AUTODESK

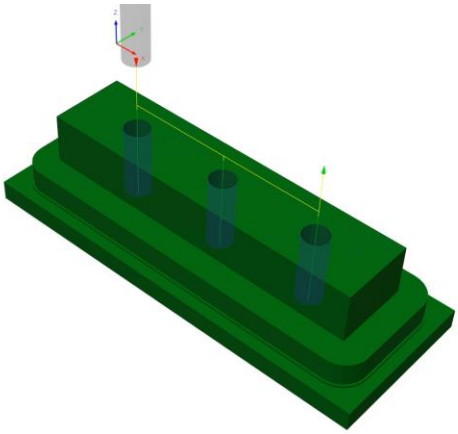
Step-by-step guide

Create 2.5 axis toolpaths

Create all the operations needed to cut one side of a part.

Learning objectives:

- Create a drilling operation.
- Create 2.5 axis roughing toolpaths.
- Create 2.5 axis finishing toolpaths.



The completed exercise

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1. Upload and open the supplied *CAM 2x Toolpaths.f3d* file.

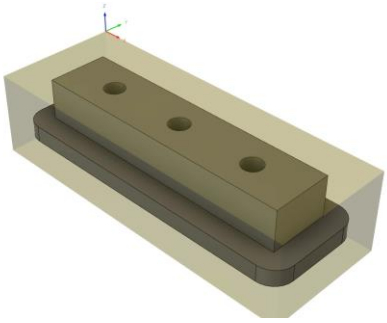

Figure 1. Open the supplied file

2. The toolpaths needed to cut the part's top features need to be created. First, the stock's extra top material needs to be removed. Click 2D> Face.

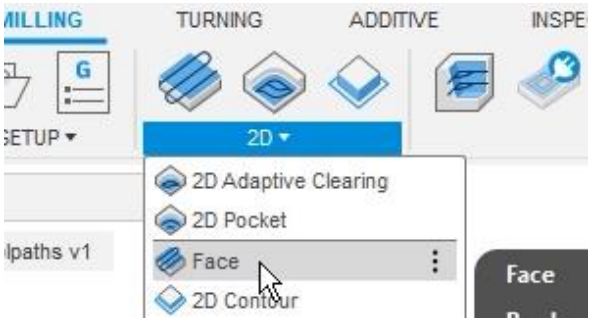

Figure 2. Open the Face tool

3. The appropriate tool needs to be selected for this operation. Click the dialog's Select to choose the tool.

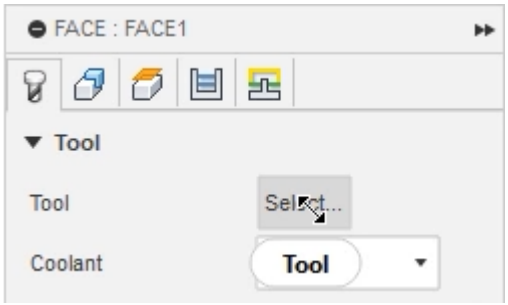

Figure 3. Choose the tool

4. In the dialog's left column, navigate to the All> Documents> CAM 2x Toolpaths library.

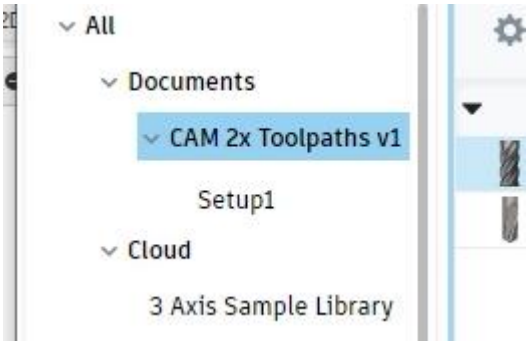

Figure 4. Open the document's library

5. Choose Tool 1 from the library. This is a 1/2" Flat Endmill.

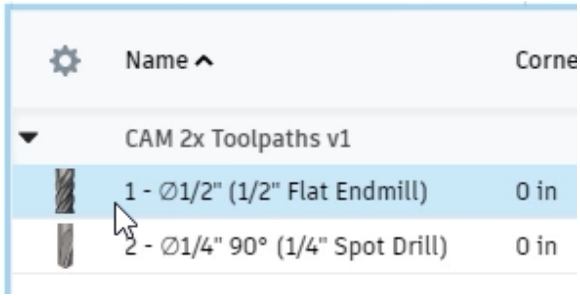

Figure 5. Choose the tool

6. From the dialog's Cutting data section, choose the Aluminum - Roughing option.

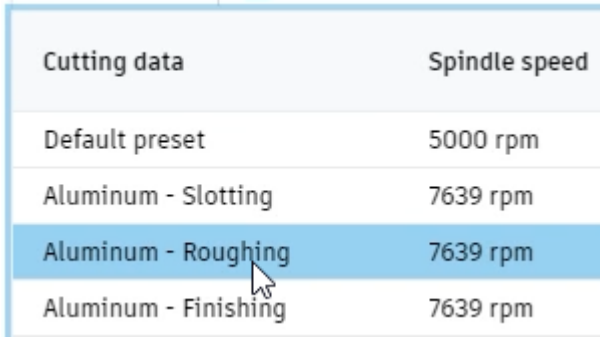

Figure 6. Choose the tool's preset

7. Click the dialog's Select.

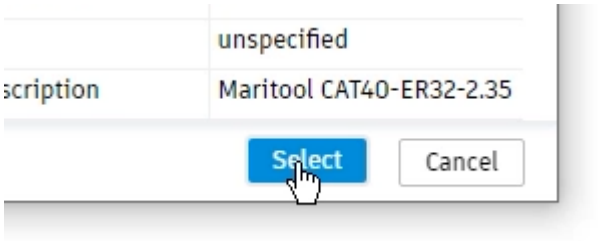

Figure 7. Select the tool

8. Notice that the tool's cutting data is displayed in the dialog's Feed & Speed section. These values can be modified if you want.

