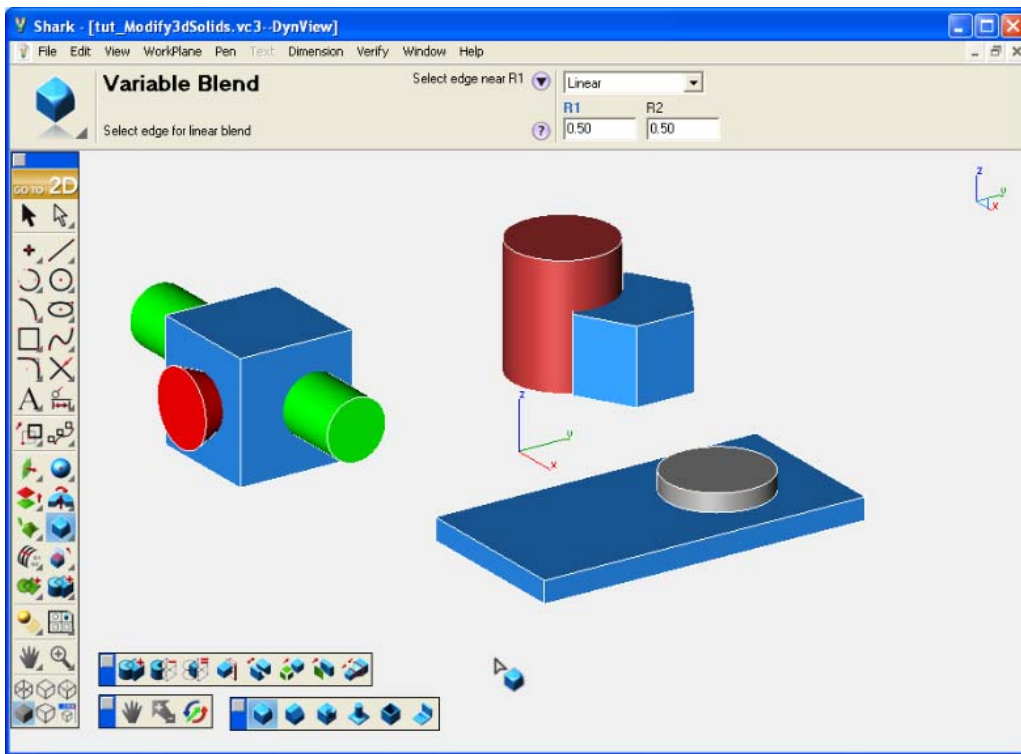


## Modify 3D Solids Tutorial

The shapes of 3D solids can be modified with a variety of different tools. Some modifications include adding, subtracting, and intersecting solid objects, as well as customizing shapes with chamfer and fillet tools.

### Setting up Your Workspace

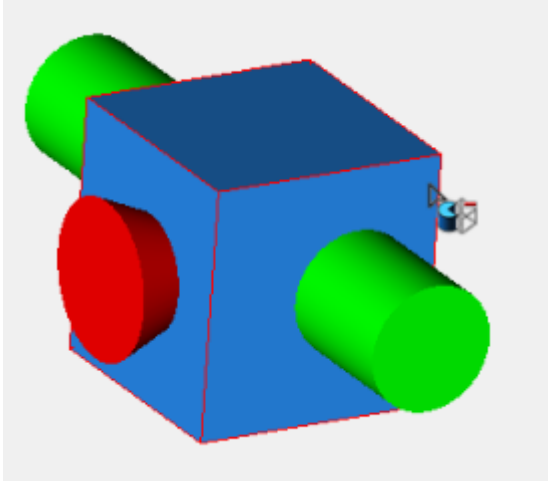
Before starting this tutorial, prepare your workspace by dragging off the toolsets you'll use. From the Main Tool Palette, drag off the Dynamic Zoom toolset, Solid Utilities toolset, and Solid Features toolset. Drag the toolsets and place them along the bottom of the workspace.



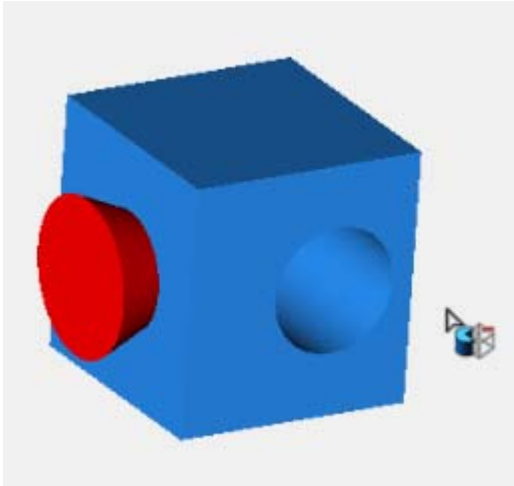
### To remove an intersecting solid object

1. From the Solid Utilities toolset, choose the Subtract Solid tool. This tool allows you to select an existing solid, then one that intersects with it, to remove it from the first.
2. On the left-most shape, click the block to select it.

