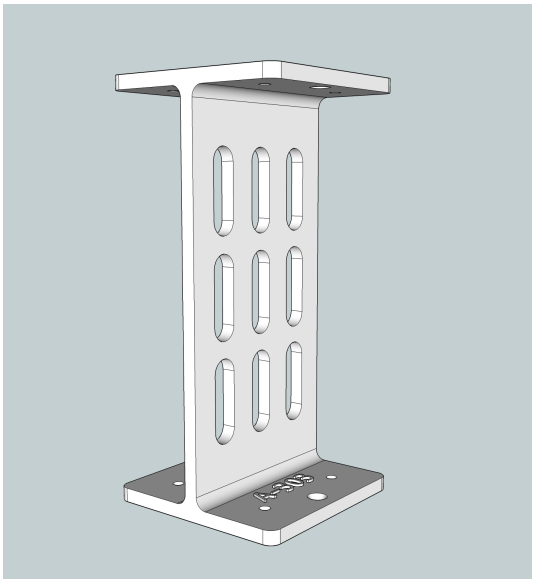
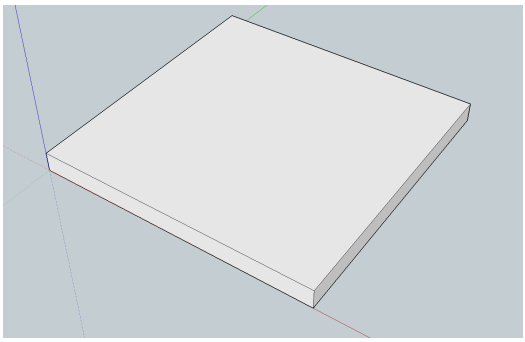
Assignment 2: I-Beam



Starting

1. Open SketchUp Make and go to Preferences > Template > “Architectural Design - Millimeters”

2. Start by drawing a rectangle of 70mm, 70mm and extrude it up by 5mm.

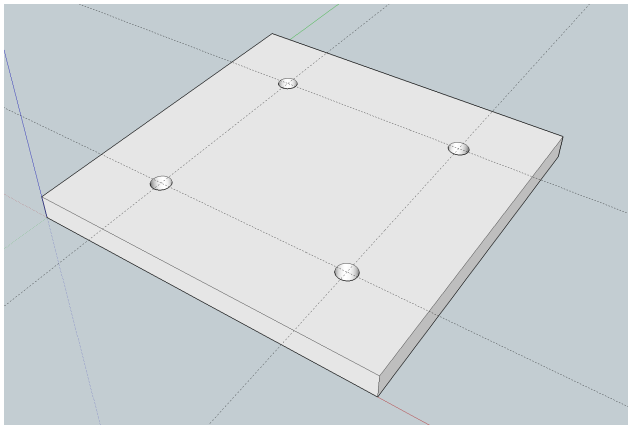


Creating Through-Holes

1. Use the tape measure tool to provide intersection points where through holes will be located. Draw infinite construction lines 15mm from each side onto the surface of the block.

2. Then click the circle tool and use the intersection points of the construction lines as the centers of the through-hole circles. Draw four circles of 2mm radius at each intersection.

3. Cut the circles out of the block by extruding them into the block 5mm down. Or use the base of the block as a reference point for your cursor. You'll see a 'on face' tag pop up.

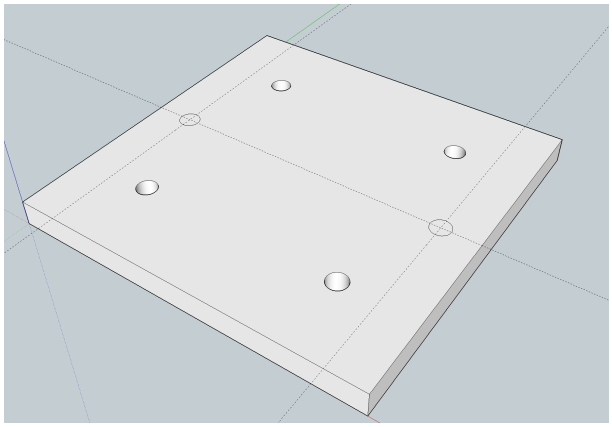


4 Erase construction lines as necessary. Voila! You have your through-holes!

Creating Countersunk Holes

1. Use the tape measure tool to draw a construction line across the middle of the block. Use the tape measure tool again to create an intersection point where the countersunk holes will be. These should be 7.5mm way from one edge.

