AUTODESK

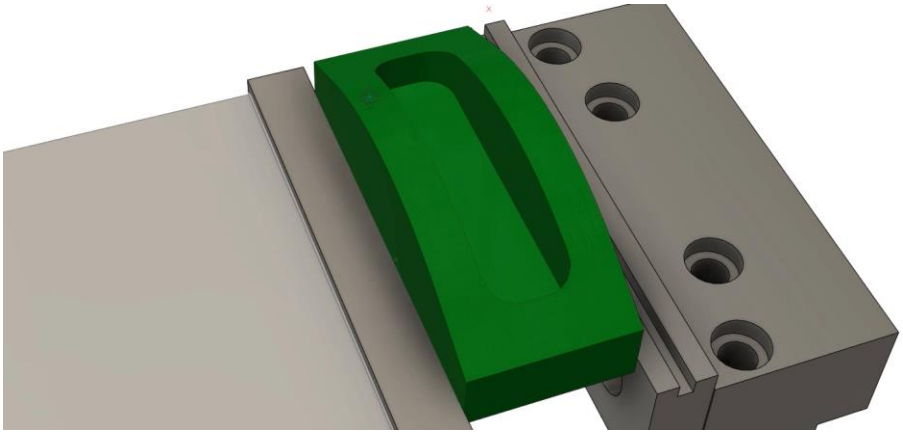
Step-by-step guide

Create 3 axis toolpaths

Explore various operation types for cutting a part's curved geometry.

Learning objectives:

- Create 3-axis roughing toolpaths.
- Create 3-axis finishing toolpaths.



The completed exercise

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1. Open the supplied *CAM 3X Toolpaths.f3d* file. This file has a model, a setup, and portions of a vise. 3-axis toolpaths can be used to cut this part's geometry.