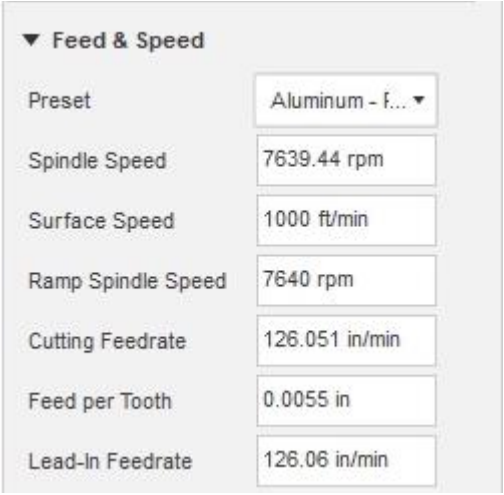

Figure 8. Notice the tool's cutting data

9. Continue to the Geometry tab and notice that Fusion 360 automatically selects the stock's perimeter.

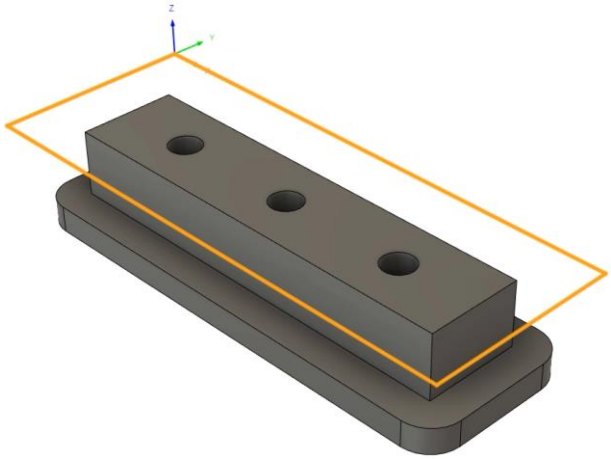

Figure 9. Notice the stock selection

10. Continue to the Heights tab and hover your cursor over each height section's From menu to learn about it. Understanding the various heights is a critical part of creating successful toolpaths. These various planes determine when you transition from your rapid movements to your feed movements, and when you begin cutting into the stock. They also determine how far down the operation cuts.

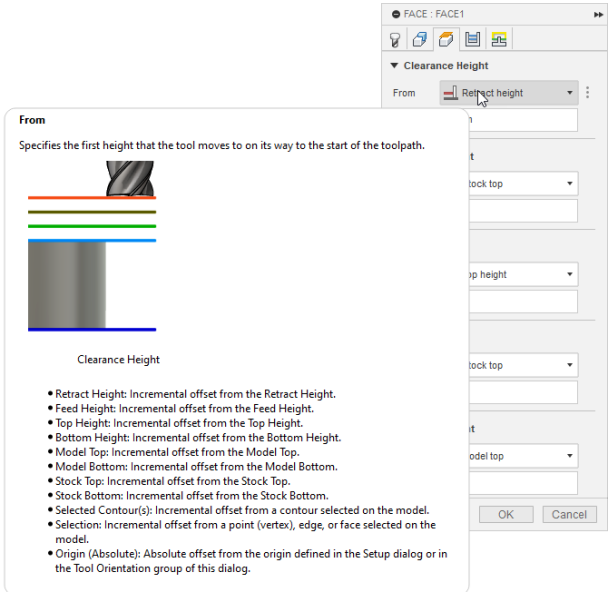

Figure 10. Learn about each height type

11. Continue to the Passes tab and explore the various options. None of these values need to be changed for this operation but you should understand each option. For example, you can control how far the tool steps over between each pass.

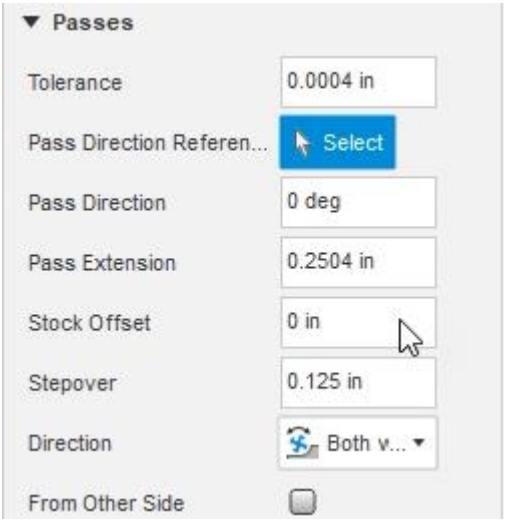

Figure 11. Explore the Passes tab

12. Continue to the Linking tab and notice the various options you can use to control the tool's motions during the operation. For example, the options in the Leads & Transitions section can be used to control how the tool enters and exits the stock. OK the dialog without making any changes to the Linking tab.