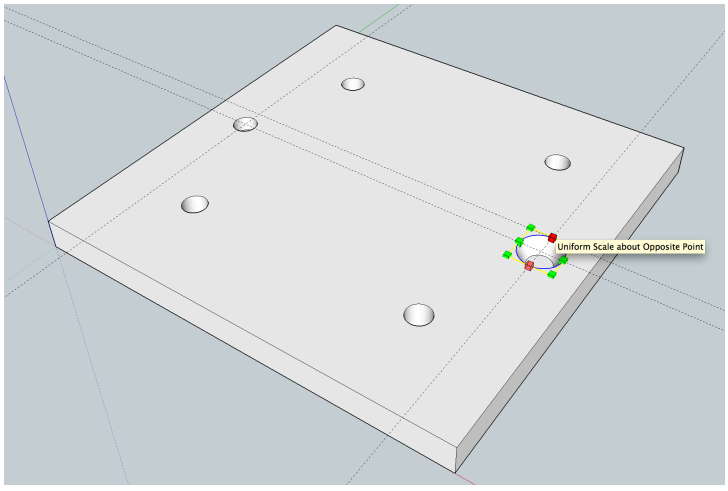
2. Draw two circles of 2.0mm radius at those intersection points



3. Cut the holes halfway into the block using the push/pull tool. Use a construction line if necessary or use the cursor to snap to the midpoint of the height dimension.

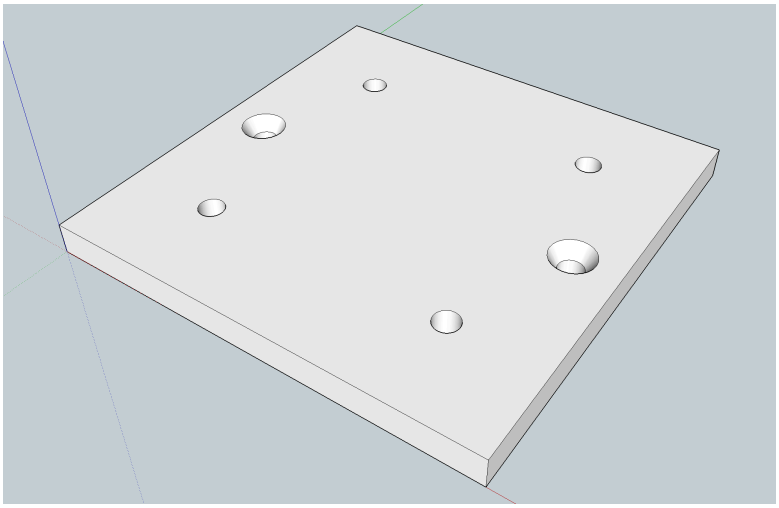
4. Create a construction line 3.5mm away from the center line

5. Highlight only the circle edge of the hole on the surface of the block. Then use the scale tool and hold down “shift” and “control” (“option” on Mac) while dragging the side handle toward the new construction line. This should expand the circle edge about its original center and create a cone-like countersunk structure.



6. Once you have the two countersunk cones created, you can then extrude the rest of the circle through the block.

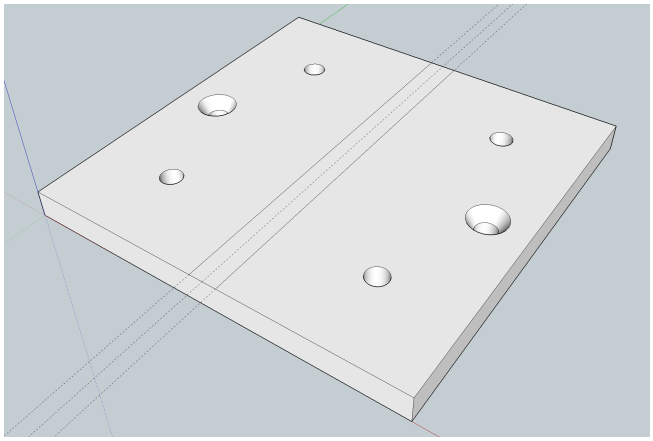
7. Again, erase any construction lines as necessary and you have just created countersunk holes!



