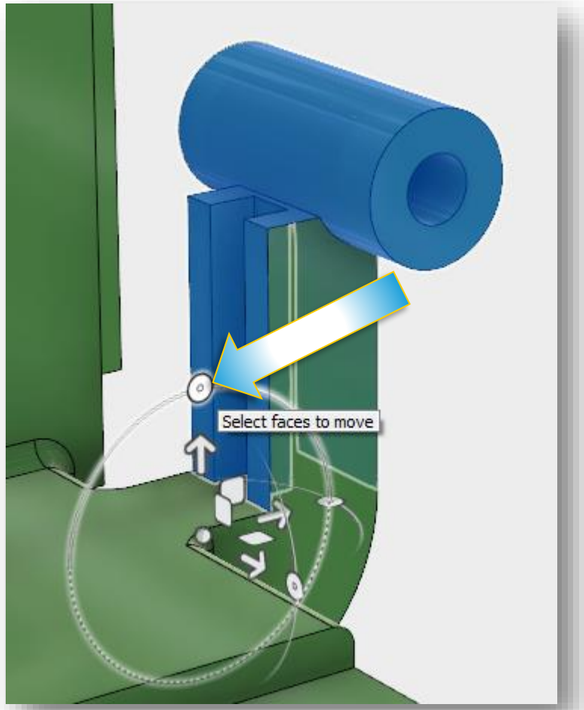


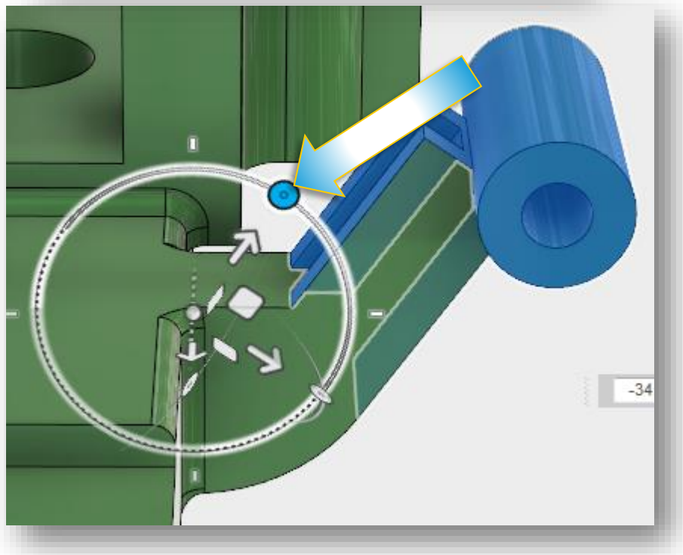


Continued...

Rotate faces - continued

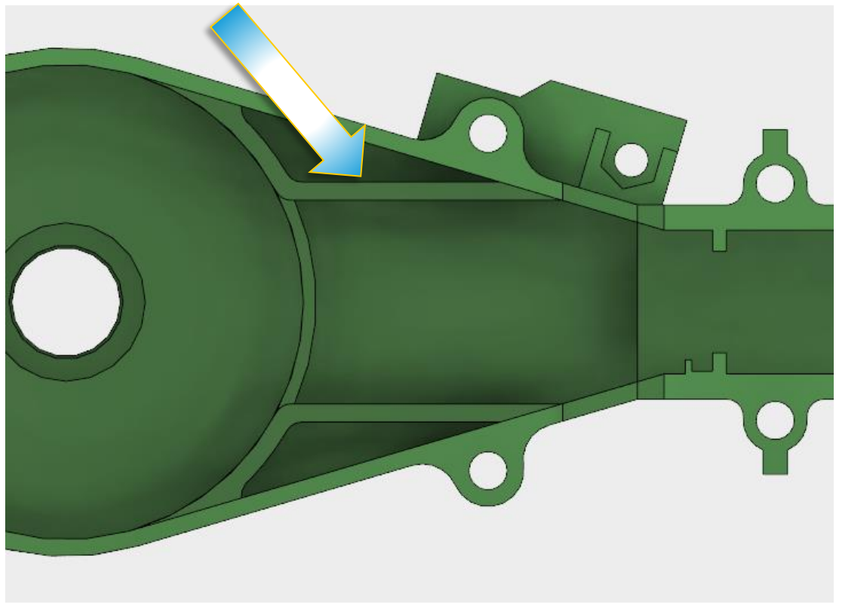
- Now grab the rotate handle of the “triad” and watch how all the faces rotate around the pivot
- Notice the curved blend at the bottom of the standoff is keeping tangency

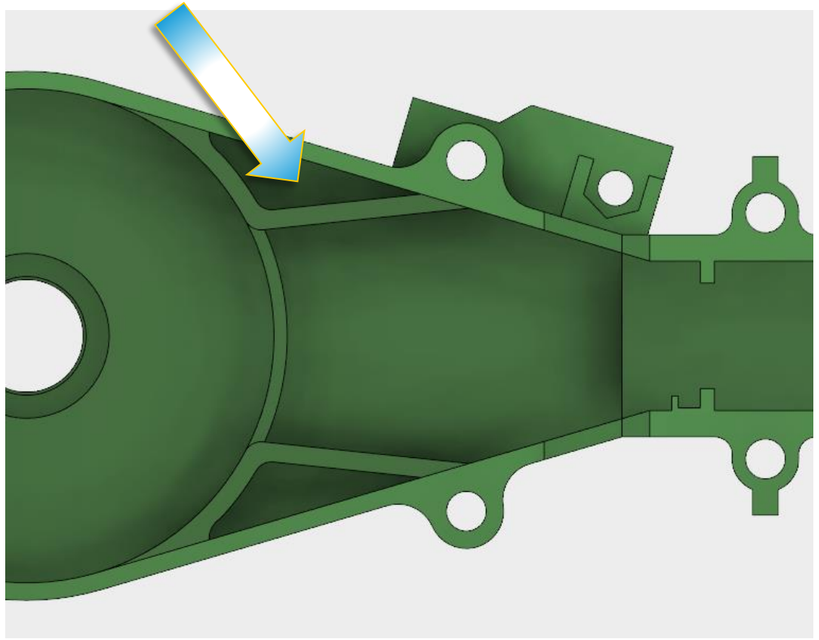




Rotate ribs

- We want to rotate the existing ribs to be more inline with the circular stand-offs
- Lets rotate these ribs a few degrees to be more structurally sound

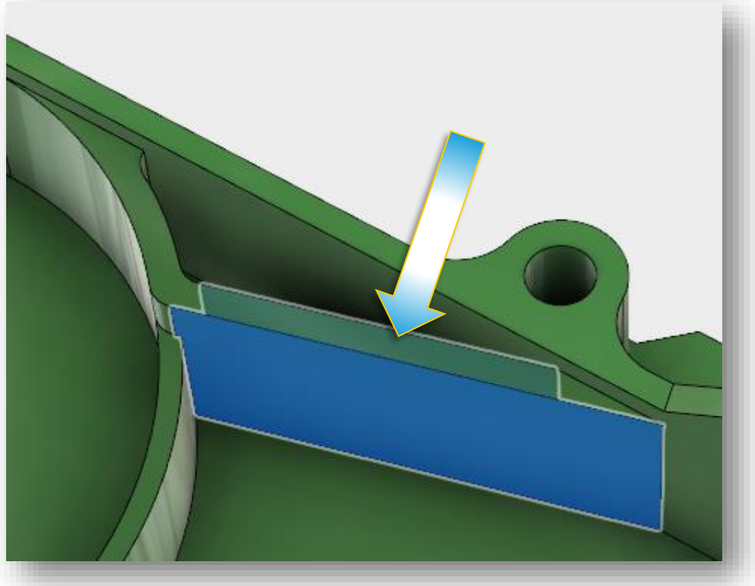


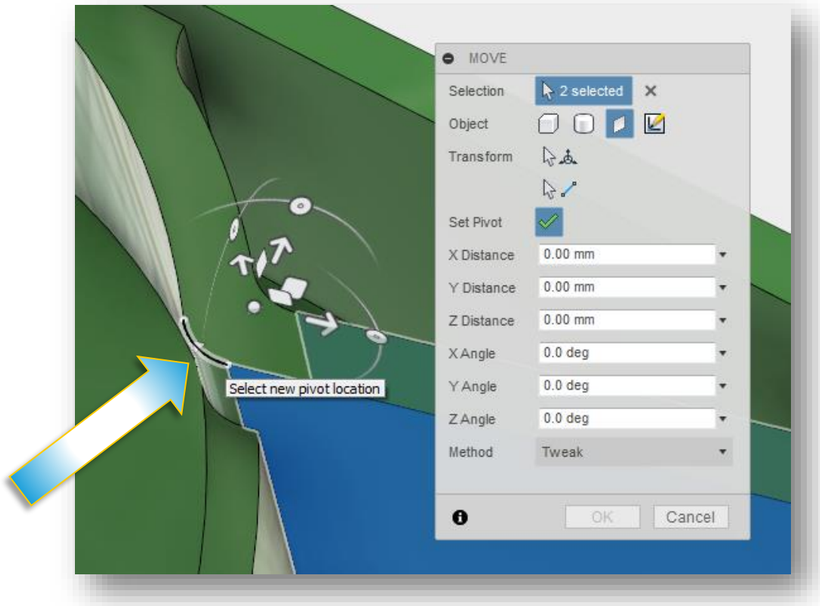


Continued…

Rotate ribs – continued…

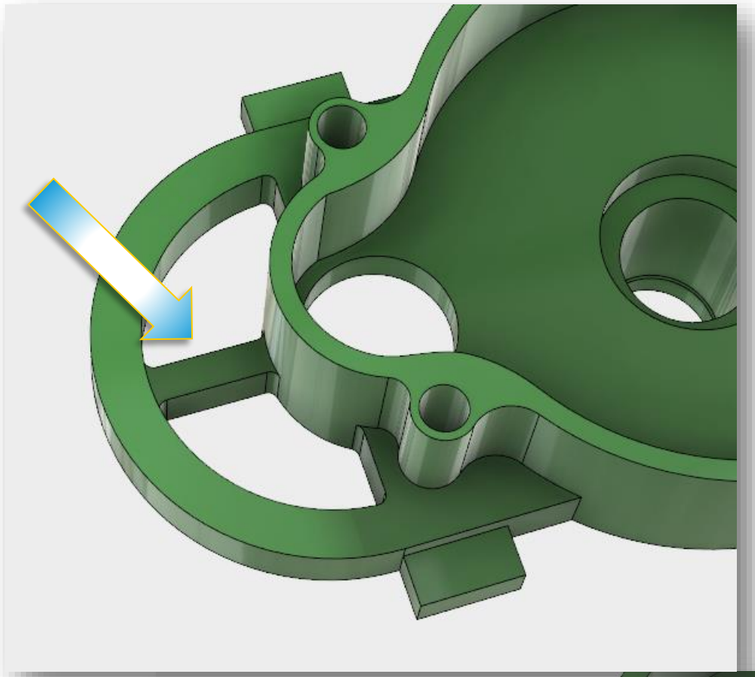
- Select the two vertical faces defining the rib
- Select **Set Pivot** and select the edge of the blend at the end of the rib
- Un-Select **Set Pivot** and then rotate the rib 6 degrees
- Repeat for the other rib

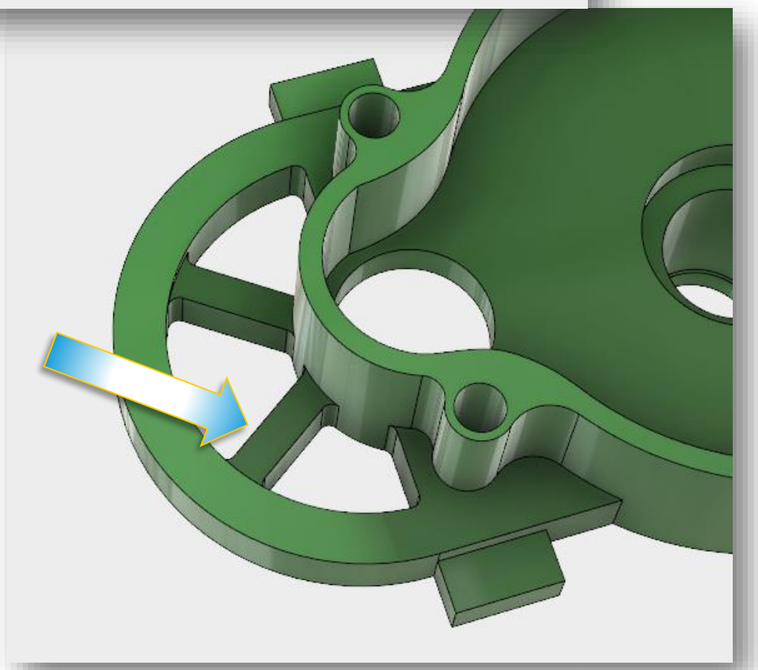




Re-using existing geometry

- We have run an analysis on this part and determined that the one support on the front is not enough
- We will use Direct Modeling to “re-use” by rotating existing geometry and then mirroring that feature

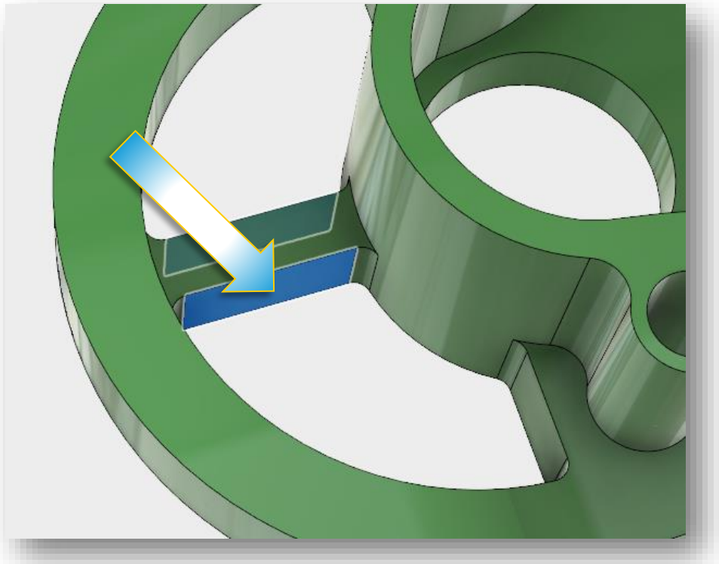


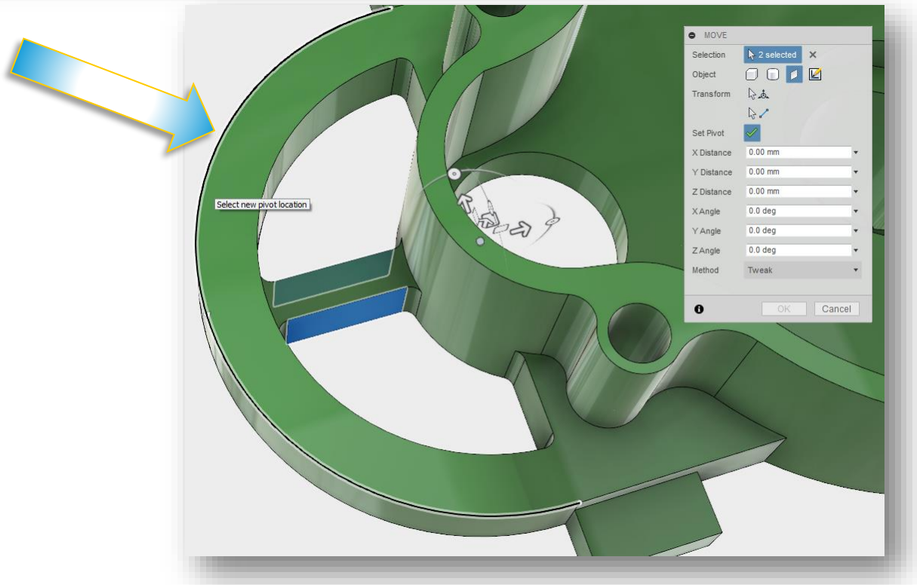


Continued…

Re-using existing geometry - continued

- Select just the two vertical faces of the rib. You do not need to select the blends
- Right-click and select **Move** and make sure the **Faces** option is selected.
- Select Set Pivot and select the outer edge of the circular rib

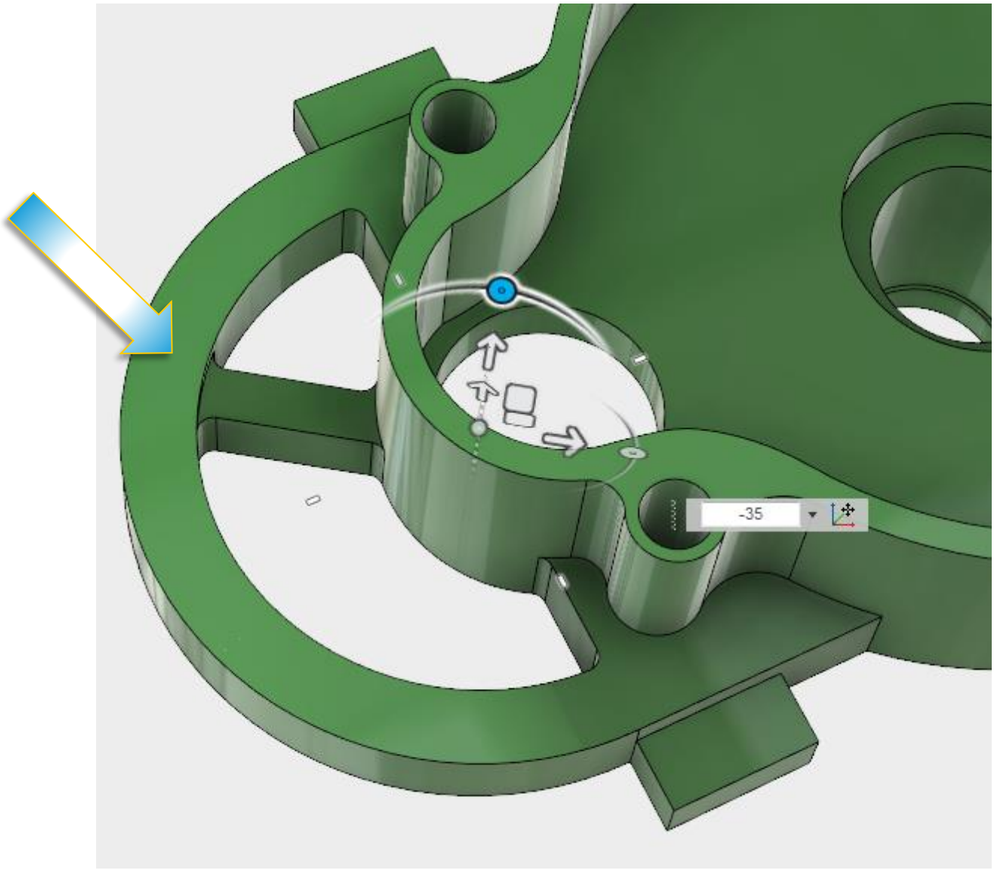




Continued…

Re-using existing geometry - continued

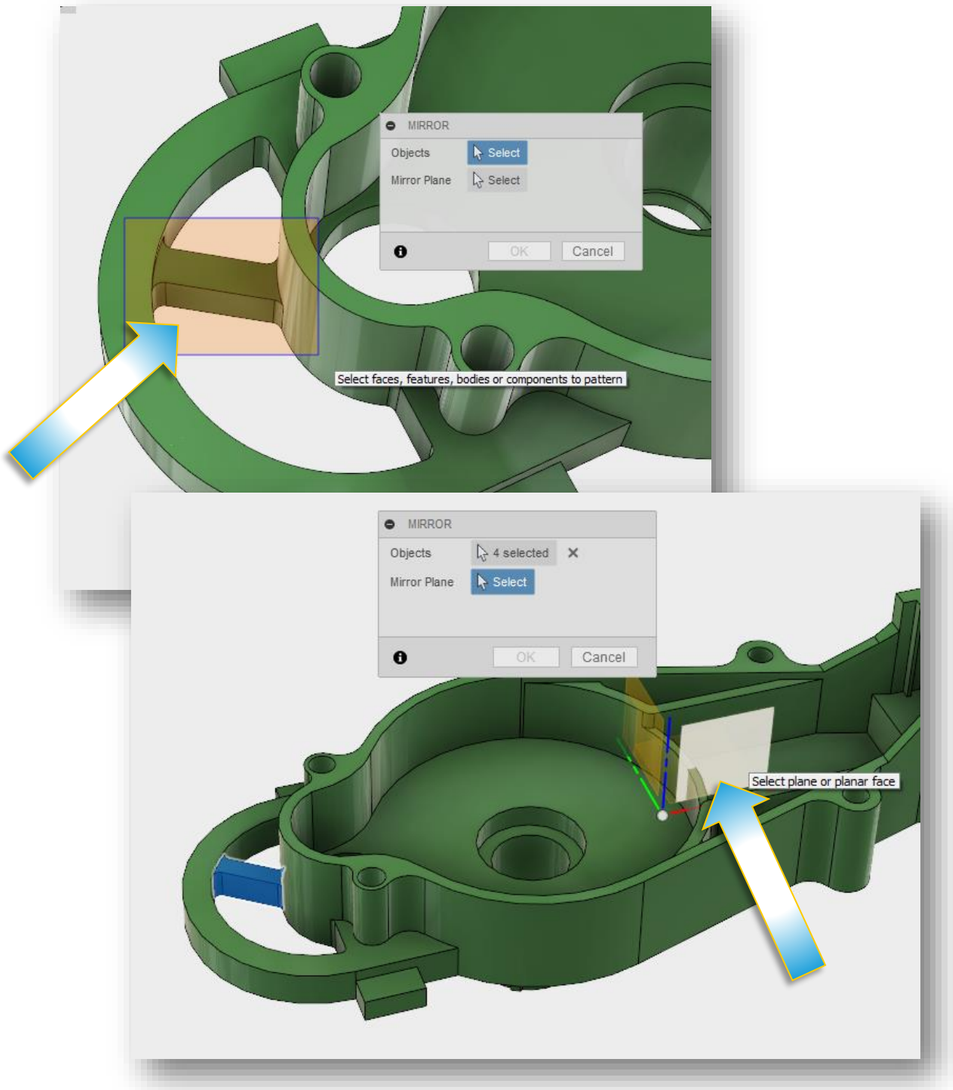
- Rotate the rib -35 degrees and then press **OK**
- Notice how we were able to move the existing rib and it's blends using Direct Modeling



Continued…

Re-using existing geometry - continued

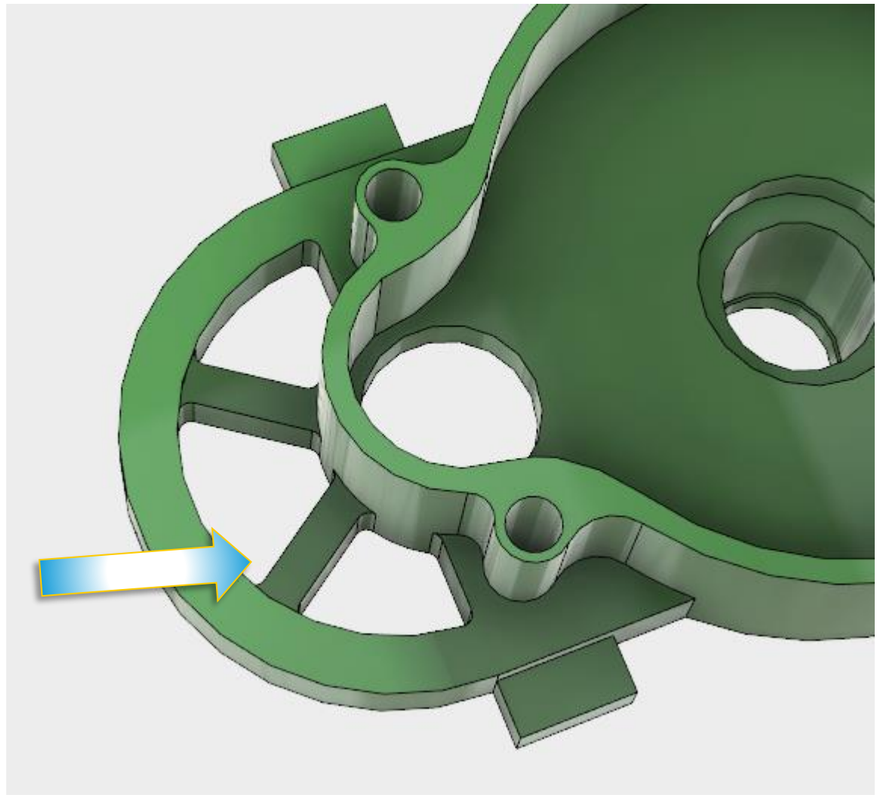
- Under the **Create** menu, select **Mirror**
- Draw a selection box around the rib and it's blends
- Then select the **Front** origin plane (XZ Plane) as the mirror plane
- Press OK to complete the mirror



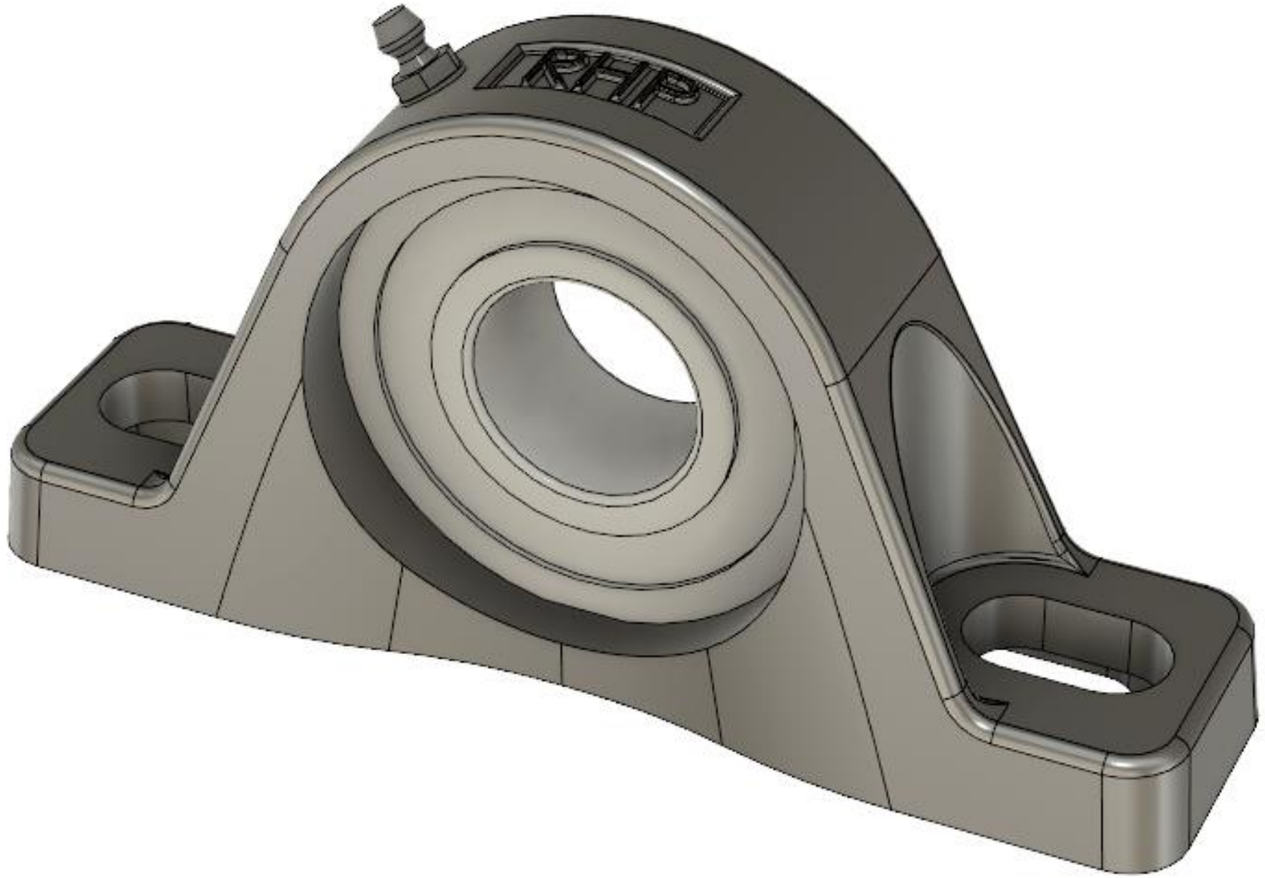
Continued…

Re-using existing geometry - continued

- Notice we were able to re-use existing geometry to create a new rib without having to create a sketch or machine away old geometry to create new geometry

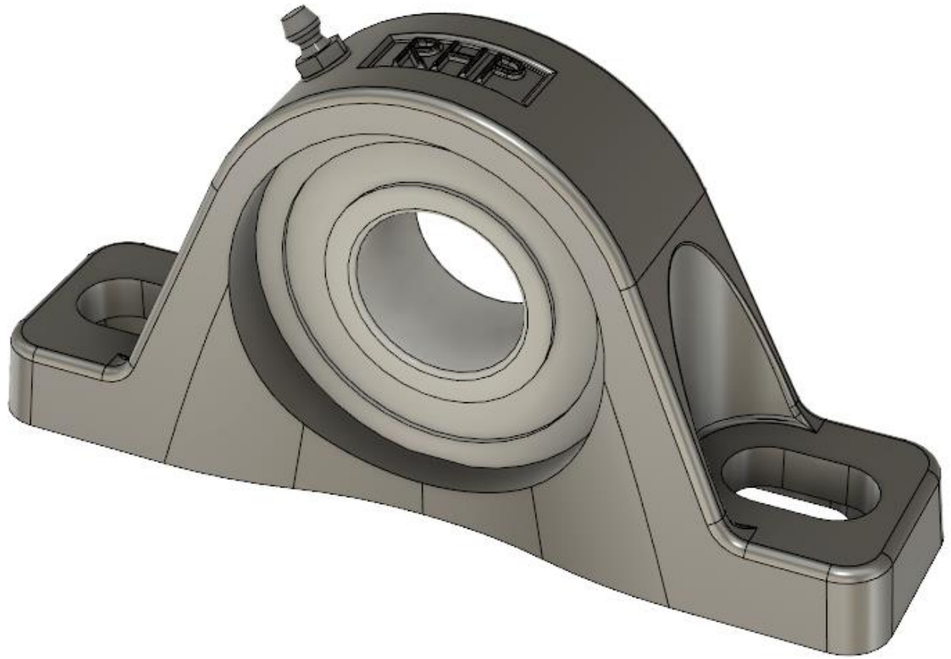


De-featuring imported geometry



De-Featuring imported geometry

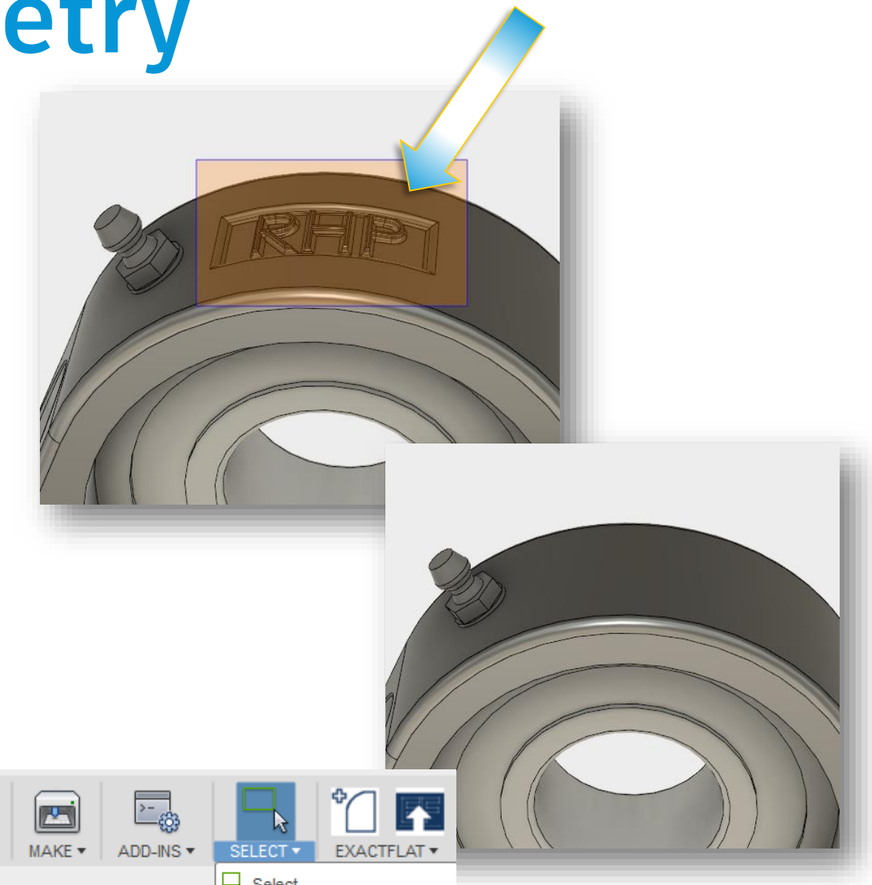
- When you import geometry from other cad systems, such as Pro/E, Solid Works, etc, it comes into Fusion 360 in Direct Modeling mode
- In this example, we will be de-featuring an imported Solid Works model.