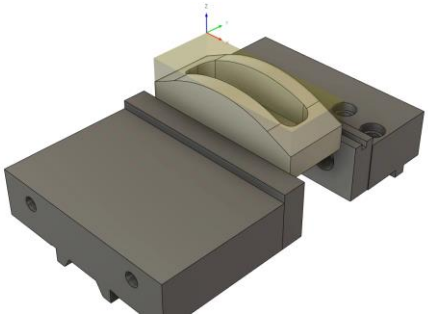

Figure 1. Open the supplied file

2. To remove a large amount of material as a single operation, click 3D> Adaptive Clearing.

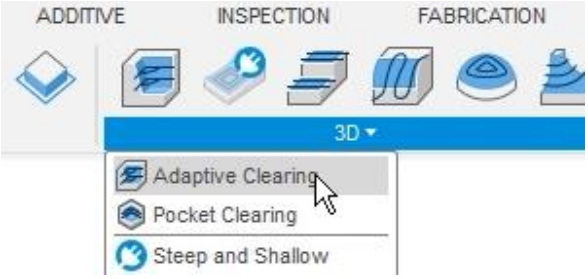

Figure 2. Create an Adaptive Clearing operation

3. Click the dialog's Select to choose the operation's tool.

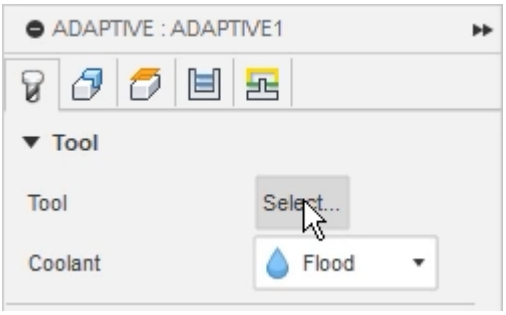

Figure 3. Choose the operation's tool

4. In the dialog's left column, navigate to the All> Documents> CAM 3X Toolpaths library.

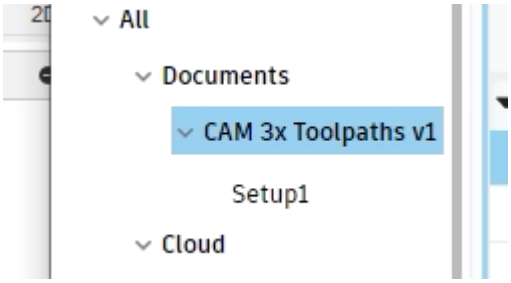

Figure 4. Navigate to this document's Library

5. Select Tool 1, which is a 1/2" Flat Endmill.

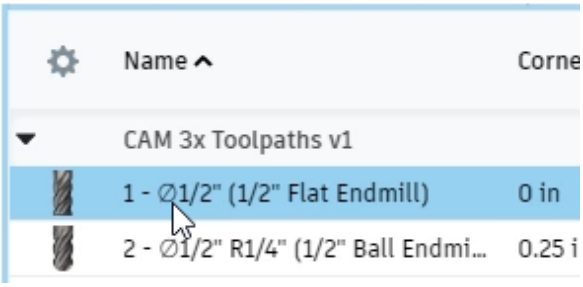

Figure 5. Select the tool

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

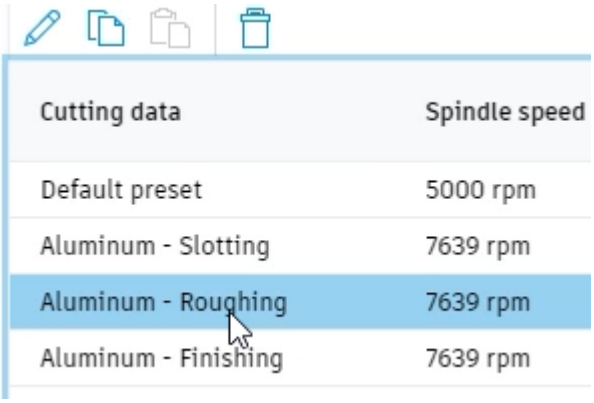

Figure 6. Choose the cutting preset

7. Continue to the Geometry tab and notice that Fusion 360 automatically selects the stock's perimeter. The 3D Adaptive Clearing operation is model aware, which means specific geometry does not need to be selected. Fusion 360 will analyze the model and cut as much as possible with the selected tool.

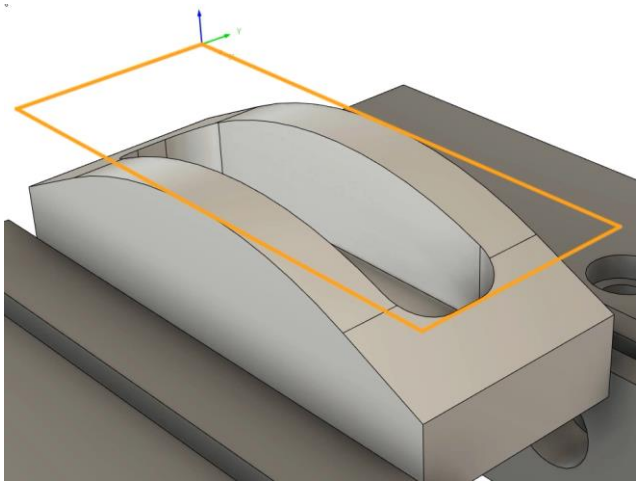

Figure 7. Note the machining boundary

8. Deactivate the Rest Machining option.

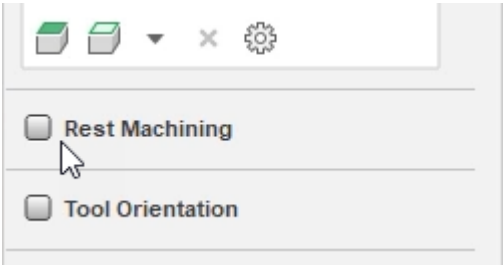

Figure 8. Deactivate the Rest Machining option

9. Continue to the Heights tab and choose the Selection option in the Bottom Height section's From menu.

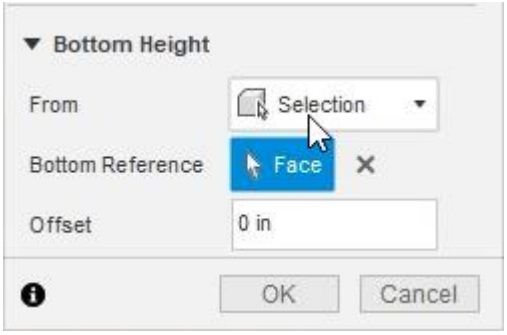

Figure 9. Define the bottom height

10. For the dialog's Bottom Reference selection, choose the face shown in the image on the right. This operation will machine down to this face.