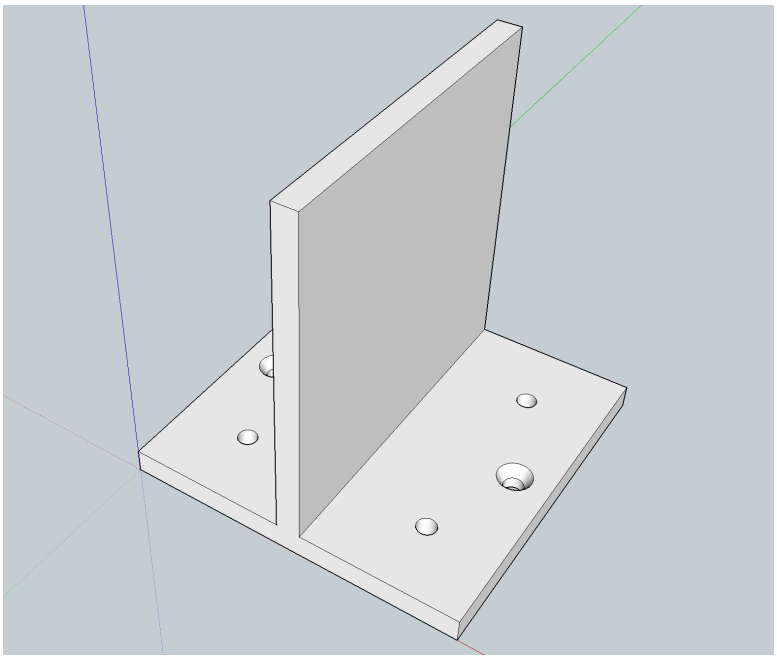
Creating the "T" Flange

1. Use the tape measure tool to draw a 5mm rectangle across the middle of the block.

   Use the Line tool to trace over the two outside construction lines.



2. Extrude the rectangle up by 70mm to create the "T" flange and erase any necessary guidelines.



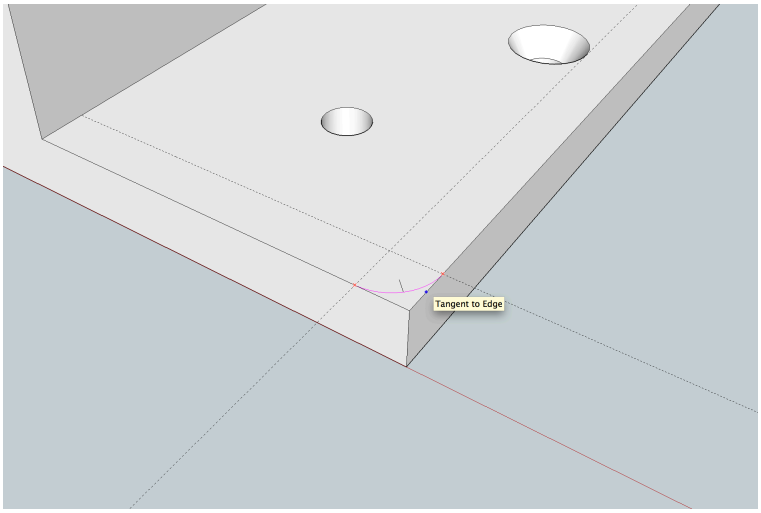
Filleting and Rounding Corners

1. First off we will round the corners of the base block. To do that, we will use the arc tool. Draw construction lines 4mm away from each edge on the base block.

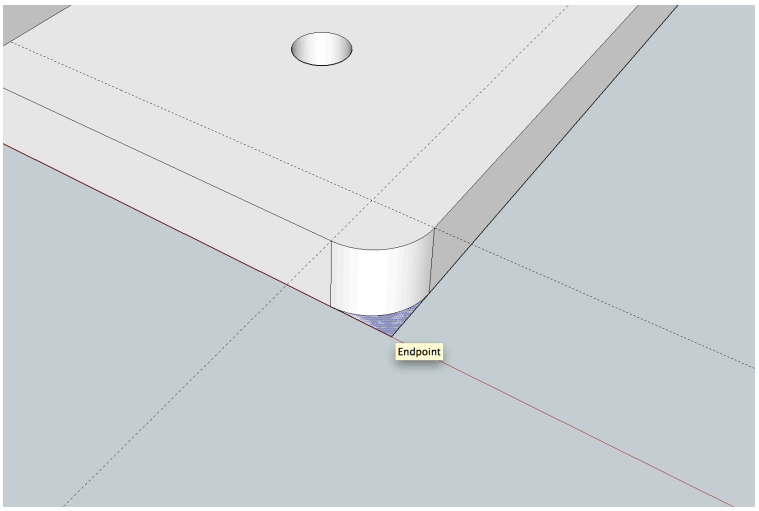
2. With the arc tool using the construction lines as a guide, draw an arc tangent to the edge of the base block. Notice how the arc color will change at significant radii. Once the arc color has changed and a label indicates that it is “Tangent to Edge,” click to release.