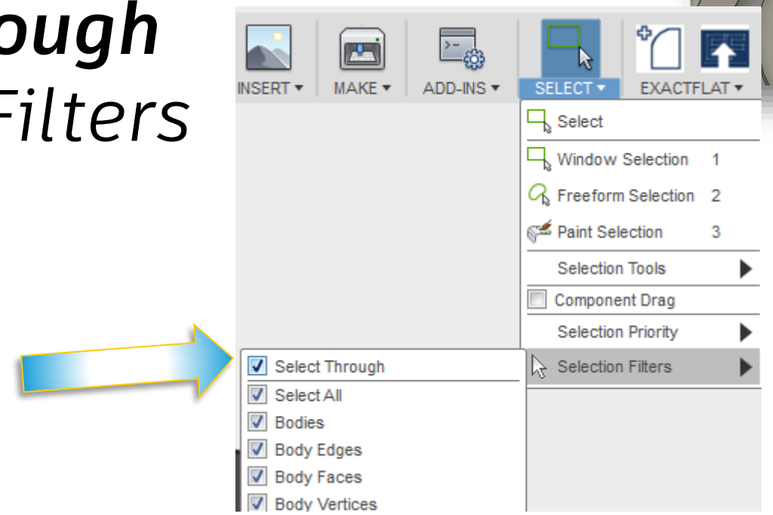


De-Featuring imported geometry

- We want to remove the logo at the top of bearing block
- Draw a selection box around the logo and hit the **Delete** key on your keyboard

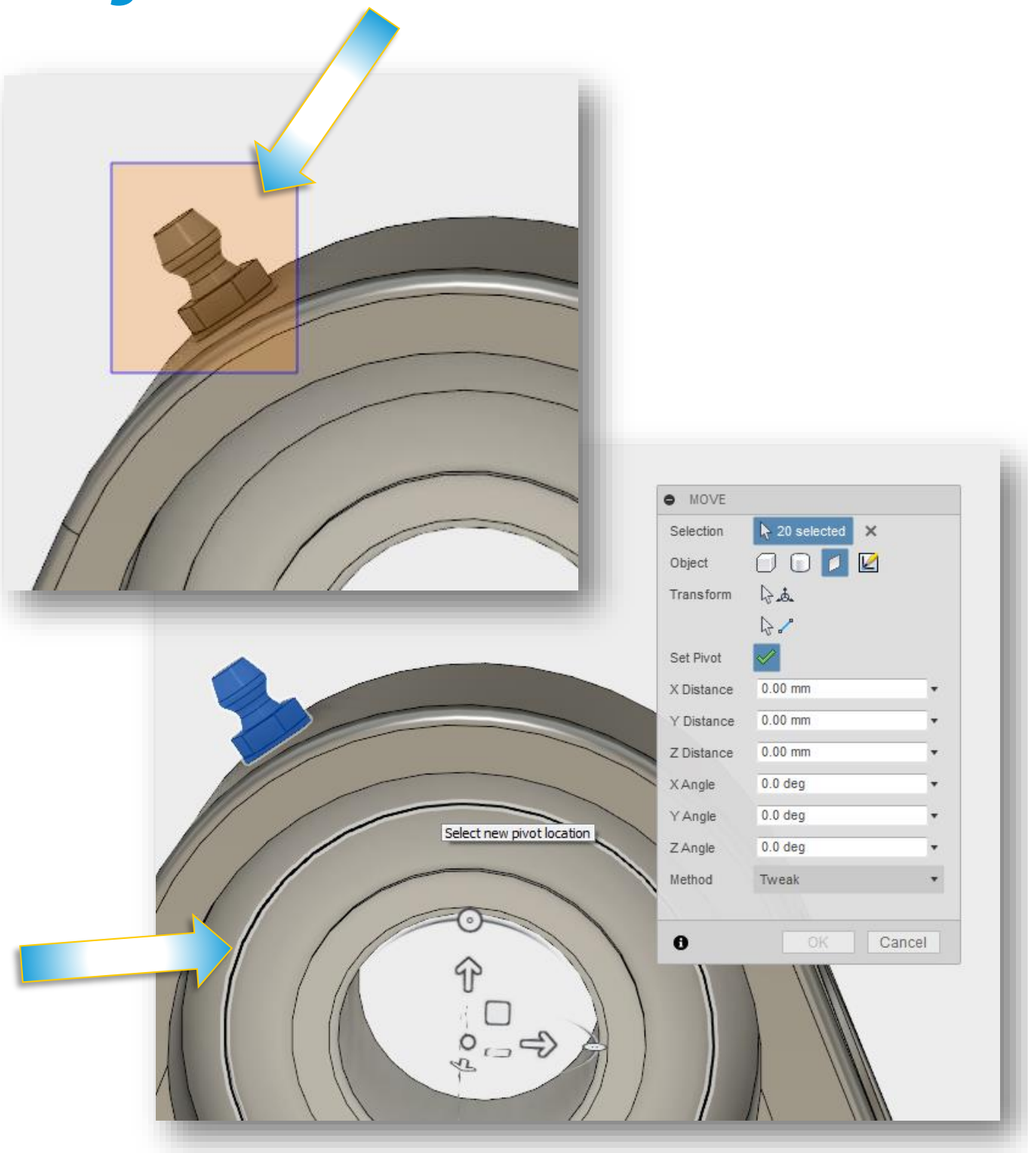
- Note: *Make sure **Select Through** is checked in the Selection Filters section of the Select menu*





De-Featuring imported geometry

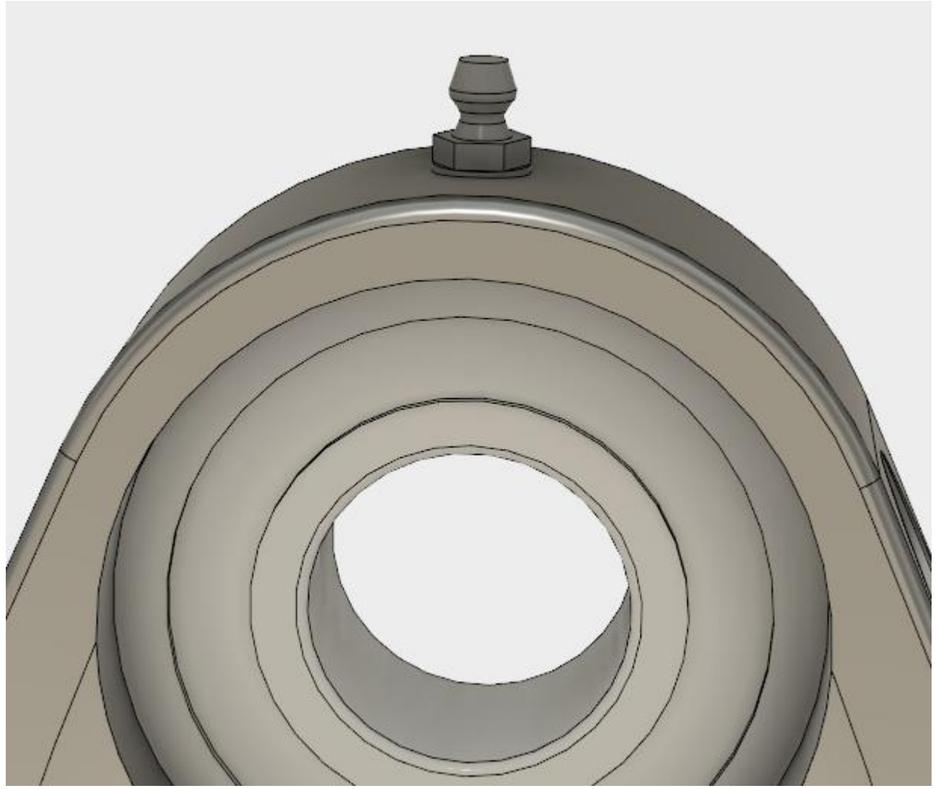
- Now we want to move the grease zerk to the top of the bearing
- Draw a selection box around the grease zerk
- Right-mouse-click and select **Move**
- Set the **pivot** around one of the circular edges of the bearing



Continued…

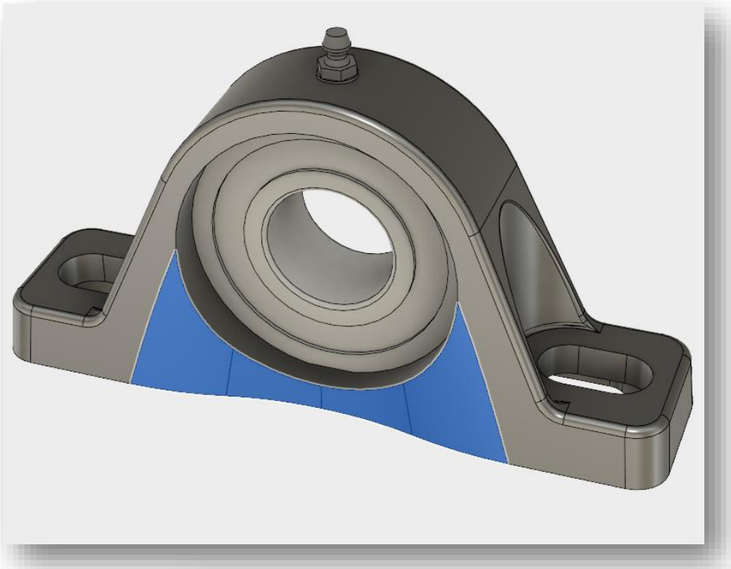
De-Featuring imported geometry

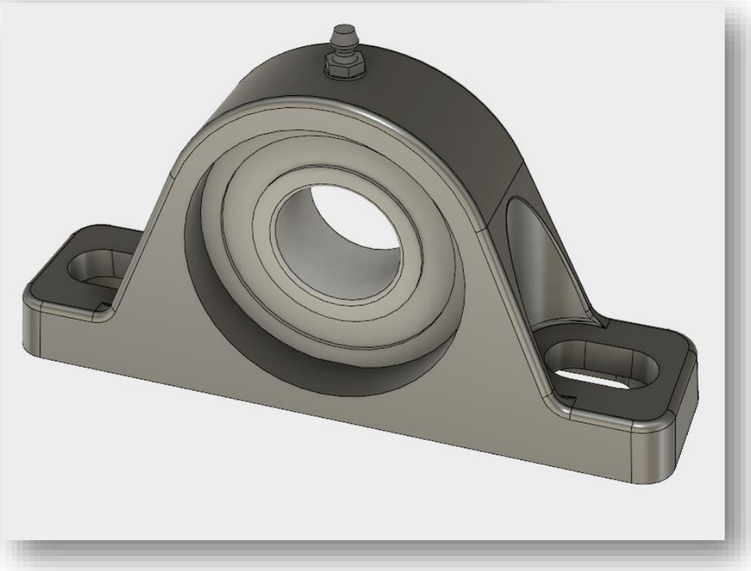
- Rotate the grease zerk **-35** degrees and click **OK**
- The grease zerk is now at the top of the model



De-Featuring imported geometry

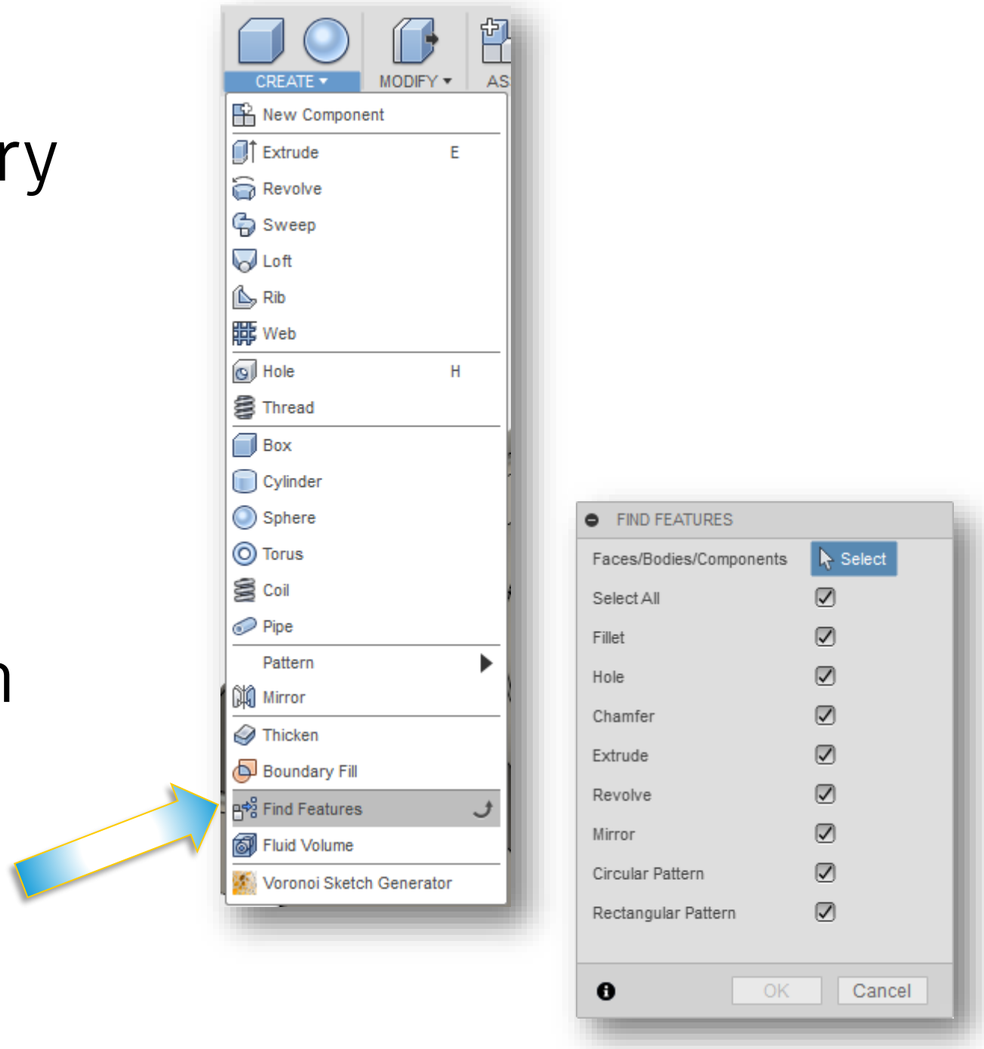
- We now want to remove the curved faces on the front and back of the bearing block
- Cntrl-click the four curved faces and then press the **Delete** key on the keyboard
- Repeat on the faces on the back side





De-Featuring imported geometry

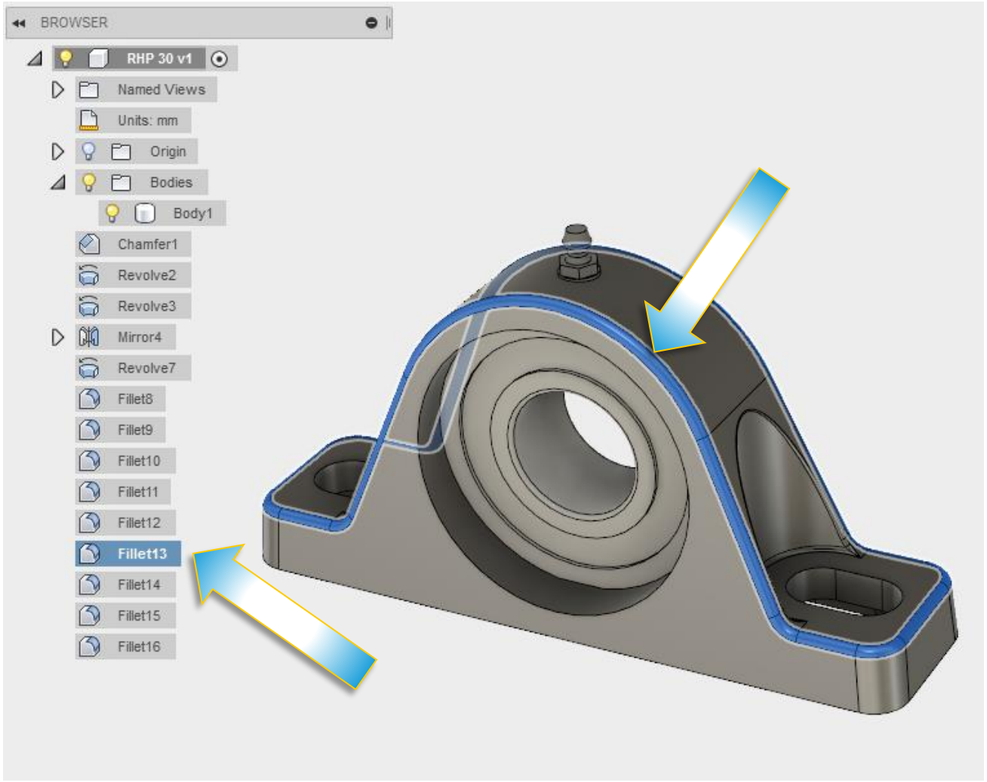
- We can also “recognize” geometry features such as fillets, chafers, holes, etc.
- Under the **Create** menu, select **Find Features**
- A menu appears allowing you to select what you want to “find” in your model



Continued…

De-Featuring imported geometry – continued

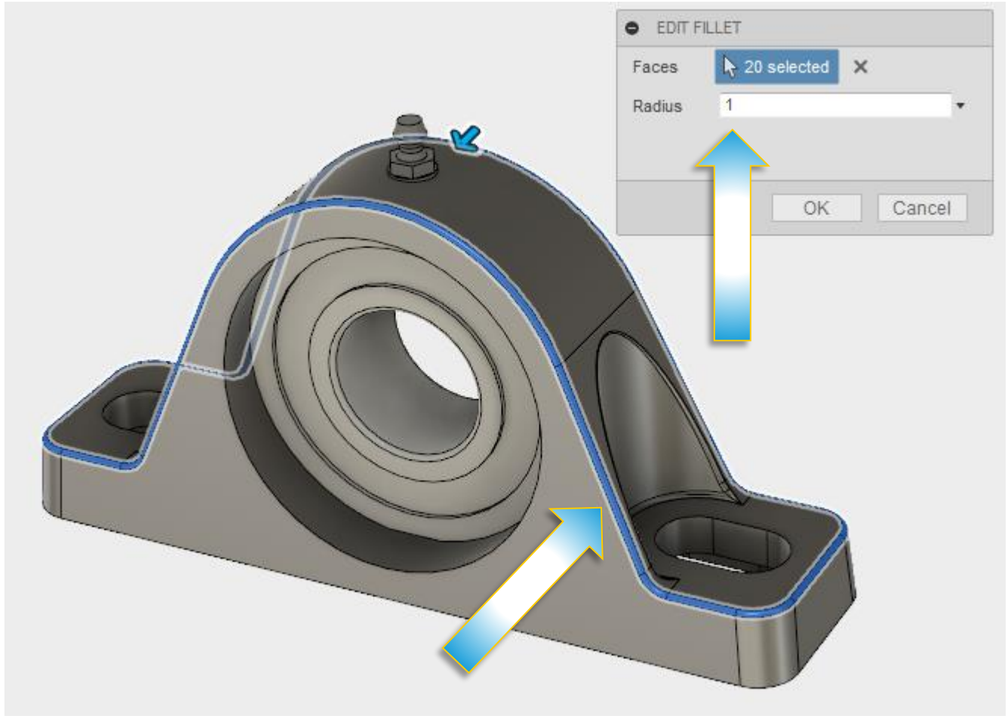
- Draw a selection box all the way around your model and press **OK**
- After a moment, you will see a list of features that was found in your model listed in the browser
- Click on one of the found features to see it highlighted on the model



Continued…

De-Featuring imported geometry – continued

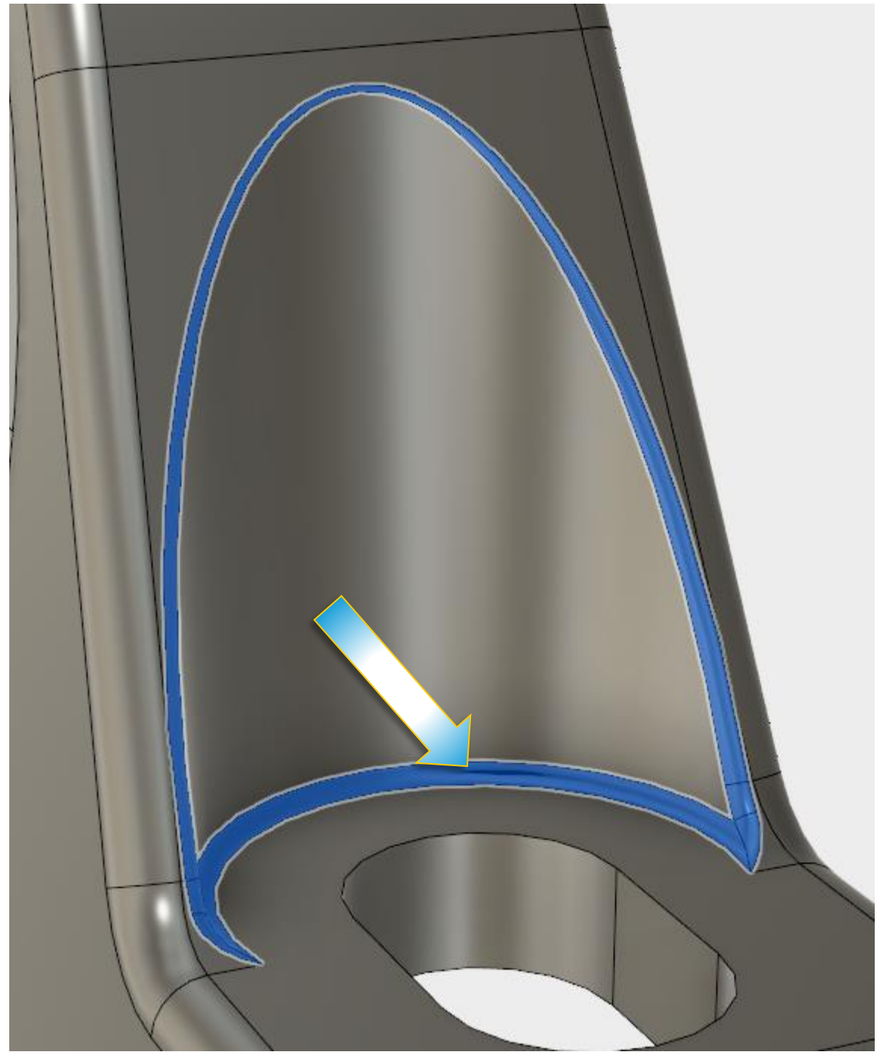
- Double-click on one of the features in the Browser to “edit” it
- Change the size of one of the fillets, for example



Continued…

De-Featuring imported geometry

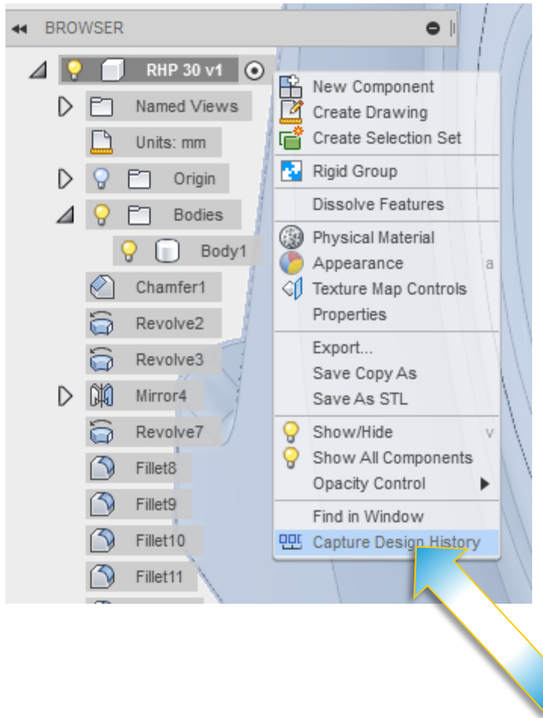
- Now we want to show how we can capture design history on an imported model
- First, cntrl-select the small blend faces as shown in the image (6 in total)
- Press the **Delete** key on your keyboard
- Notice how the blend is removed and geometry healed

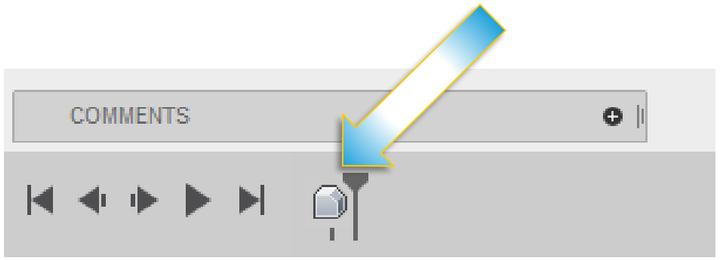


Continued…

De-Featuring imported geometry

- Right-click on the name of the model in the browser and select **Capture Design History**
- The history timeline will appear at the bottom of the screen with a **Base Feature** icon

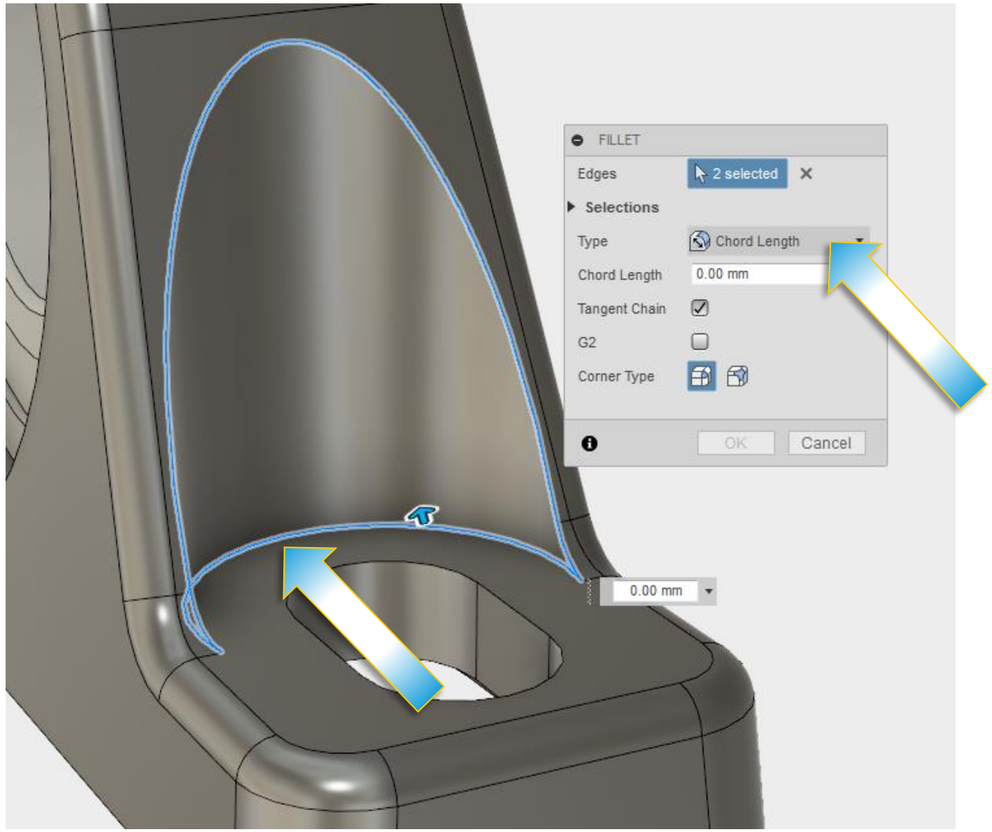




Continued...

