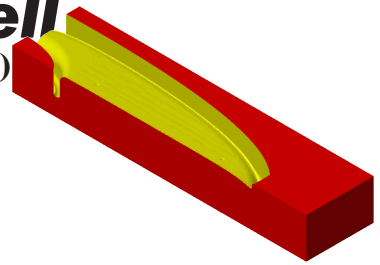


# Toolpaths for CO2 Shell

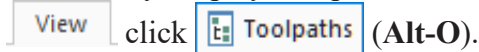
Wheel Shells (Area Roughing & Raster)  
Cut Body (Equal Scallop)



## A. Machine Type and Stock Setup.

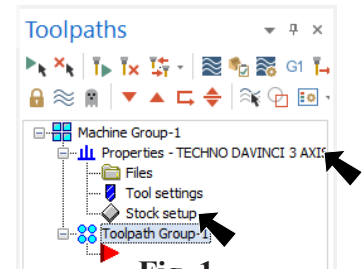
Step 1. If necessary, open your file from Chapter 3.

Step 2. If necessary, display Toolpaths Manager. On the View tab



Step 3. If Machine Group is **not** displayed in the Toolpaths Manager,

**Fig. 1** on the Machine tab  , click Mill  > De-  
**fault** from the menu.



**Fig. 1**

Step 4. Expand **Properties** (click +) in Toolpaths Manager and click **Stock setup** in Toolpaths Manager, **Fig. 1**.

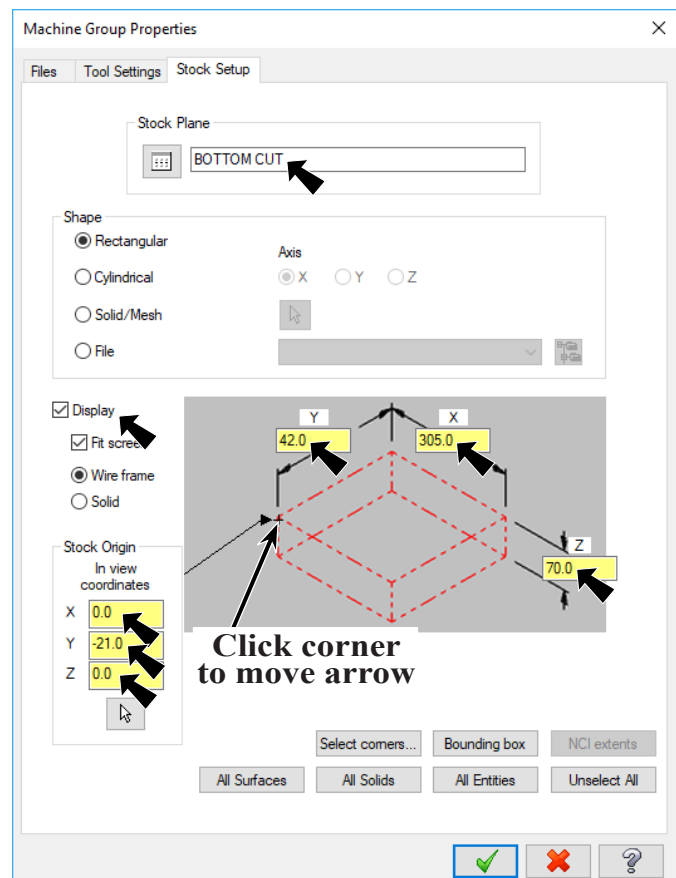
Step 5. Confirm Stock Plane is **Bottom Cut**, **Fig. 2**.

Step 6. Confirm **Display** check box is checked.


Step 7. Click **top left corner** of the red stock to move the Origin. After you click corner the arrow will point to corner.

Step 8. Key-in X, Y and Z stock dimension:  
**X 305**  
**Y 42**  
**Z 70**

Step 9. Key-in Stock Origin coordinates:  
**X 0**  
**Y -21**  
**Z 0**



**Fig. 2**

Step 10. Click OK  in the Machine Group Properties.

## B. Confirm WCS BOTTOM CUT.

Step 1. The Stock is displayed as red wireframe, Fig. 3.

Step 2. In Status bar at bottom of display, confirm CPLANE:BOTTOM CUT, Fig. 3.

Step 3. Confirm Bottom Cut Origin. Use F9 to toggle axes.

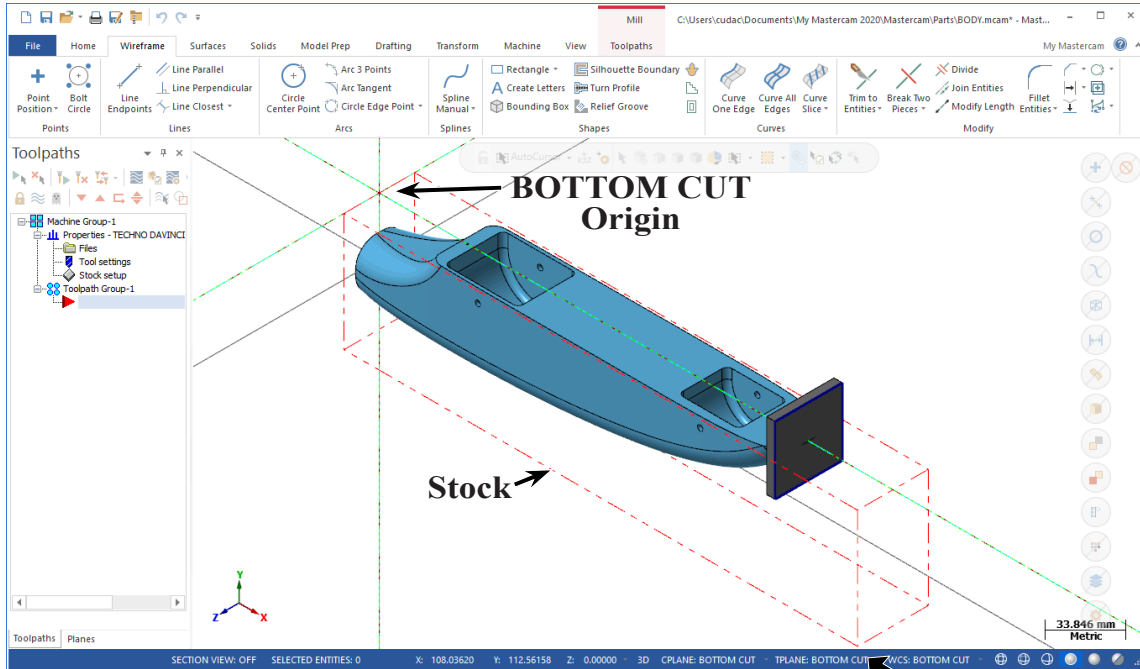


Fig. 3

## C. REAR SHELL Rough Area Roughing Toolpath.

Step 1. On the Toolpaths tab **Toolpaths** in the 3D group click **expand gallery** button and click **Area Roughing**, Fig. 4.