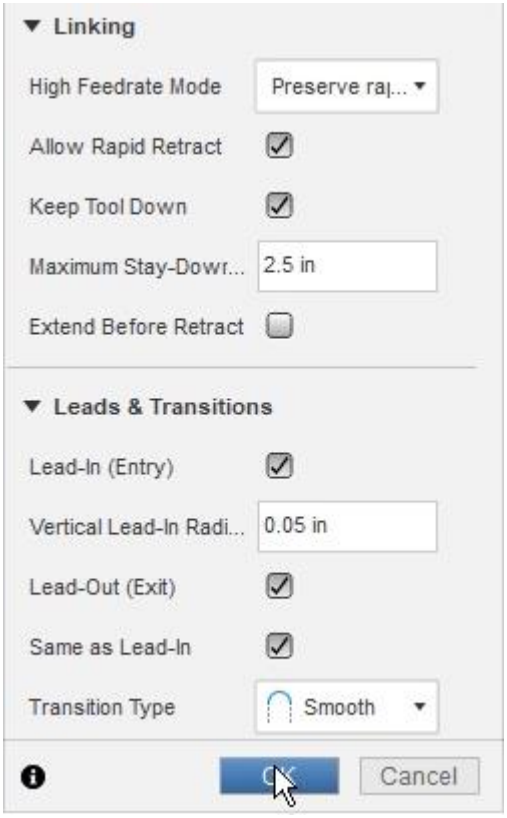

Figure 12. Explore the Linking tab

13. Explore the toolpath preview and notice that the tool removes the extra material from the stock body's top. Fusion 360 modified the green stock body to approximate the removed material. Notice that the toolpath is divided into colored segments. The yellow segments are the leads, the green segments are the links, and the blue segments are the cutting moves. The red arrow indicates the toolpath's beginning and the green arrow indicates the end.

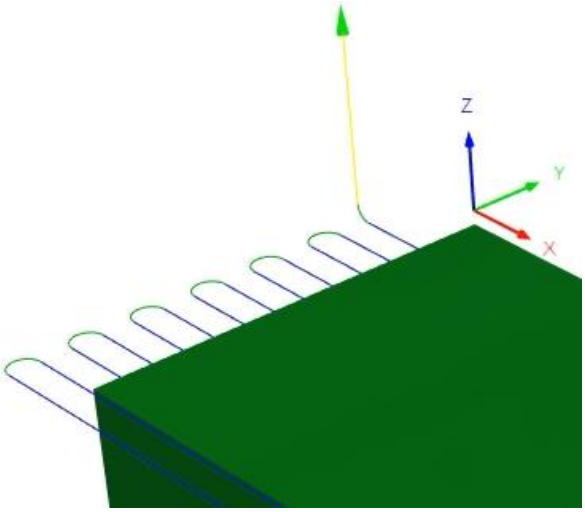

Figure 13. Inspect the toolpath preview

14. If you want to customize the previewed toolpath, open the Display and Settings bar's Toolpath visibility menu. You can use these options to toggle the whole toolpath or individual sections.

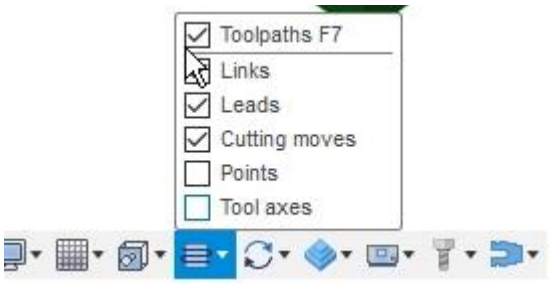

Figure 14. Customize the toolpath

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15. The green in-process stock body can be toggled using the options in the Display and Settings bar's Stock visibility menu. The in-process stock helps you visualize the material that the operation removes so it's helpful to leave it on.

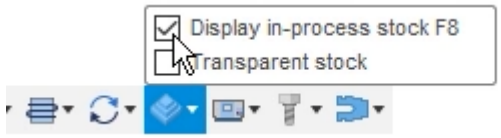

Figure 15. Toggle the in-process stock

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16. Click 2D> 2D Adaptive Clearing.

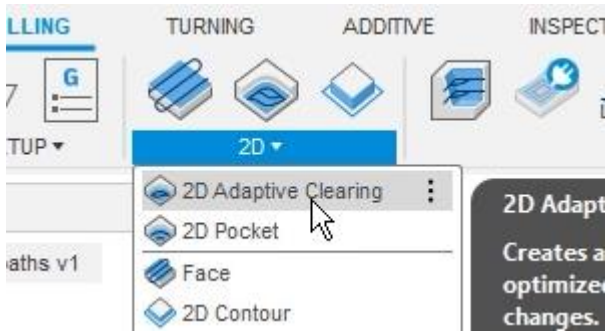

Figure 16. Open the 2D Adaptive Clearing tool.

17. The previous operation's tool is automatically selected for the next operation. The tool does need to be changed because it is also appropriate for the current operation.

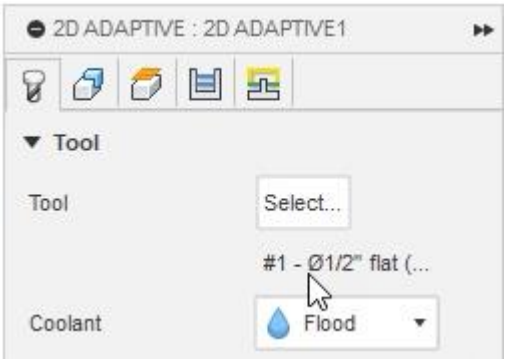

Figure 17. Verify the selected tool

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18. Continue to the Geometry tab and choose the model's bottom edge as the dialog's Pocket Selection. The blue shaded area indicates the machined area so make sure it is outside the solid body.

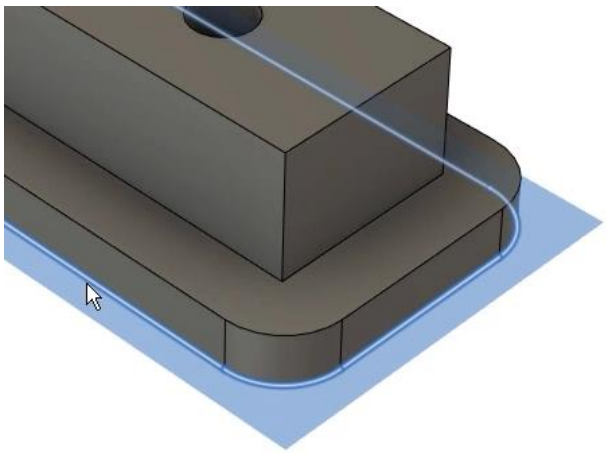

Figure 18. Select the edge

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19. If the blue shaded area is on the wrong side of the selection, click the operation's red arrow to flip the direction. The current selection does not need to be flipped.