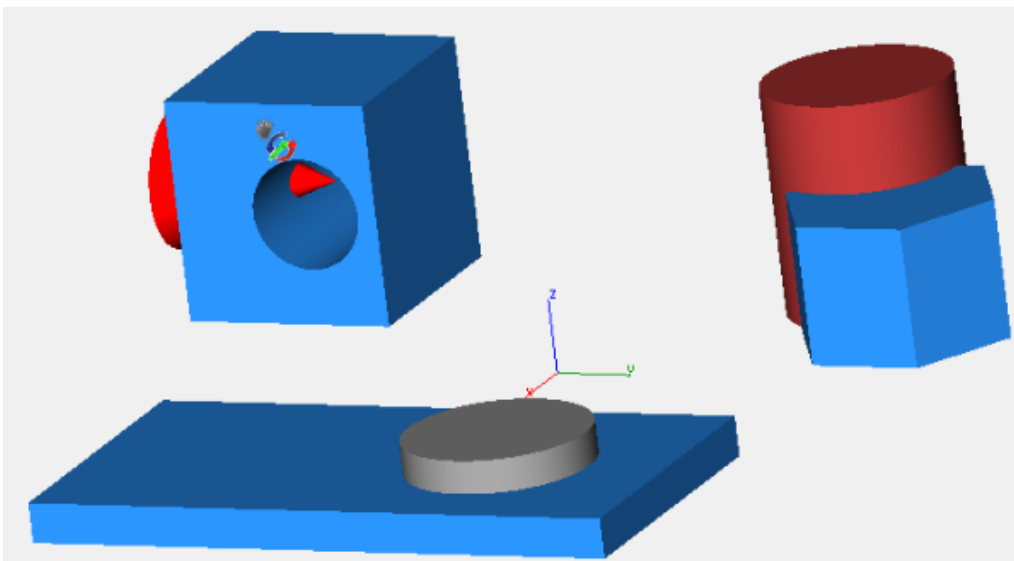




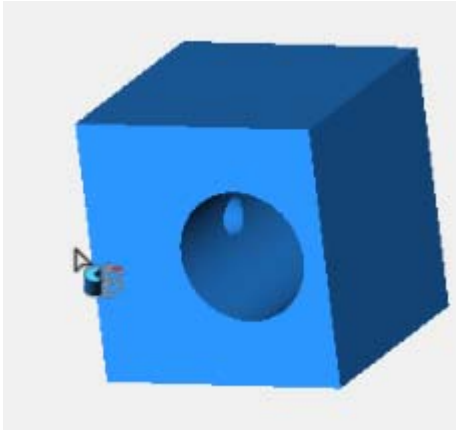
3. Select the green cylinder that intersects with the block. The cylinder is removed.



4. Click the Dynamic Rotate tool and rotate so you're looking at the right side of the drawing.

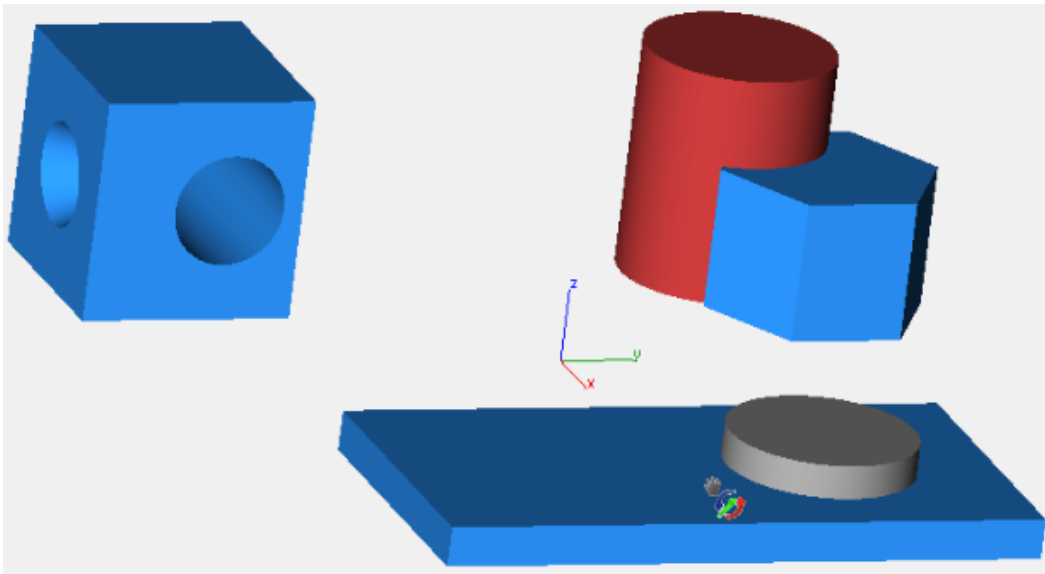


5. Click the Subtract Solid tool.
6. Click the block, selecting it as the object to subtract from.
7. Click the red cone to remove it from the block as well.



### To combine two solid objects

1. Use the Dynamic Rotate tool to rotate to the left so the polygon is in front, and you can see the tops of the solids.



2. Click the Add Solid tool. This tool allows you to take two individual solids and combine them into one.
3. On the workspace, click the blue polygon.
4. Click the gray circle to add it to the first selection. Notice the color of the resulting single object is inherited from the first of the two picked.

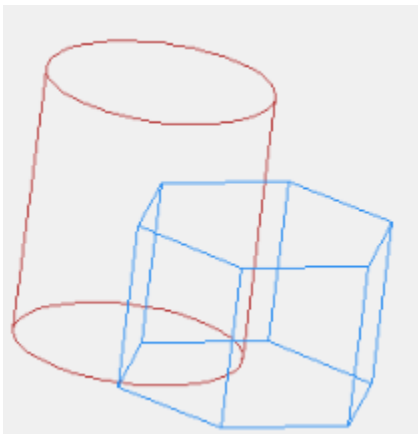




5. From the Edit menu, choose UNDO Add Solid3, to undo the add.
6. Click the small circle to select it as the object to be added to.
7. Click the polygon to add it to the circle. Notice the color of the selection being added is inherited from the first selection.
8. Click the Selection tool.
9. Select the object. Notice it is now a single object.