De-Featuring imported geometry

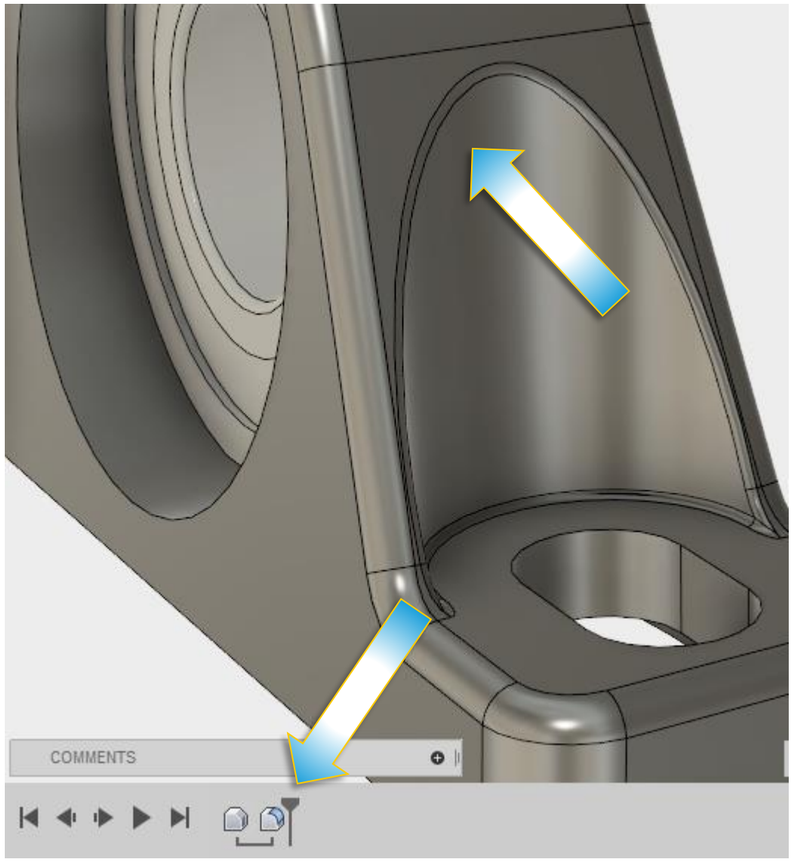
- Cntrl-click the edges you had removed the old fillet off of and right-click and select **Fillet**
- Change the fillet type to **Chord Length**
- Enter **1mm** for the Chord Length



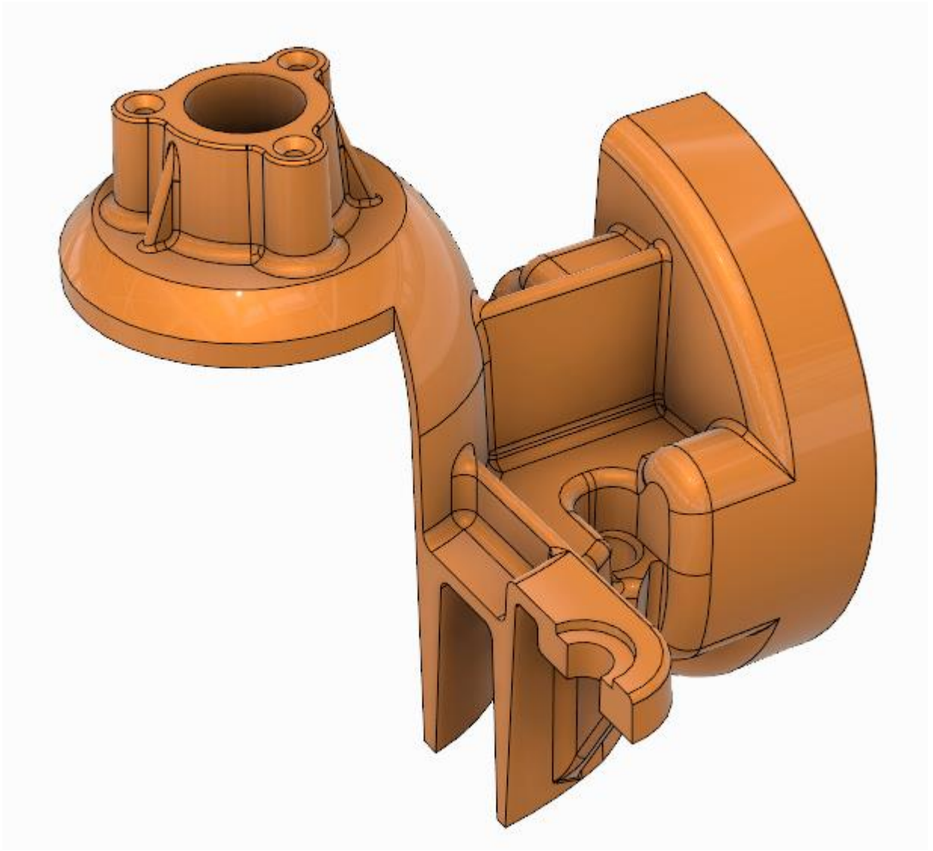
Continued…

De-Featuring imported geometry

- Notice how the blend is now a constant chordal width and that the fillet feature shows up in the timeline

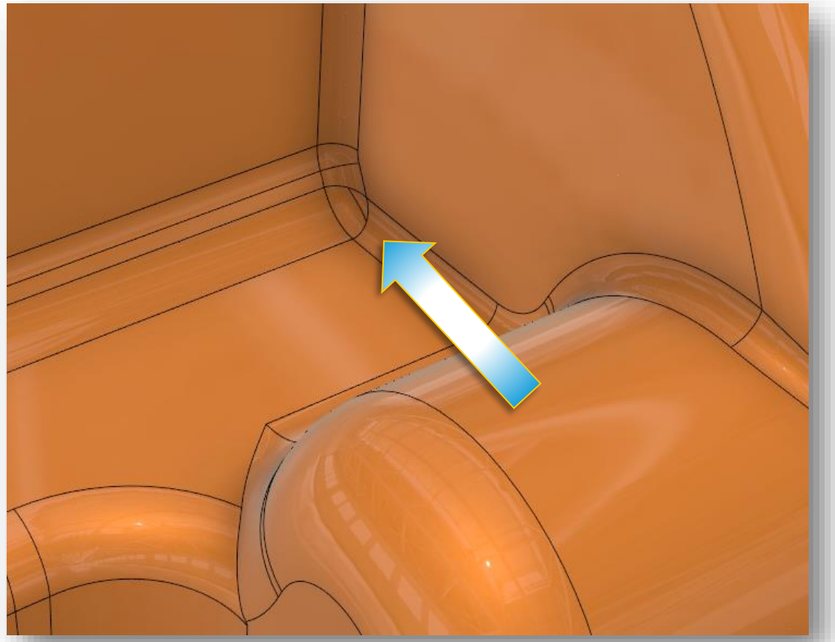


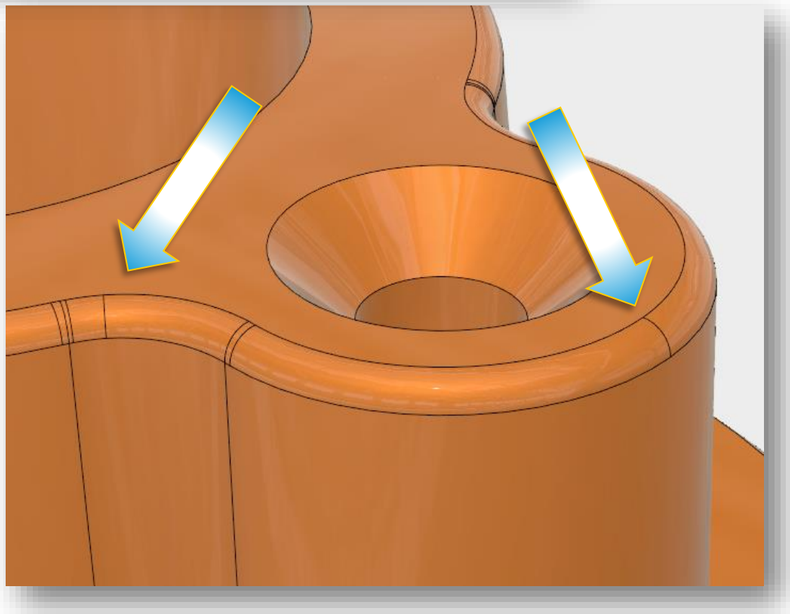
Fixing corrupt geometry with Direct Modeling



Fixing corrupt models

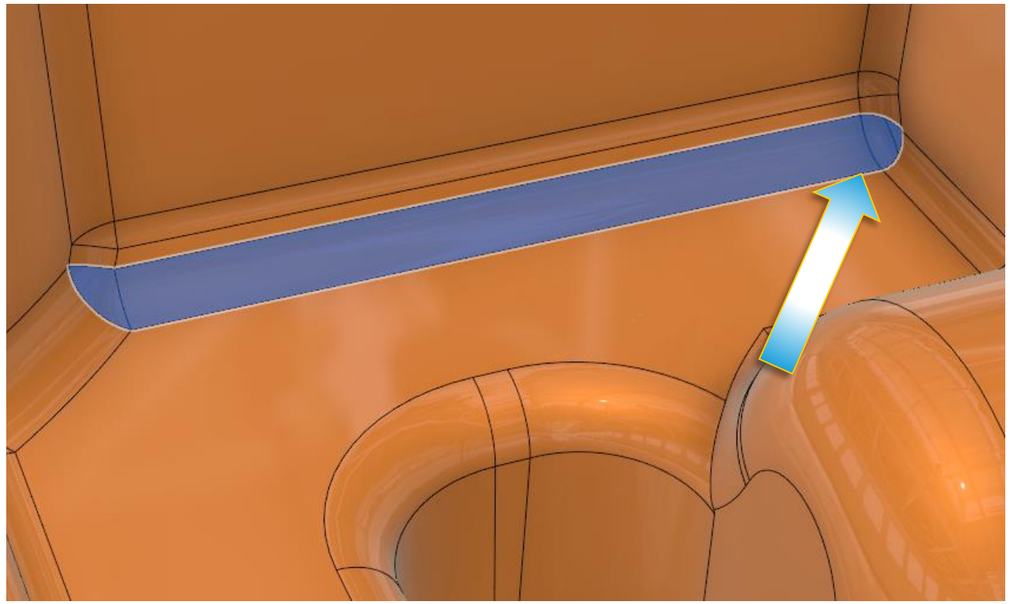
- This imported part has multiple issues, such as odd blends, extra face lines, etc.
- In this section, we will learn the "**Wound & Heal**" method.





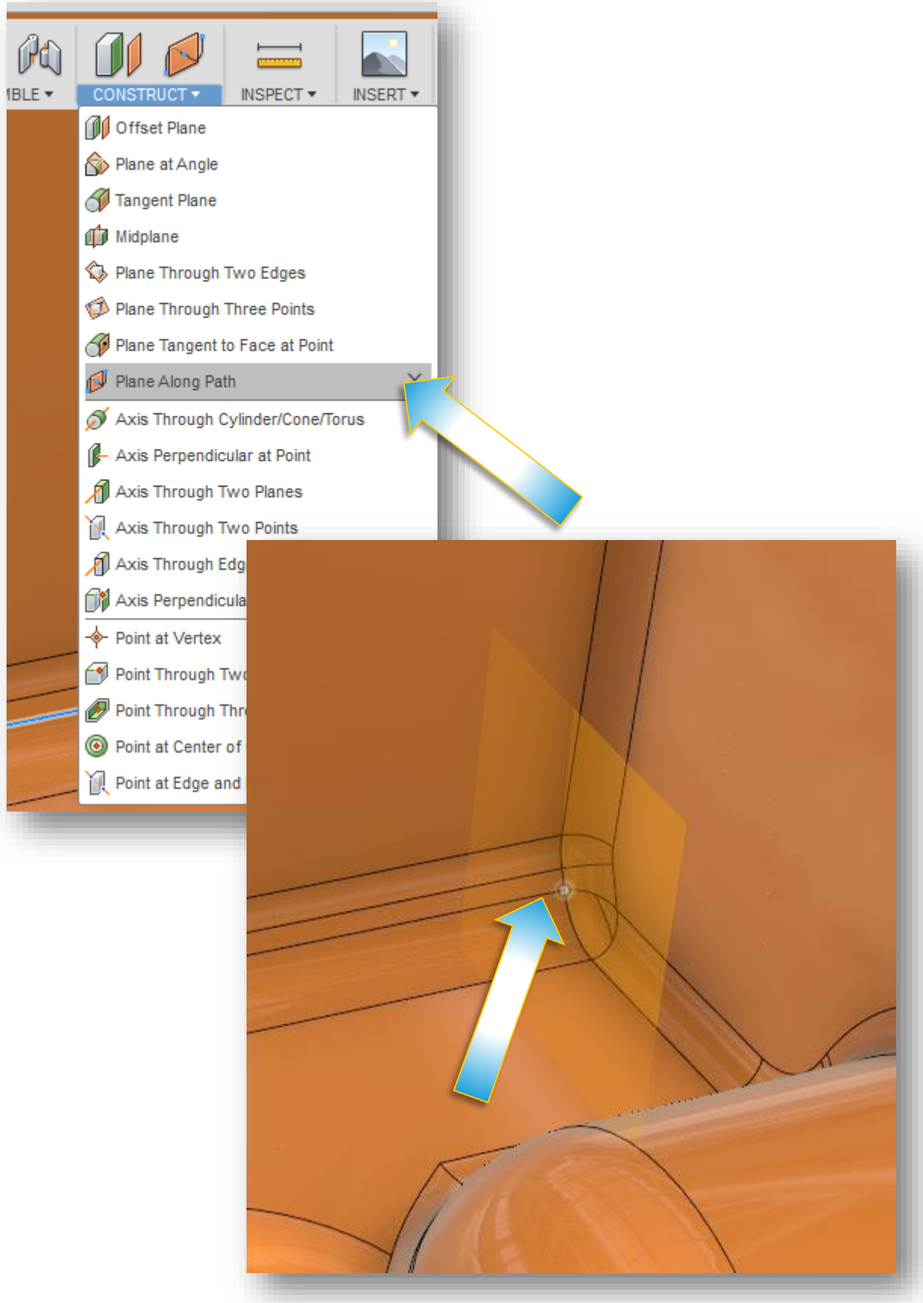
Fixing corrupt models

- I want to remove the highlighted blends, which looks like it should work, but I get an error.
- The issue is the odd blend at the right end of the long blend, so we need to “destroy” it and have Fusion 360 “heal” that area.



Fixing corrupt models

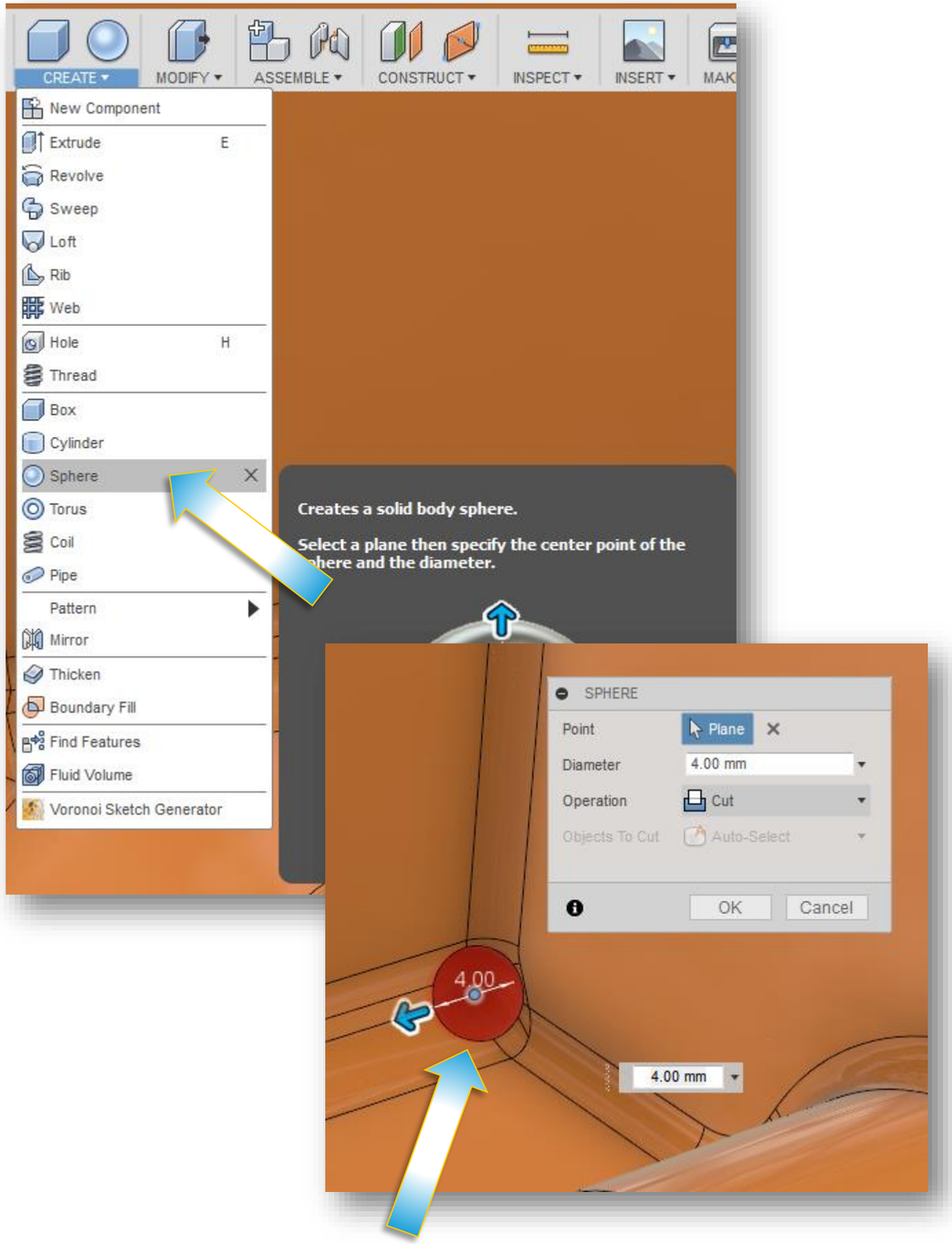
- Select a **Construction → Plane on a Path**
- Click on one of the edges to place the plane
- Drag the plane to the end of the path edge you selected



Continued…

Fixing corrupt models

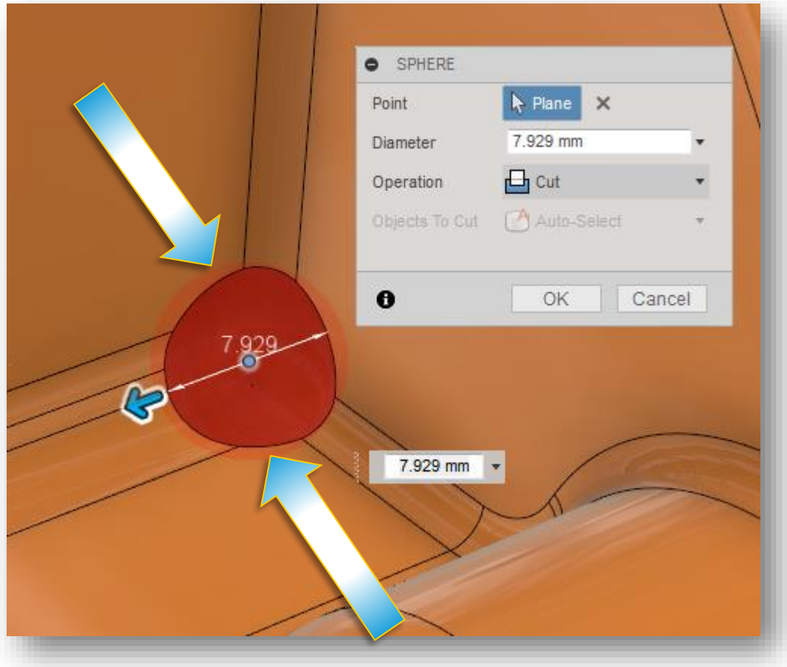
- Next, select the **Create → Sphere** command
- Click on the plane you just created to start a sphere
- *Note: I recommend catching to the origin of the plane*



Continued…

Fixing corrupt models

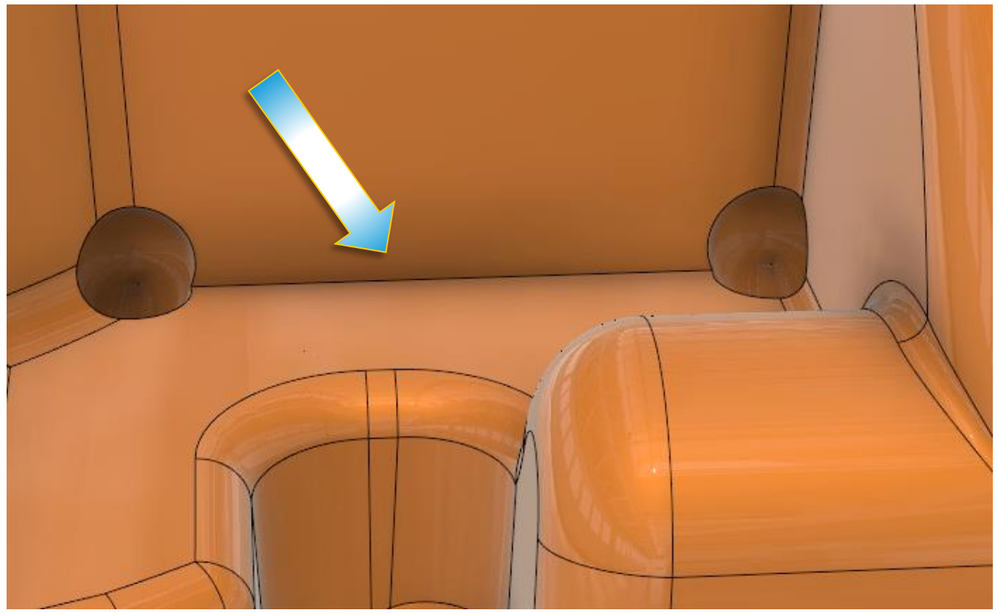
- Drag the size of the sphere larger so it covers up all the bad blend areas (see picture)
- Click **OK** and repeat the same steps on the other side of the long blends

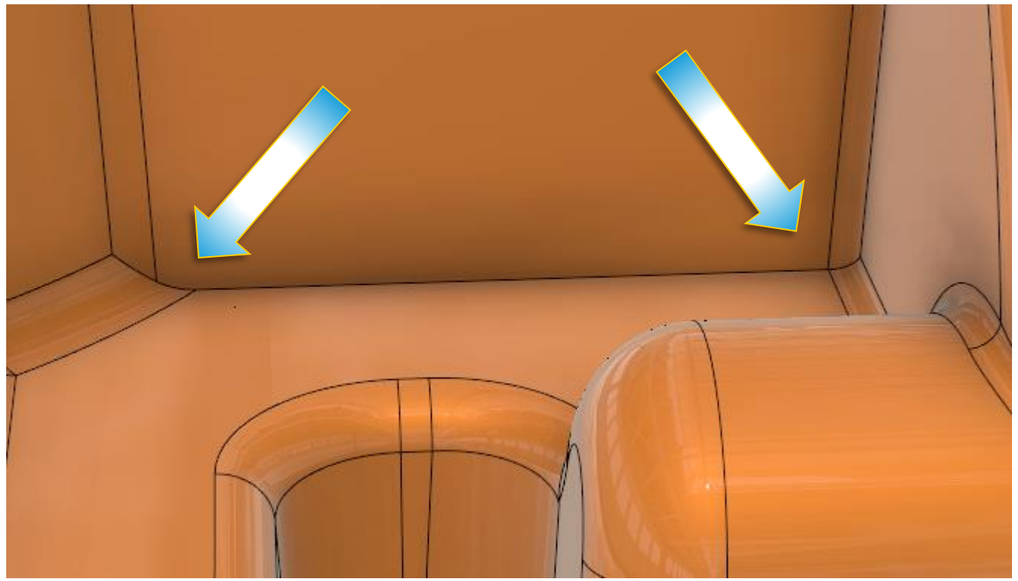


Continued…

Fixing corrupt models

- Now select the blend faces that are between the two spherical faces and press the **Delete** key on your keyboard
- Now, select and **Delete** the spherical faces
- Notice how the blend area has healed





Continued…

Fixing corrupt models

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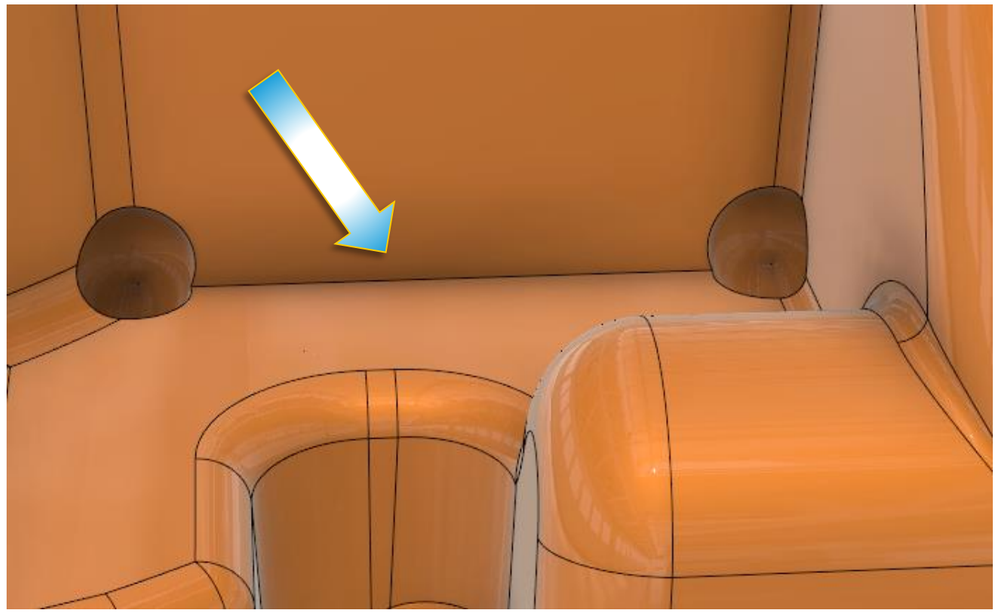
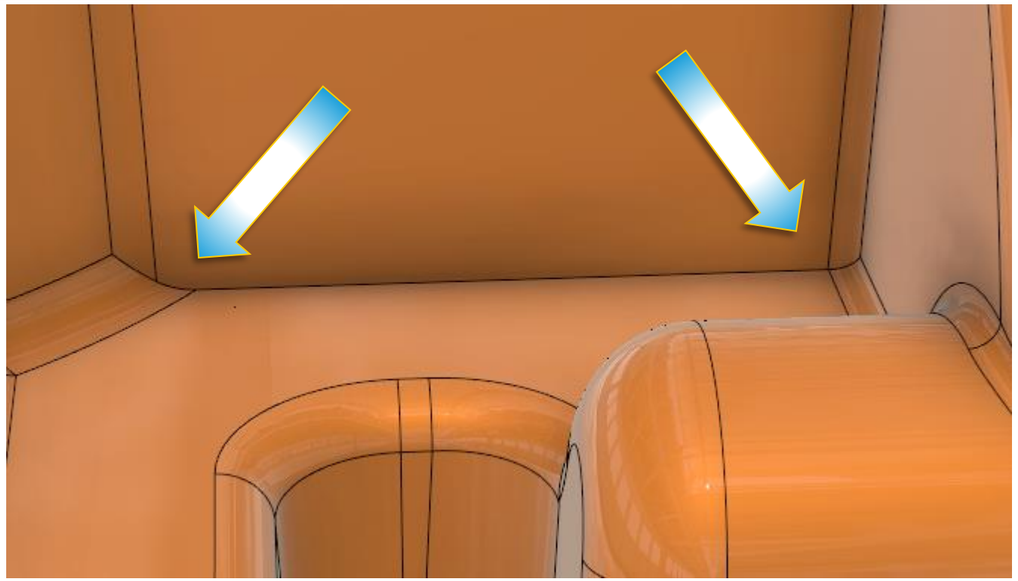
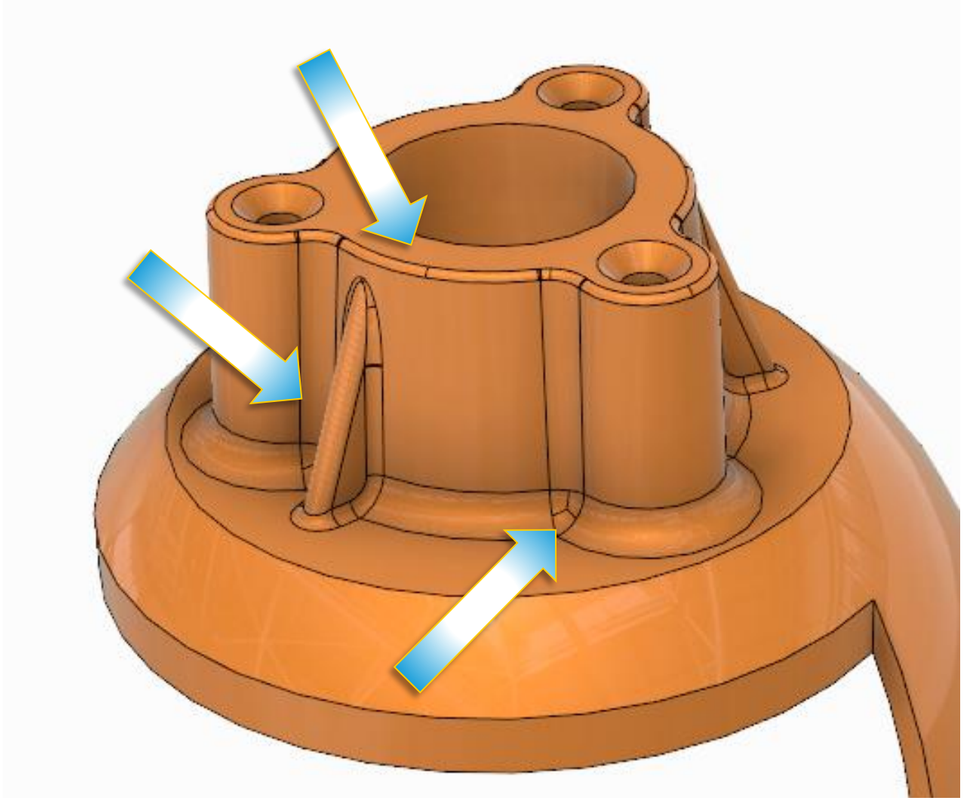