   Another method is to draw a 4mm square starting at the corner then draw a 4mm circle centred on the inner corner.

   Repeat this with all four corners.

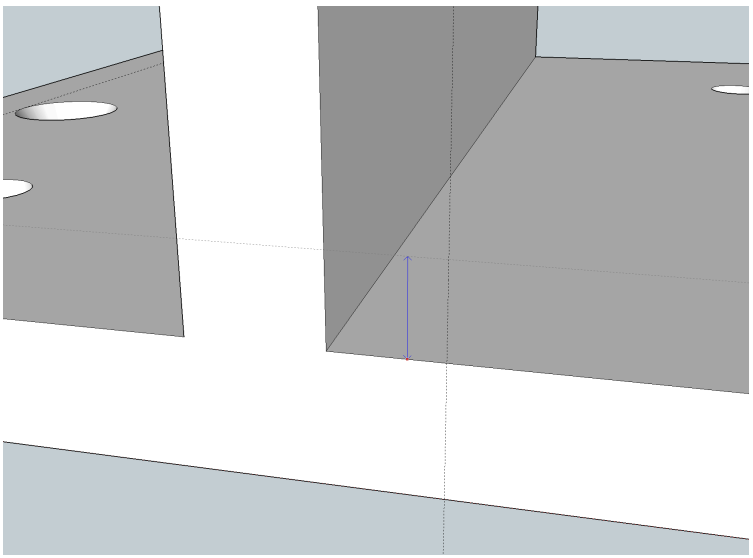


3. Extrude (Push/Pull) the unwanted corners down to round off corners.

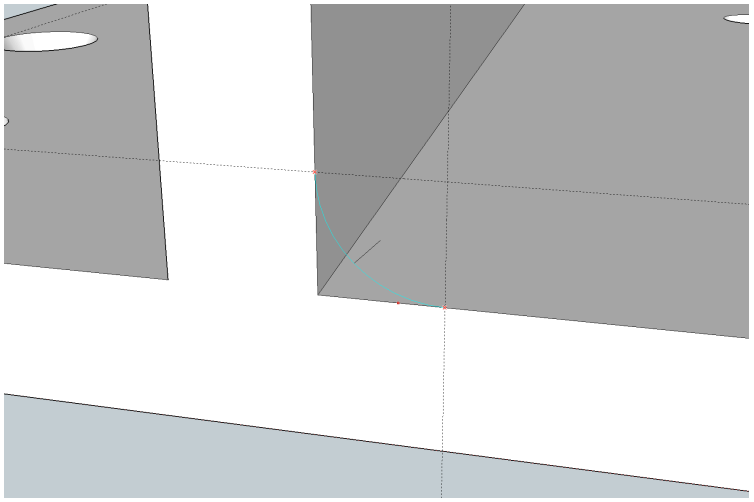


4. To fillet the flange, we will again draw an arc, but this time, we will draw an arc in free space.

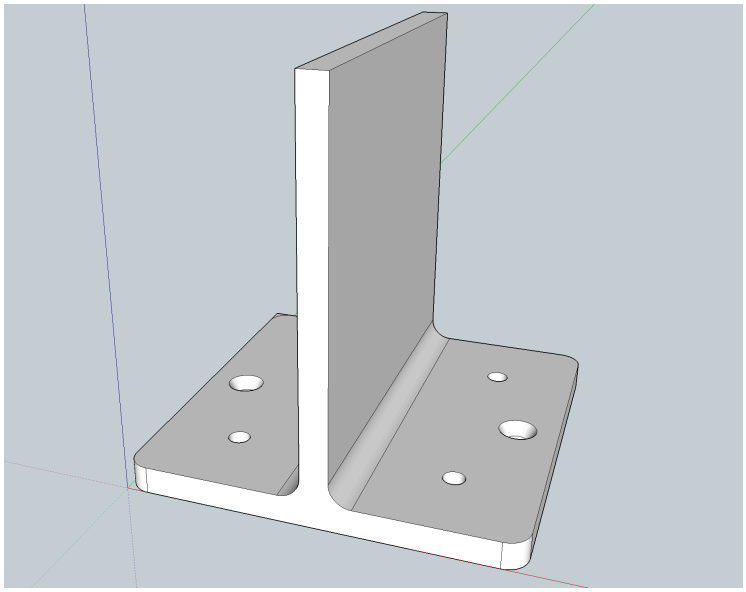
5. Draw construction lines 4mm away from each edge of the flange. Take advantage of the colored axes to draw perpendicular to each edge.