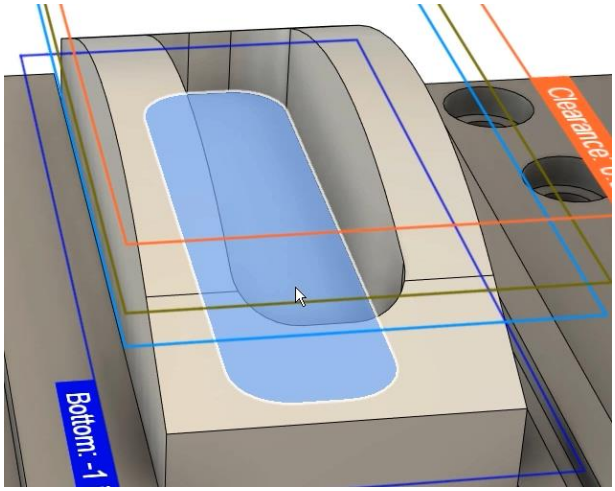

Figure 10. Select the face

11. Continue to the Passes tab and verify that all the default values are appropriate for this operation. OK the dialog.

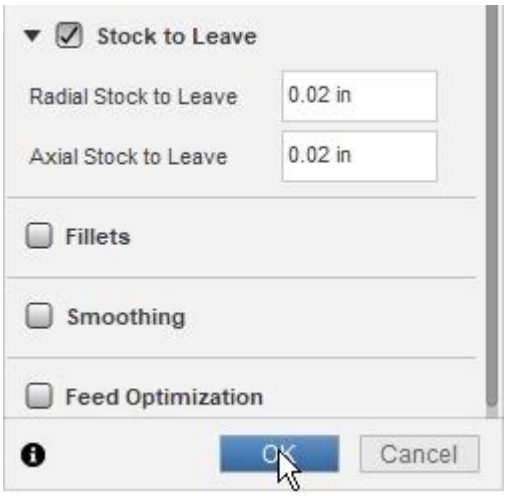

Figure 11. Verify the Passes tab's options

12. Inspect the toolpath preview and notice that there are many yellow rapid movements.

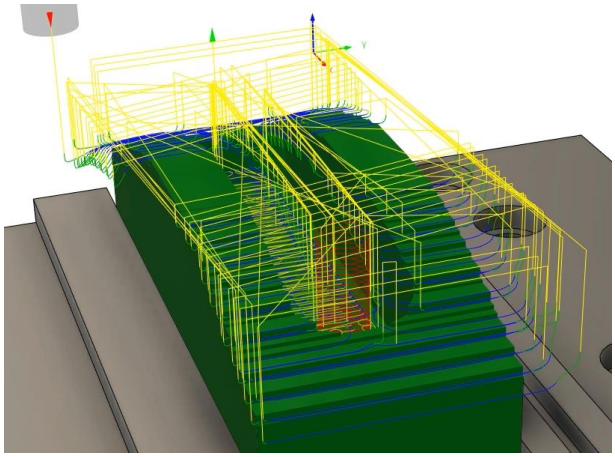

Figure 12. Inspect the toolpath preview

13. In the screen's bottom right corner, notice that Fusion 360 estimates the operation's machining time to be less than three minutes.

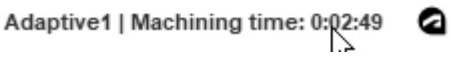

Figure 13. Note the operation's estimated time

14. Right-click the Browser's Adaptive operation and choose Machining Time from the menu.

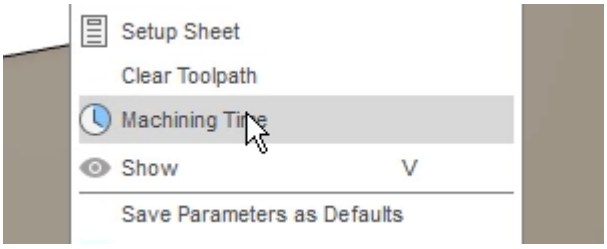

Figure 14. Open the operation's Machining Time dialog

15. The Machining Time dialog displays additional information such as the feed time, rapid time, number of tool changes, and more. Close the dialog after you finish reading this information.

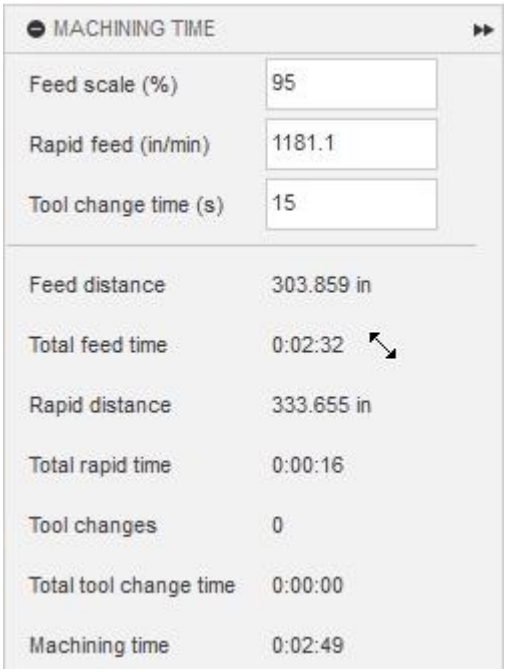

Figure 15. Inspect the dialog

16. The operation's machining time can be reduced by modifying the operation's parameters. Right-click the Browser's Adaptive operation and choose Edit from the menu.

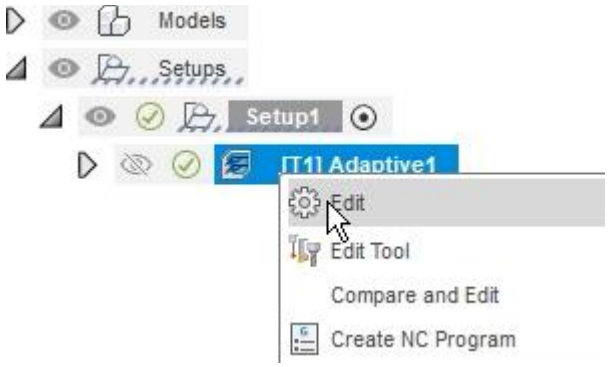

Figure 16. Edit the Adaptive operation

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17. Navigate to the dialog's Passes tab and activate the Order by Depths option.

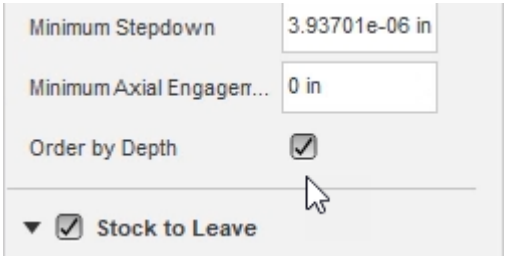

Figure 17. Activate the Order by Depth option

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18. Continue to the Linking tab and choose the Minimum retraction option from the Retraction Policy menu. Enter **5** into the Maximum Stay-Down Distance box. OK the dialog to update the toolpath preview.