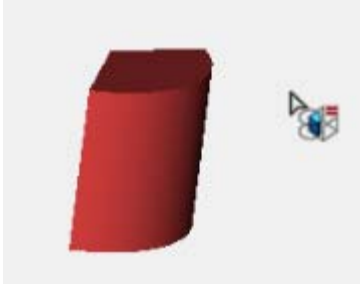
### To create an intersecting object

1. Click the Intersect Solid tool.
2. On the Main Tool Palette, change to Display in wireframe so you can see the intersection.



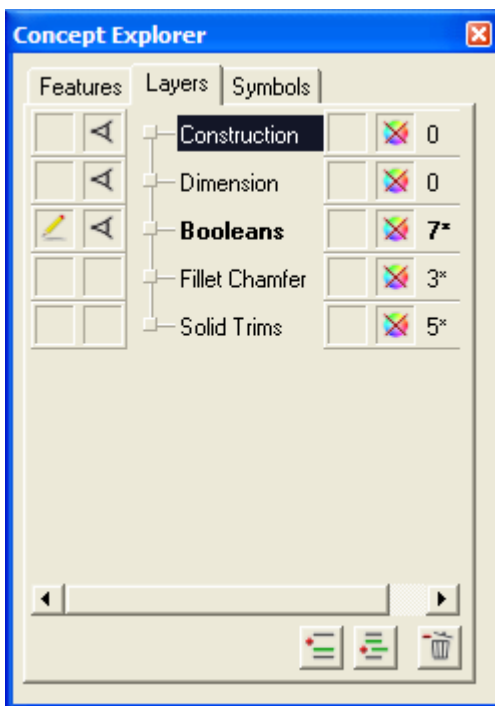
3. Switch back to Display with Shading.
4. Click the orange cylinder.
5. Click the blue object. Notice the resulting object is the color of the first of the two selections.





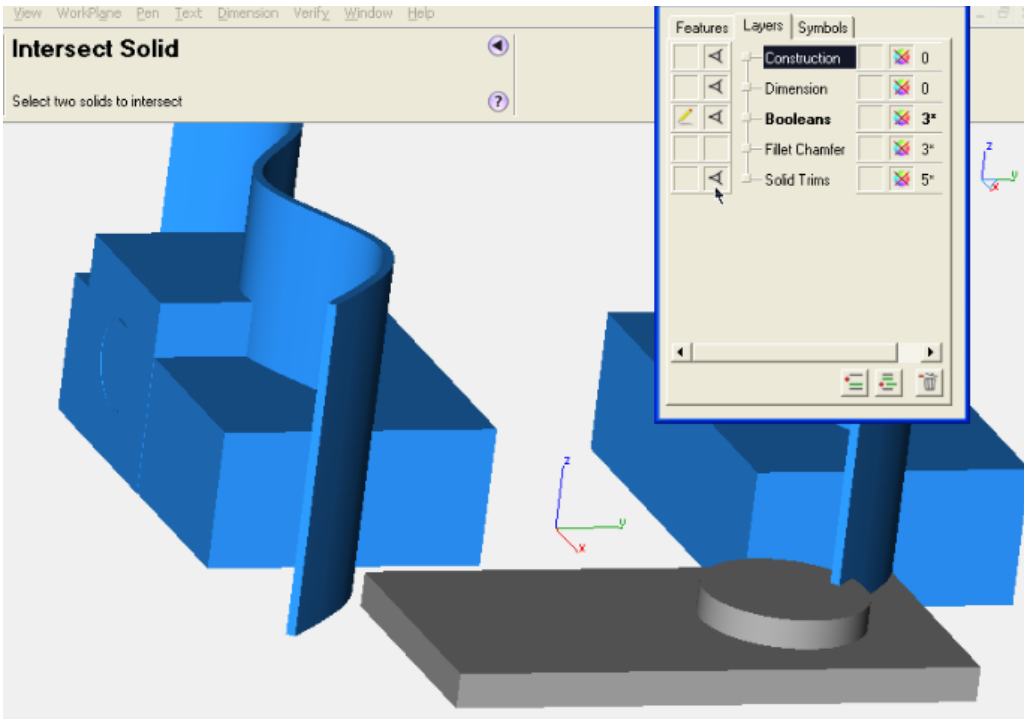
## To control working layers and visibility