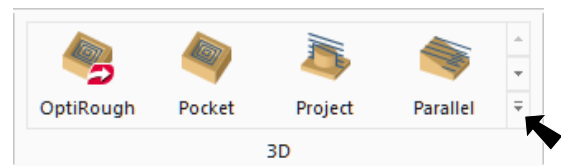

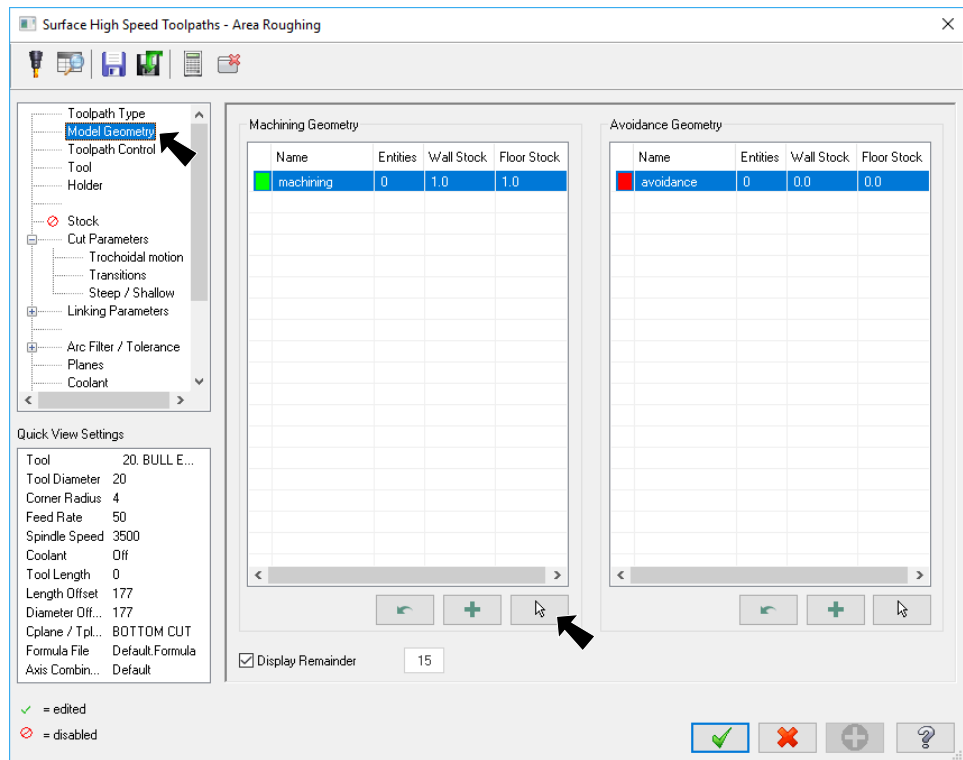


Fig. 4

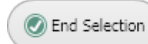
Step 2. Select **Model Geometry** from the tree control and set:

Under **Machining Geometry** click **Select entities** button  **Fig. 5.**



**Fig. 5**

Step 3. Triple click the **solid car body** to select as machine geometry and click **End Selection**



(ENTER), **Fig. 6.**

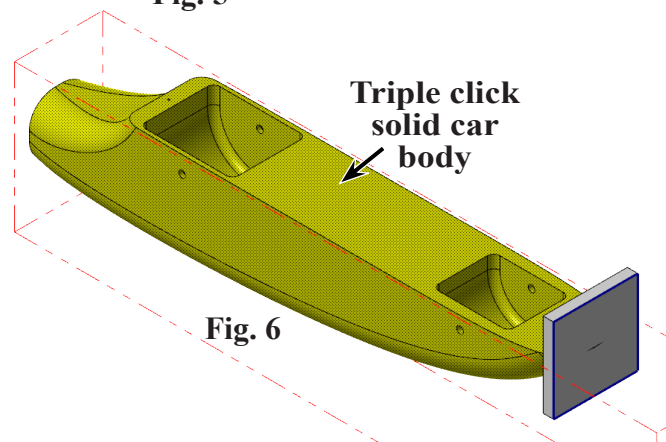
Step 4. Back in **Model Geometry** page set:

**Wall Stock 1**

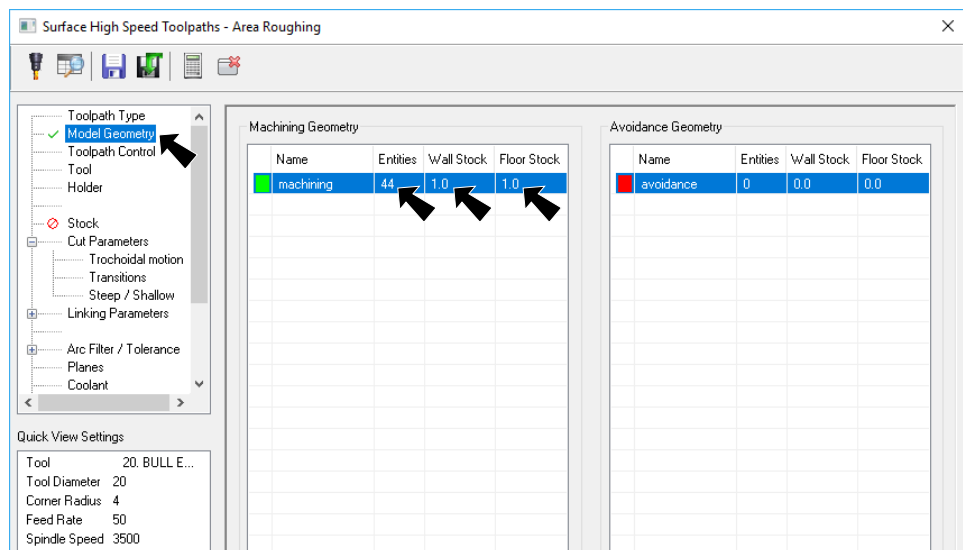
**Floor Stock 1**

To set, double click and key-in.

**Fig. 7.**




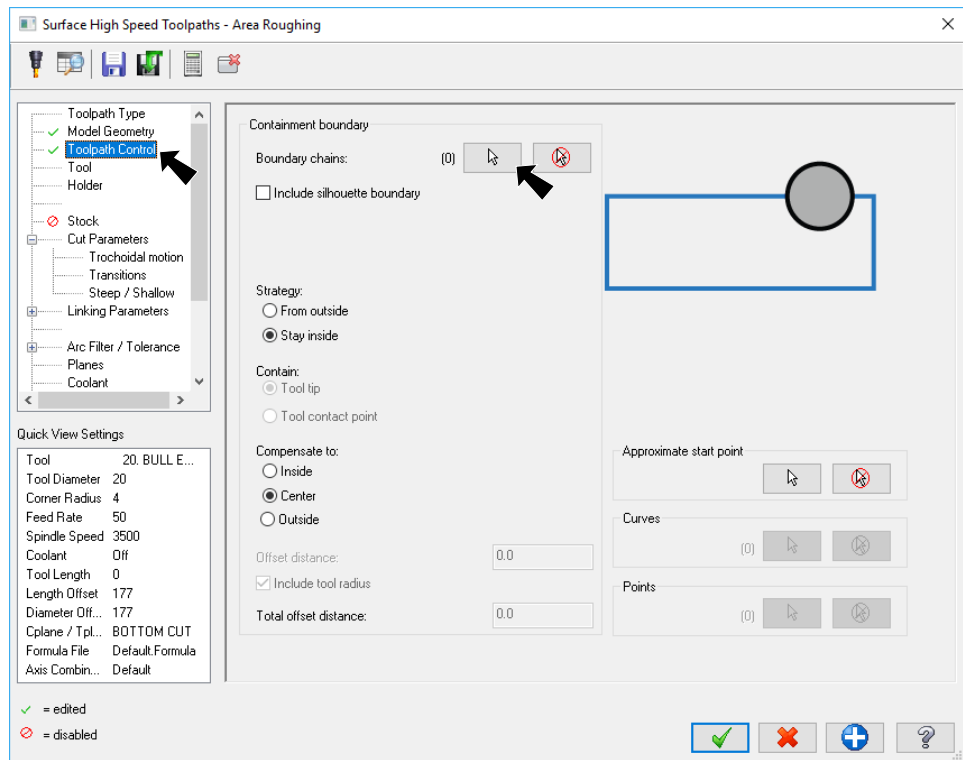
**Fig. 6**




**Fig. 7**


Step 5. Select **Toolpath Control** from the tree control and set:


Click **Containment Boundaries** button  **Fig. 8.**

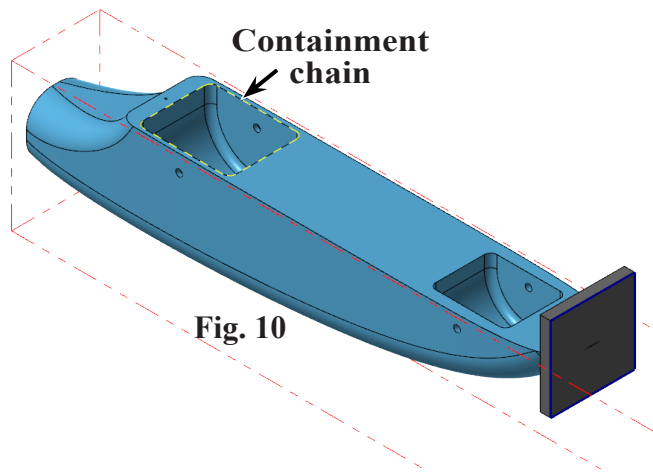


**Fig. 8**


Step 6. Select **Solids**  in the Chaining dialog box, **Fig. 9.**

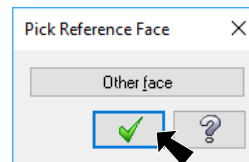
Step 7. Under Selection Method in the Chaining dialog box, click **Loop**  and unselect all others.

Step 8. Click **edge of rear wheel shell**, **Fig. 10.** If you select the wrong edge, click **Unselect** .



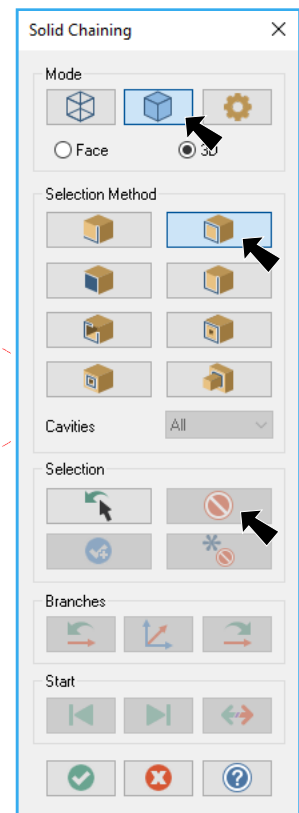
**Fig. 10**

Step 9. Click OK  in Pick Reference Face dialog box. If the wrong face is selected, click **Other face** in Pick Reference Face dialog box, **Fig. 11.**



**Fig. 11**

Step 10. Click the OK  in the Chaining dialog box.



**Fig. 9**

Step 11. Back in **Toolpath Control** page:

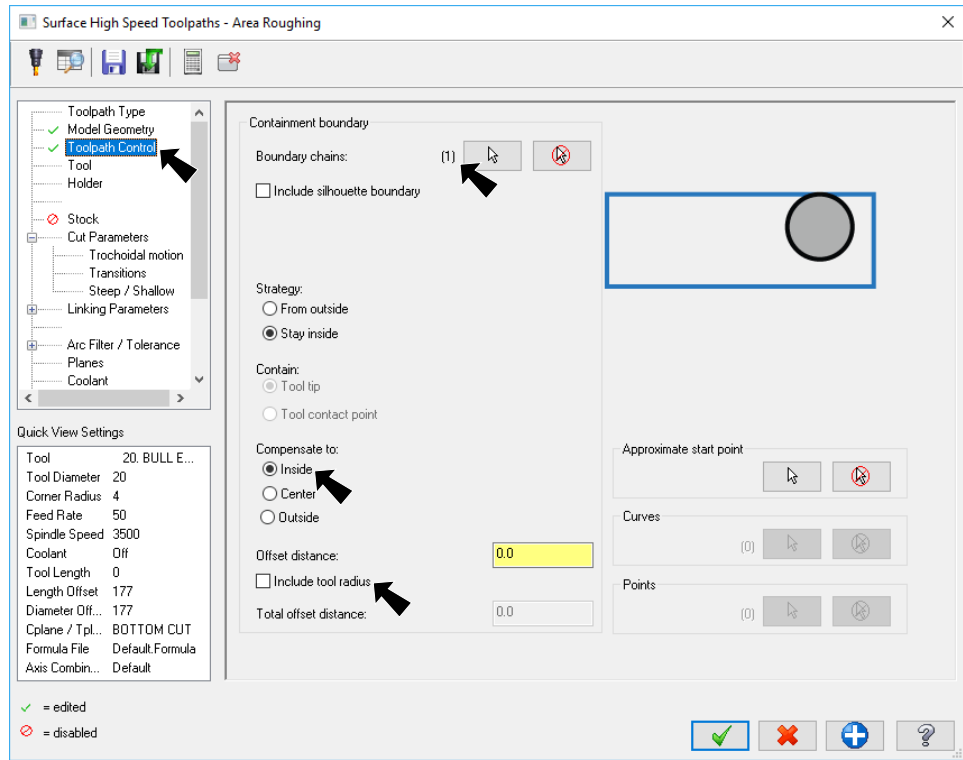
**Confirm 1 Boundary chain**

**Compensate to Inside**

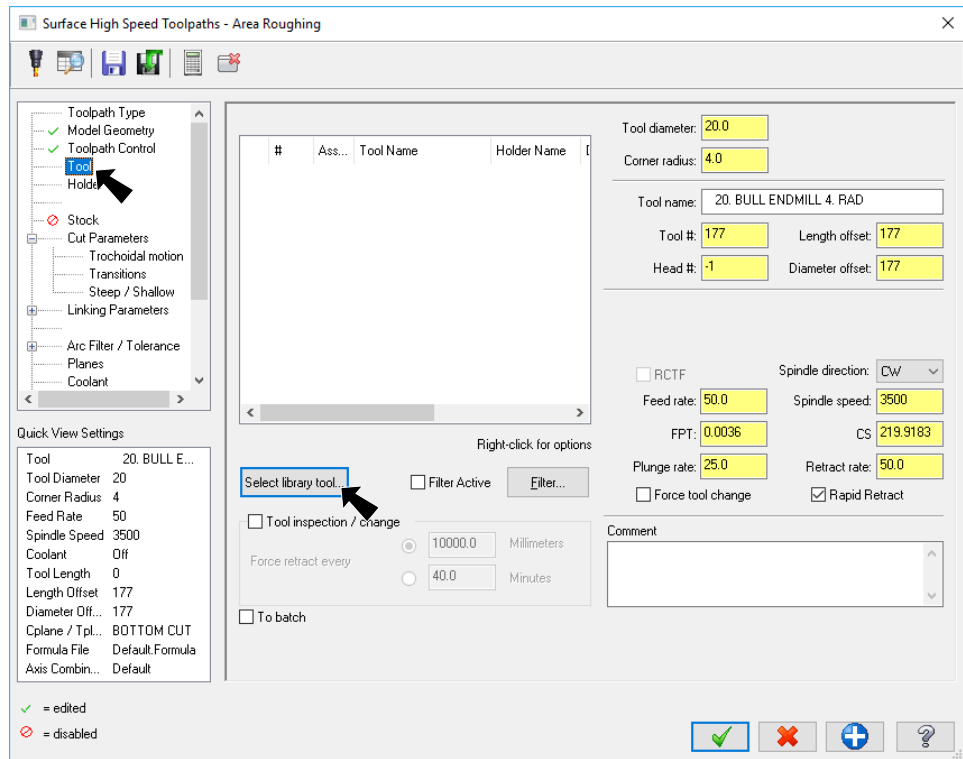
**Uncheck Include tool radius**  
**Fig. 12.**