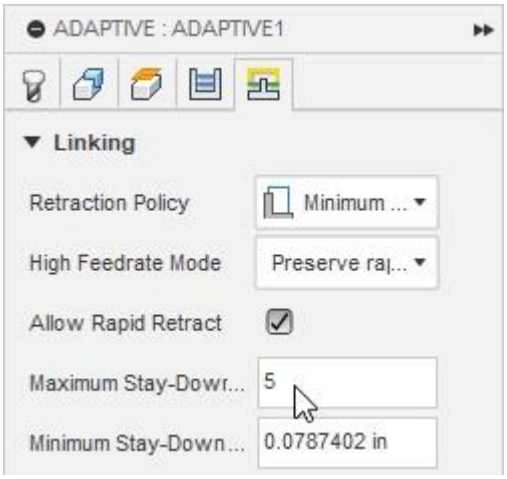

Figure 18. Modify the Linking Parameters

19. Right-click the Adaptive operation and choose Machining Time from the menu. Notice that the changes reduce the rapid time by one second but add five seconds to the feed time. Close the dialog.

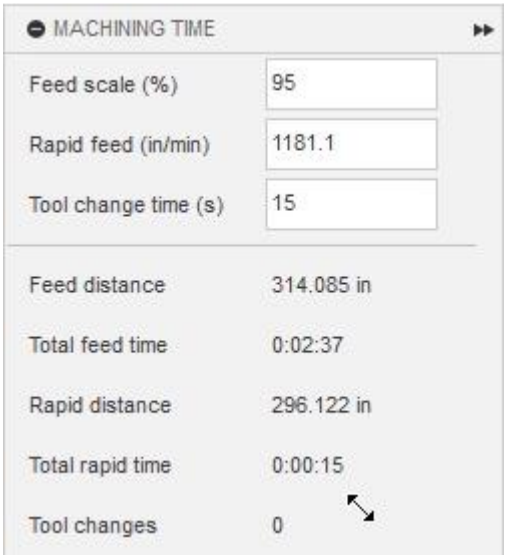

Figure 19. Inspect the Machining Time dialog

20. A Pocket operation can be used to cut the model's center pocket; click 2D> 2D Pocket.

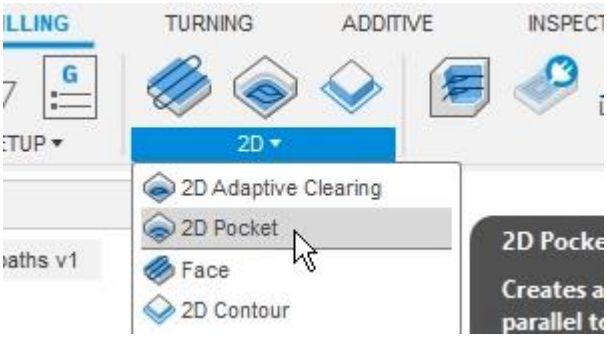

Figure 20. Create a 2D Pocket operation

21. Select the face shown in the image on the right as the dialog's Pocket Selection.

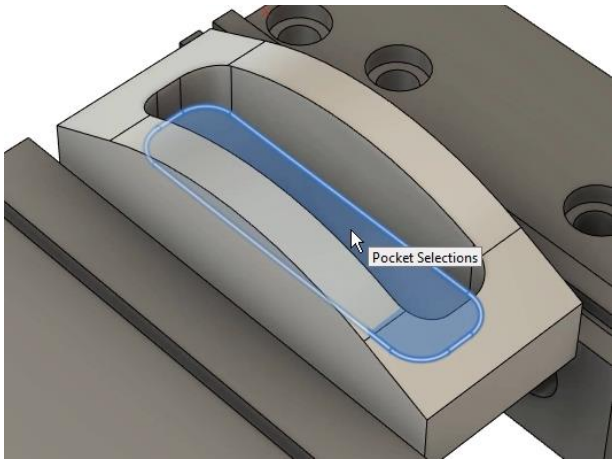

Figure 21. Select the face

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22. Continue to the Passes tab and deactivate the Stock to Leave option. OK the dialog.

Figure 22. Deactivate the Stock to Leave option

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23. Fusion 360 has several options for finishing the model's curved geometry. Click 3D> Flow.