1. From the Window menu, choose Concept Explorer. The Concept Explorer appears.

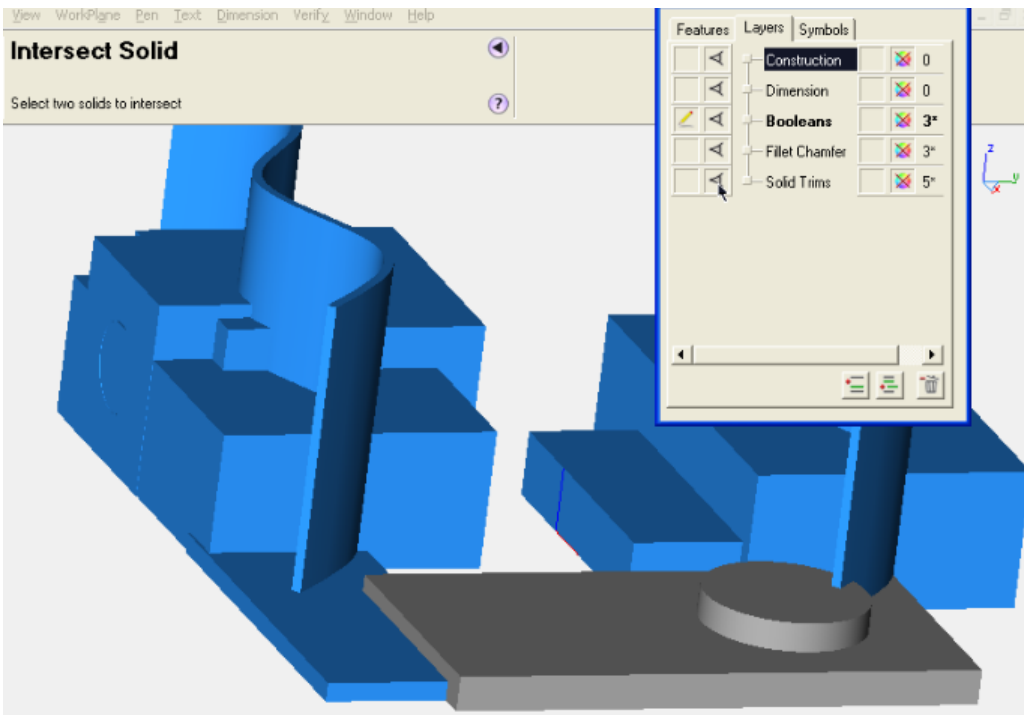


Be sure the Layers tab is selected. Layers are the electronic version of overlay drafting. It's like working on a variety of clear acetate sheets.

2. Click to show the Solid Trims layer.

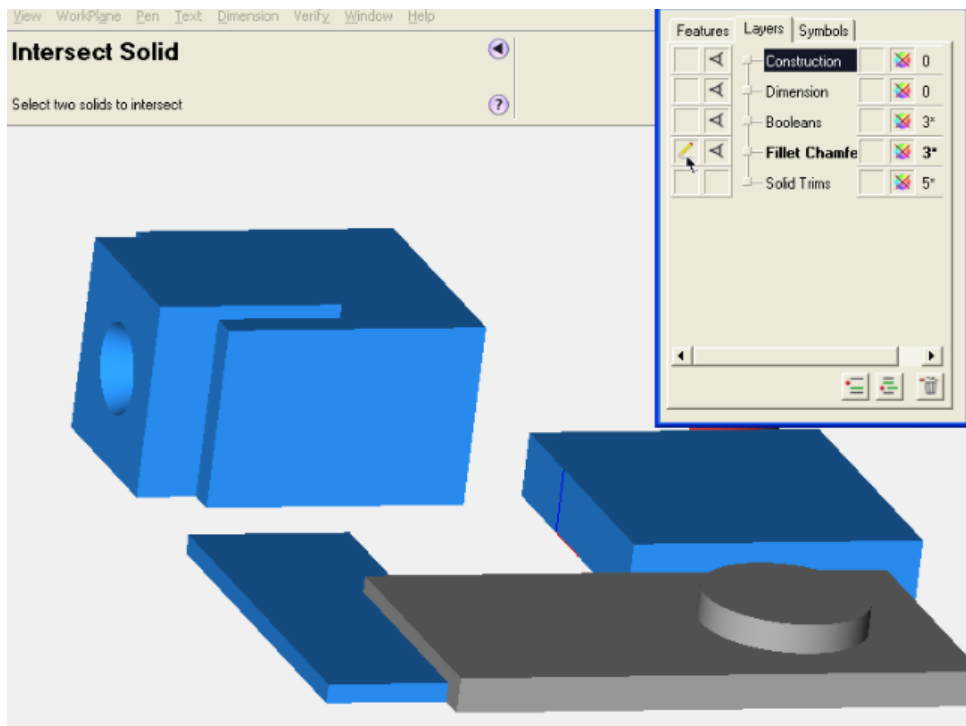


3. Click again to hide Solid Trims layer.
4. Click to show the Fillet Chamfer layer.
5. Click to see the Solid Trims layer.



6. Hide the Solid Trims and Fillet Chamfer layers.

7. There is only one current work layer, on which all new items are added. Click to activate Fillet Chamfer as the current work layer. Notice it automatically shows that layer.

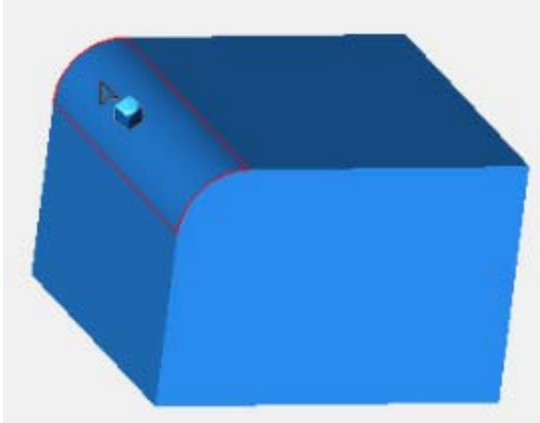


8. Click to turn off the Booleans layer visibility.
9. Turn on the Solid Trims layer, then turn it off again.
10. Close the Concept Explorer.

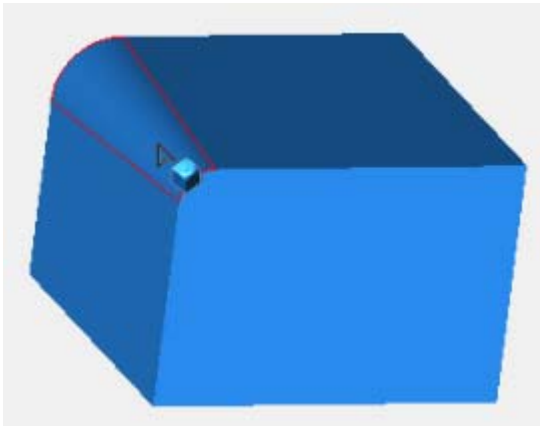
### To blend a solid edge

1. From the Solid Features toolset click the Blend Edge tool. This tool is much like the 2D fillet tool, extended to use in 3D. The tools on this toolset are operations that allow you to modify the existing solids.
2. From the Blend sub-toolset, choose the Variable Blend tool.
3. Position your cursor on the top left edge of the block and click to blend the edge.