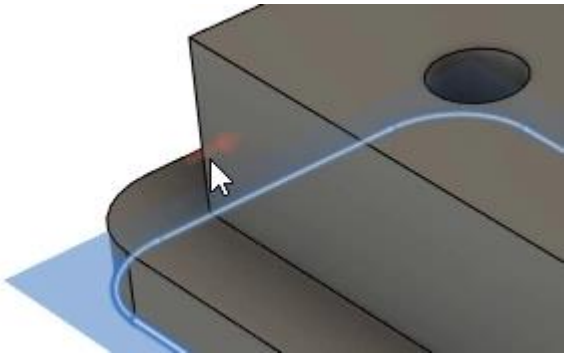

Figure 19. Note how to flip a selection

20. Continue to the Heights tab and notice that the operation needs to plunge slightly past the contour you selected. Enter **-0.05 inches** into the Bottom Height Section's Offset box.

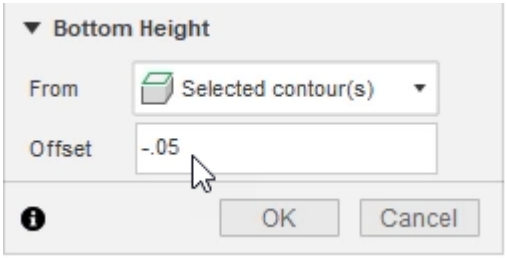

Figure 20. Offset the bottom height

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21. Continue to the Passes tab and reduce the Optimal Load value to **0.1 inches**.

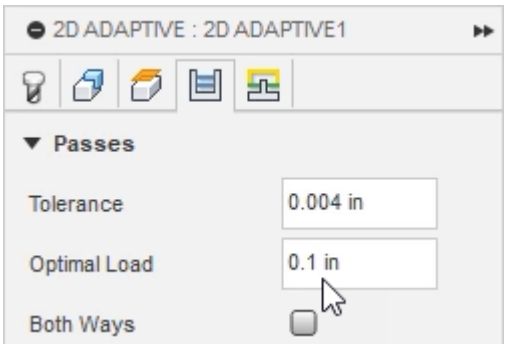

Figure 21. Reduce the optimal load

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22. Enter **0 inches** into the Axial Stock to Leave box. OK the dialog to generate the toolpath preview.

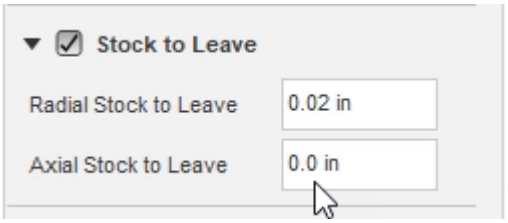

Figure 22. Modify the Axial Stock to Leave value

23. Inspect the toolpath preview and notice that the material is removed from the stock body's perimeter.

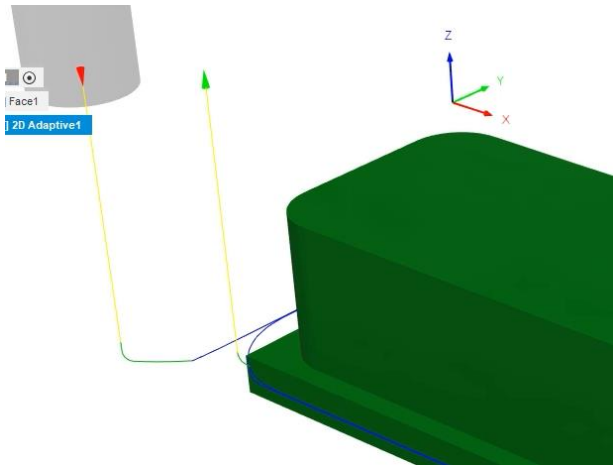

Figure 23. Inspect the toolpath preview

24. Press F8 to temporarily toggle the in-process stock body. Notice that the operation cuts slightly below the model's bottom edge that you selected. Press F8 to toggle the in-process stock body after you finish exploring the model.

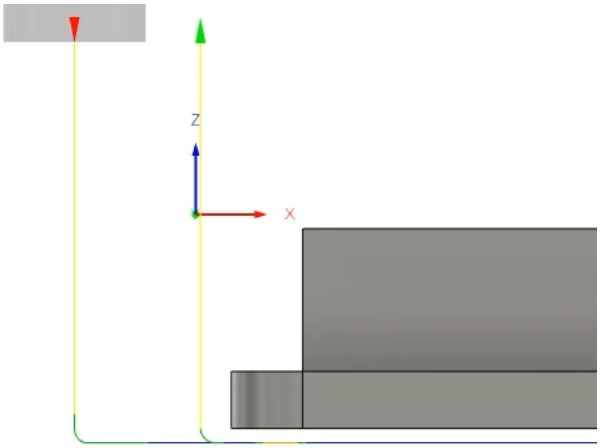

Figure 24. Toggle the in-process stock body

25. The settings from the operation you just created can be reused and tweaked to create a new operation. Right-click the Browser's 2D Adaptive operation, then choose Create Derived Operation> 2D Milling> 2D Adaptive Clearing.