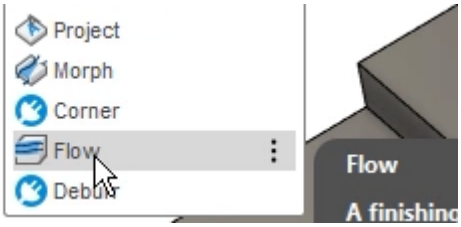

Figure 23. Create a Flow operation

24. Click the dialog's Select to choose the operation's tool and choose Tool 2 from the CAM 3X Toolpaths library.

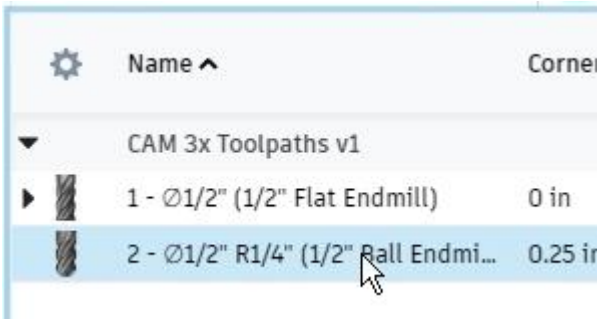

Figure 24. Select Tool 2

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25. Choose the Aluminum – Finishing option from the Cutting data section, then click the Select Tool dialog's Select.

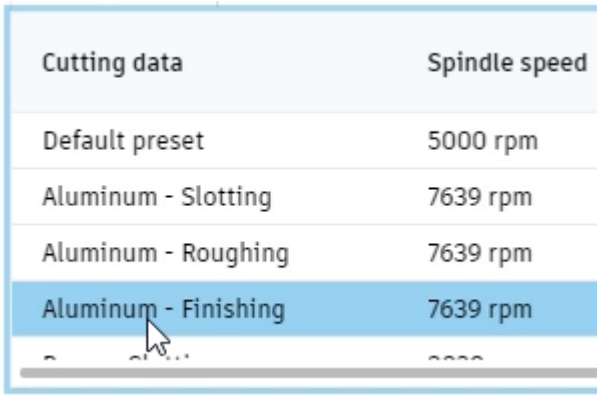

Figure 25. Select the cutting preset

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26. Continue to the Geometry tab and select the face shown in the image on the right. Click the red arrow so it parallels the body's length. This red arrow indicates the operation's machining direction.

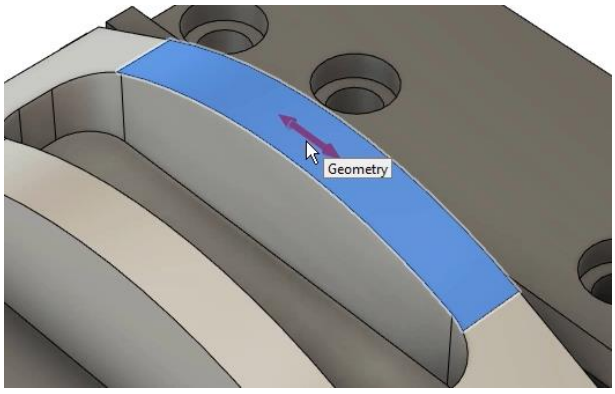

Figure 26. Select a face

27. Continue to the Passes tab and increase the Number of Stepovers value to **15**. OK the dialog to generate the toolpath preview.

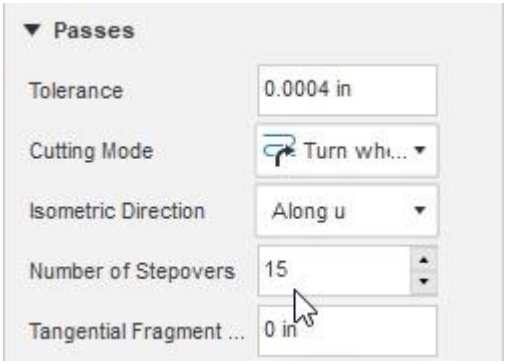

Figure 27. Increase the stepovers

28. The operation uses 15 passes to cut the selected face.

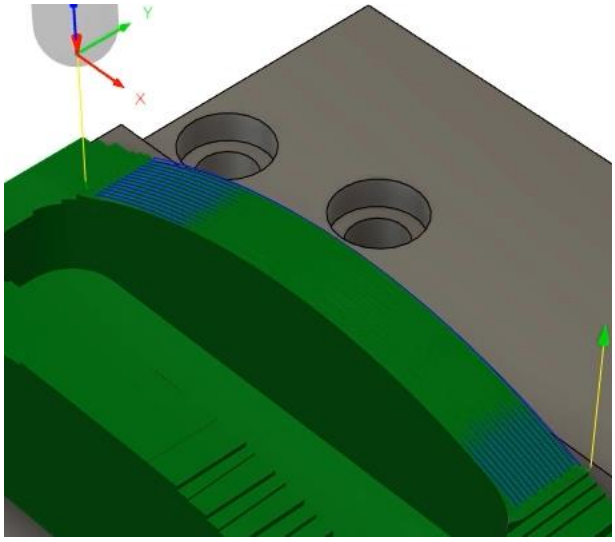

Figure 28. Inspect the toolpath preview

29. Press F7 to temporarily toggle the toolpath, then inspect the part. Notice that you can see the lines in between each pass. With a little bit of additional work, the Flow operation could be acceptable for cutting this geometry. Press F7 to show the toolpaths.