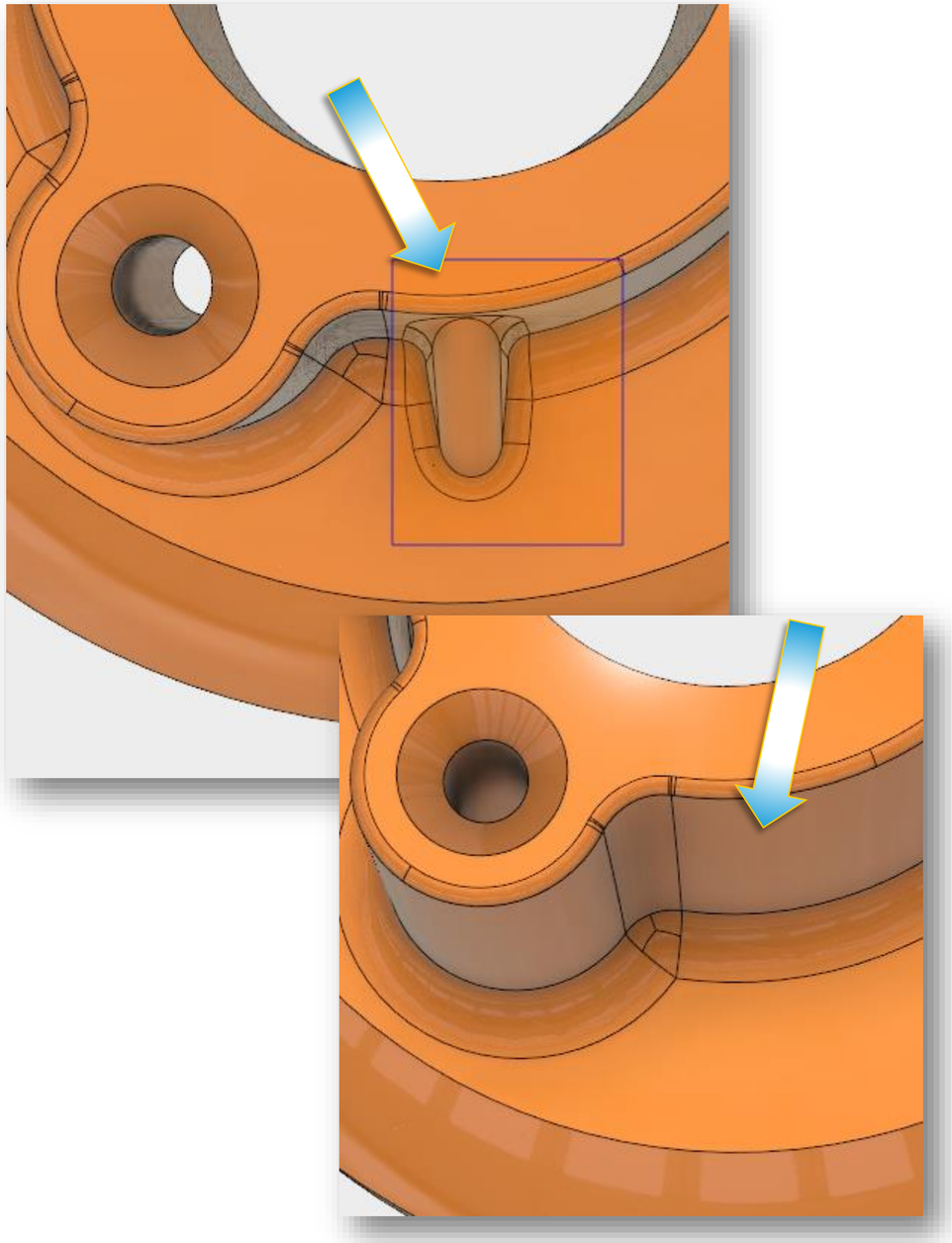
Fixing corrupt models

- Now lets fix the feature at the top of the model
- There are lots of extra lines in the blends that are unnecessary and we also want to remove the vertical ribs and reposition it



Fixing corrupt models

- Draw a selection box around the vertical rib and its blends and hit the **Delete** key
- Notice how quick we were able to remove that problematic rib

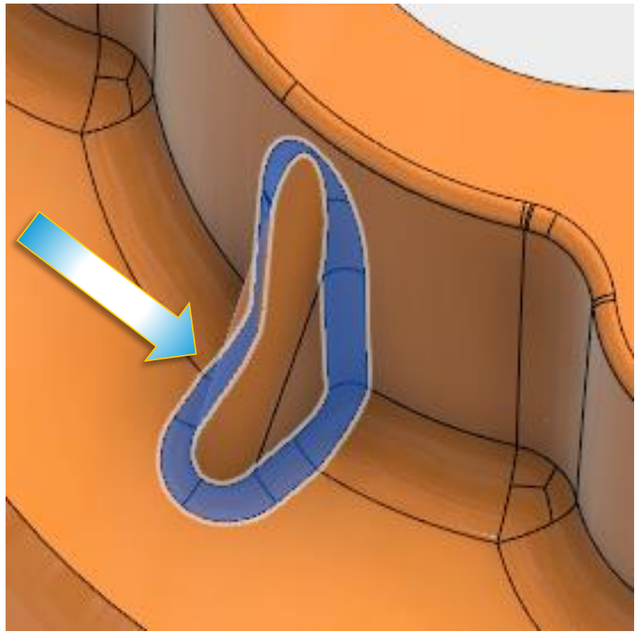


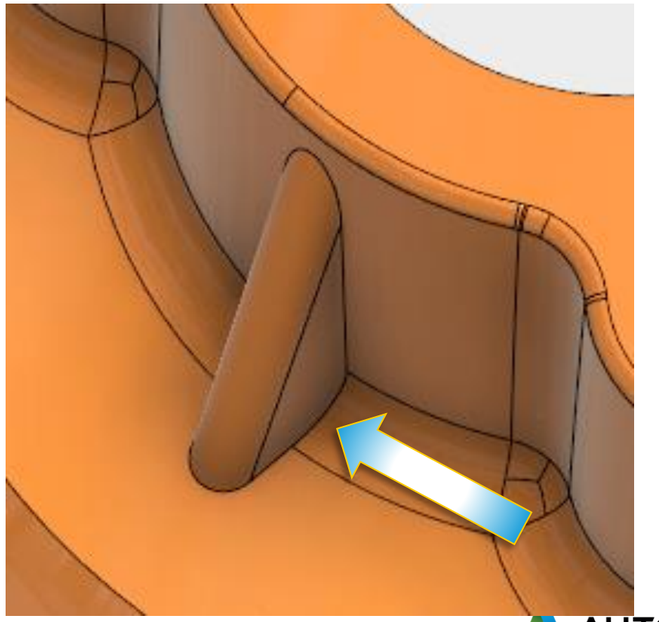
Continued…

Fixing corrupt models

- Draw a selection box around the other vertical rib and then **cntrl-select** the 3 faces that define the rib so only the blend faces are selected (see picture)

- Hit the **Delete** key and notice that the problematic blends were deleted

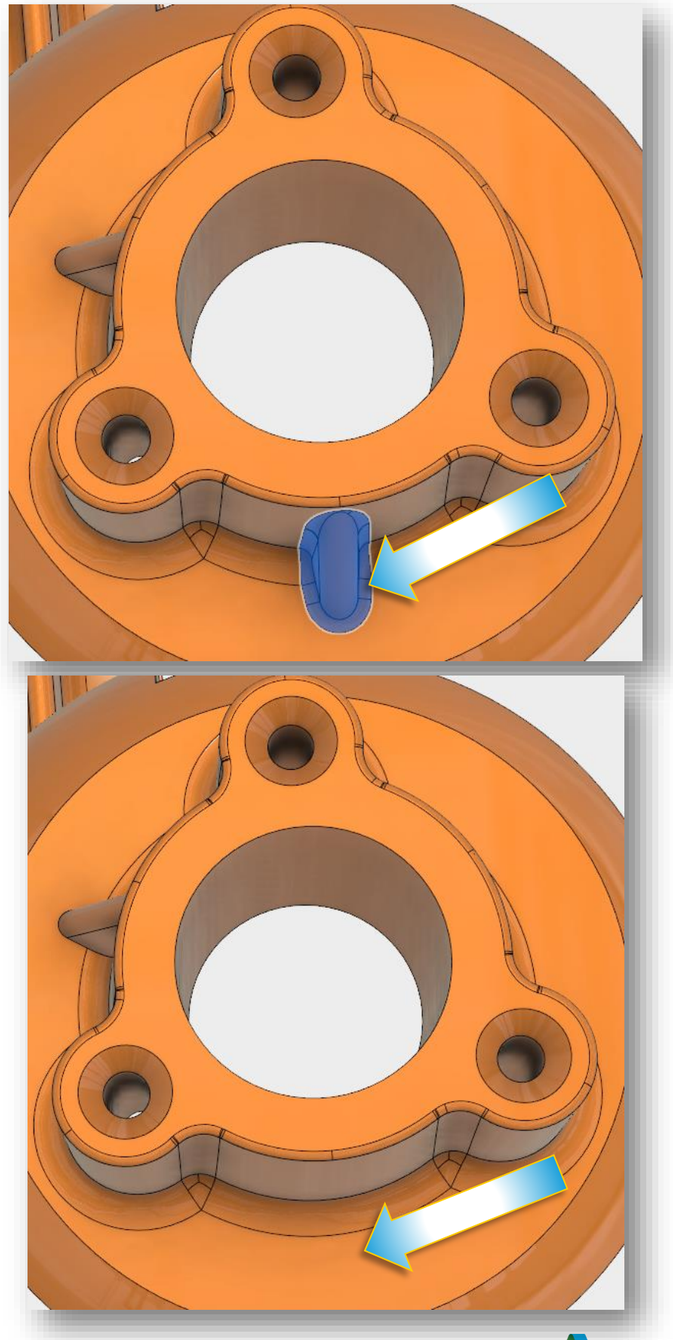




Continued…

Fixing corrupt models

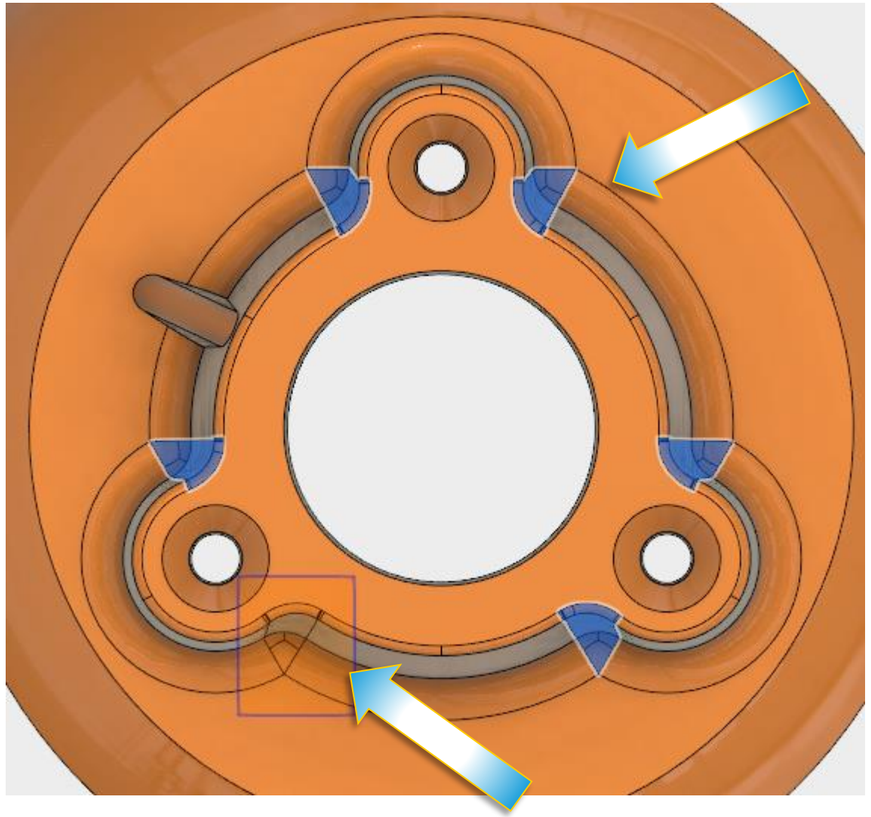
- Finally, draw a selection box around the remaining rib that has the problematic blends and hit the **Delete** key



Continued…

Fixing corrupt models

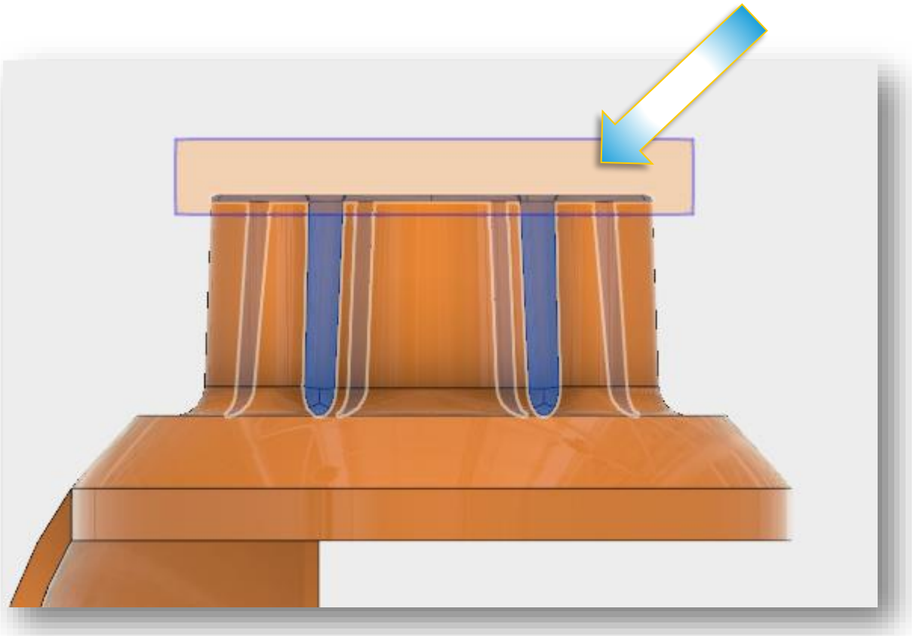
- This next step is probably the most difficult. We need to remove all of the blends at the same time, so we will need to do multiple selections in the same step
- First, **Shift-Select** multiple selection windows around all of the vertical blends (see picture)
- ***(do not press the delete key yet!)***

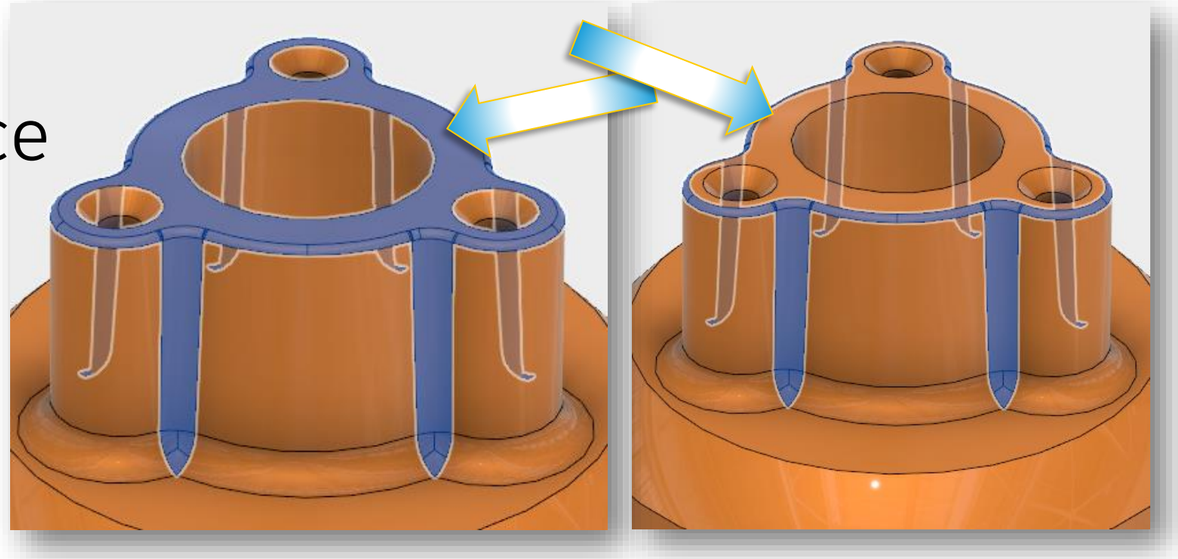


Continued…

Fixing corrupt models

- Now, looking from the side view, press the **shift key** down again and draw a selection box around the top blends (see picture)
- Rotate the view so you can see the top of the model
- **Shift-Click** on the top planar face to **un-select** it (see picture)

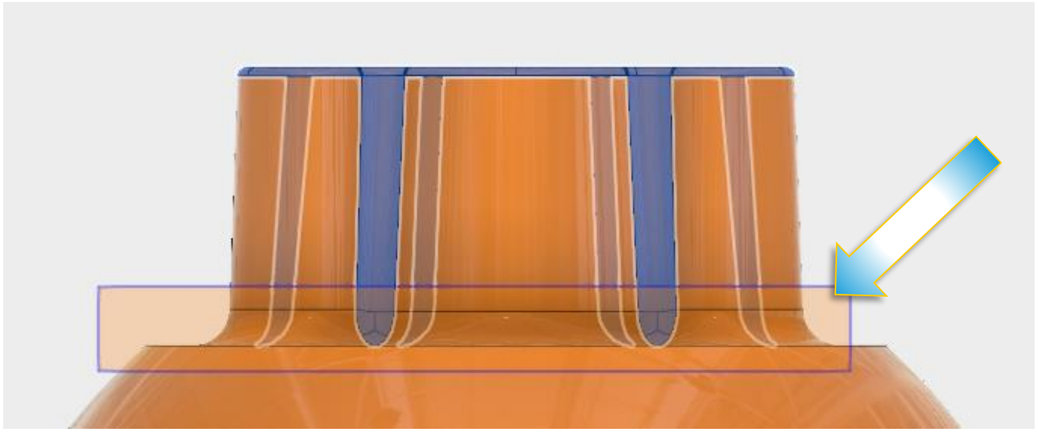


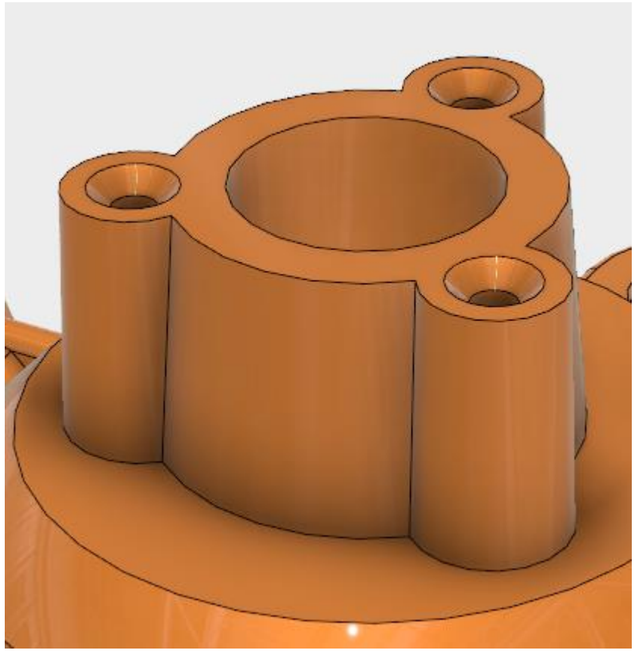


Continued…

Fixing corrupt models

- **Shift-Select** another selection window around the bottom large blends (see picture)
- Finally, hit the **Delete** key and watch how all the bad blends are removed all at once!

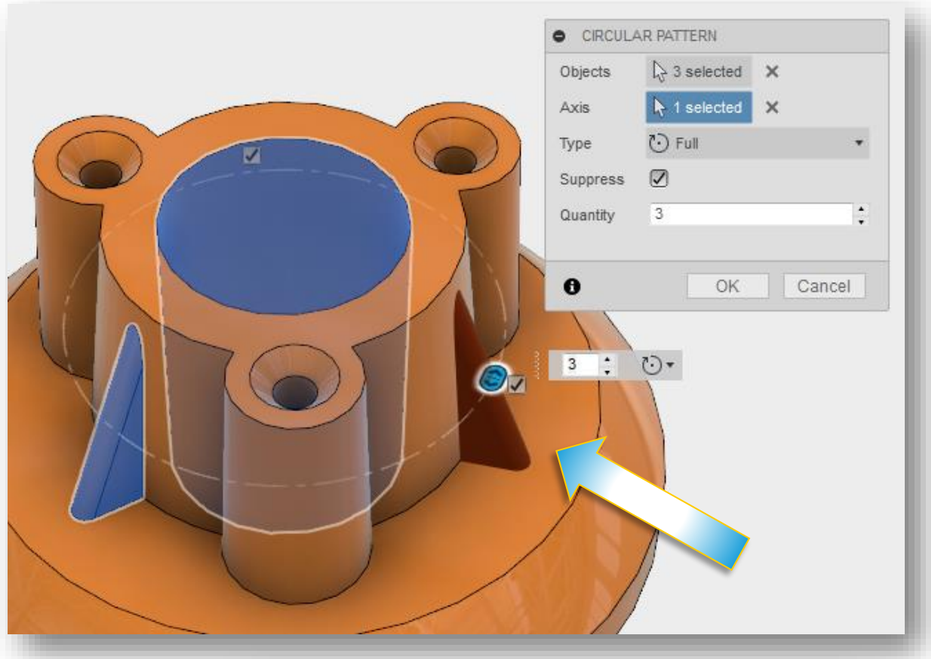


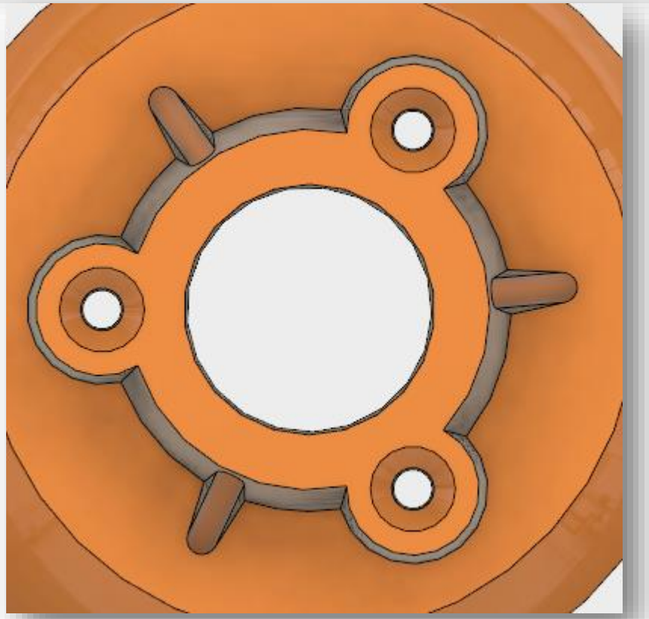


Continued…

Fixing corrupt models

- Now create a circular pattern of the one rib we left.
- Use the center cylinder as the axis
- Do a quantity of 3 ribs

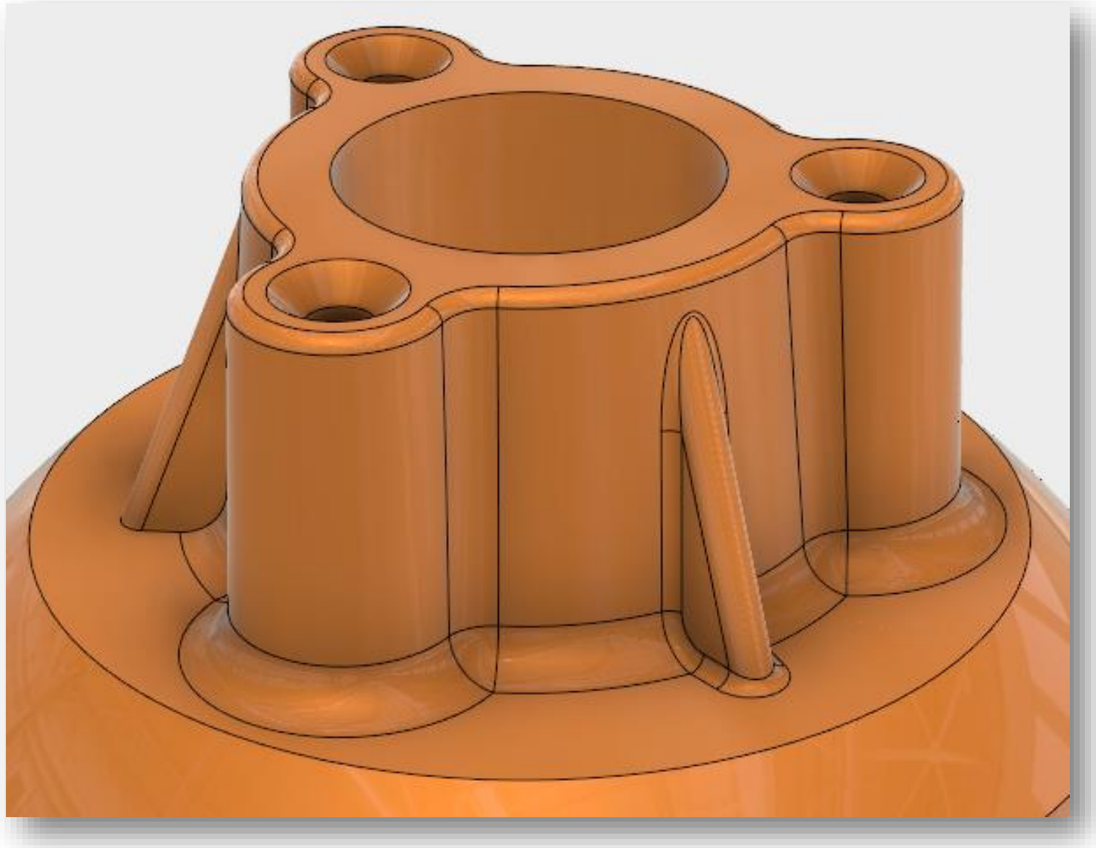




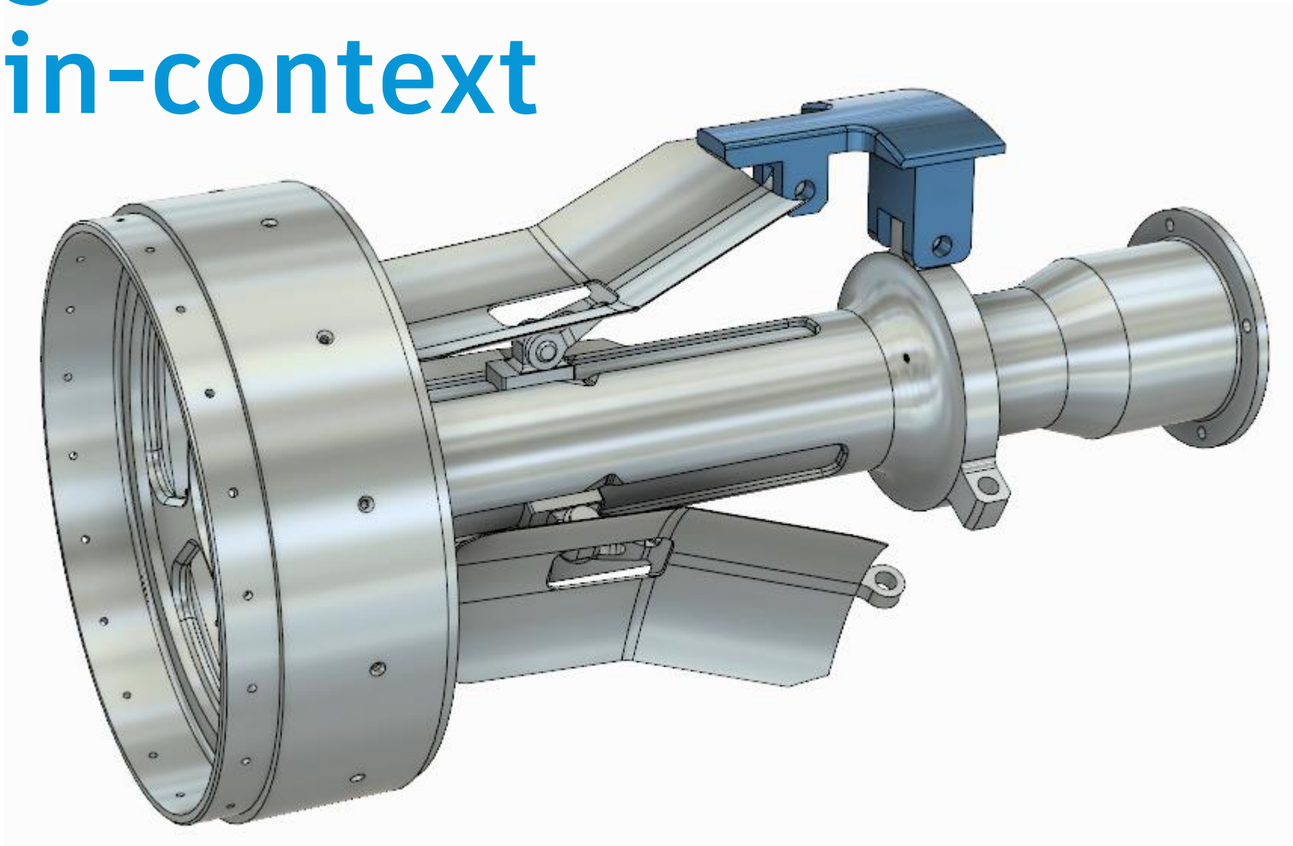
Continued…

Fixing corrupt models

- If you want, you can now add new blends back in and notice how they look much nicer and don't have all the extra edges
- In completion, we were able to fix problematic areas, remove existing geometry and recreate a pattern, and remove bad looking blends are recreate them