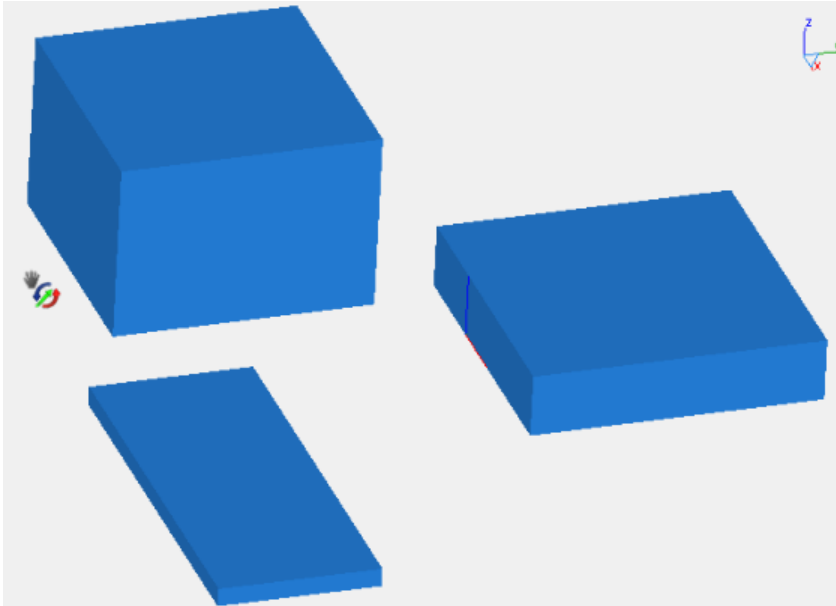




4. From the Edit menu, choose UNDO Fillet17.
5. There are two radius values on the Data Entry window because this tool can create a blend from one end to the other. Type .25 in the R1 Data Entry field and press ENTER.
6. Click on the left edge again to blend the edge.

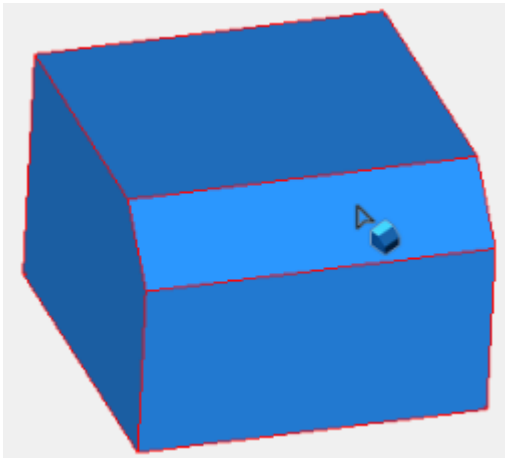


7. Use the Dynamic Rotate tool to rotate around the drawing to see the result of using the Blend Edge tool on the edges of that 3D block object.
8. Click the opposite edge to blend it.
9. Choose Edit>Undo twice to undo both edges.
10. Use the Dynamic Rotate tool to re-position the drawing.

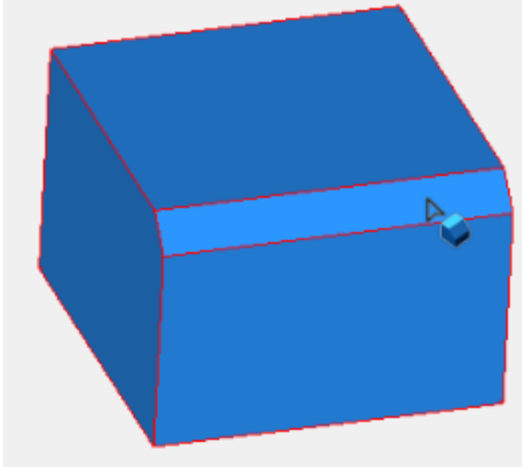


### To chamfer a solid edge

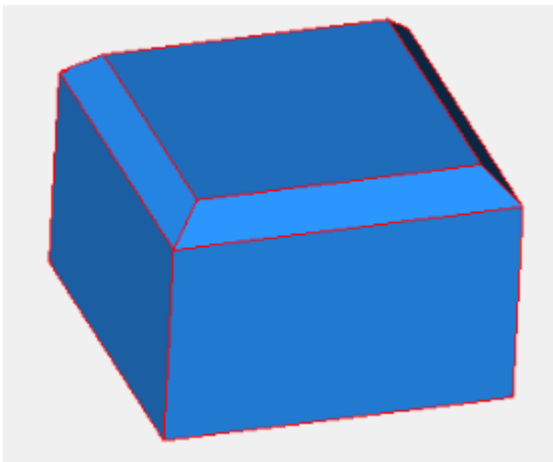
1. Click the Chamfer Edge tool.
2. When you click the Chamfer tool, options appears on the Data Entry window. Type .5 in the L1 Data Entry field and press ENTER.
3. Click the top front edge of the block.



4. From the Edit menu, choose UNDO Chamfer17.
5. Type .25 in the L1 Data Entry field and press ENTER.
6. Click the top front edge of the block to apply the chamfer.