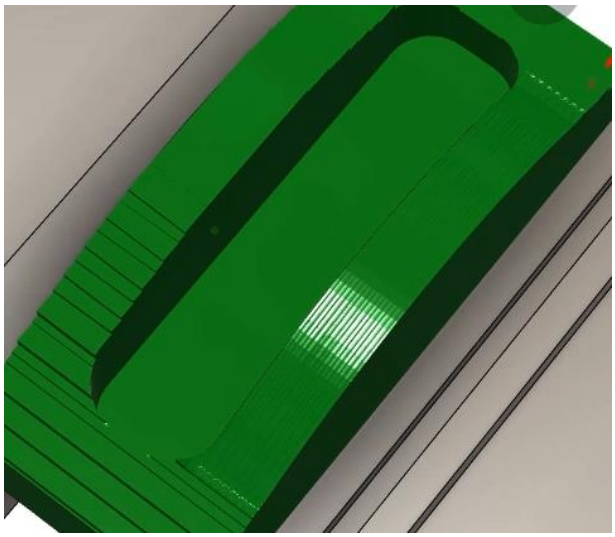

Figure 29. Analyze the result

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30. To explore a different option for cutting the model's geometry, click 3D> Parallel.

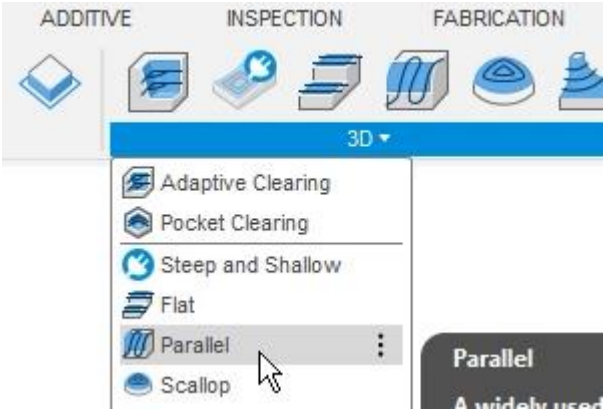

Figure 30. Create a Parallel operation

31. Select the face shown in the image on the right.

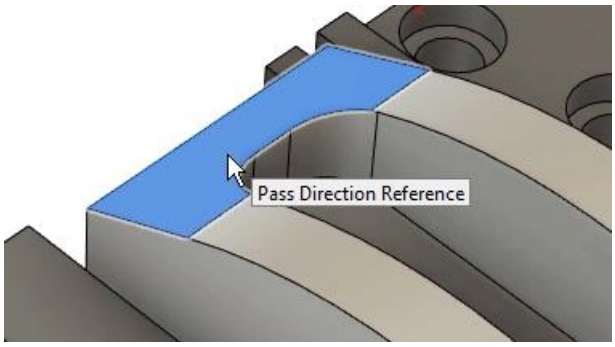

Figure 31. Select a face

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32. Continue to the Passes tab and notice that you can define the Cusp Height value. The cusp height is the small ridge artifact that is created between each pass. When you define this value, Fusion 360 will calculate the number of passes required to meet this value. OK the dialog to generate the toolpath preview.

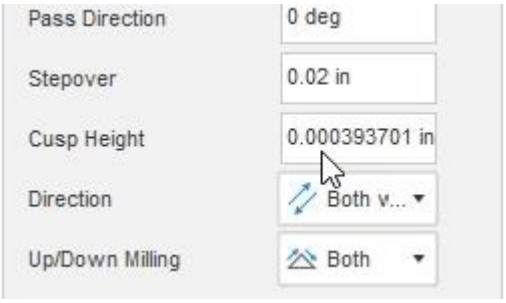

Figure 32. Note the Cusp Height value

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33. Inspect the toolpath preview and notice how many stepovers are needed to cut the selected face. Also notice that the operation cuts the entire model instead of just the face you selected.

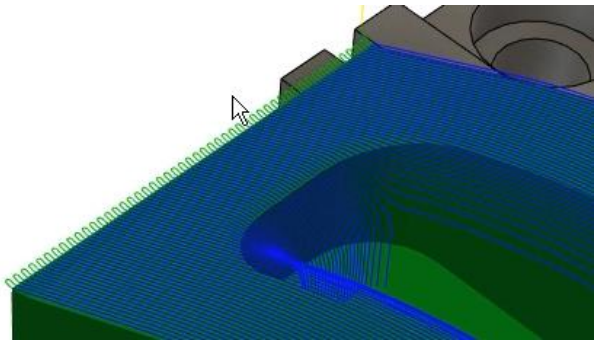

Figure 33. Inspect the toolpath preview

34. Right-click the Browser's Parallel operation and choose Edit from the menu. Navigate to the Geometry tab and activate the Avoid/Touch Surfaces option. Select the Touch option from the Mode menu.