Step 12. Select **Tool** from the tree control and:

**click Select library tool button**  
**Fig. 13.**




**Fig. 12**




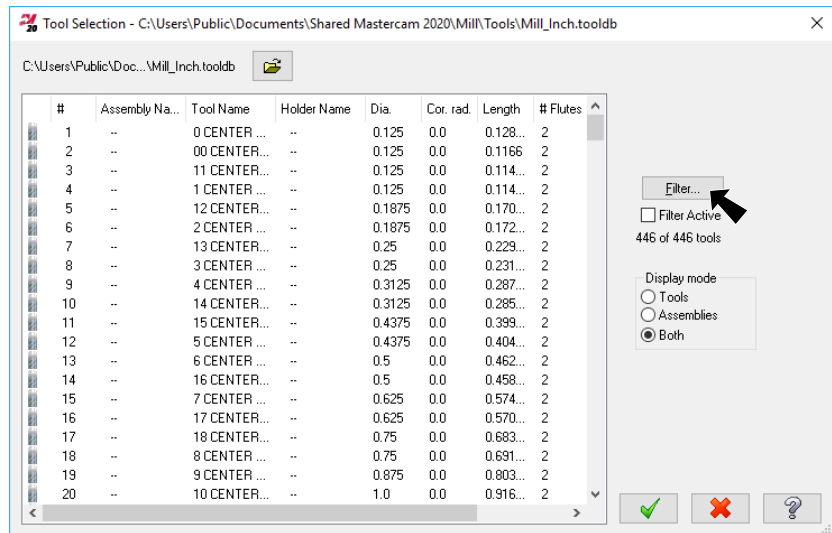
**Fig. 13**

Step 13. Click the **Filter** button  
**Fig. 14.**

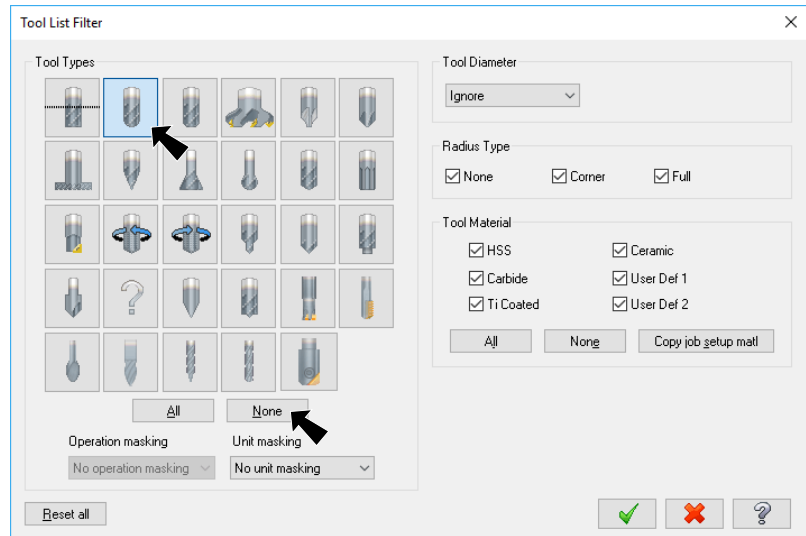
Step 14. Click **None** button under Tool Types  
**Fig. 15.**

Step 15. Click **Endmill2 Sphere** button (second button top row) and click OK  
  
**Fig. 15.**

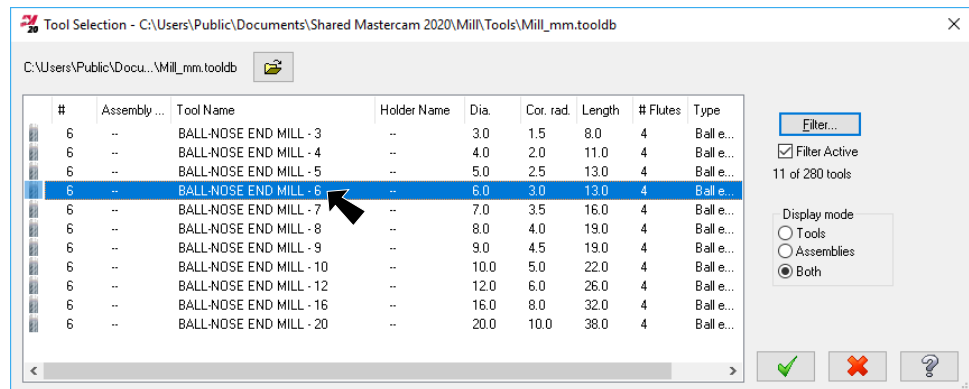
Step 16. Select **BALL-NOSE ENDMILL 6.0 mm Diameter** and click OK  
  
**Fig. 16.**



**Fig. 14**



**Fig. 15**



**Fig. 16**

Step 17. Back in Tool page set:

**Feed rate 300**

**Plunge rate 200**

**Fig. 17.**

Step 18. Select Cut Parameters from tree control and set:

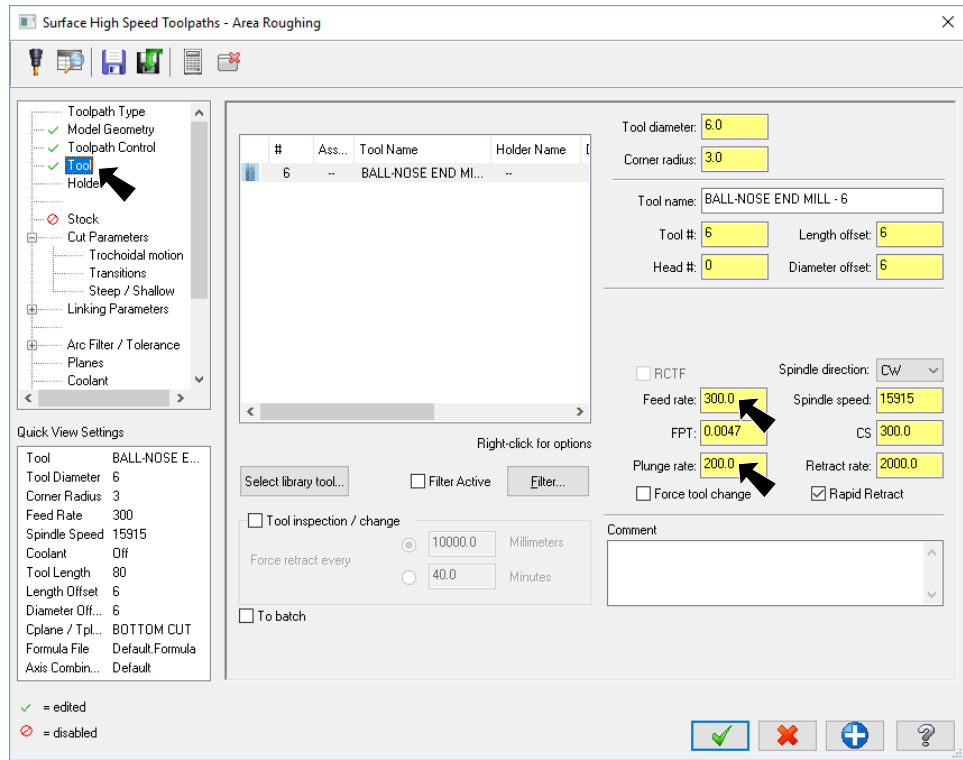
**Cutting method Climb**

**Stepdown 12.5**

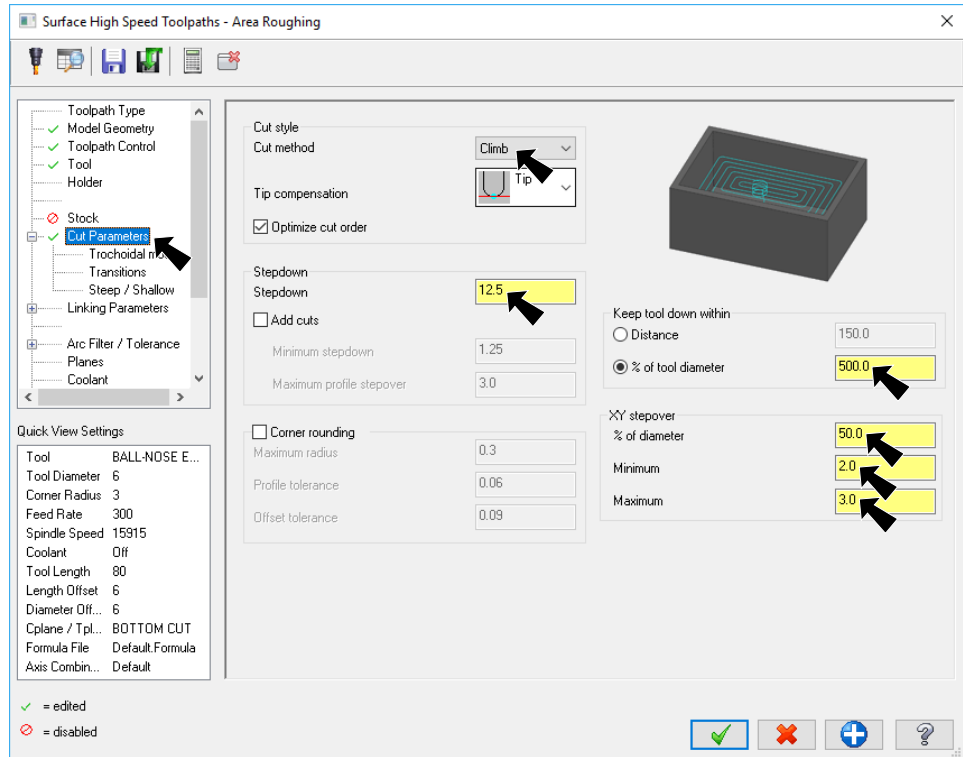
**Keep tool down within % of tool diameter 500**

**XY stepover 50%**

**Minimum 2  
Maximum 3  
Fig. 18.**



**Fig. 17**



**Fig. 18**

Step 19. Select **Trochoidal motion** from tree control and set:

**Minimize burial**  
Fig. 19.

Step 20. Select **Transitions** from tree control and set:

**Entry helix Radius 3**  
Fig. 20.

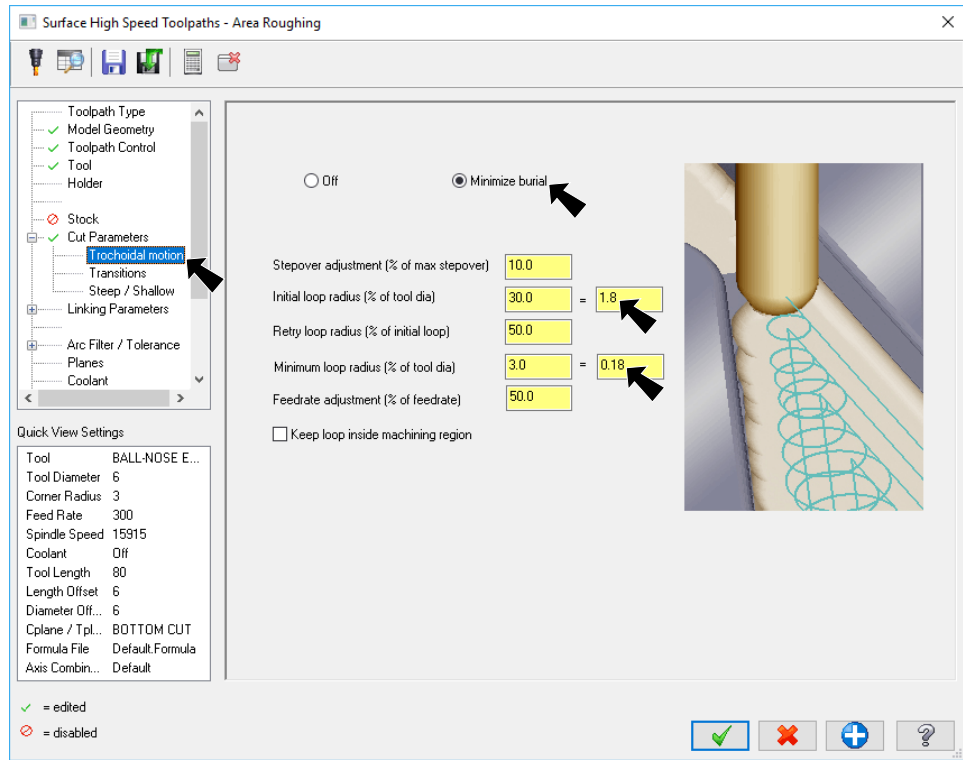


Fig. 19

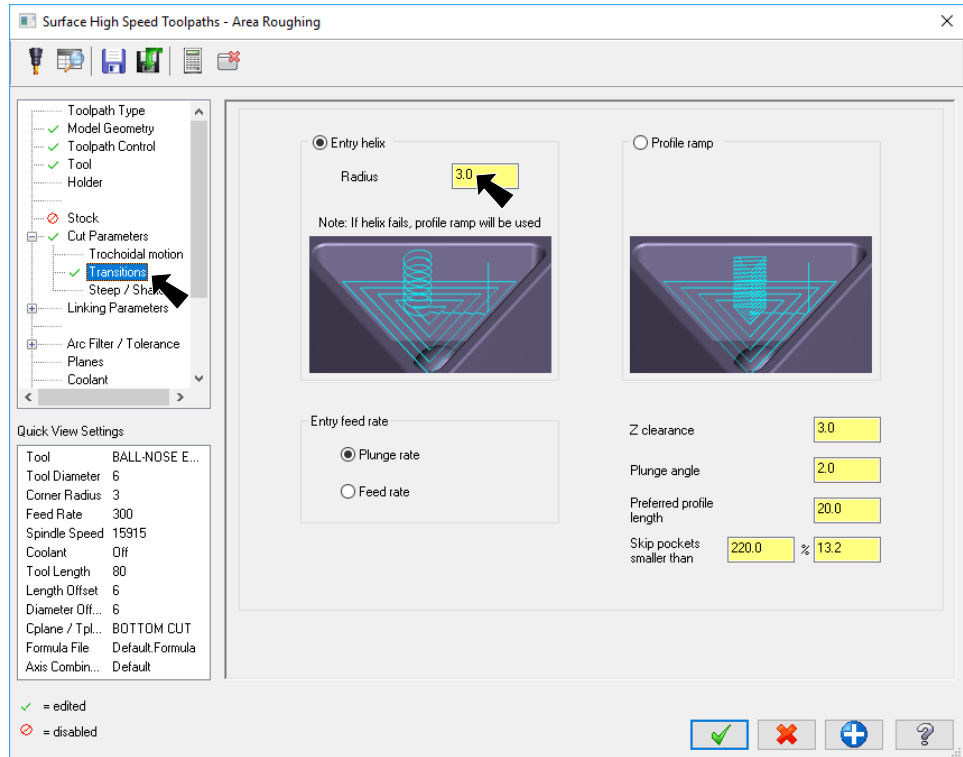


Fig. 20

Step 21. Select **Step/ Shallow** from tree control and set:

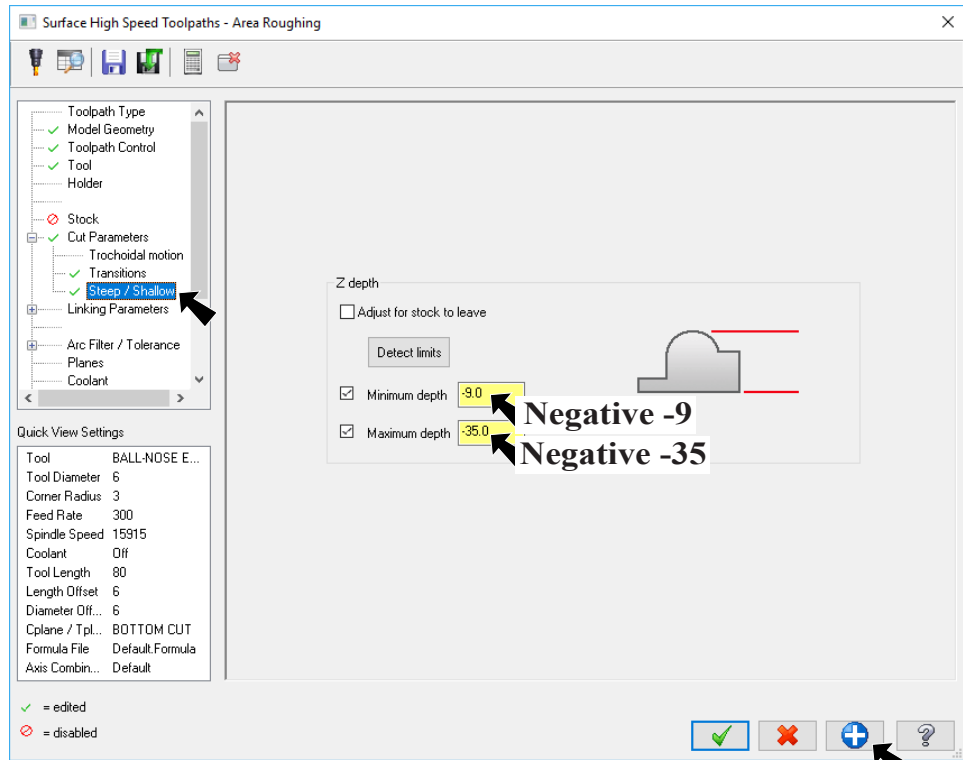
Check **Minimum depth -9**

Check **Maximum depth -35**

Click **Apply**



**Fig. 21.**



**Fig. 21**

Step 22. Select **Linking Parameters** from tree control and set:

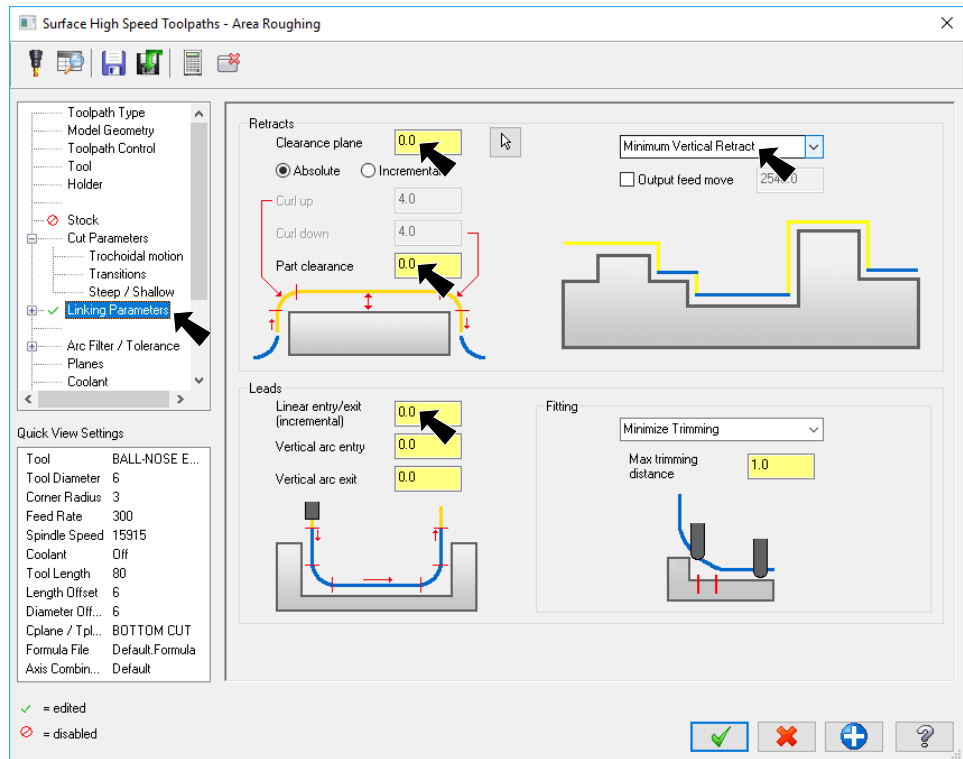
**Clearance plane 0**

Select **Minimum Vertical Retract**

**Part clearance 0**

**All Leads 0**

Step 23. Click **OK** in Area Roughing dialog box.



**Fig. 22**

Step 24. Allow Mastercam to calculate toolpath.

Step 25. Save (Ctrl-S).

## D. Verify REAR SHELL Rough Area Roughing.

Step 1. Use **Alt-T** to toggle on toolpath display, **Fig. 23**.