6. After drawing the construction lines, we can again draw an arc, but this time in free space.



7. Extrude these new surfaces and erase any unwanted lines.

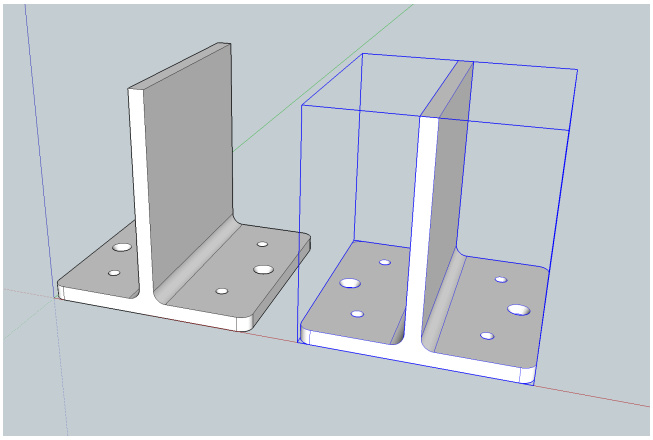


Mirroring the Flange

1. Now that we have half of the symmetrical structure built, we can mirror it about itself and join the two structures.

2. First triple-click or highlight the entire object and create a group by 'Edit, Make Group'.

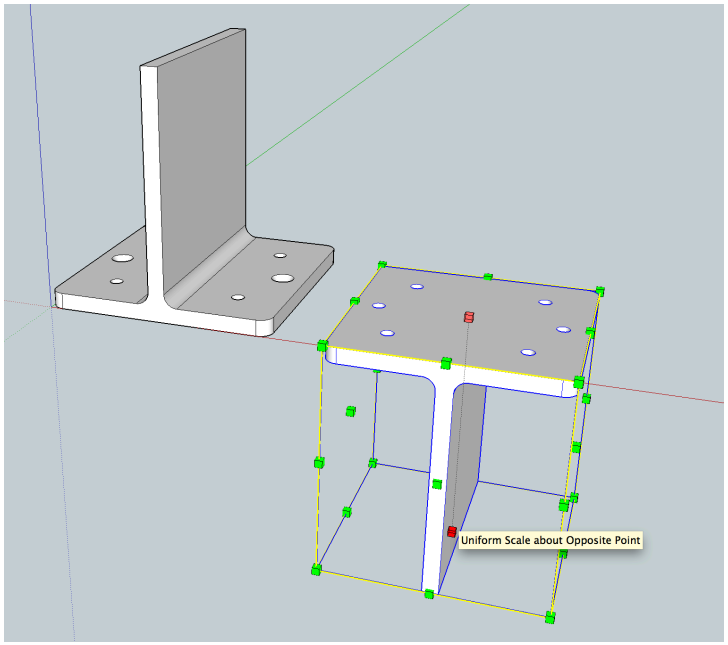
3. Then, using the move tool, we will move the object aside. However, while doing so, press “control” and this will create a duplicate object.