Figure 34. Activate the Avoid/Touch Surfaces option

35. Choose the face shown in the image on the right as the dialog's Surfaces selection. OK the dialog.

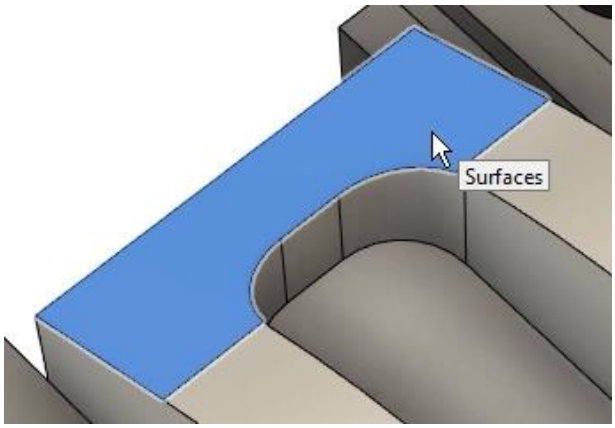

Figure 35. Select the face

36. The operation no longer machines the entire model, but it still rolls down into the pocket.

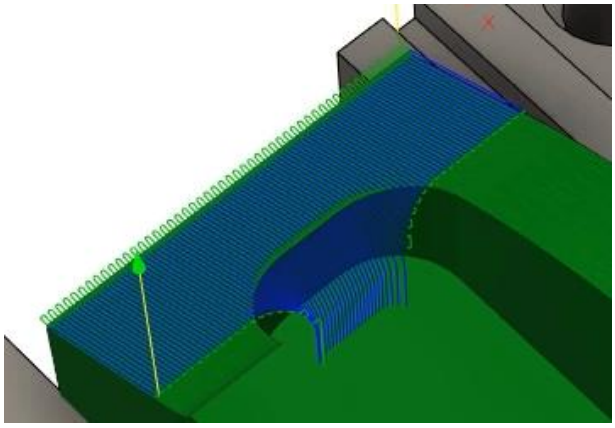

Figure 36. Inspect the result

37. Press F7 to temporarily toggle the toolpath, rotate the model, and notice the small cusps that the operation creates. Press F7 to show the toolpaths.

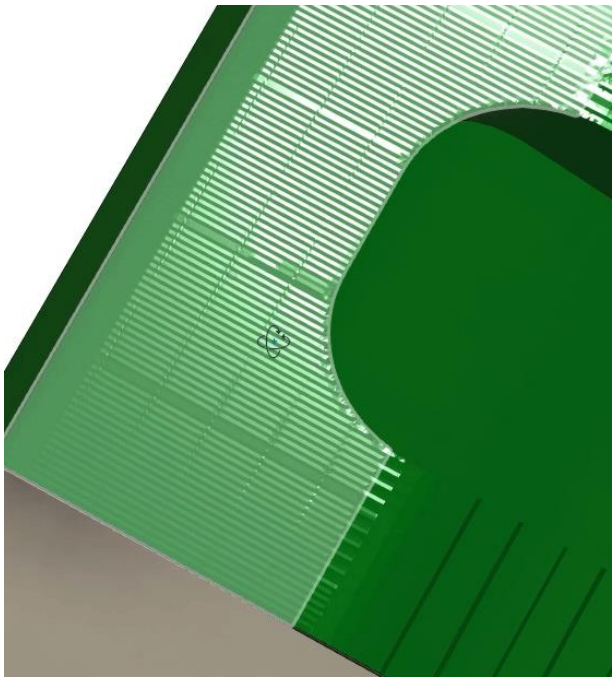

Figure 37. Inspect the cusps

38. To explore a different operation, click 3D> Scallop.

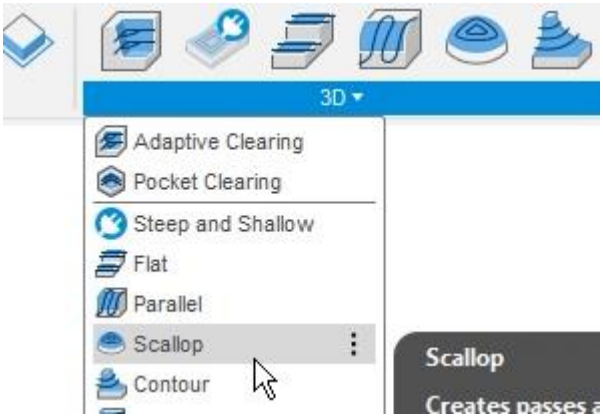

Figure 38. Create a Scallop operation

39. Navigate to the Geometry tab and activate the Avoid/Touch Surfaces option. Choose the Touch option from the Mode menu.

Figure 39. Activate the Avoid/Touch Surfaces option

40. Select the two faces shown in the image on the right as the dialog's Surfaces selection. OK the dialog.

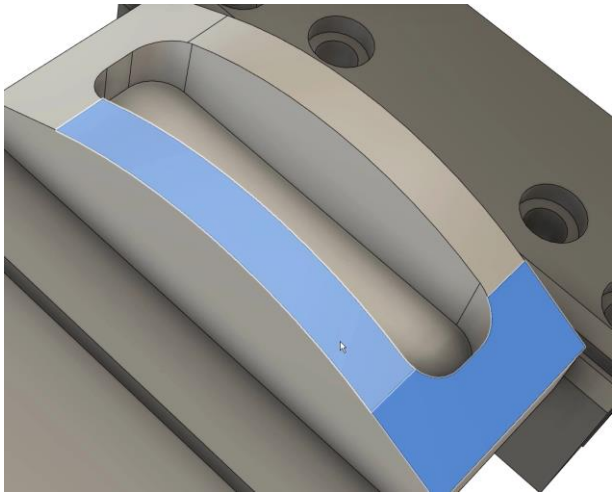

Figure 40. Select two surfaces

41. Press F7 to toggle the toolpaths, then analyze the result and compare it to the faces machined by the other operations. Press F7 to show the toolpaths.