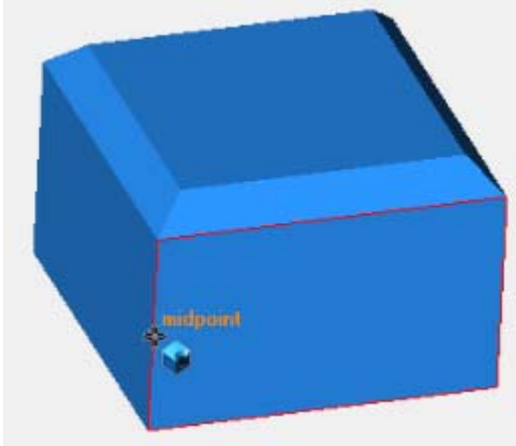
7. Press and hold the SHIFT key, then select each of the top edges of the block.
8. Release the SHIFT key to chamfer the selected edges.



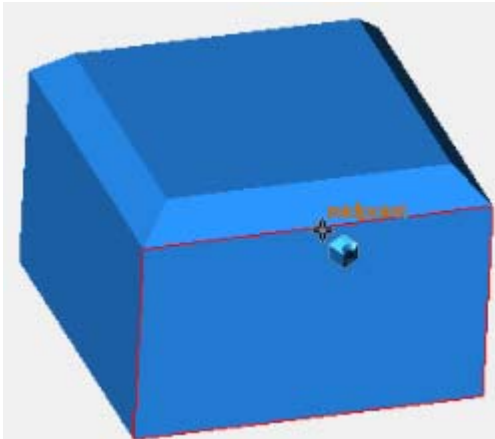
9. Use the Dynamic Rotate tool to view the design.

### To counter sink to the center of a solid object

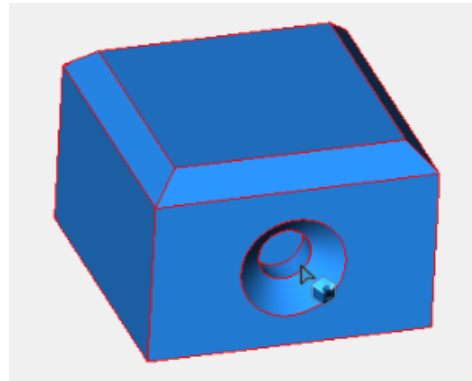
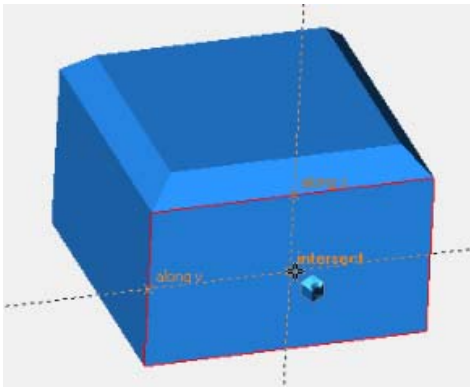
1. Click the Hole Feature tool. This tool allows you to create a countersink. 
2. Notice, on the Data Entry window, there are two diameters, one bigger than the other for the countersink.
3. Type .5 in the Diameter text field and press ENTER.
4. Type 1 in the Sink text field and press ENTER.
5. Click on the front flat edge of the block and choose Part\_7242: Face 3956.
6. Use alignment to align the center of the countersink hole with the horizontal and vertical midpoints. Position your cursor along the left vertical line's midpoint to set the point for alignment.



7. Position your cursor on the midpoint of the top horizontal line to set the point for alignment.

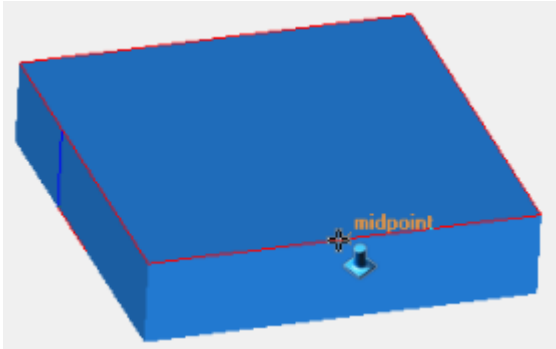


8. Drag to find the intersection of the reference points and click to place the countersink.

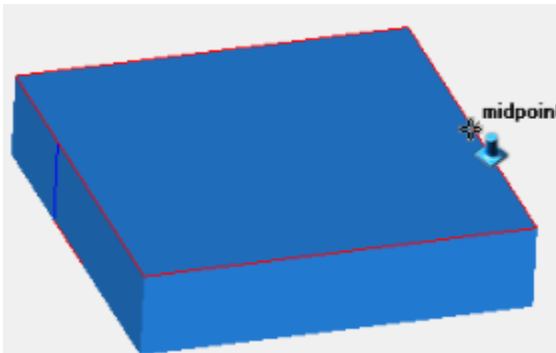


## To add an extruding feature

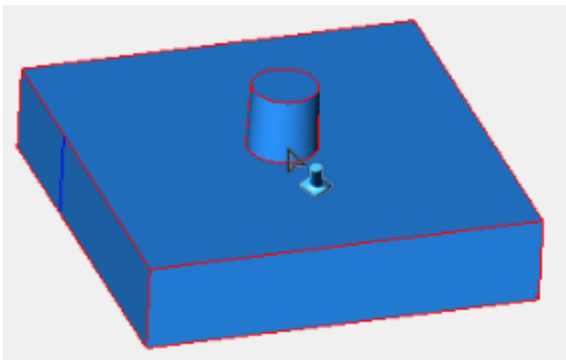
1. Click the Boss Feature tool.
2. On the Data Entry window, type 2 in the Draft Angle text field and press ENTER.
3. On the workspace, click the polygon on the right and choose Part\_7256: Face 3969.
4. Again, using alignment to find the center, position your cursor on the midpoint of the front horizontal line to set it for alignment.