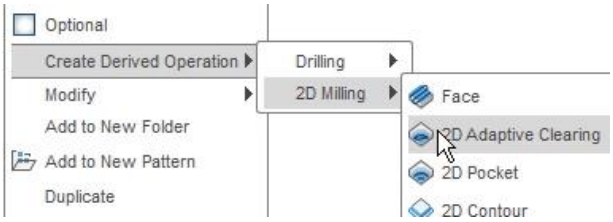

Figure 25. Create a derived operation

26. Navigate to the dialog's Geometry tab and clear the current selection.

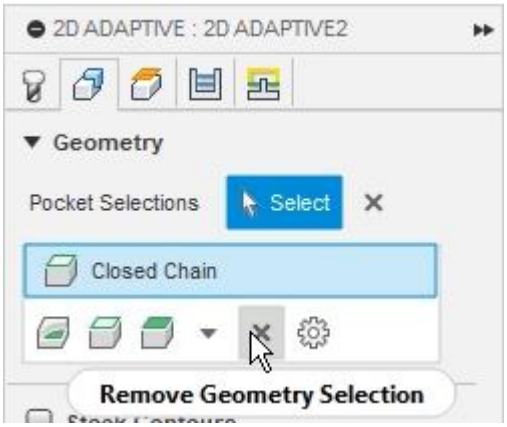

Figure 26. Clear the current selection

27. For the dialog's new selection, choose the edge shown in the image on the right. Verify that the blue region is outside the selection.

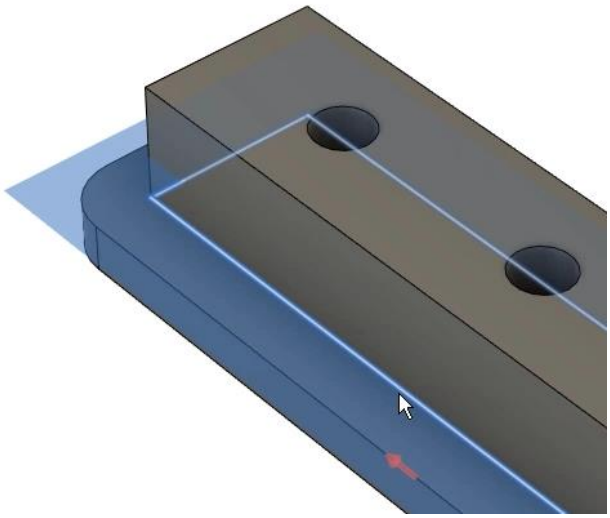

Figure 27. Select the new edge

28. Continue to the Heights tab and enter **0** into the Bottom Height section's Offset box. This will ensure that the operation does not cut below the model's edge you selected.

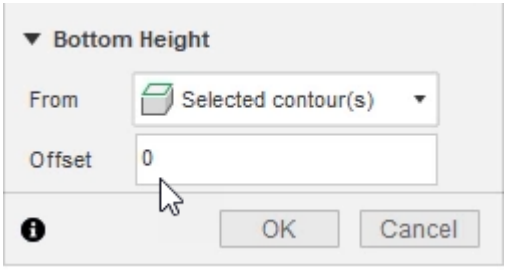

Figure 28. Remove the bottom height's offset

29. Continue to the Passes tab and enter **0.02 inches** into the Axial Stock to Leave box. This will ensure that a small amount of material will be left behind so that a finishing pass can finalize the geometry. OK the dialog to generate the toolpath preview.

Figure 29. Define the Stock to Leave values

30. Inspect the toolpath preview and make sure it correctly cuts the model's geometry.

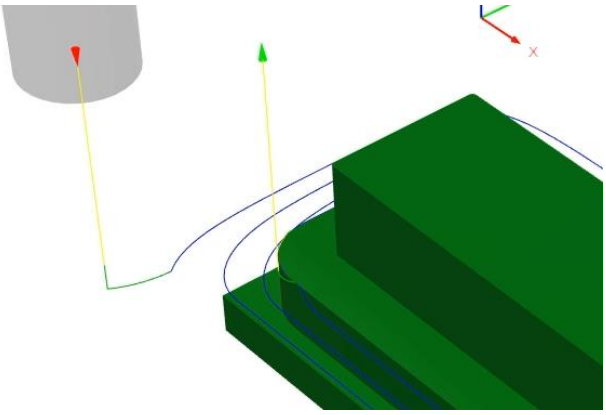

Figure 30. Inspect the toolpath preview

31. A 2D Contour operation can be used as a finishing pass to finalize the part's geometry. Click 2D> 2D Contour.

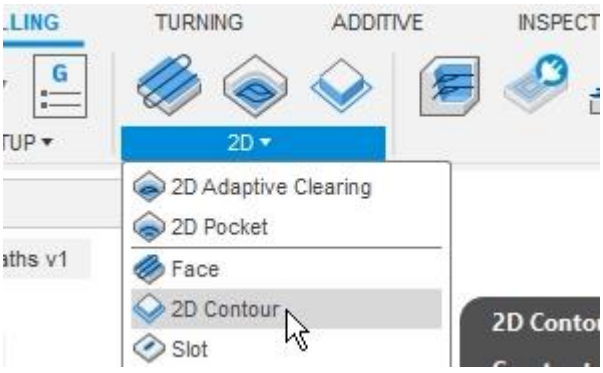

Figure 31. Create a 2D Contour operation

32. Navigate to the Geometry tab and select the two edges shown in the image on right as the Contour Selection.

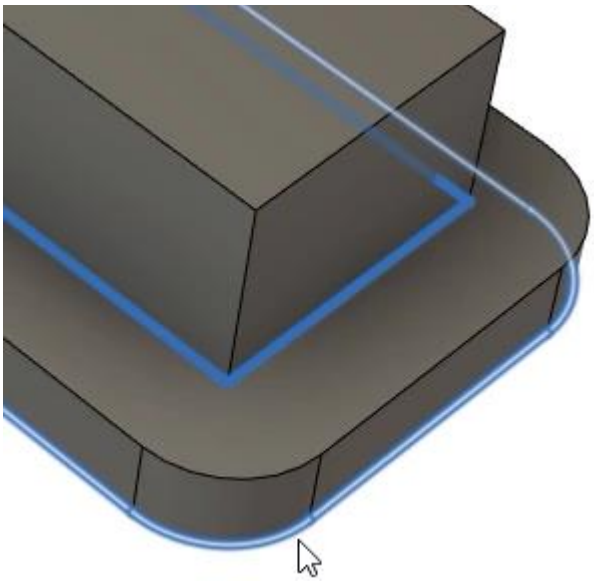

Figure 32. Select the edges

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33. Continue to the Passes tab and verify that the Stock to Leave option is deactivated. OK dialog.