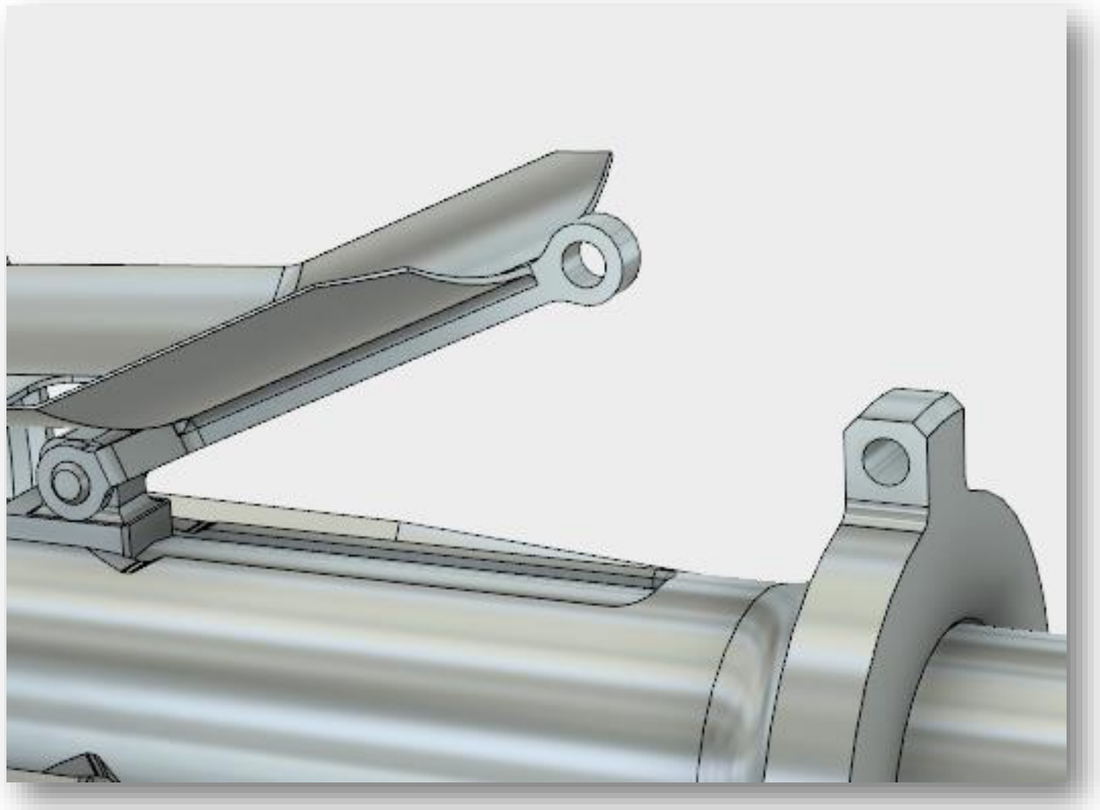


Using Direct Modeling techniques to create in-context designs



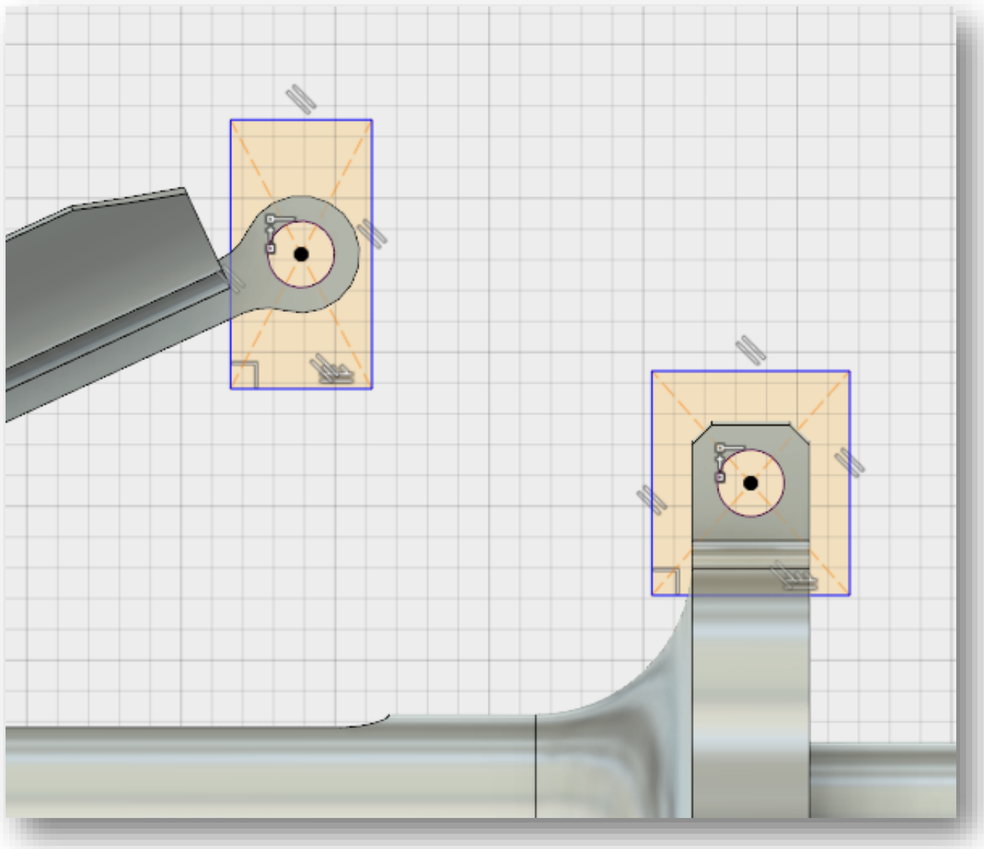
In-Context design

- We want to create a bracket that connects the two mechanical parts, but we aren't sure what the final part will look like and we want to use information from the existing parts to help us design the new part



In-Context design

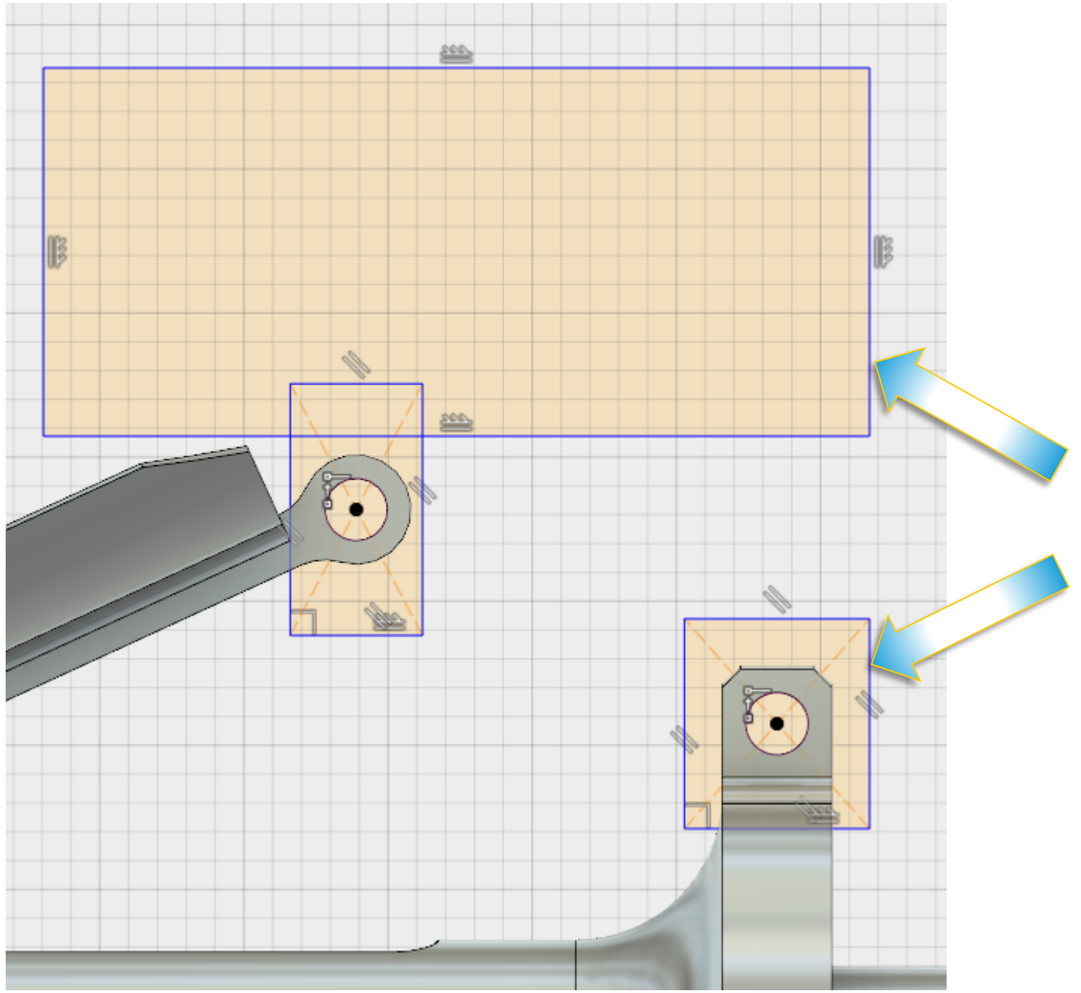
- Lets start with a simple sketch.
- Create a sketch on the front plane and **project** the two circles
- Create a couple of center rectangles from the center of the circles. Don't worry about dimensions at this time



Continued…

In-Context design

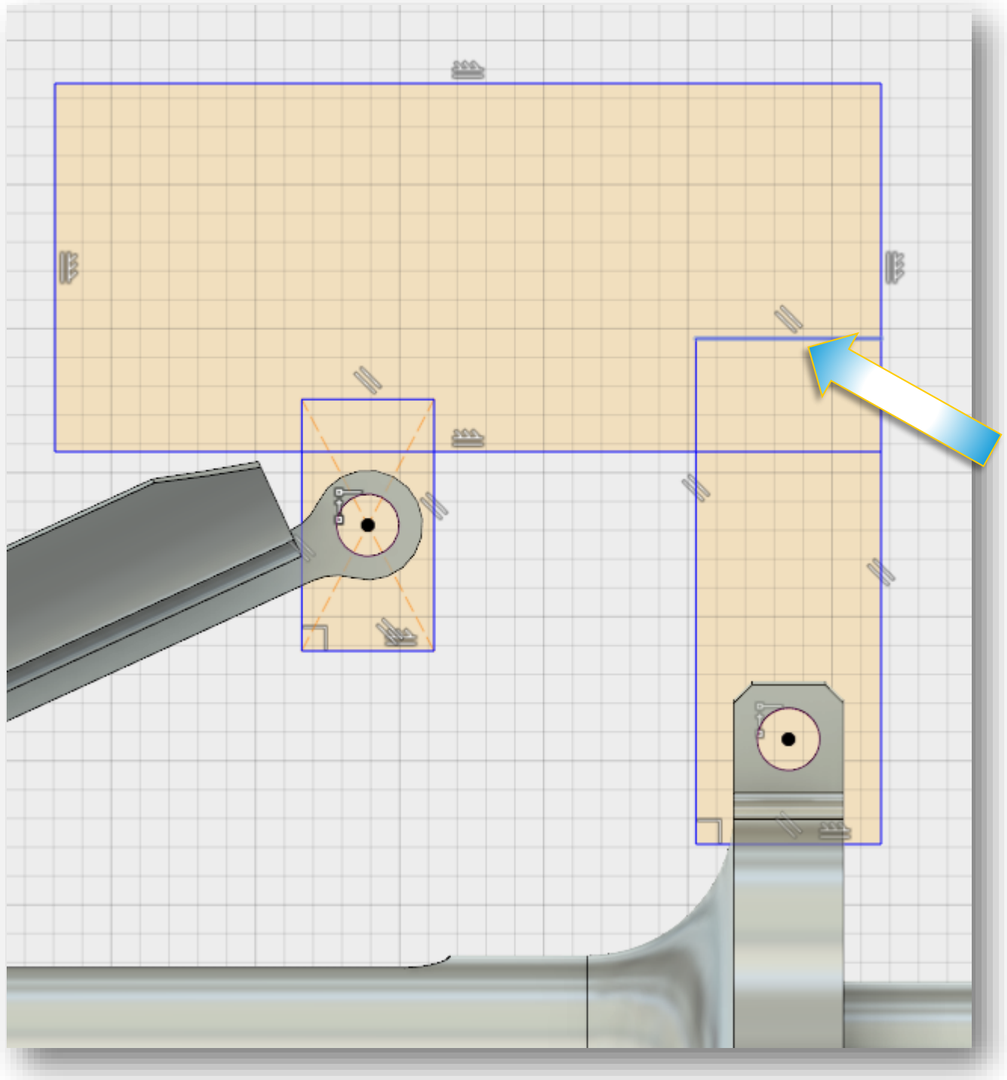
- Draw another rectangle that lines up with the back of the right rectangle



Continued…

In-Context design

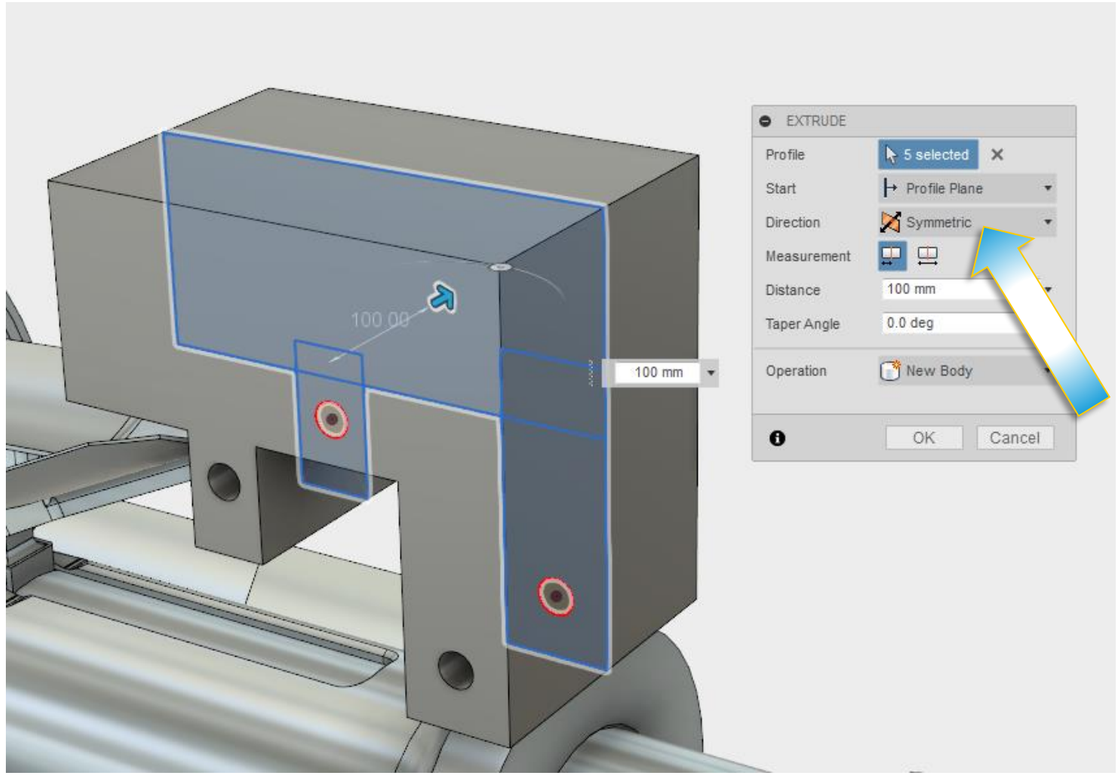
- Delete the construction lines in the lower-right rectangle and then stretch the top of that rectangle up into the large rectangle
- Exit the sketch



Continued…

In-Context design

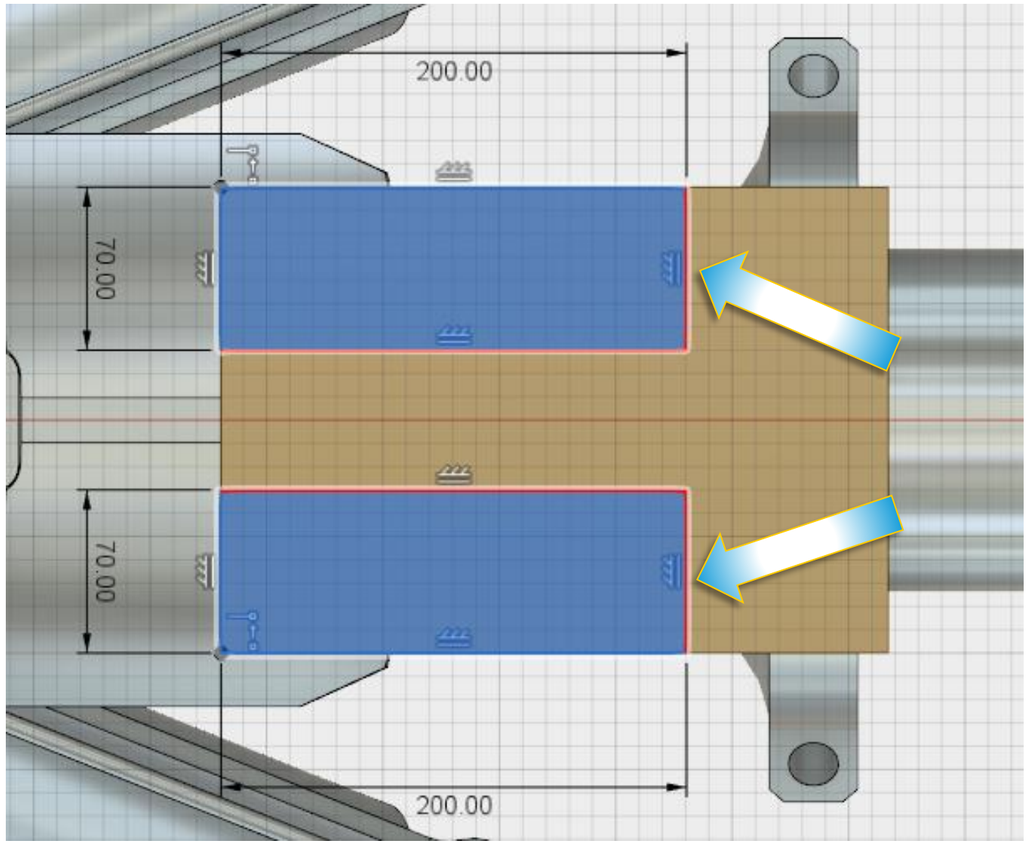
- Select the profile regions and extrude **100mm** in both directions (symmetric)
- Also, make sure it is creating a new body and not doing the **cut** operation



Continued…

In-Context design

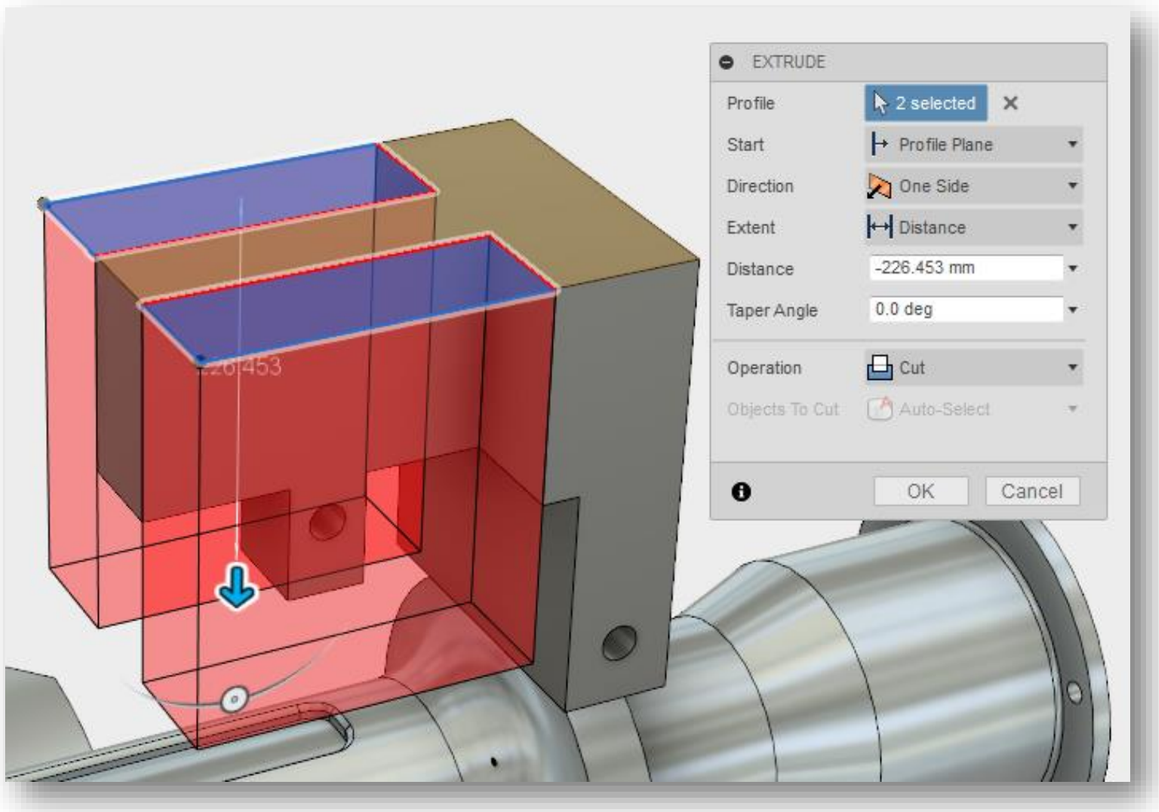
- Now we want to remove some material
- Click on the top face and create a sketch
- Draw two **70 x 200mm** rectangles as shown in the picture
- Stop the sketch



Continued…

In-Context design

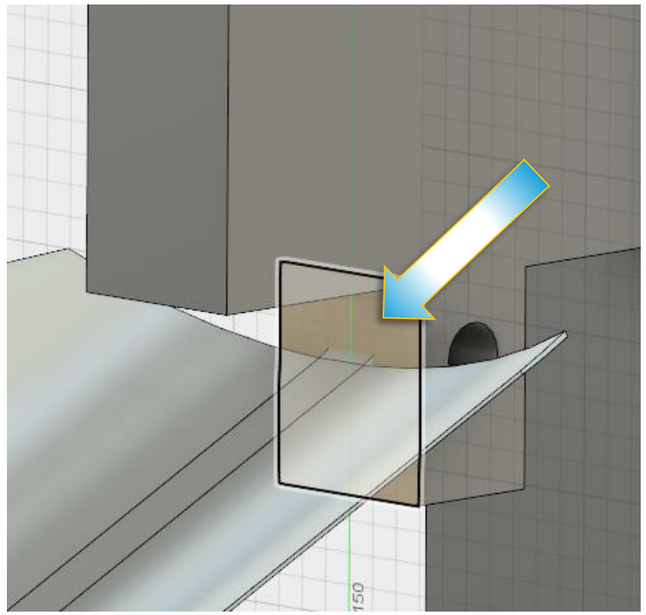
- Turn off the part **Brake01** in the browser
- Machine away the profiles all the way through the part
- Press **OK**

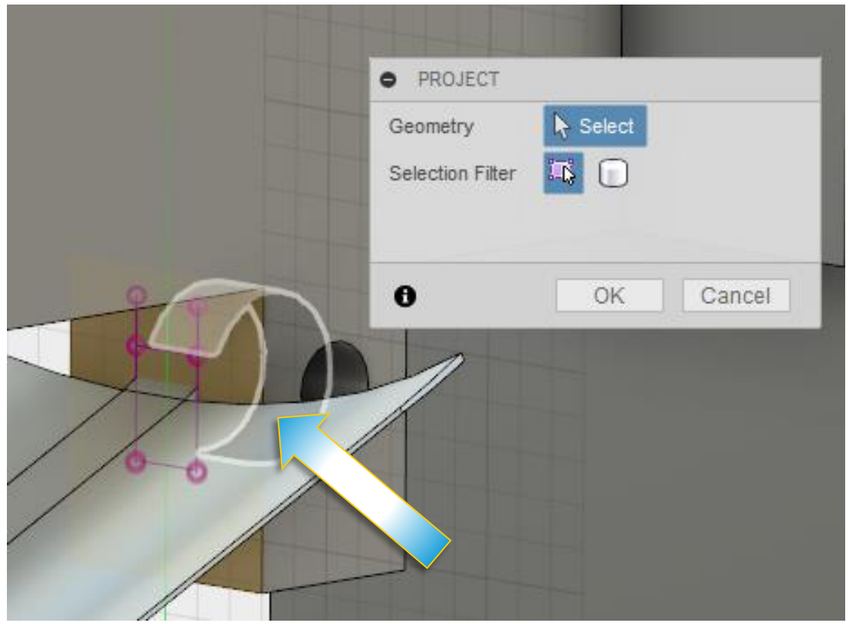


Continued…

In-Context design

- Turn the part **Brake01** back on in the browser
- Zoom up on the section where the Brake intersects the new part
- Create a sketch on the front face of the clevis area, as shown in the picture
- Hit the **P** key for **Project** and pick the circular face shown in the picture

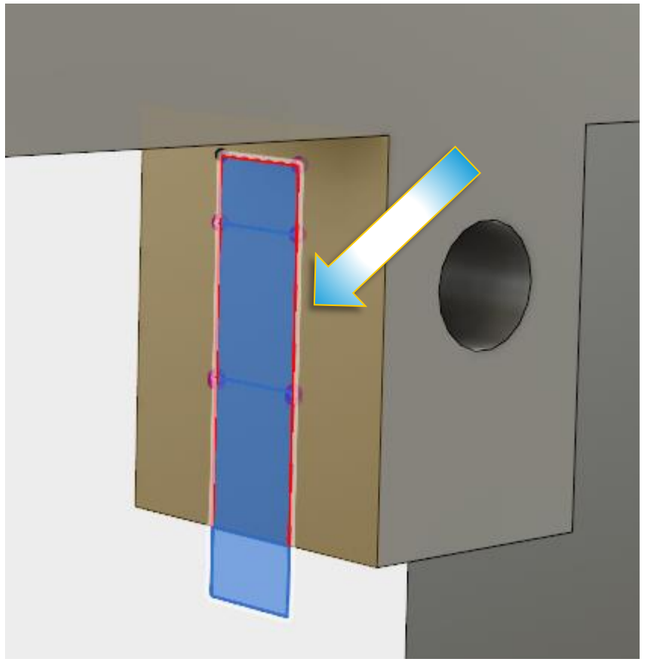


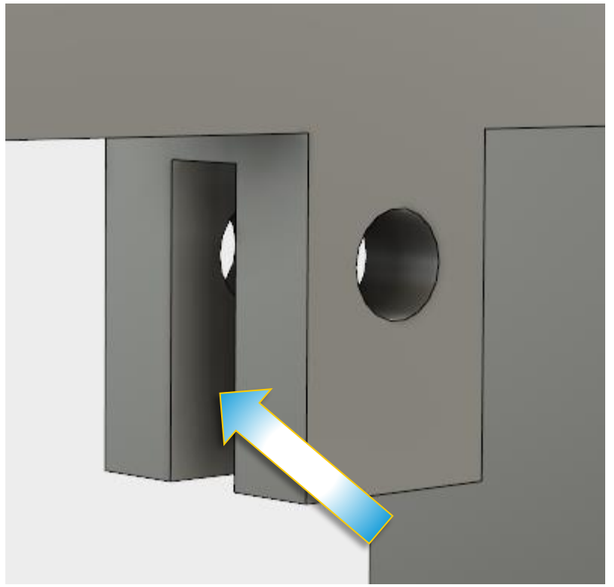


Continued…

In-Context design

- Now draw a rectangle that uses that projected geometry
- Turn off the **Brake01** part and machine the profile through the clevis
- Turn the **Brake01** part back on

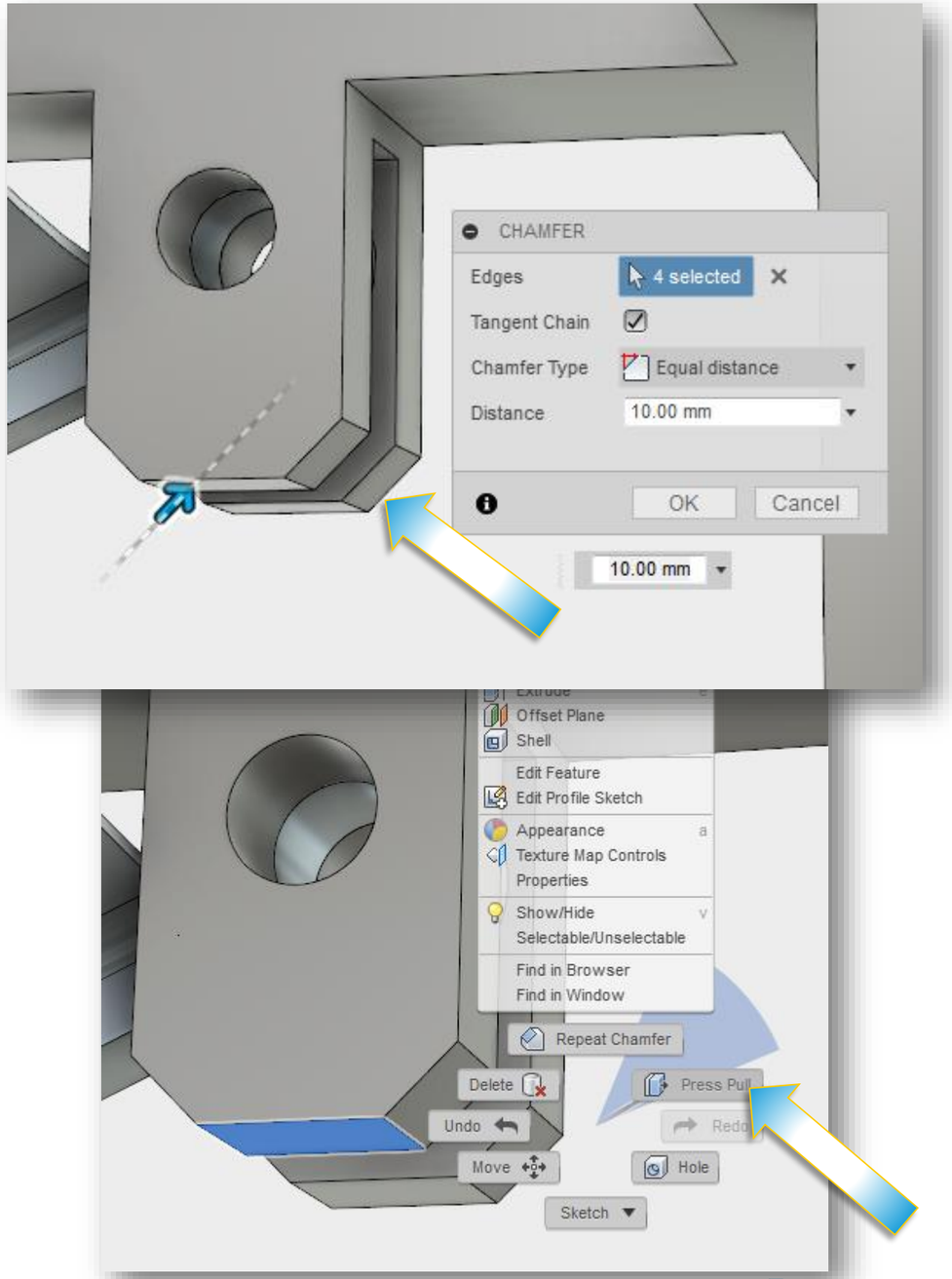




Continued…

In-Context design

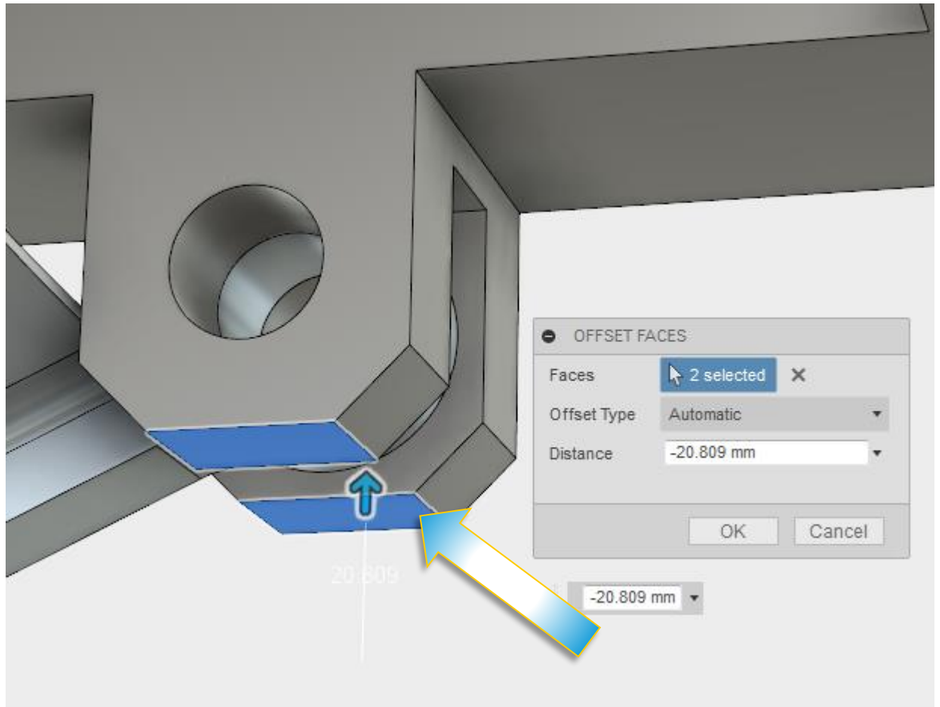
- Chamfer the 4 bottom edges with a **10mm** chamfer
- The clevis is too long, so let's shorten it
- Select one of the bottom faces of the clevis, **right-mouse-click** and select **Press Pull**