5. Position your cursor on the midpoint of the right vertical line to set it for alignment.

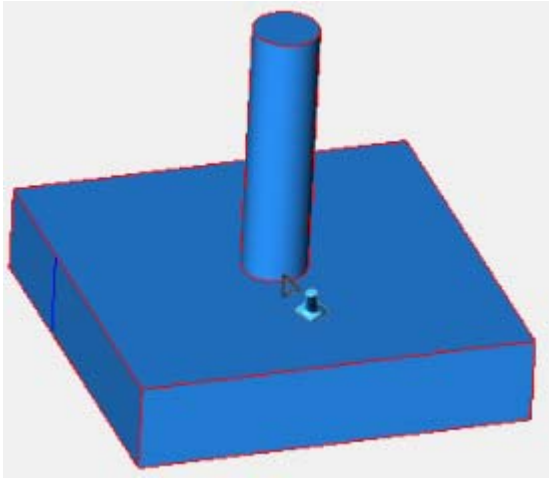


6. Drag to find the intersection of the reference points and click to place the feature. Perimeters appear in the Data Entry window.



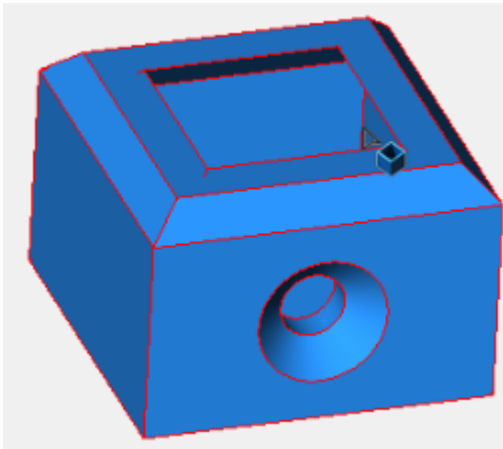
7. From the Edit menu, choose UNDO Boss20.
8. Type 2 in the Height text field and press ENTER.

9. Type 0 in the Draft Angle text field and press ENTER.
10. Select the top face of the same polygon.
11. Use alignment to find the center of the top face and place another extruding feature.



### To shell, or cutout, a solid

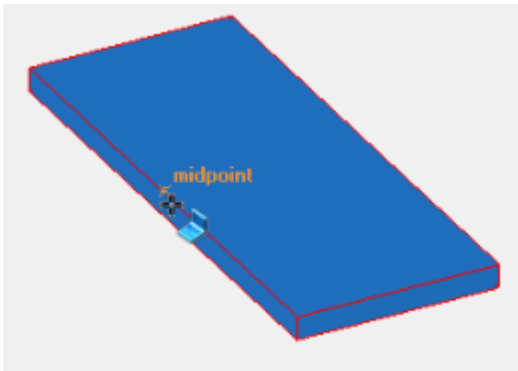
1. Click the Shell Feature tool. This tool allows you to make a solid object into an open container, if you will.
2. Click the block and choose Part\_7242: Face 3951.



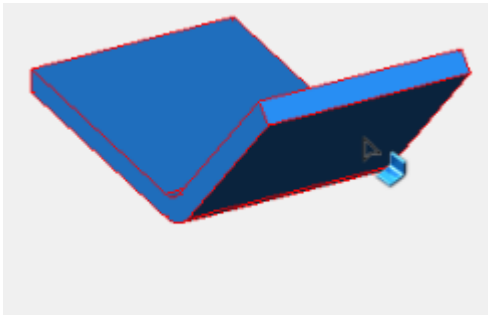
3. Use the Dynamic Rotate tool to see the shelled out, or cut out, container. The thickness is controlled on the Data Entry window.

## To bend a shape

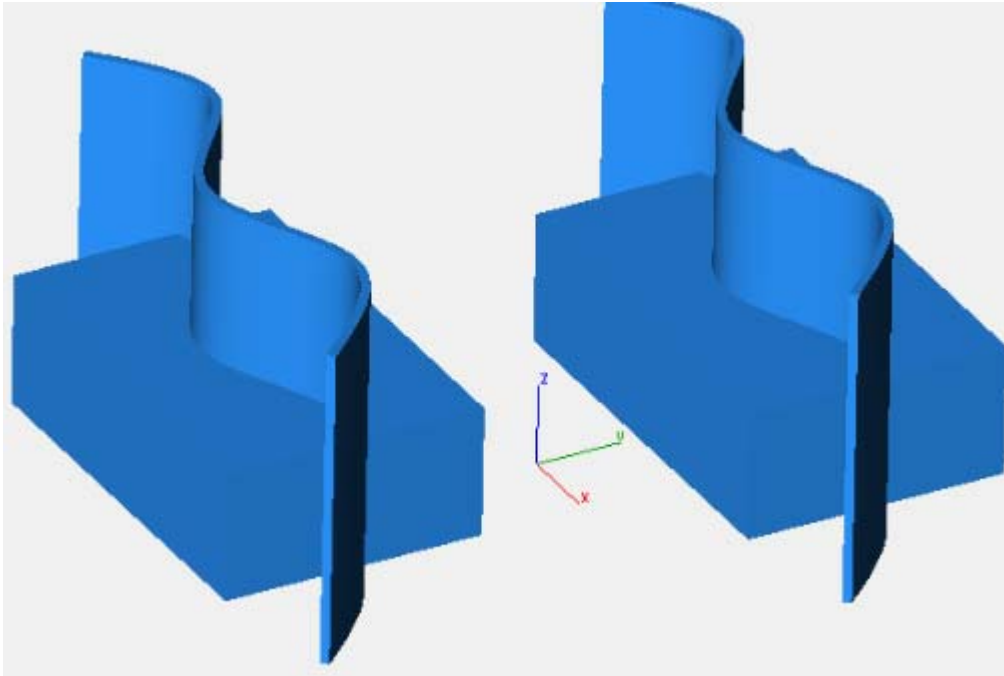
1. Click the Bend Feature tool. This tool allows you to find the bend angle and then an axis that it will bend around.
2. Type .25 in the Bend text field and press ENTER.
3. On the Data Entry window, type 50 in the Bend Angle text field and press ENTER.
4. Select the flat polygon.
5. Click on the midpoint of the bottom horizontal line closest to the bottom of the workspace.