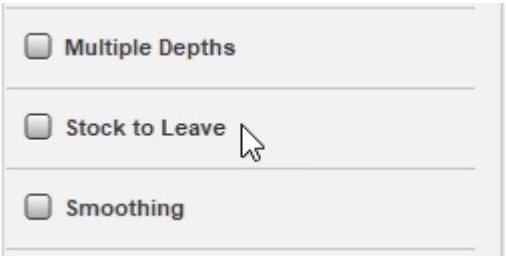

Figure 33. Make sure Stock to Leave is deactivated

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34. Inspect the toolpath preview to make sure it correctly cuts the model's geometry. The stock body should precisely match the solid model's features except for the holes on top.

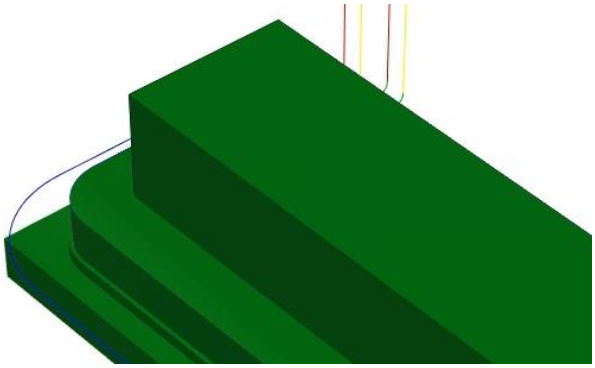

Figure 34. Inspect the toolpath preview

35. Notice that the finishing pass did not cut all the way down to the first operation's depth. The 2D Contour operation's two contour selections can be divided into two separate operations.

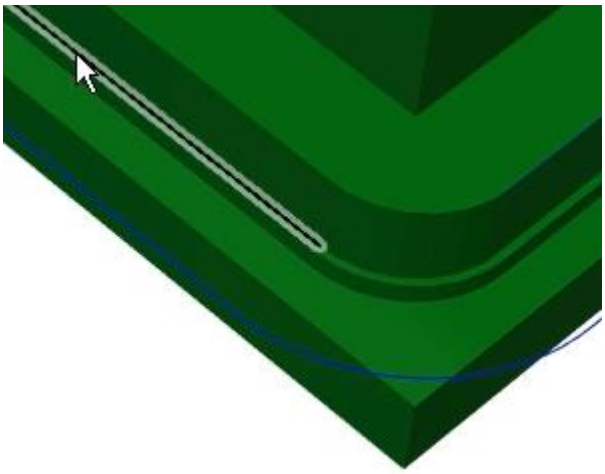

Figure 35. Notice the small amount of material

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36. Right-click the 2D Contour operation and choose Duplicate from the menu.

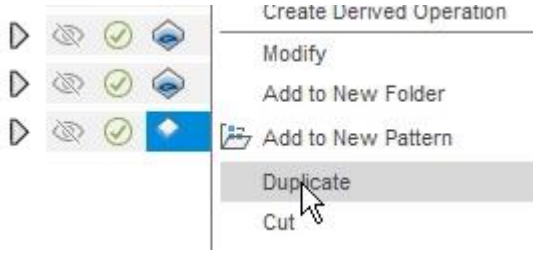

Figure 36. Locate the 2D Contour operation

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37. Right-click the original 2D Contour operation and choose Edit from the menu.

Figure 37. Edit the original 2D Contour operation

38. Navigate to the dialog's Geometry tab and verify that the model's bottom edge is selected. Remove this selection by clicking Remove Geometry Selection. OK the dialog.

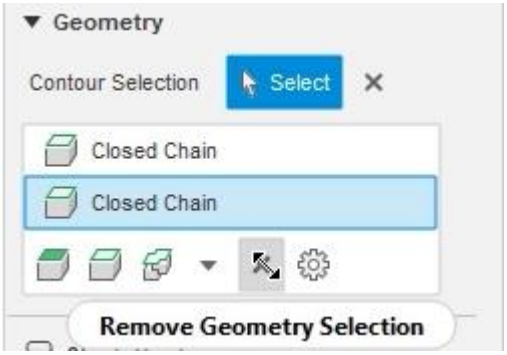

Figure 38. Remove one of the selected edges

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39. Edit the new 2D Contour operation.

Figure 39. Edit the new 2D Contour operation

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40. Remove the other selected edge.