Continued…

In-Context design

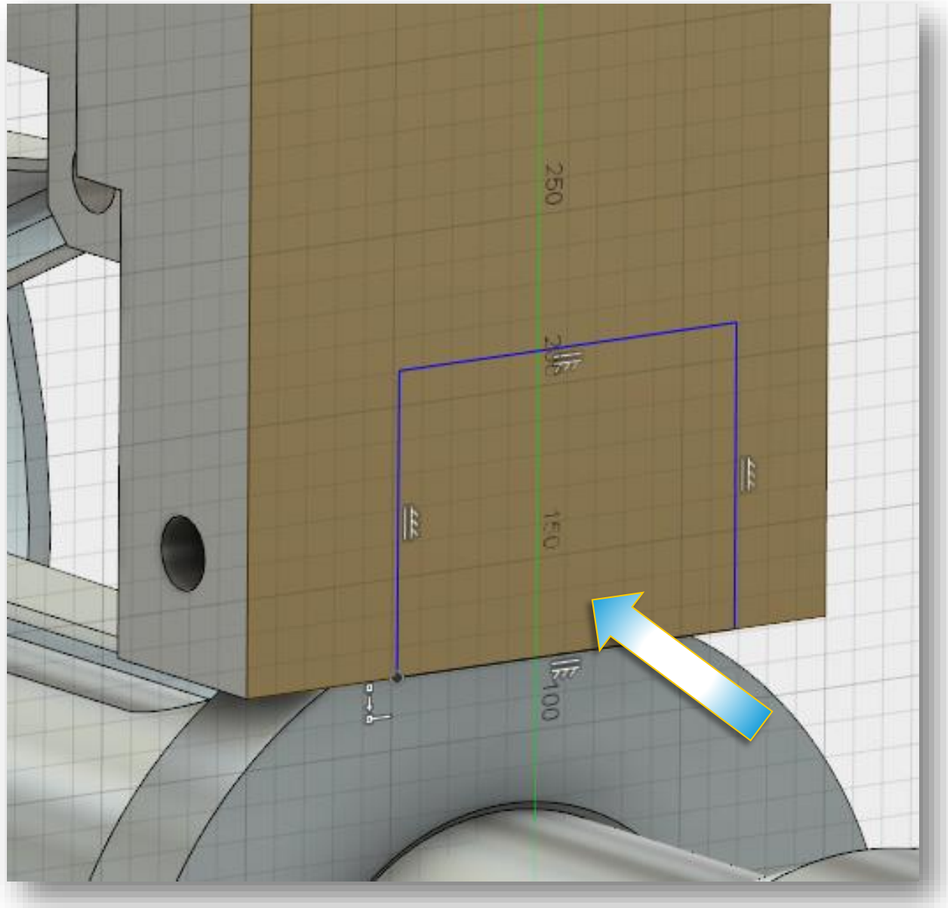
- **Cntrl-Click** the other bottom face of the clevis to select it also
- Dynamically drag the faces up closer to the hole until it looks good to you
- Notice how the chamfers move with the faces



Continued…

In-Context design

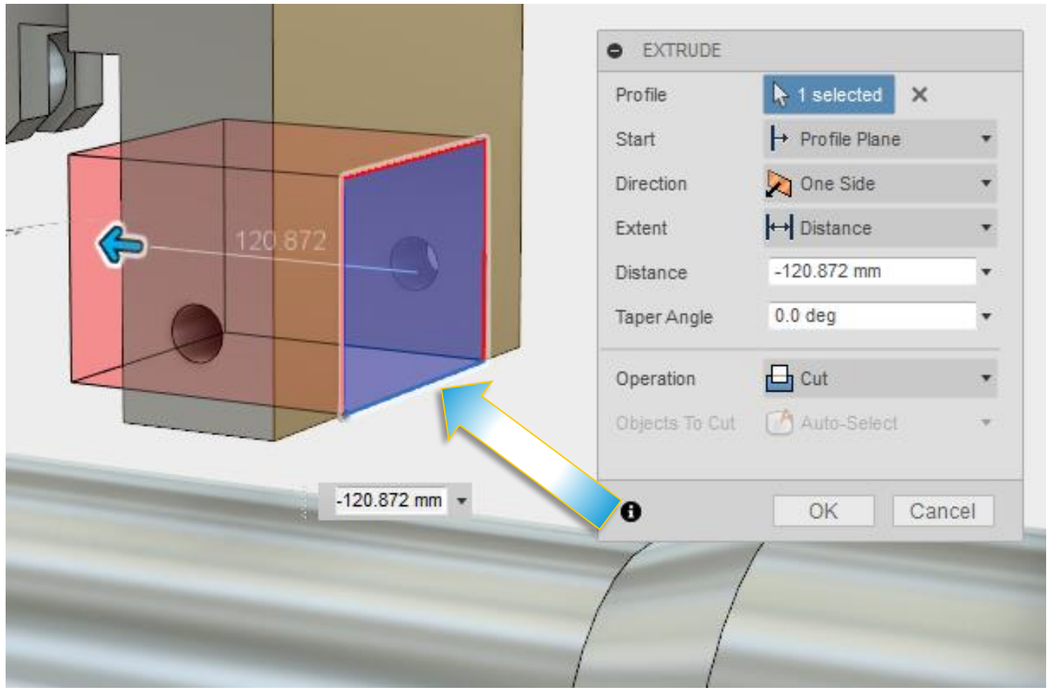
- Now we want to create an opening for the other clevis
- Just draw a rectangle on the back face of the part. Don't worry about the size
- Stop the sketch
- Turn off the **Sliding Shaft** part



Continued…

In-Context design

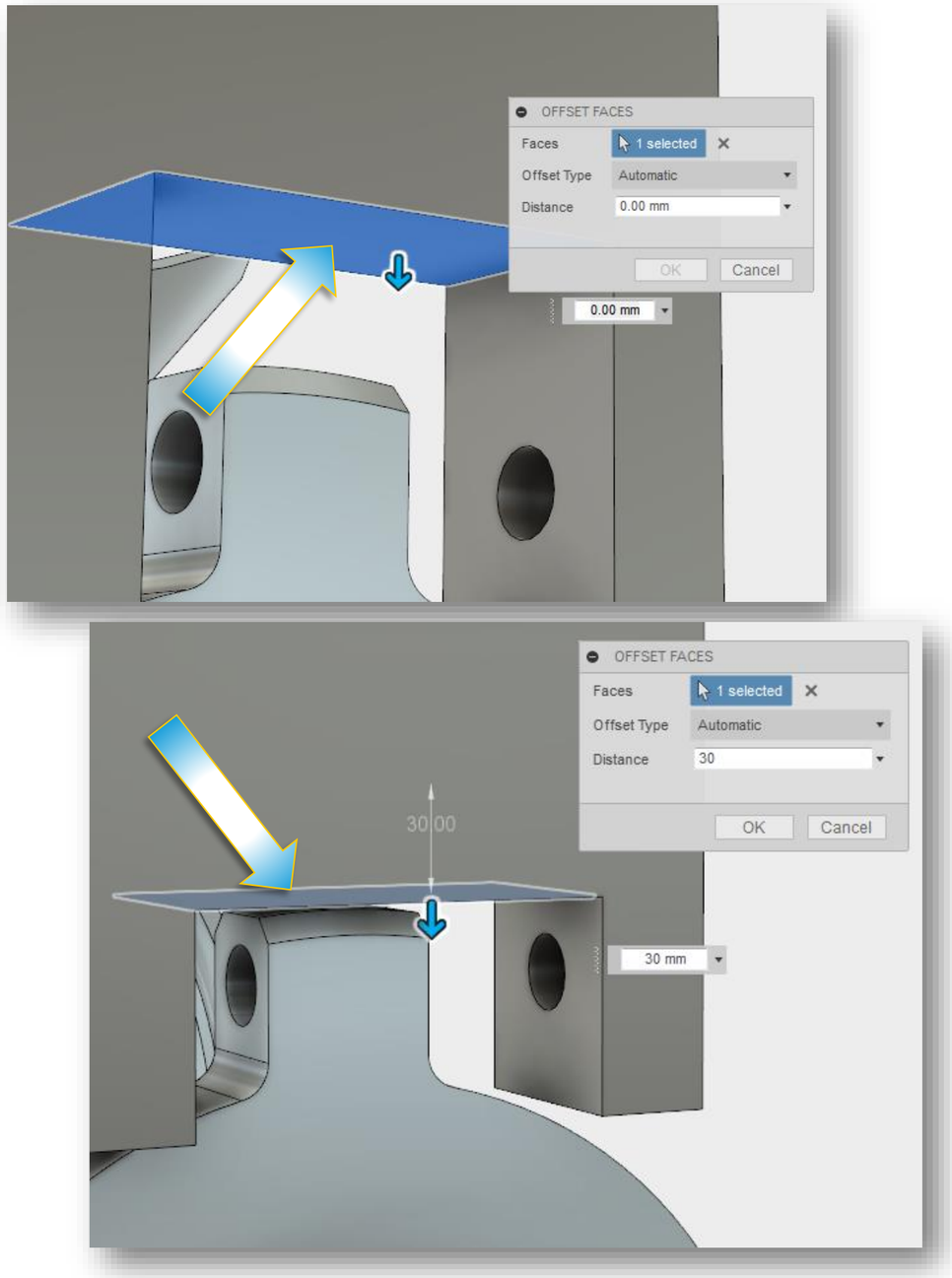
- **Extrude → Cut** the rectangle out of the part
- Press **OK**
- Turn the **Sliding Shaft** part back on



Continued…

In-Context design

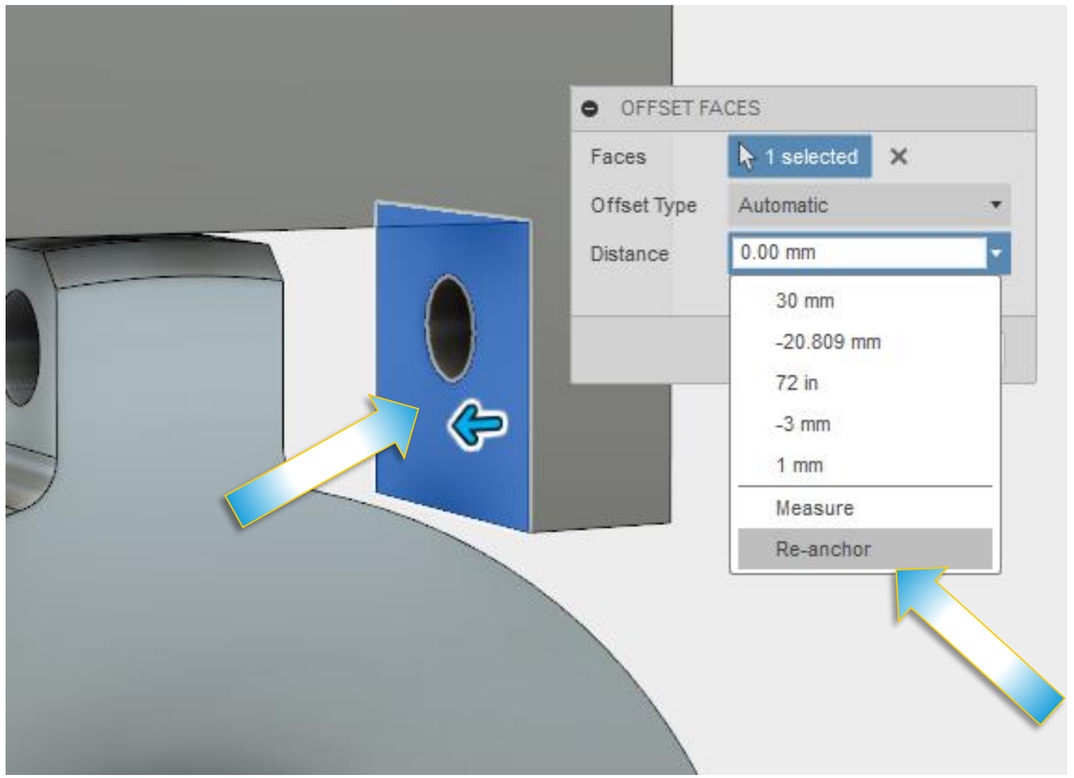
- Click on the horizontal face (in picture) and dynamically drag down until it is close to the other part
- Press **OK**



Continued…

In-Context design

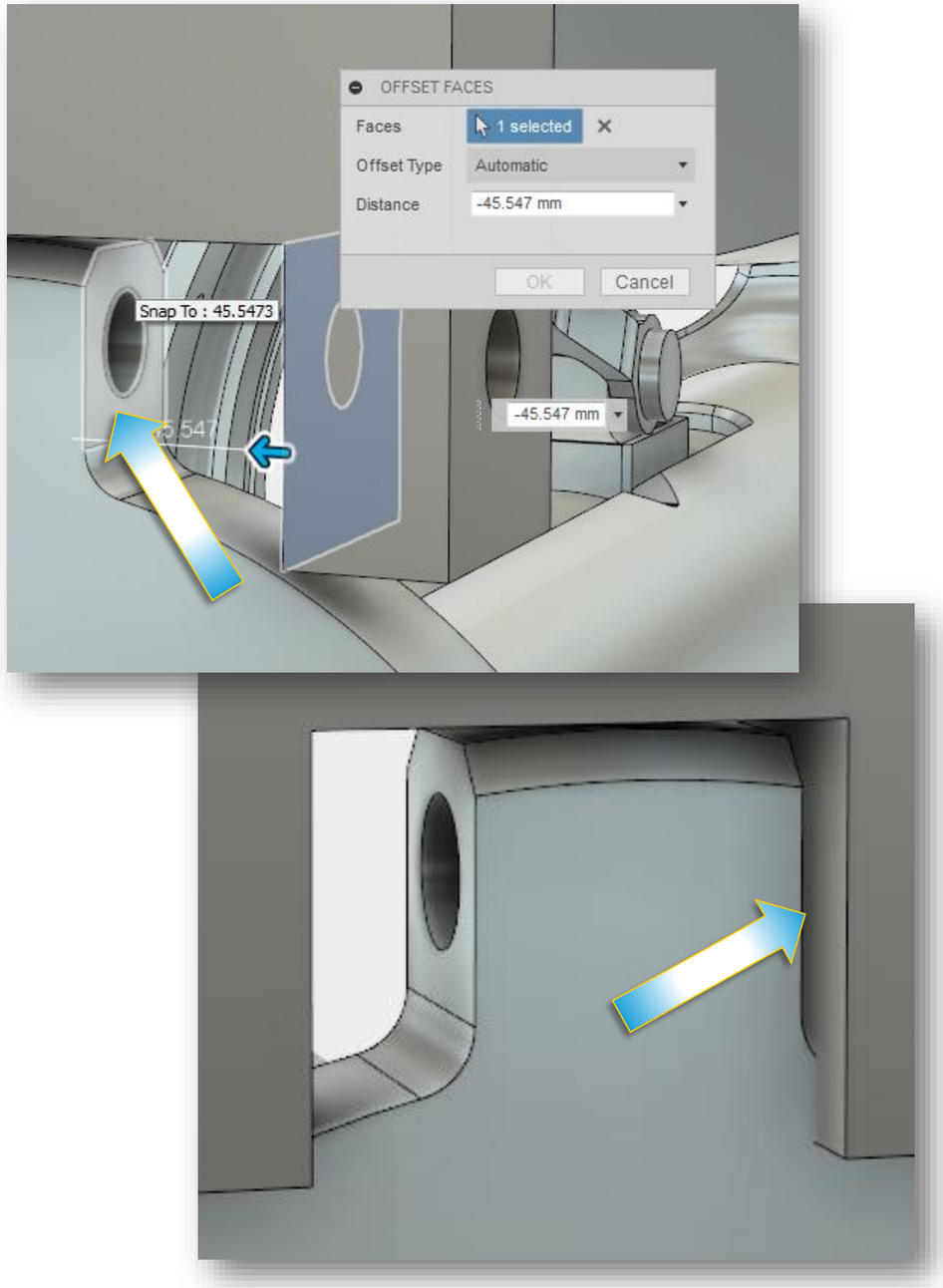
- This next part is so cool. We now want to move the side faces to match the side faces of the sliding shaft, but also to have 2mm of clearance
- Click on the side face of the new part and select **Press Pull**
- Click on the little down arrow next to the **Distance** field and select **Re-anchor**



Continued…

In-Context design

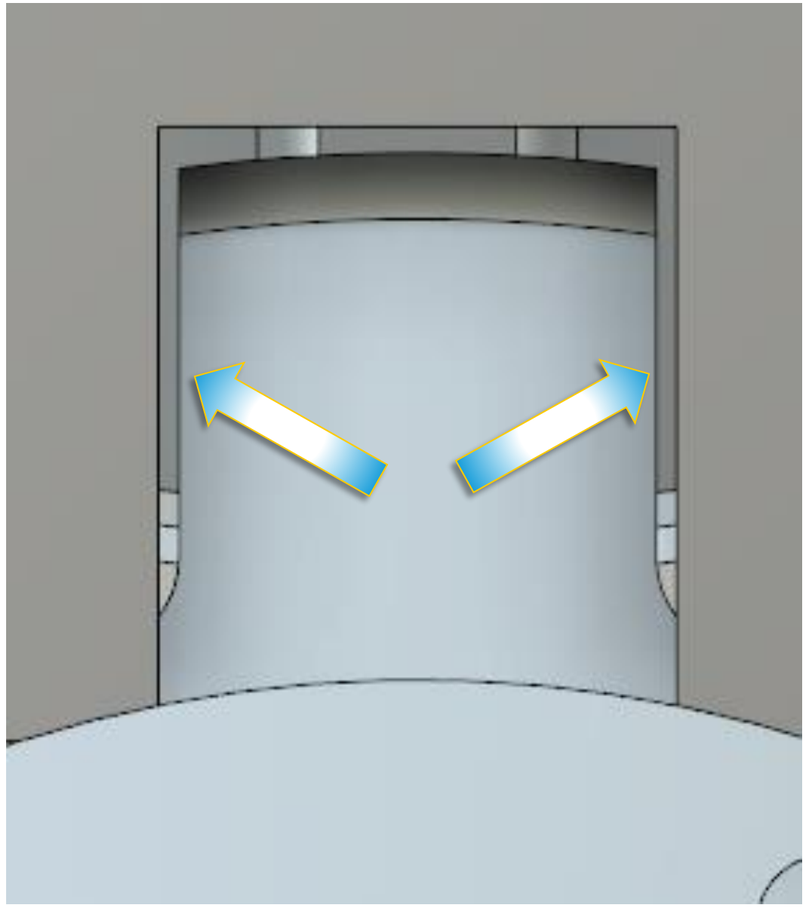
- Click on the vertical face of the **Sliding Shaft** to specify that we will be measuring the distance from this new face
- Notice the distance is now a larger negative number
- In the **Distance** field, type in **-2mm** for the distance and press **OK**
- Notice how the face is now 2mm from the sliding shaft part



Continued…

In-Context design

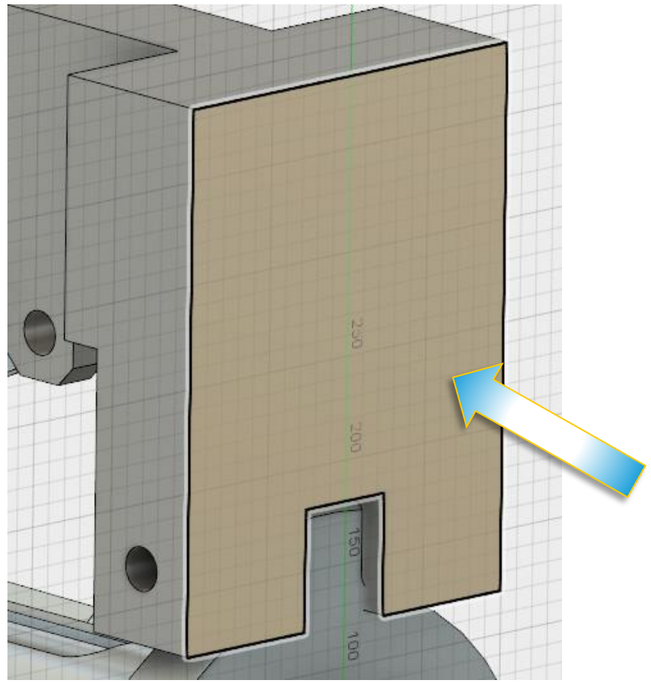
- Repeat the same procedure on the other side
- We now have created the opening we want using information from the sliding shaft part

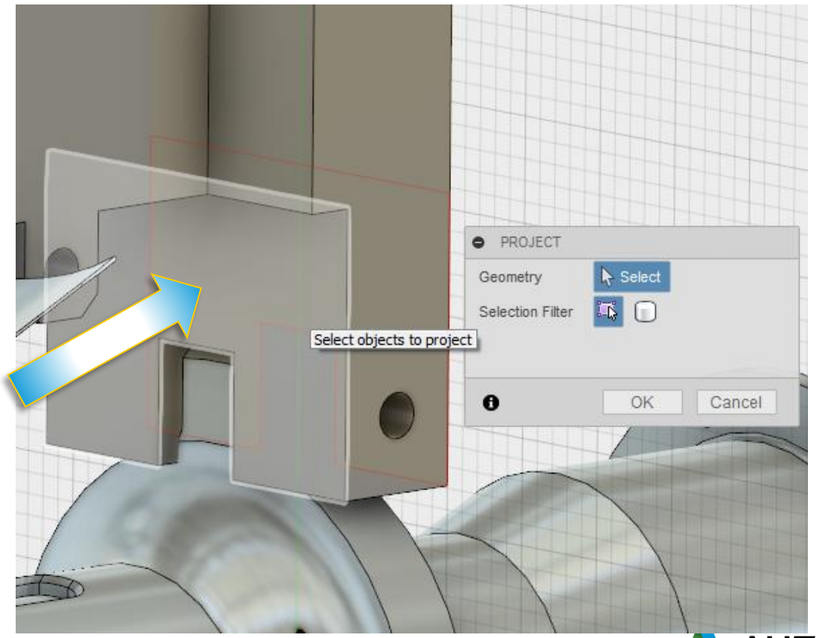


Continued…

In-Context design

- Now we want to remove some extra material fro the sides and we will use standard parametric commands for this
- Create a sketch on the back face of the part
- Press the **P** key for **Project** and project the inside face onto the sketch (see image)

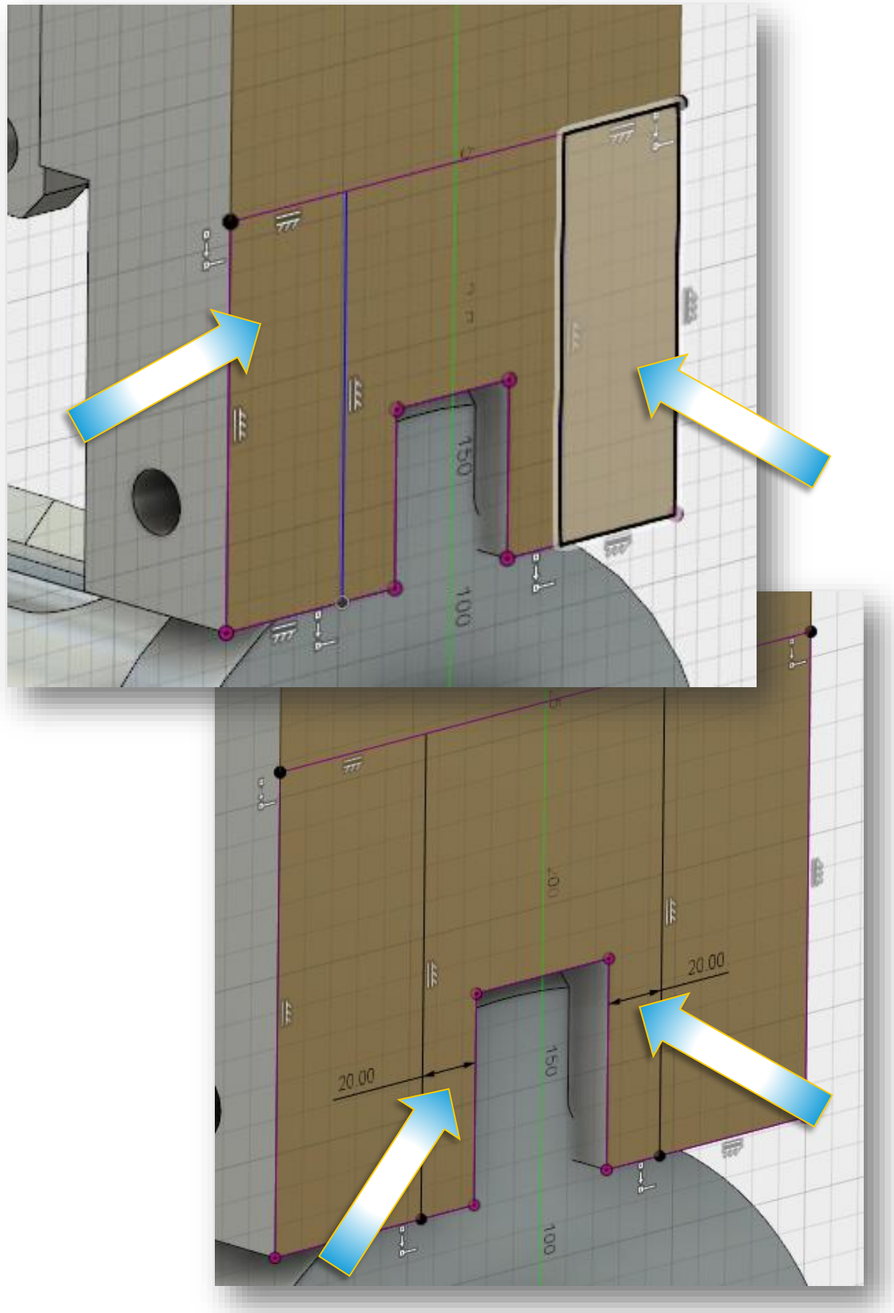




Continued…

In-Context design

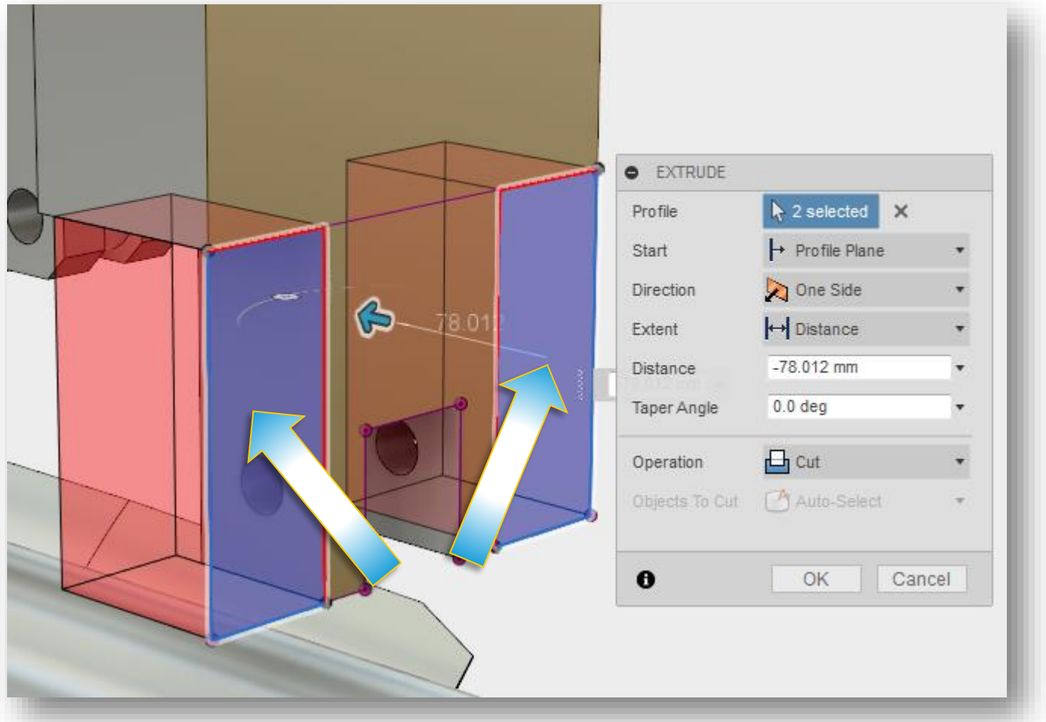
- Draw two rectangles as shown in the picture. Catch to the projected geometry from the previous step
- Add a dimension between the rectangle and the clevis opening of **20mm** on both sides (see picture)
- Turn off the **Sliding Shaft** part