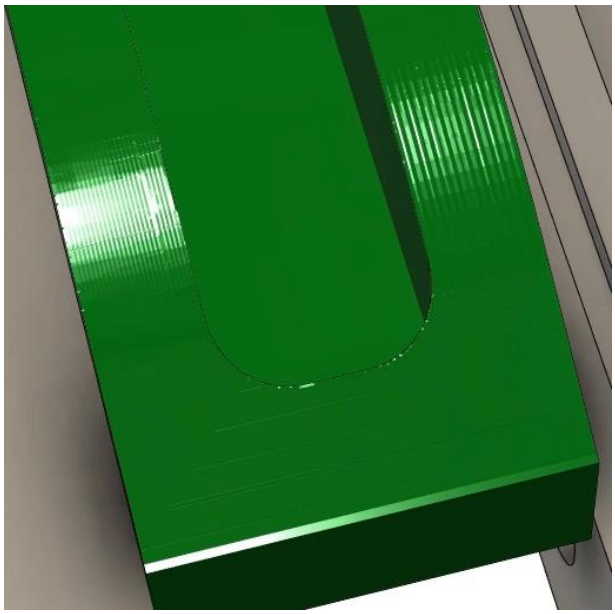

Figure 41. Analyze the result

42. Edit the Scallop operation and navigate to the Geometry tab. Choose the Avoid option from the Mode menu, then select the pocket's vertical faces. These selections will keep the tool from rolling down into the model's pocket.

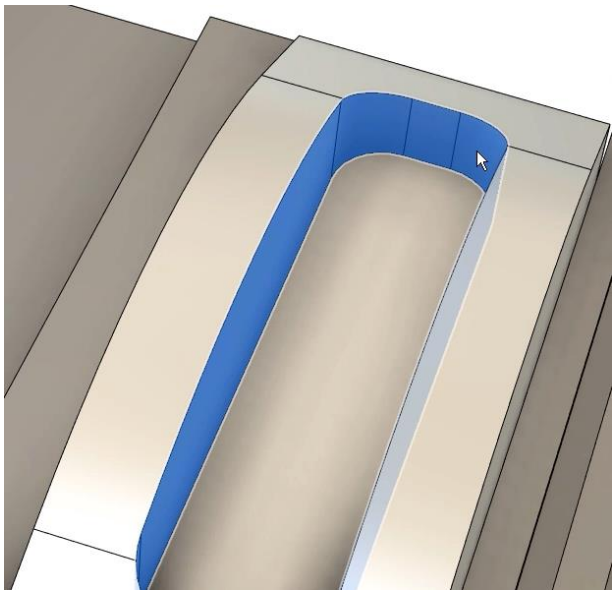

Figure 42. Select the surfaces to avoid

43. Activate the Contact Point Boundary option, then OK the dialog.

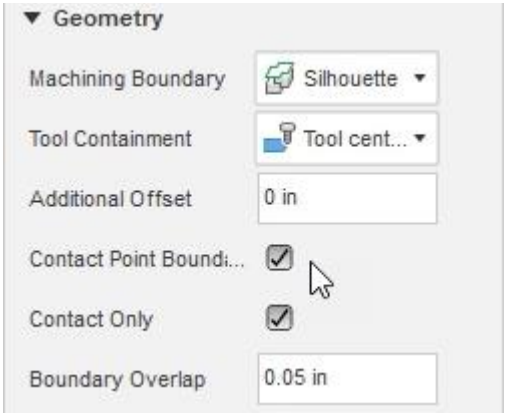

Figure 43. Activate the Contact Point Boundary option

44. Inspect the result and notice that the tool does not roll down into the pocket but still machines the pocket's floor. To entirely avoid machining the pocket, add the pocket's floor to the Avoid selection. Save the design.

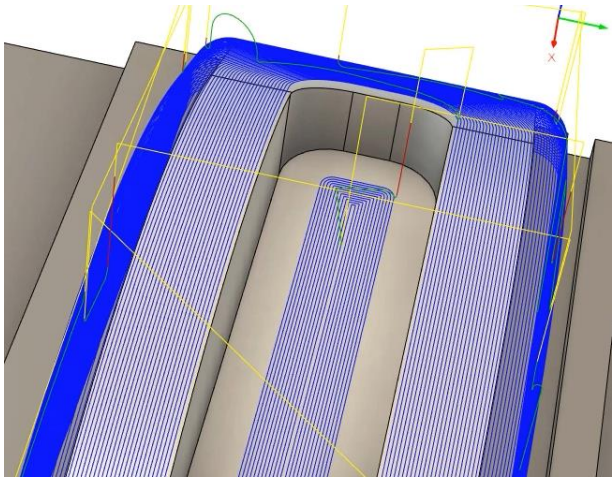

Figure 44. Inspect the result