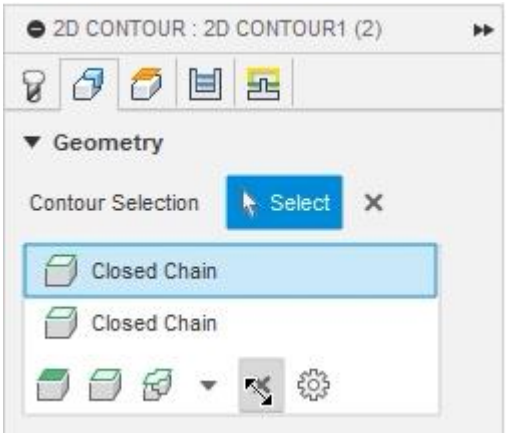

Figure 40. Remove a selected edge

41. Continue to the Heights tab and enter **-0.03 inches** to the Bottom Height section's Offset box. OK the dialog.

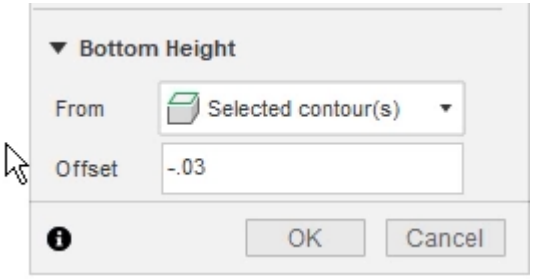

Figure 41. Offset the bottom height

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42. The part's holes need to be drilled to finalize the setup's features. Click Drilling> Drill.

Figure 42. Create a Drill operation

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43. Click the dialog's Select to choose an appropriate tool for the operation.

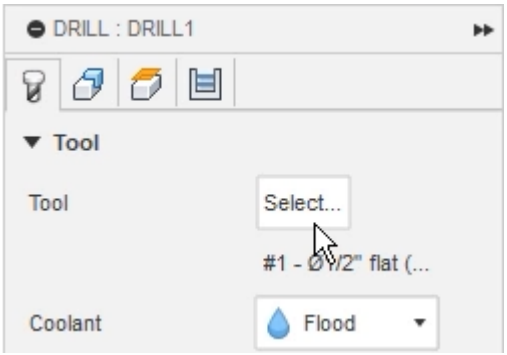

Figure 43. Choose the operation's tool

44. Verify that you are in the CAM 2X Toolpaths library, then choose Tool 2. This is a 1/4" Spot Drill. Click the Select Tool dialog's Select.

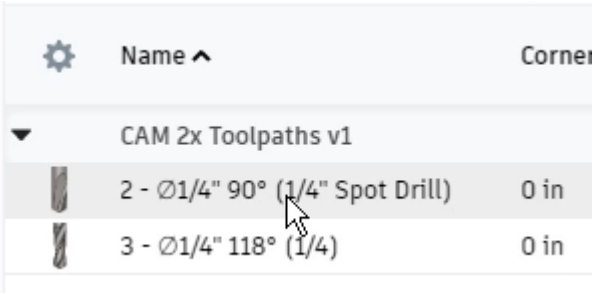

Figure 44. Choose Tool 2

45. Navigate to the dialog's Geometry tab and choose the three faces shown in the image on the right as the dialog's Hole Faces selection.

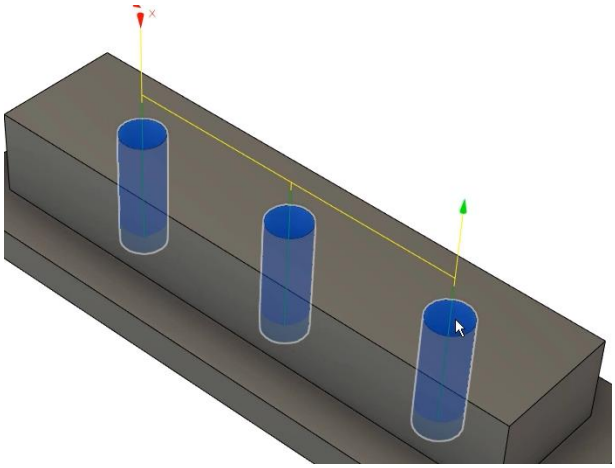

Figure 45. Select the holes

46. Because this operation is spot drilling the holes' locations, the tool does not need to plunge very deeply. Continue to the Heights tab and select the Hole top option in the Bottom Height section's From menu.

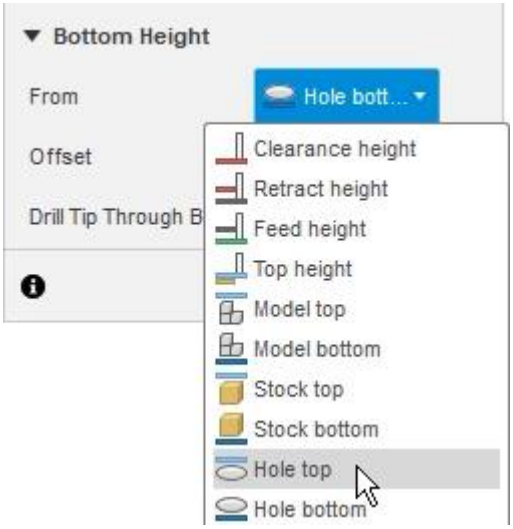

Figure 46. Configure the bottom height

47. Activate the Drill Tip through Bottom option so that the tool plunges slightly past the hole's top. OK the dialog to generate the toolpath preview.