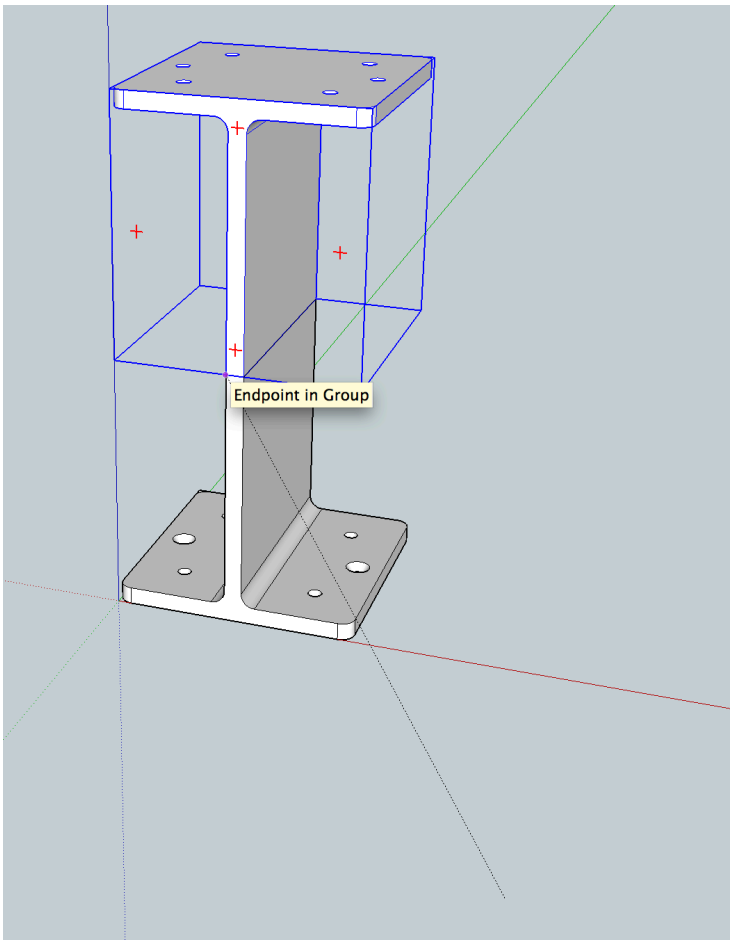
4. Since the object is symmetrical across two planes, we can either use the rotate tool to rotate one part upside down, or use the scale tool to mirror one part.

5. To rotate the part, use the rotate tool. Make sure the rotate tool is on the correct plane. In this case, it should be on the green plane.

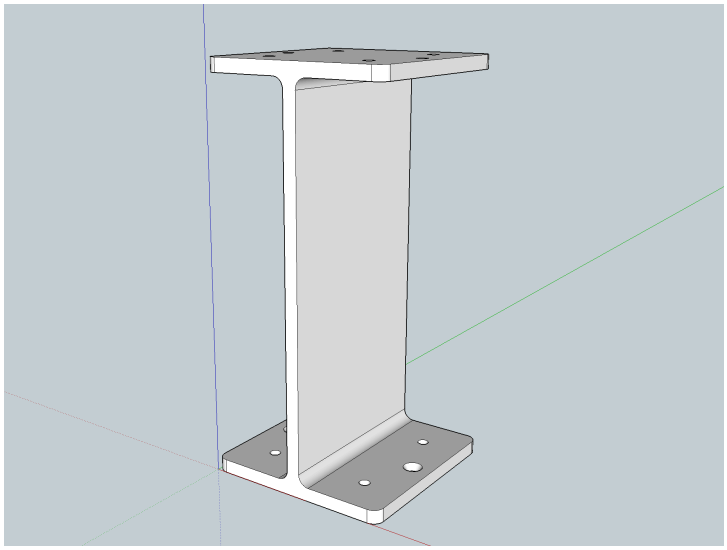
6. To mirror the part, use the scale tool and drag the center handle on face into the negative region. Make sure it snaps to the ratio of -1.00.



7. Now we can use the move tool to move the reflected part onto the original part. Using the move tool, click a corner on the surface of the “T” to be butt against the corresponding location on the original part.

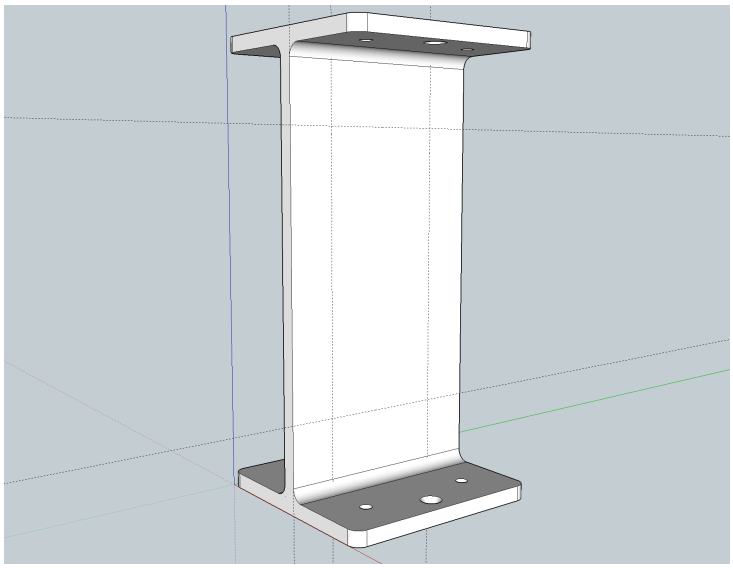


8. Once this is done, select a half, right click, select 'Explode'. Repeat for the other half and erase the 4 dividing lines. This effectively joins the two parts into one.