6. Drag to the top horizontal line's midpoint and click to set the bend angle and bend the shape.



7. From the Window menu, choose Concept Explorer and click the Layers tab.
8. Click to change Solid Trims to the current work layer.
9. Click to turn off Fillet Chamfer's visibility.
10. Close the Content Explorer and zoom out so you can see the two objects.

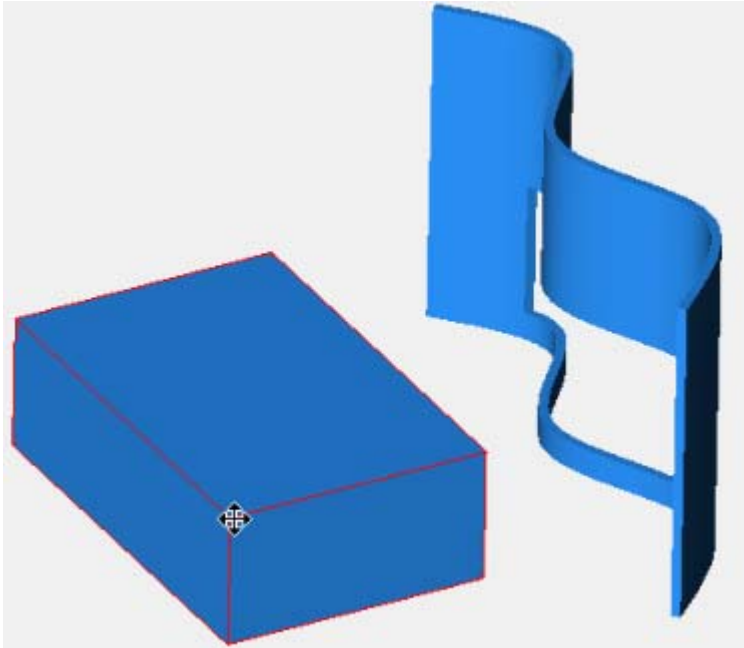


Remember to always select a new current work layer before turning off the current work layer's visibility.

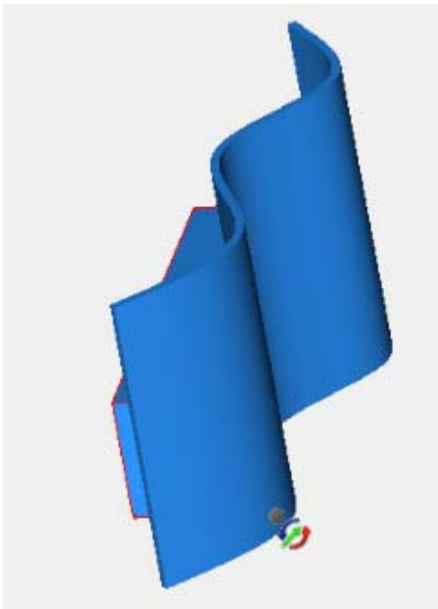
### To trim solids

1. Choose the Trim Solid tool.
2. We'll work on the object on the left. Click the block; this is what will be trimmed away.
3. Click the extruded curve.
4. Click the Selection tool then drag the block away from the curve. Notice the block has been removed from the extruded curve.



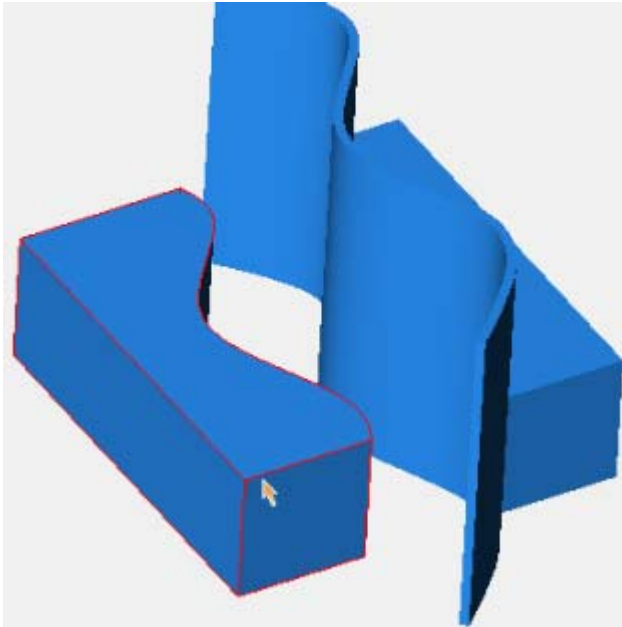


5. Choose Edit>Undo twice.
6. Click the Trim Solid tool. This time, we'll use the extruded curve, and that will be where we trim to.
7. First, pick the solid or surface that defines what you will trim to. Click the curve.
8. Then pick what you'll trim to that first object; click the block. Be sure to click on the portion you want to keep.
9. Use the Dynamic Rotate tool to view the object. Notice the block is trimmed right up to the curve.



10. Rotate back to the original position.

11. Click the Split Solid tool. This tool behaves similarly to the Trim Solid tool, except the Split Solid tool splits the object being trimmed into two pieces; removing one from its original position.
12. We'll move to the object on the right and click the block.
13. Click the curve.
14. Click the Selection tool, then drag the front part of the block away, Part8505.



15. Drag the back part of the block away.