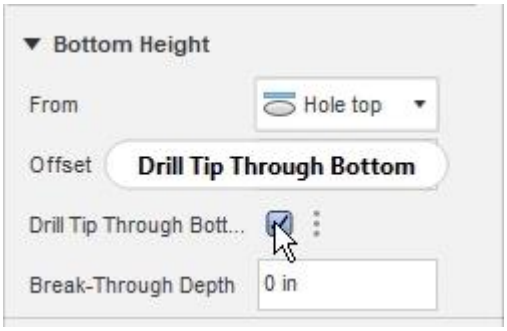

Figure 47. Activate the Drill Tip through Bottom option

48. Notice that the spot drill dimples the top of the stock.

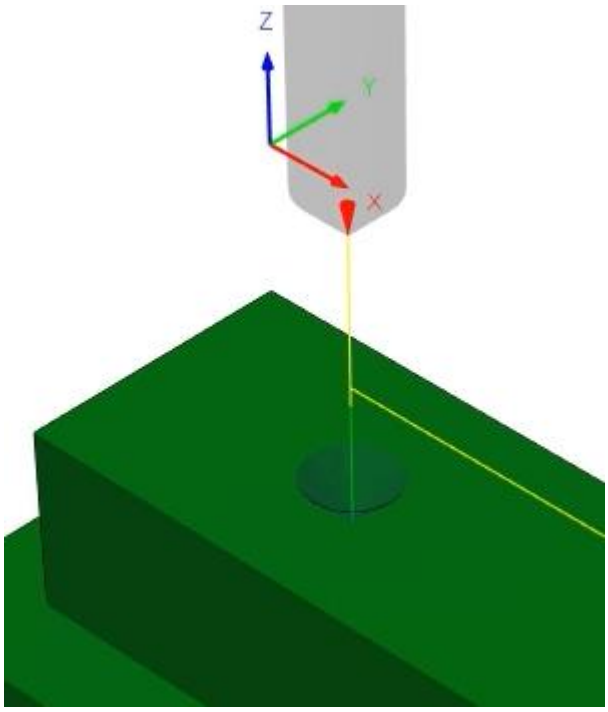

Figure 48. Inspect the toolpath preview

49. Create a new Drilling operation by clicking Drilling> Drill. Click the dialog's Select to choose the appropriate tool. Choose Tool 3 from the CAM 2X Toolpaths library.

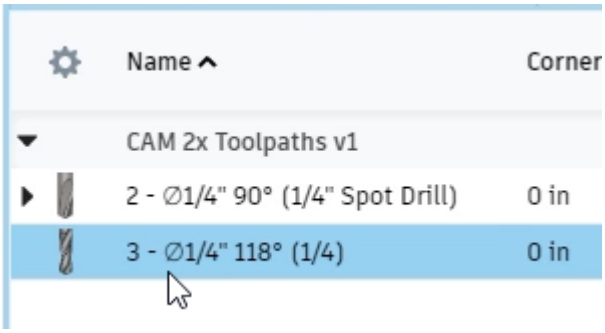

Figure 49. Create a Drill operation and choose its tool

50. Choose the Aluminum - Drilling option from the Cutting data section, then click the Select Tool dialog's Select.

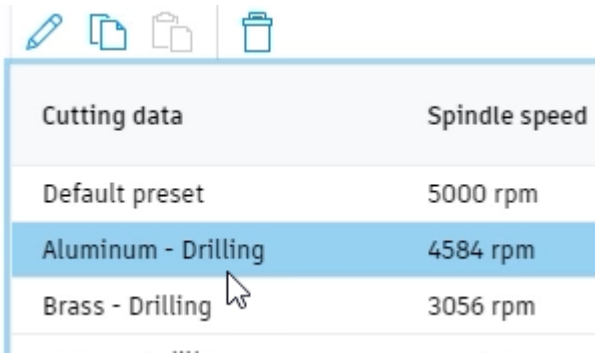

Figure 50. Choose the cutting preset

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51. Continue to the Geometry tab and select the three hole faces.

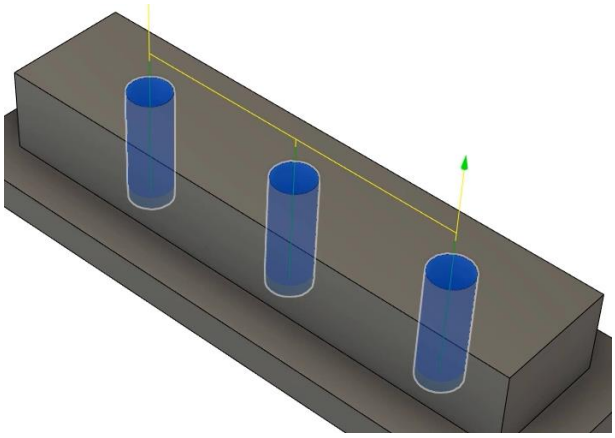

Figure 51. Select the holes

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52. Continue to the Heights tab and choose the Hole bottom option in the Bottom Height section's From menu. Activate the Drill Tip Through Bottom option.

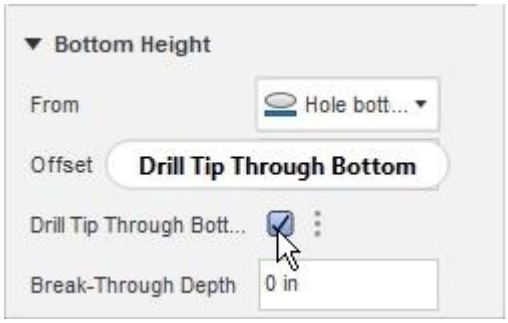

Figure 52. Configure the bottom height

53. Continue to the Cycle tab and choose the Chip breaking-partial retract option from the Cycle Type menu. OK the dialog. All the operations needed to machine this part's top geometry are complete.

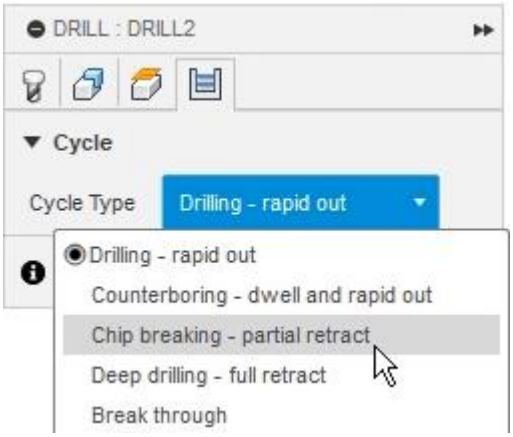

Figure 53. Choose the operation's type