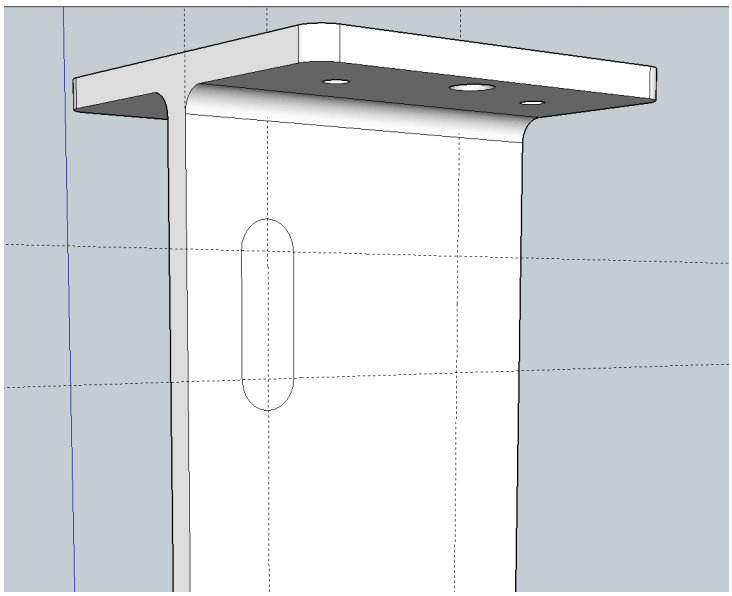


Creating an Array of Holes

1. On one face of the midsection of the I-Beam, create construction lines 15mm away from the sides and 20mm away from the edges of the fillet.

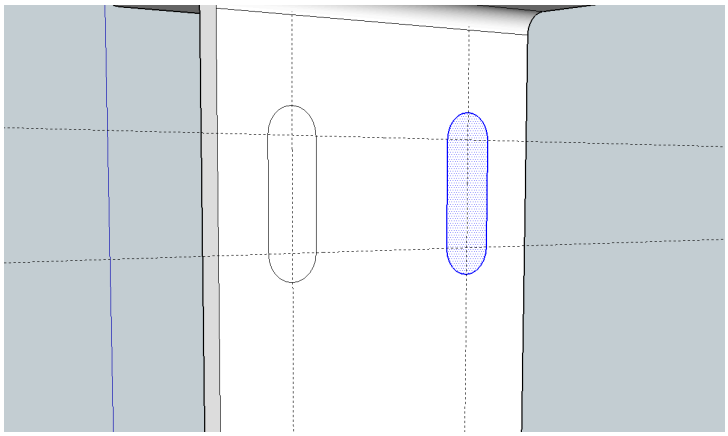


2. Create the shape (two circles and two lines then erase the inside half circles) seen on the right. The radius of curvature is 5mm, and the centers are 20mm apart

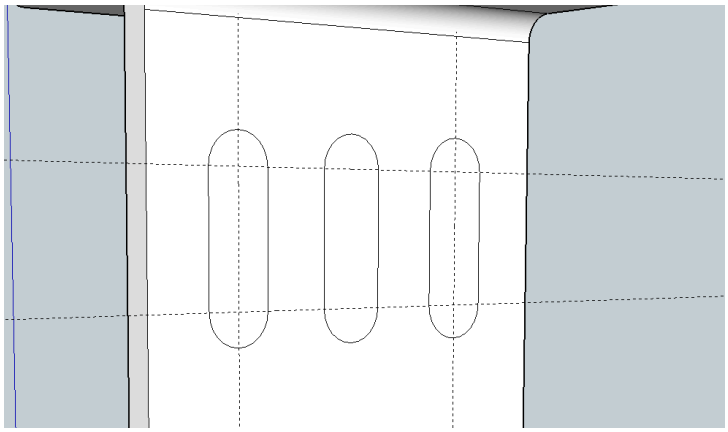


3. To create an array, we will use the move tool, coupled with the “control” key and a simple keystroke.

4. Highlight the boundary of the shape you just created and create a duplicate to be moved to the intersection point to its right.