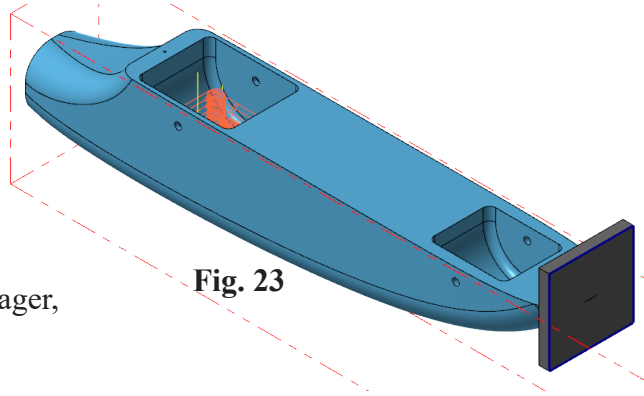


Fig. 23

Step 2. Click **Verify**  in the Toolpaths Manager, **Fig. 24**.

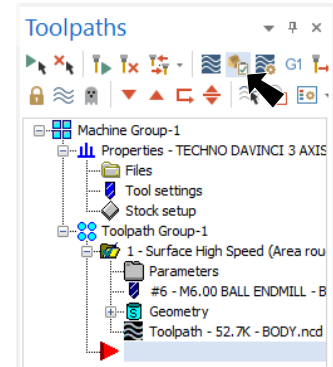


Fig. 24

Step 3. We like to **uncheck Wireframe** in the Visibility group on the Home tab, **Fig. 25**.

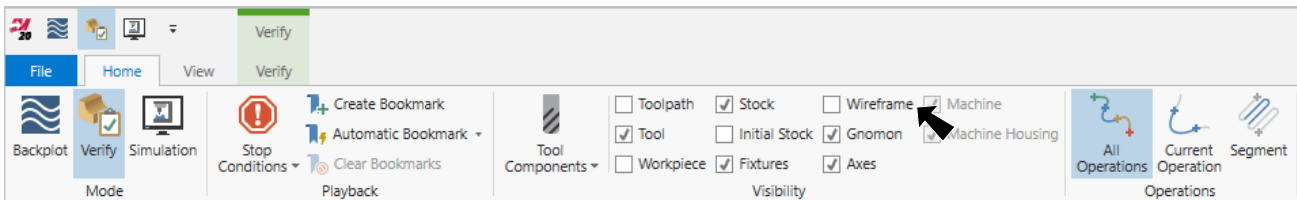


Fig. 25

Step 4. Click **Play**  (R) in playback bar along bottom of the window, **Fig. 26**.



Fig. 26

Step 5. Note **Total Time** to run program under Toolpath Info in Move List panel (**8min 48.90s**), **Fig. 28**.

Step 6. Switch back to Mastercam (**Alt-Tab**).

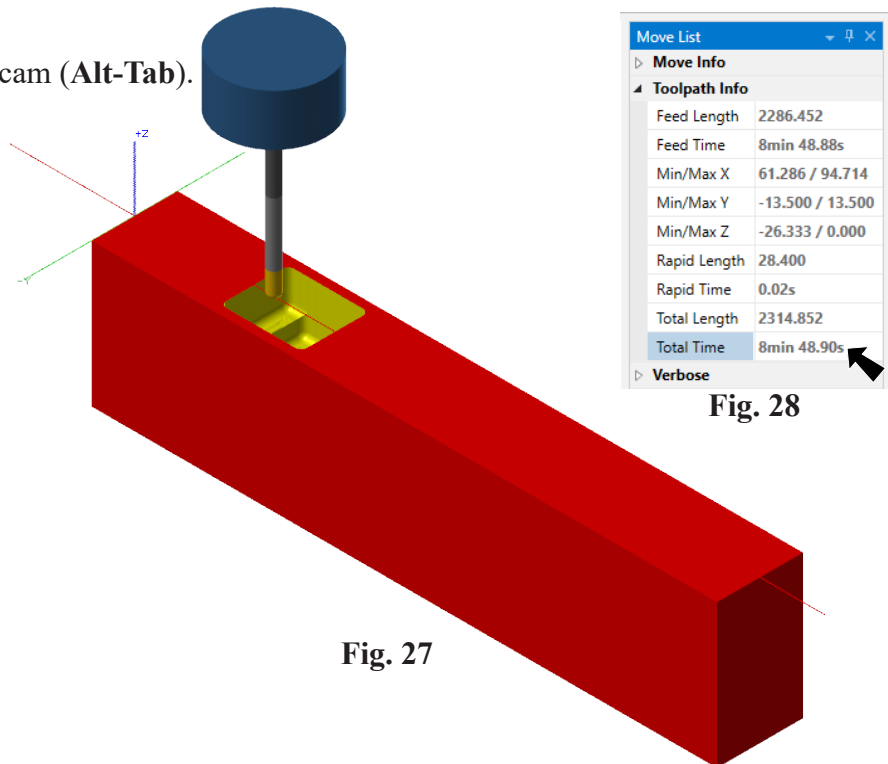


Fig. 28

Fig. 27

## E. FRONT SHELL Area Roughing Surface Toolpath.

Step 1. Use **Alt-T** to toggle off toolpath display.

Step 2. Copy Roughing toolpath in the Toolpaths Manager. To copy, click to select toolpath, **Fig. 29**. Then, use **Ctrl-C** and **Ctrl-V**, **Fig. 30**.

Step 3. Expand copied **2-Surface High Speed toolpath** and click **Parameters**, **Fig. 30**.

Step 4. Select **Toolpath Control** from tree control and set:

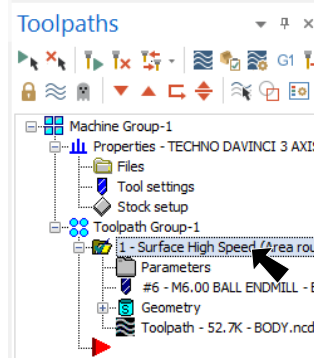


Fig. 29

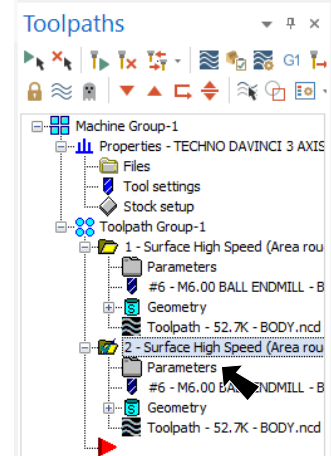


Fig. 30

Click **Remove selected containment boundaries**  button

Click **Containment Boundaries**  button

Fig. 31.