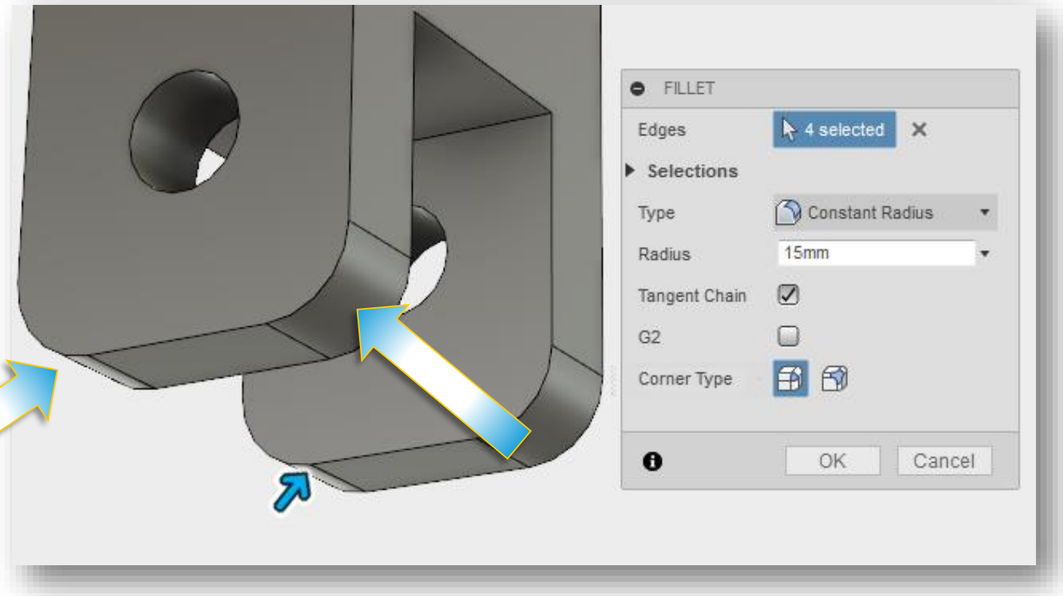


Continued…

In-Context design

- Machine away the two rectangular profiles
- Add **Fillets** of **15m** to the bottom edges of the clevis (see picture)
- Turn the **Sliding Shaft** part back on

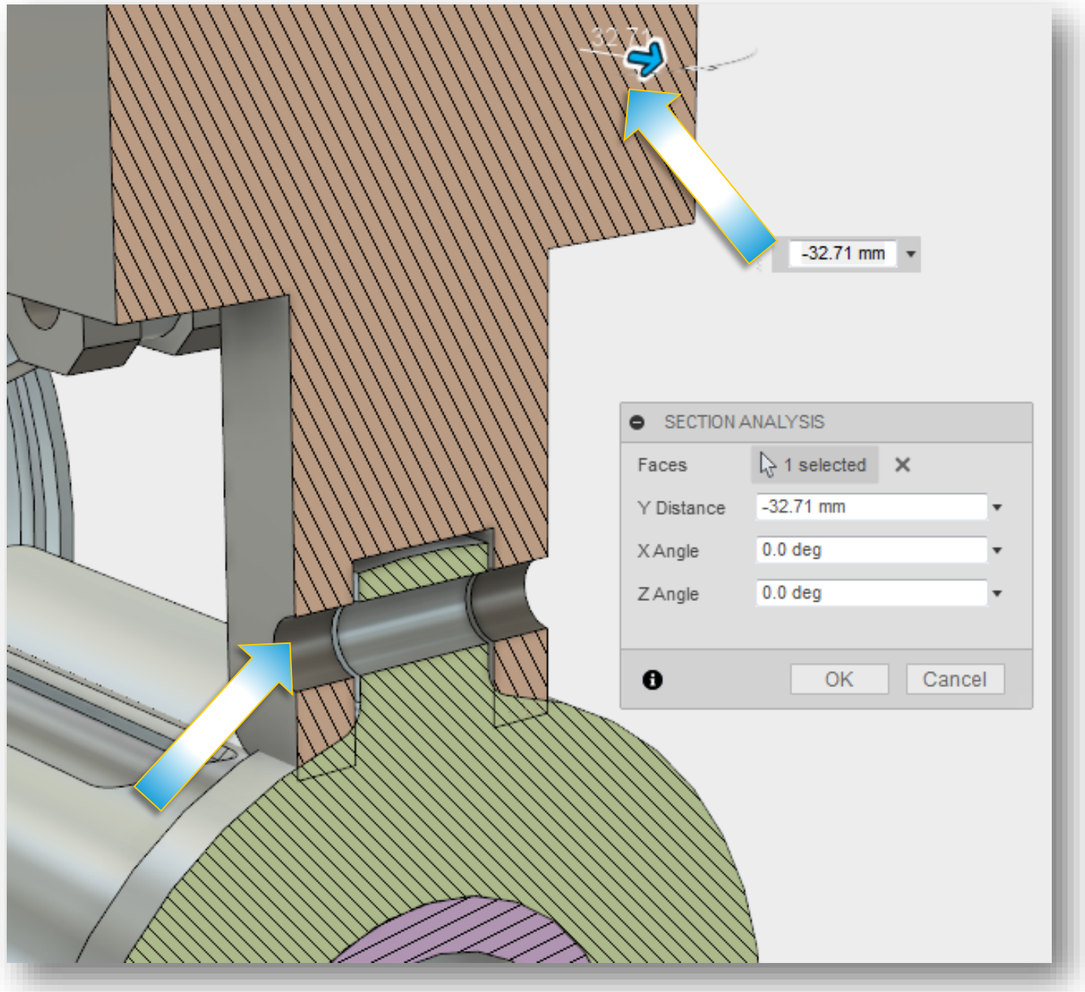




Continued…

In-Context design

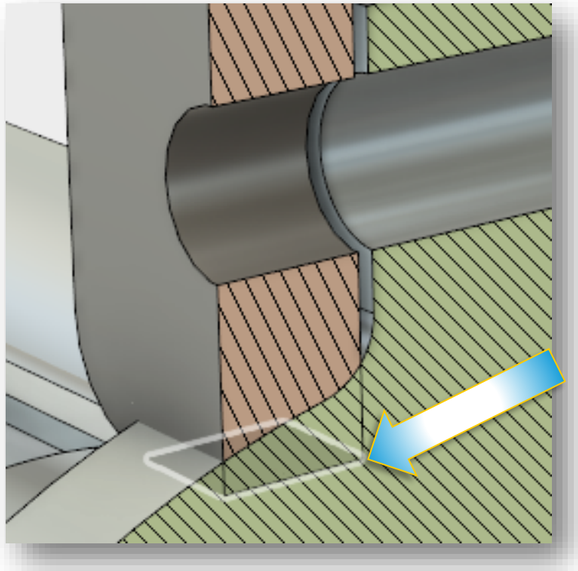
- It kind of looks like our new part is clashing with the sliding shaft part. Lets section through the assembly to check…
- Click on the large flat face of your new part and select **Inspect→Section Analysis**
- Drag the slider arrow back until you cut through the holes (see picture)

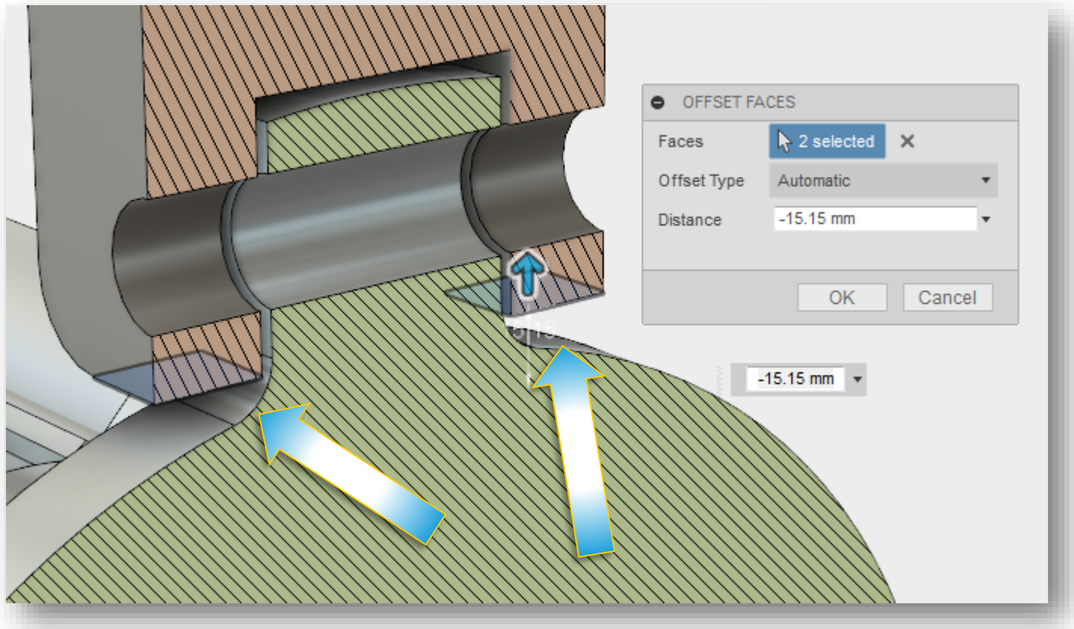


Continued…

In-Context design

- Click on the edge that is clashing and it will select the face associated with it.
- **Right-Mouse-Click** and select **Press Pull**
- **Cntrl-click** the other clashing edge/face and drag them up until they are no longer clashing (see picture)
- Press **OK**

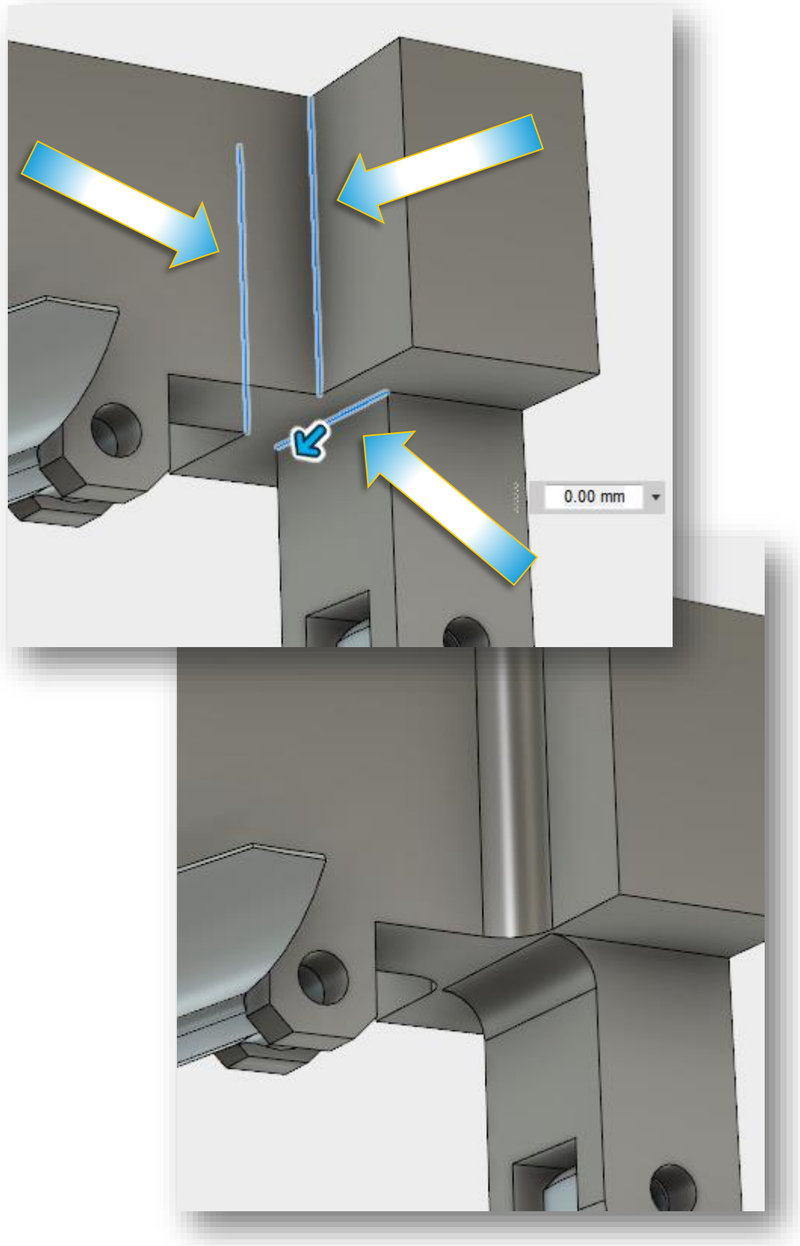




Continued…

In-Context design

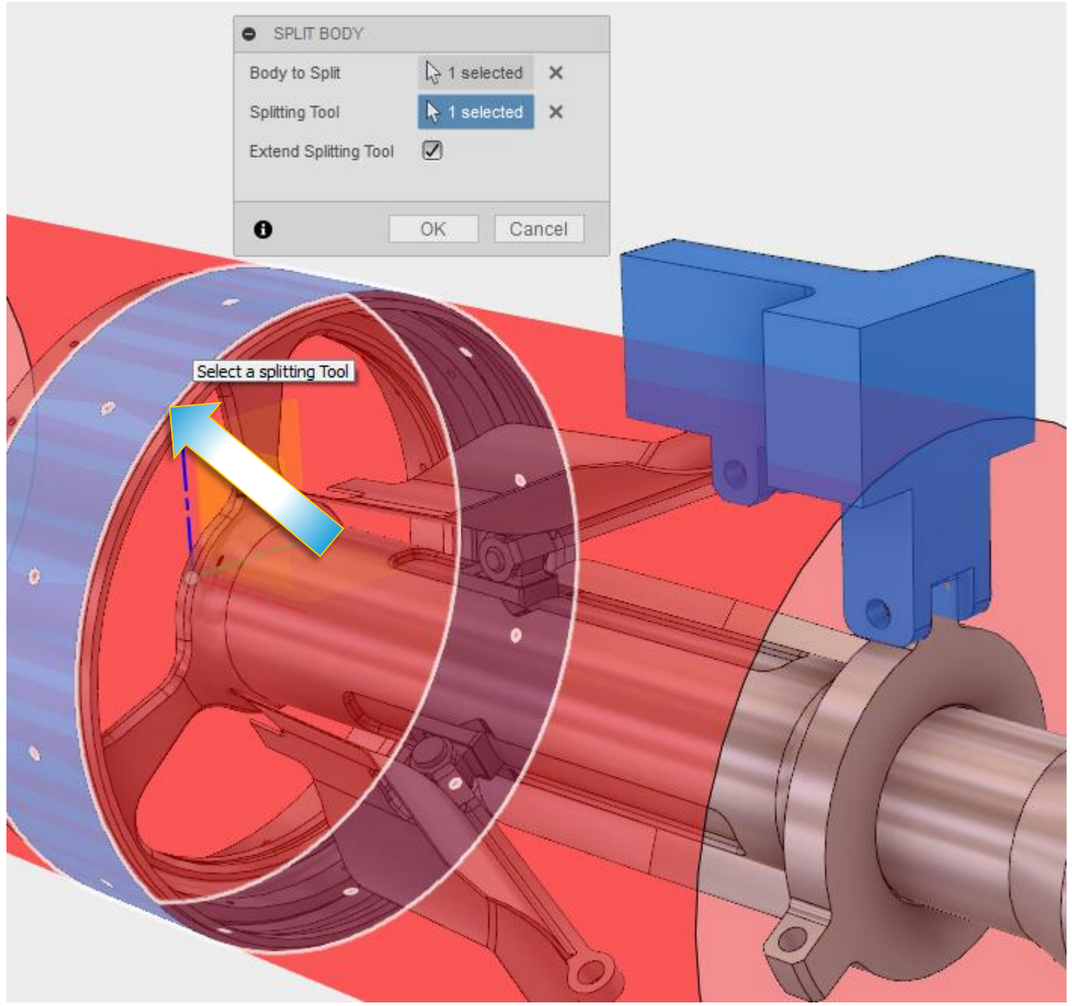
- Turn off the **Analysis** folder in the Browser to turn off the section
- Add a couple of **20mm** fillets to the edges shown in the picture



Continued…

In-Context design

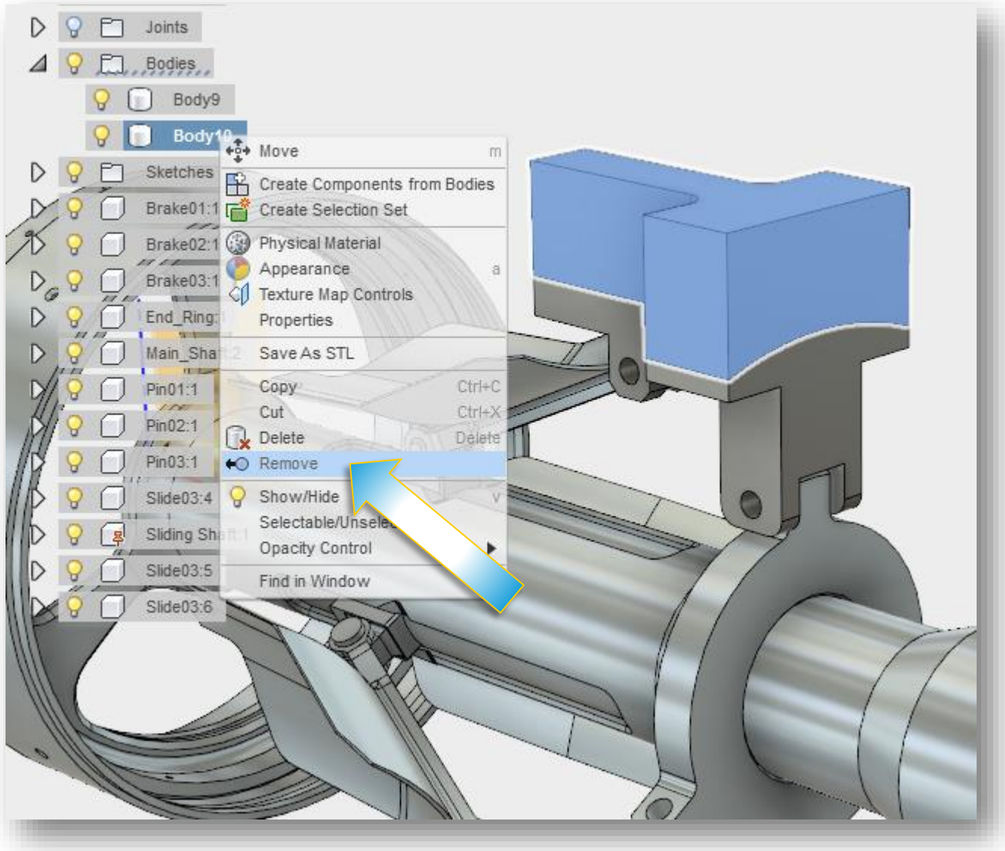
- Now we want the bracket part to fit inside of an enclosure. We will use existing geometry to help accomplish this
- Under the **Modify** menu, select **Split Body**
- Select the bracket part as to body to split
- Pick the outer ring of the circular part as the splitting tool



Continued…

In-Context design

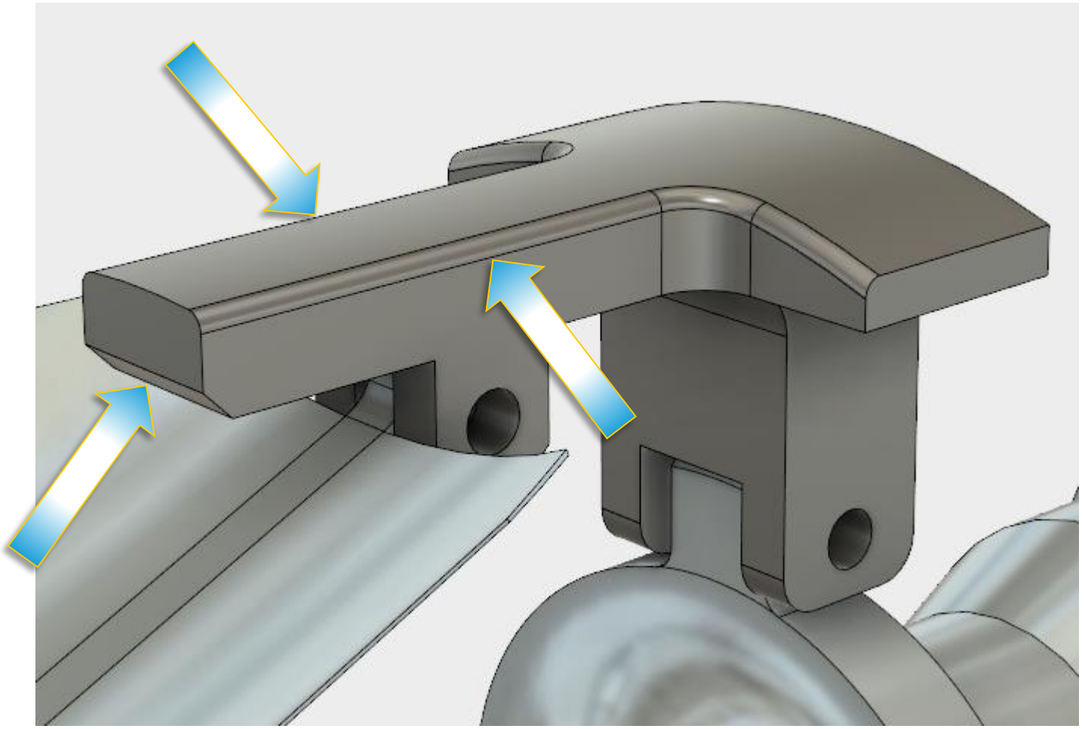
- Press **OK** and the bracket will split into two parts
- Expand open the **Bodies** folder in the browser
- Click on the top part of the bracket and see which body gets highlighted in the browser
- Right-click on it in the browser and select **Remove**



Continued…

In-Context design

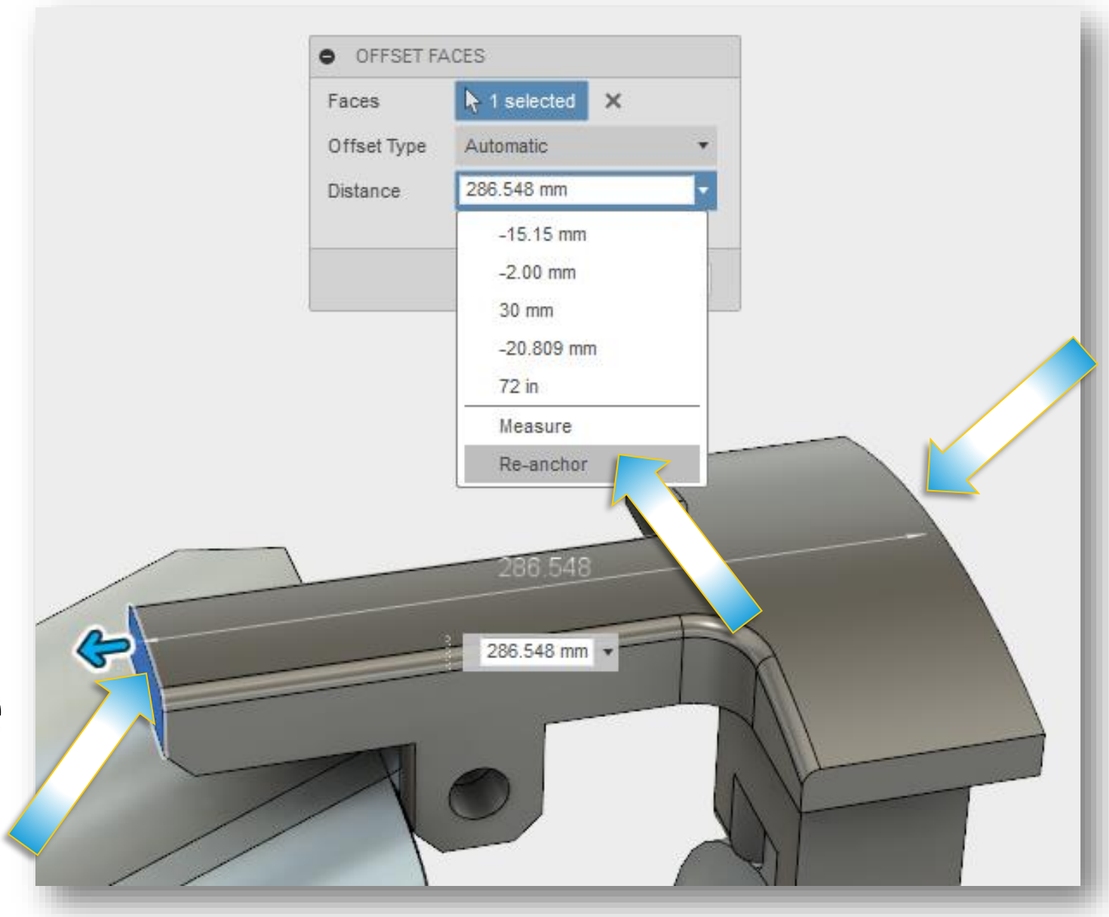
- Add a **10mm** chamfer to the front edge (see picture)
- Add **6mm** fillets to the top edges (see picture)



Continued…

In-Context design

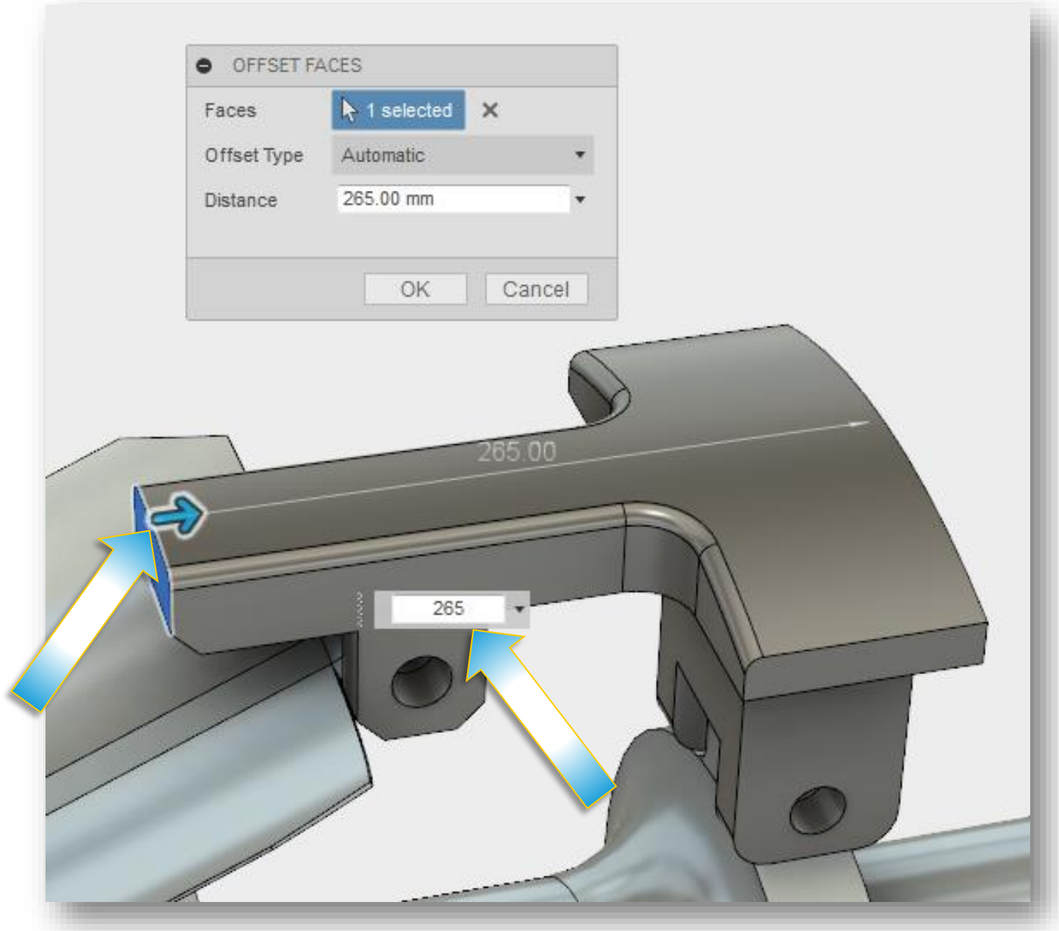
- We are done with our concept. Now, let's refine some of the dimensions
- Click on the front face of the bracket and **Right-Mouse-Click → Press Pull**
- Select the down arrow next to the distance field and select **Re-Anchor**



Continued…

In-Context design

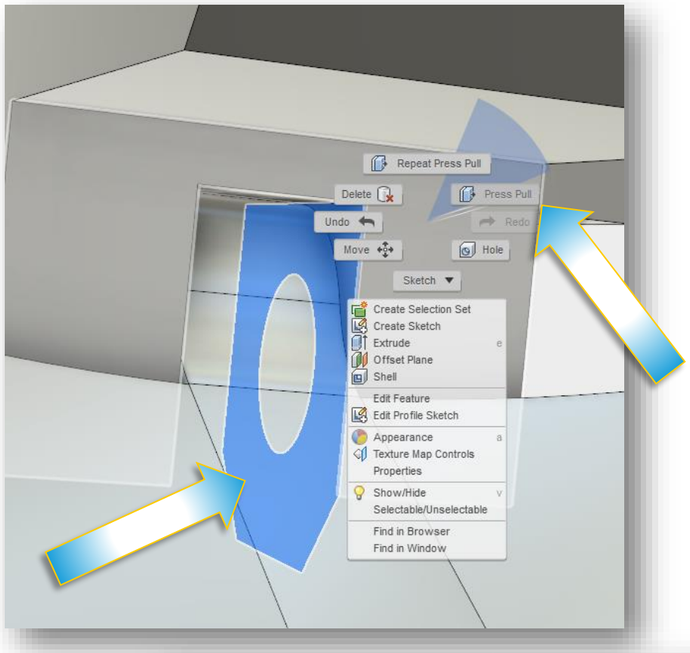
- Notice the dimension is some random number out to three decimal places. Mine was **286.548**
- Type in **280mm** into the distance field and notice the part updates to this new dimension
- You could also drag the dynamic arrow until the part looks close to what you want and then type in that distance (**265.00mm**, for example)