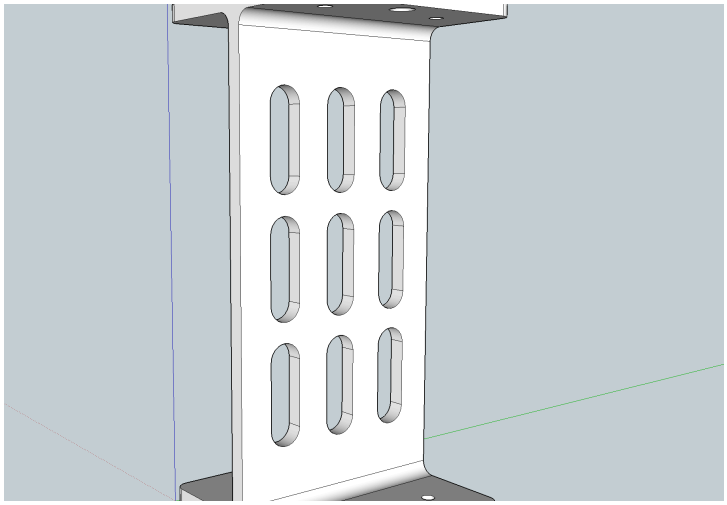


5. Then right after clicking the mouse to release the object, type in “/2.” What this does is it creates two copies of the object you just duplicated and it positions them evenly spaced across the distance the object was moved.



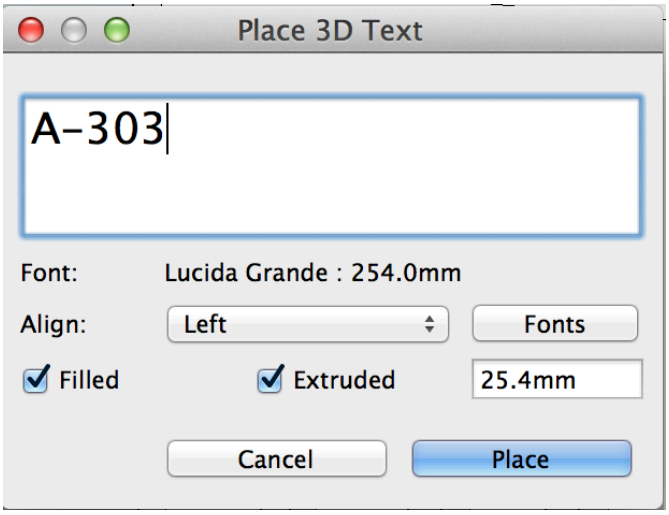
6. To make a 2D array, we will highlight all three shapes that were just created and move and duplicate them vertically in a similar fashion to create an array of 9 shapes.

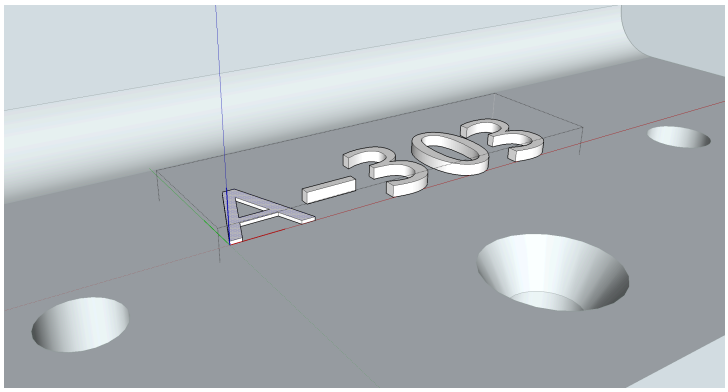
   Finally, extrude all shapes to create holes and erase all necessary lines.



Creating 3D Text

1. Find the 3D Text tool under Tools > 3D Text. A dialogue window will pop up. Type in what you want, and specify the font.



2. Once you press “place,” an object appears that is the word that you just typed in 3D. Move and scale the label and place it on your model. Use guidelines if you would like an exact placement.

3. Double click into the group to edit the 3D shapes. You can adjust the height of the extrusion here.