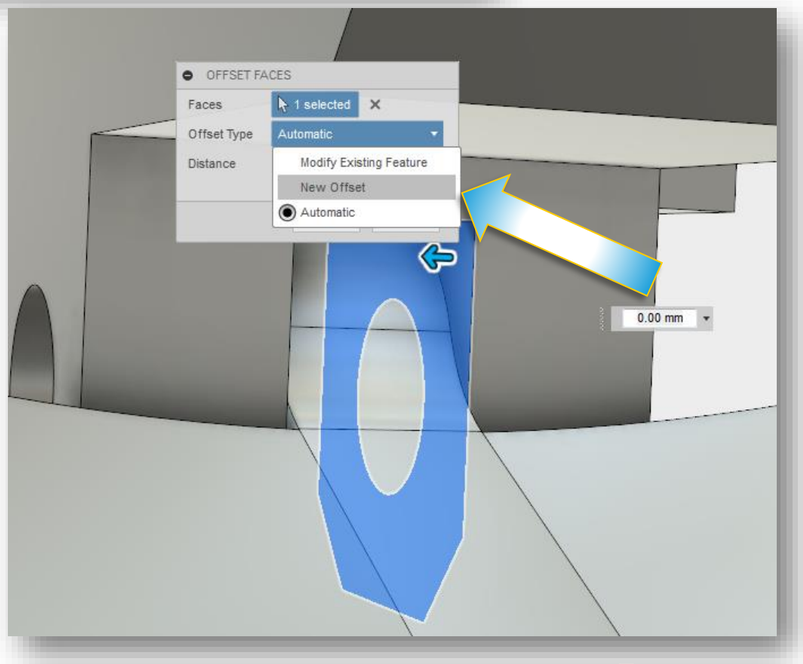


Continued…

In-Context design

- Now we want to add some clearance in the clevis area where the Brake01 part pivots around
- Zoom up to the clevis area and select one of the inside faces
- **Right-Mouse-Click** and select **Press Pull**
- Change the **Offset Type** to **New Offset**

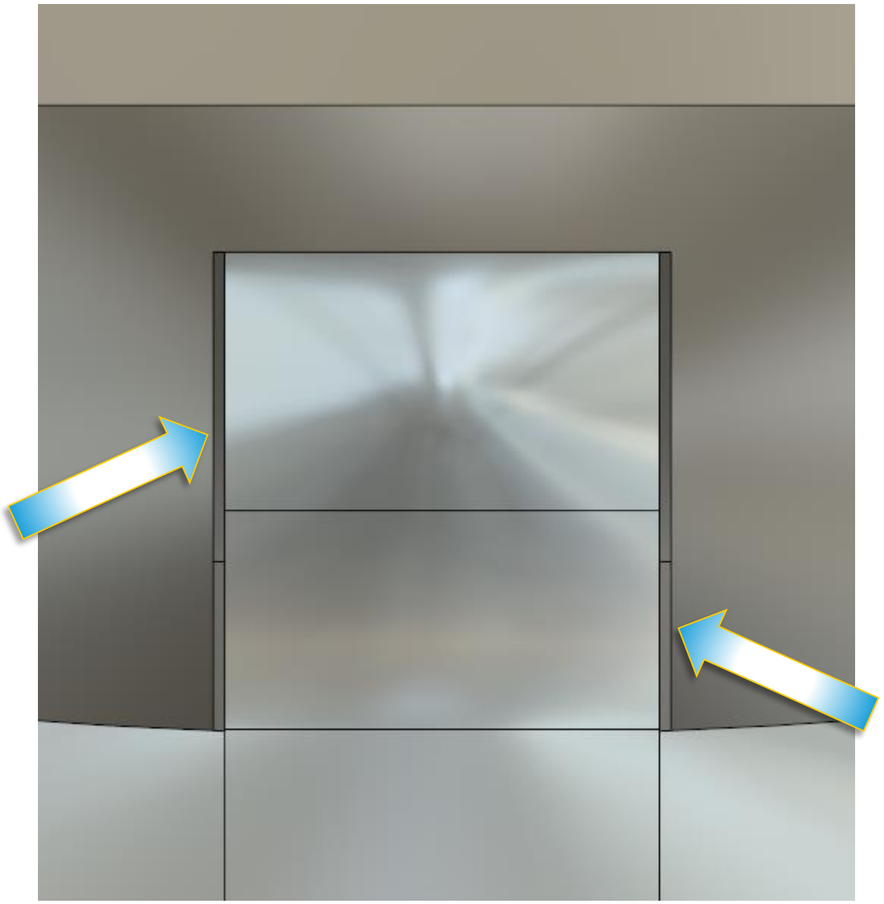




Continued…

In-Context design

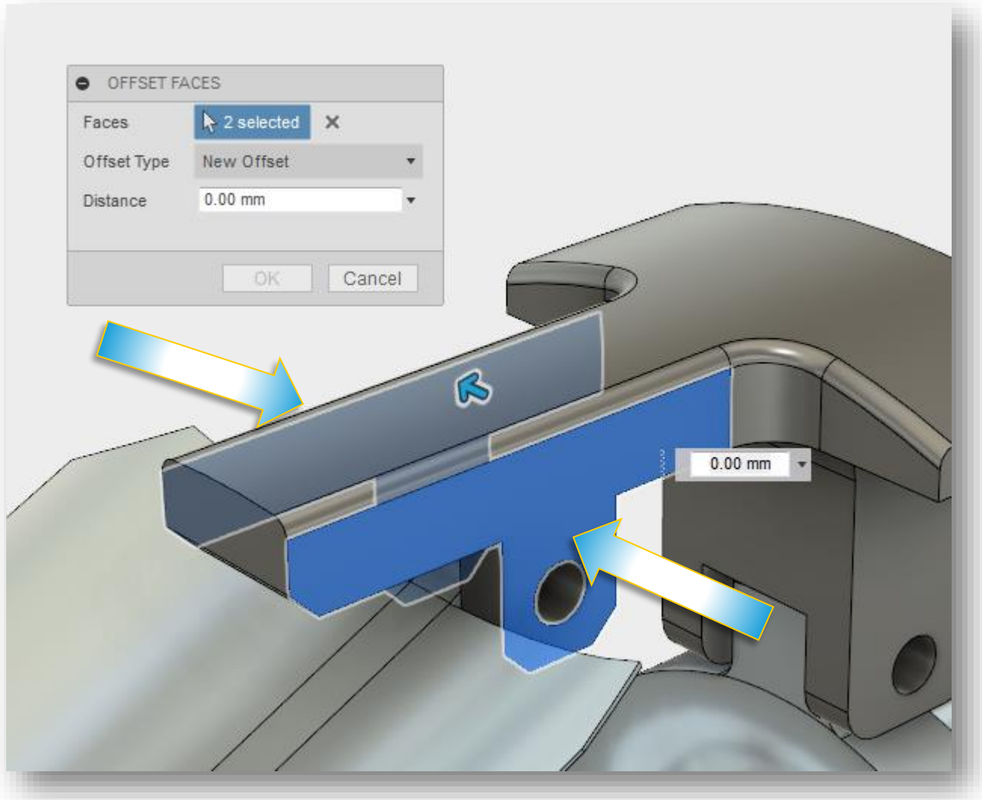
- **Cntrl-Click** the other inside face of the clevis to select it
- In the **Distance** field, type in **-.5mm**
- Press **OK**
- Notice you now have offset both of those faces to provide a bit of clearance



Continued…

In-Context design

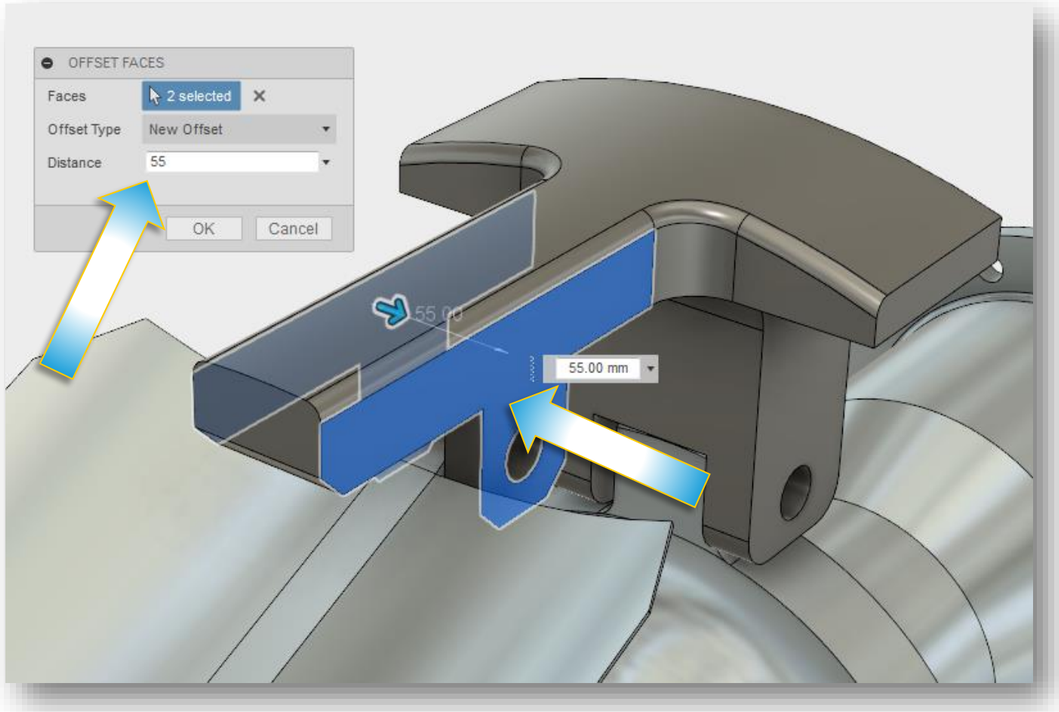
- We want to change the “width” of the arm that sticks out on the bracket part
- Click on one side of the bracket, **Right-Mouse-Click** and select **Press Pull**
- Make sure the **Offset Type** is set to **New Offset** and **Cntrl-Click** the other face of the arm on the bracket



Continued…

In-Context design

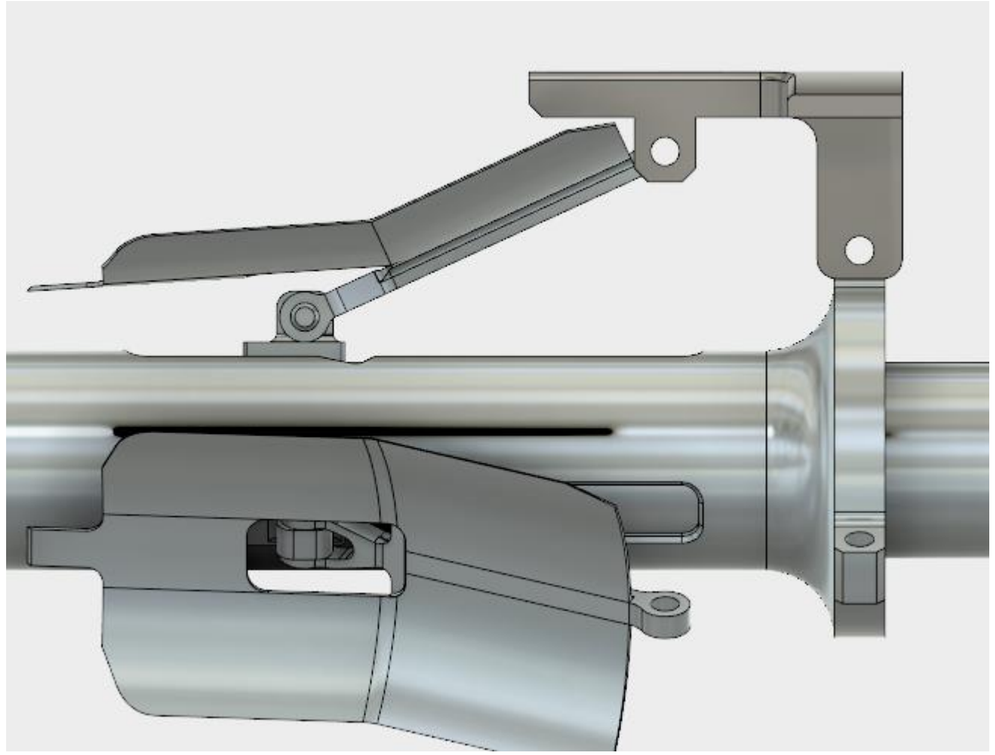
- Dynamically drag the arrow and watch how the arm changes width and how all of the blends move with it
- Click on the down arrow next to the **Distance** field and select **Re-Anchor**
- Select the opposing face from the dynamic drag arrow and a dimension will appear
- Type in **55mm** for the distance and press **OK**



Continued…

In-Context design

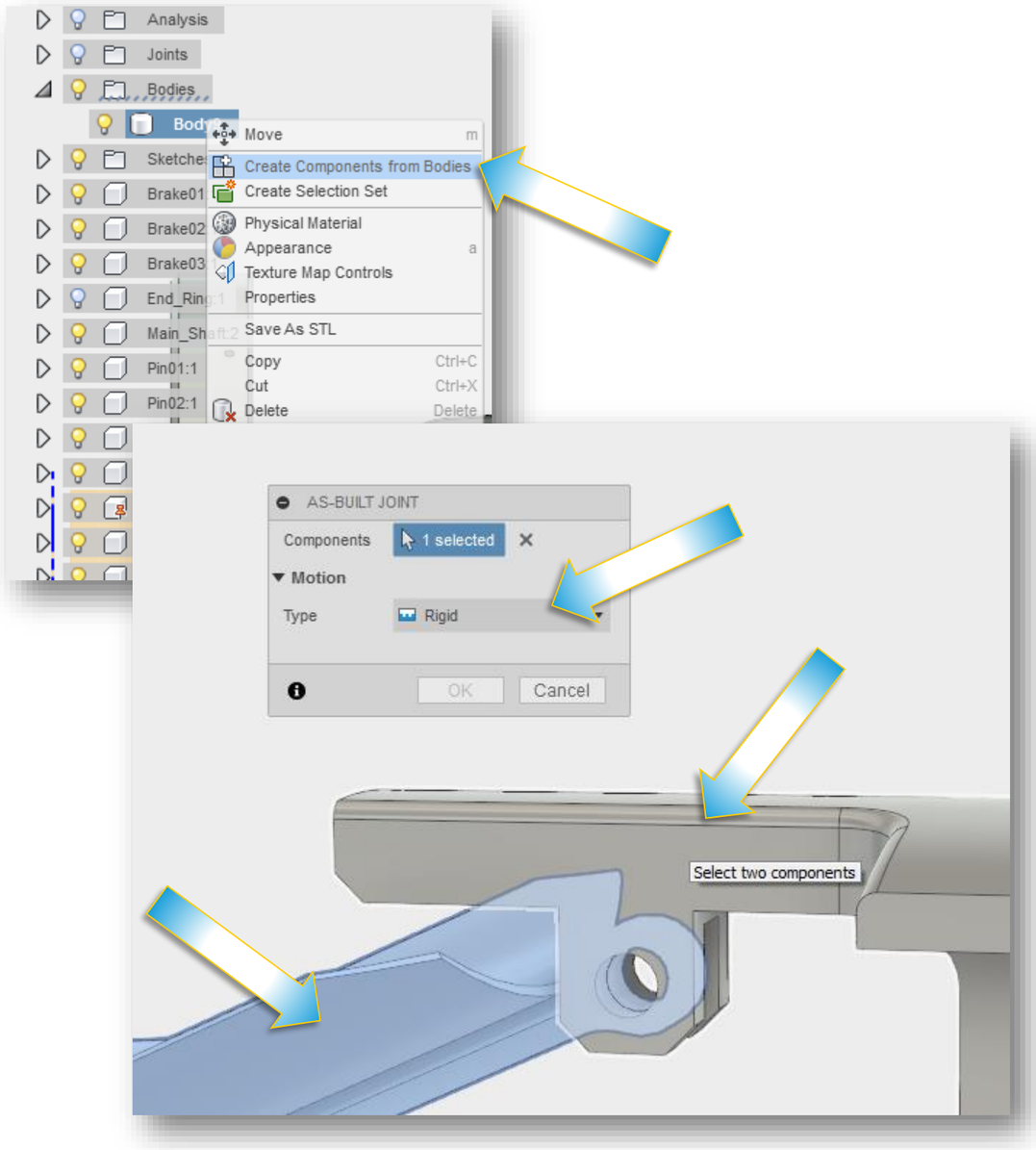
- Finally, we want to see how our new bracket would interact with the other parts
- Since we built it “in context”, we can use the **As Built** joint option



Continued…

In-Context design

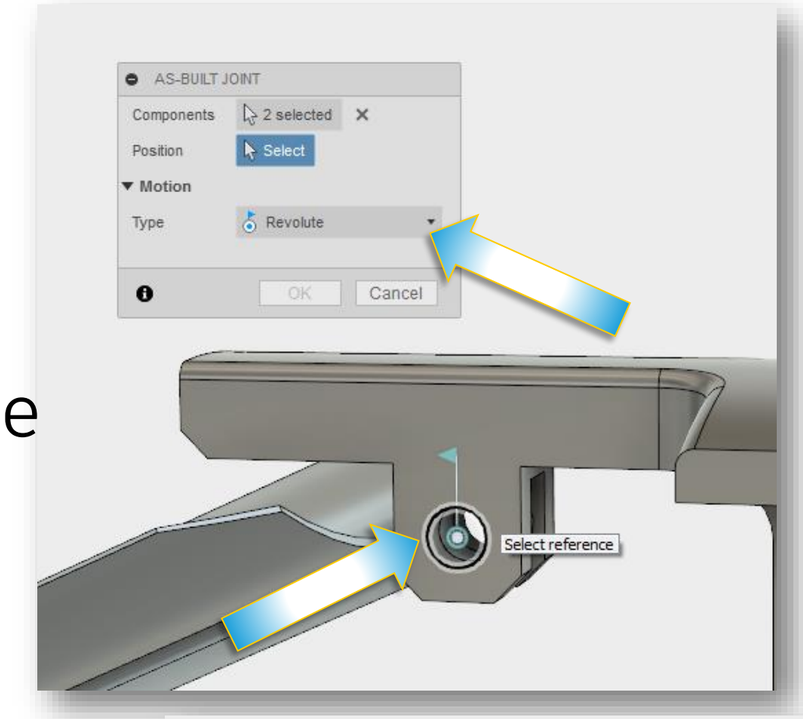
- **Right-Click** on the body in the browser and select **Create Components From Bodies**
- Under the **Assemble** menu, select **As-Built Joint**
- Select your **bracket** and then select the **Brake01** component
- By default, the **Type** may be set to **Rigid**. If so, you will see the animation wiggle like the parts are rigid with each other

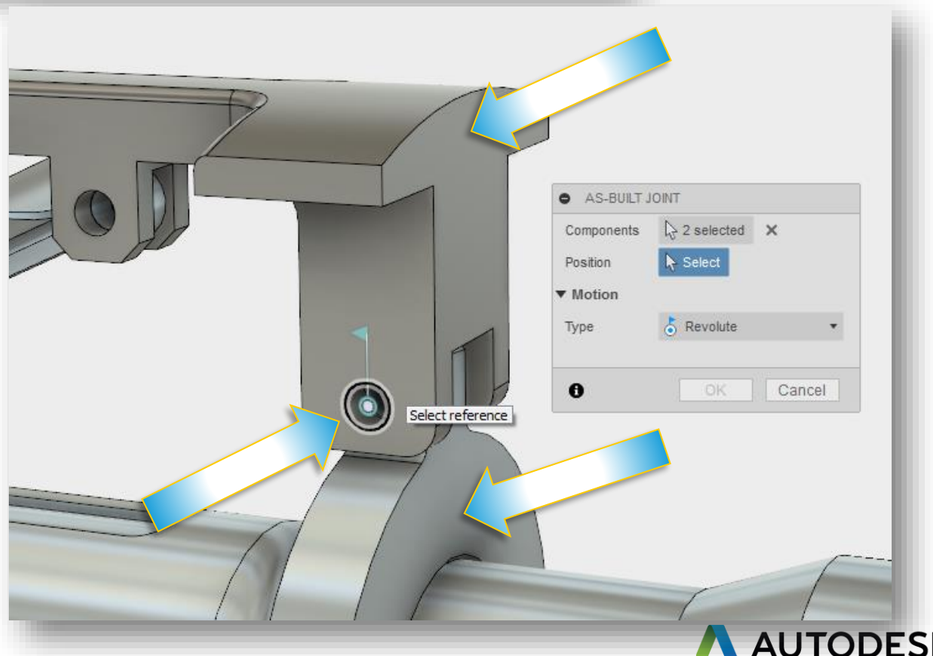


Continued…

In-Context design

- Change the **Type** to **Revolute** and then select the circular edge on the **bracket**
- The preview will show the part rotating around the axis of that edge
- Repeat the **As-Built Joint** on the **Sliding Shaft** and the **Bracket** around the other circular edge



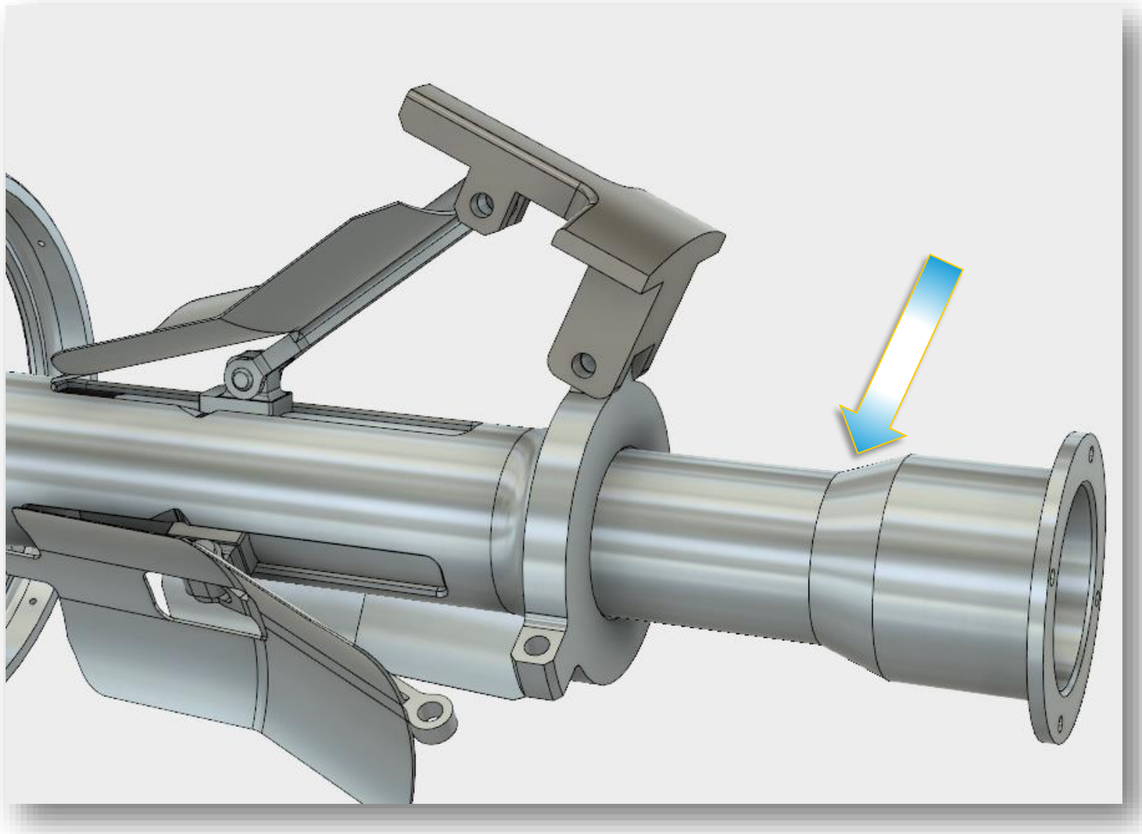


Continued…

In-Context design

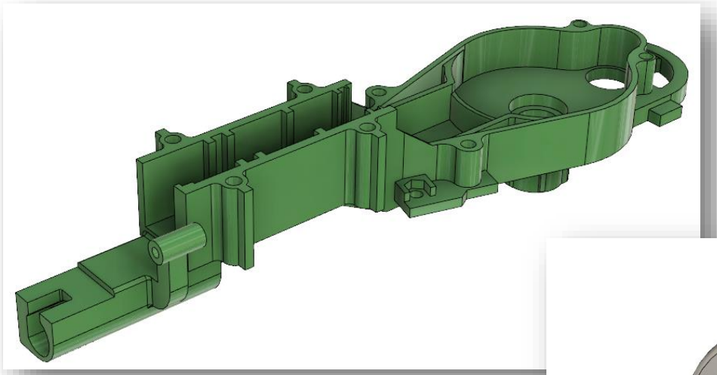
- Click on the part sticking out the back of the assembly (**Main Shaft**) and drag it forward and backward. You will see how your new design now interacts with the other parts of the assembly

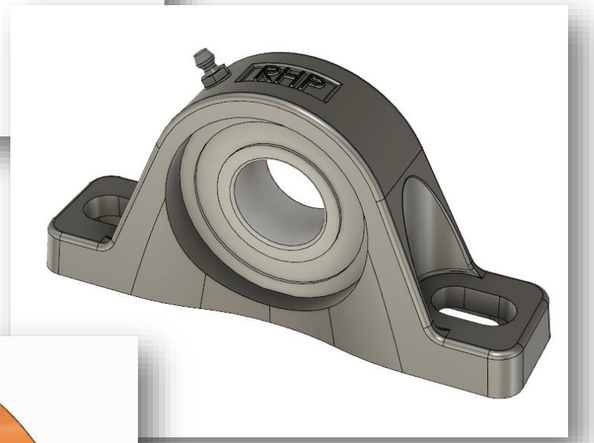
- **That's it! Congratulations!**

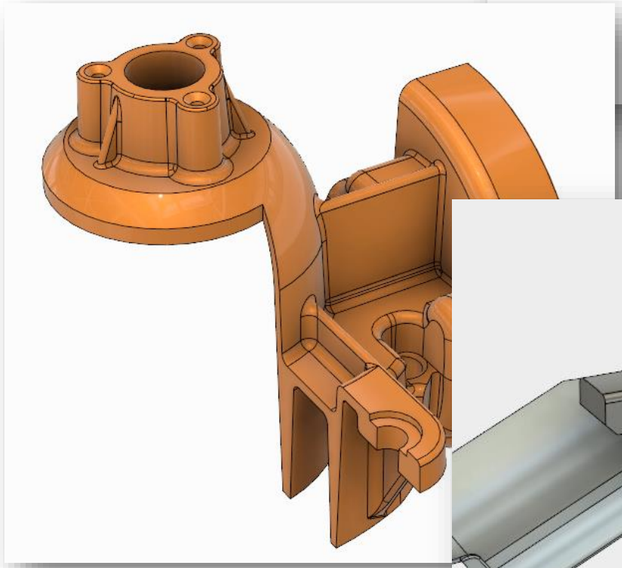


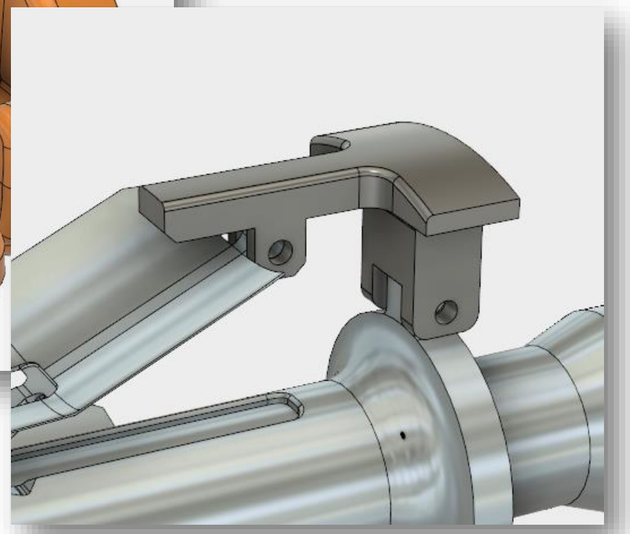
Conclusion

- In conclusion, you have learned how to use Direct Modeling to:
  - Edit and make changes to history based or history free models
  - De-feature imported models
  - Heal corrupted geometry
  - Create quick, in-context designs using existing geometry



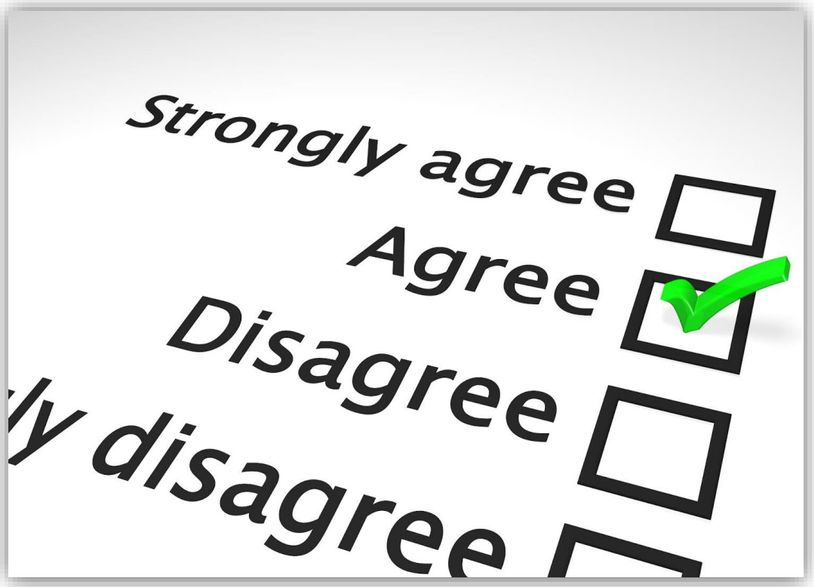






How did I do?

- Your class feedback is critical. Fill out a **class survey** now.
- Use the AU mobile app or fill out a class survey online.
- Give feedback after each session.
- AU speakers will get feedback in real-time.
- **Your feedback results in better classes and a better AU experience.**



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