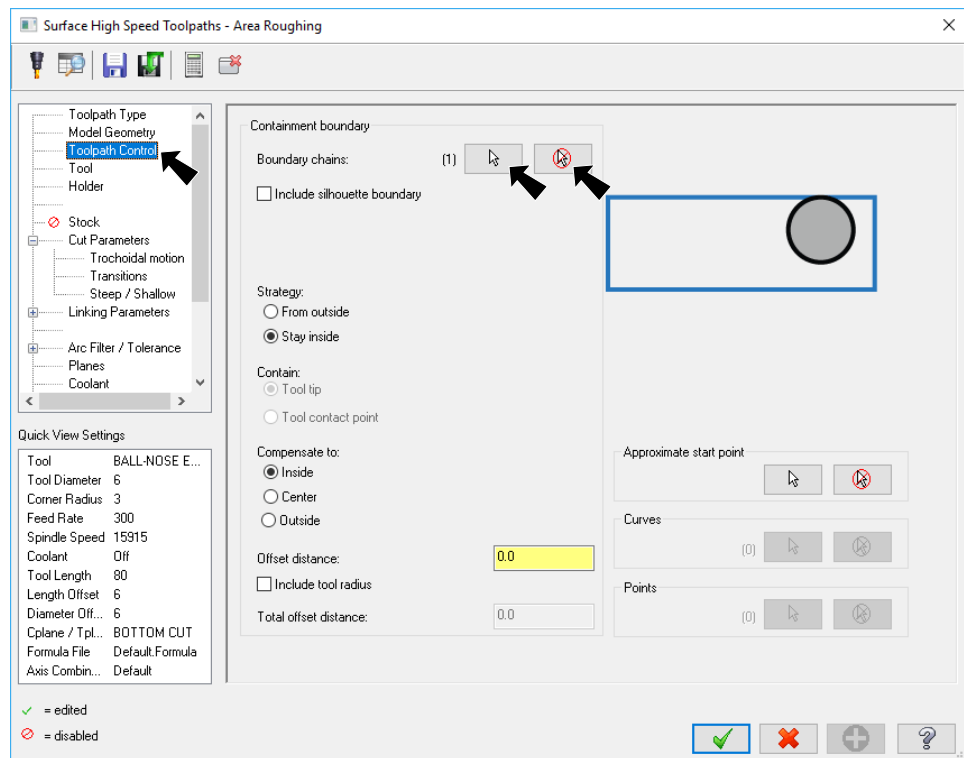


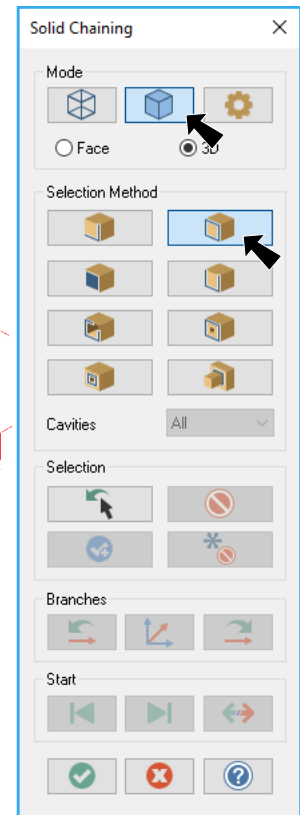
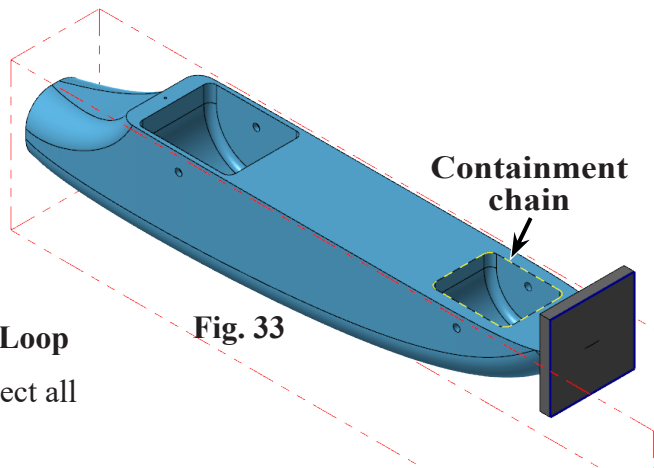



Fig. 31

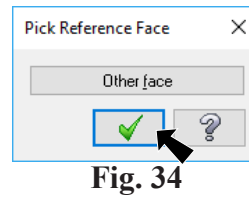
Step 5. **Select Solids**  in the Chaining dialog box, **Fig. 32**.

Step 6. Under Selection Method in the Chaining dialog box, click **Loop**  and unselect all others.




Step 7. Click **edge of front wheel shell**, **Fig. 33**.

Step 8. Click OK  in Pick Reference Face dialog box. If the wrong face is selected, click **Other face** in Pick Reference Face dialog box, **Fig. 34**.

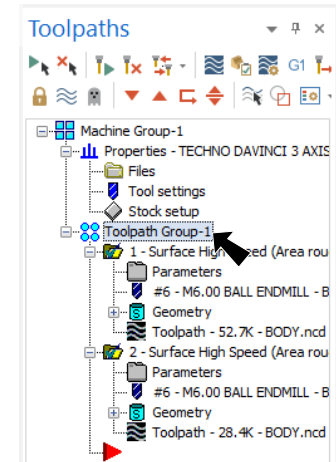
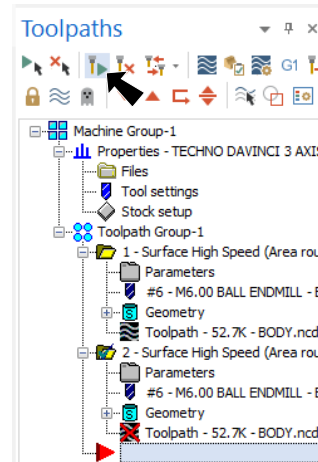


Step 9. Click the OK  in the Chaining dialog box.

Step 10. Click OK  in Area Roughing dialog box.

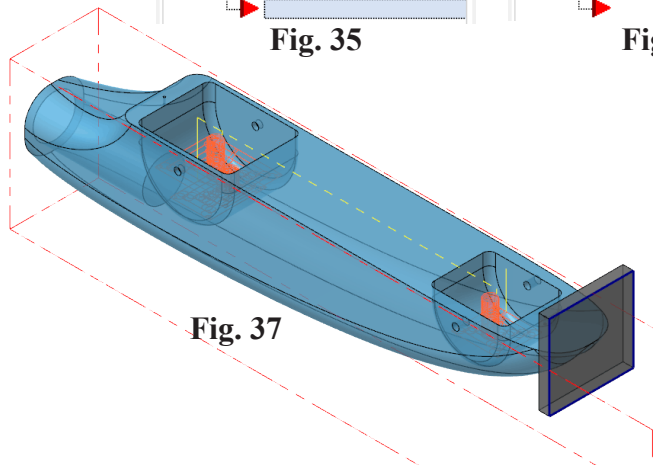
Step 11. In the Toolpaths Manager, click **Regenerate all selected operations** , **Fig. 35**.

Step 12. Click the **Toolpath Group-1** in the Toolpaths Manager to select **both** toolpaths, **Fig. 36**.



Step 13. Use **Alt-T** to toggle toolpath display.

Step 14. Save  (**Ctrl-S**).



## F. BOTH SHELLS Finish Raster Toolpath.

- Step 1. Use **Alt-T** to toggle off toolpath display.
- Step 2. Copy the **2nd Area Roughing toolpath** in the Toolpaths Manager. To copy, click to select 2nd toolpath, **Fig. 38**. Then, use **Ctrl-C** and **Ctrl-V**, **Fig. 39**.
- Step 3. Expand the pasted **3-Surface High Speed** and click **Parameters**, **Fig. 39**.
- Step 4. Select **Toolpath Type** from the tree control and select:

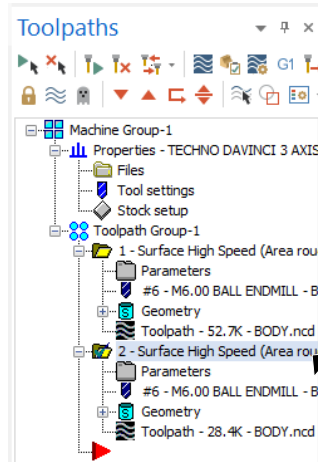


Fig. 38

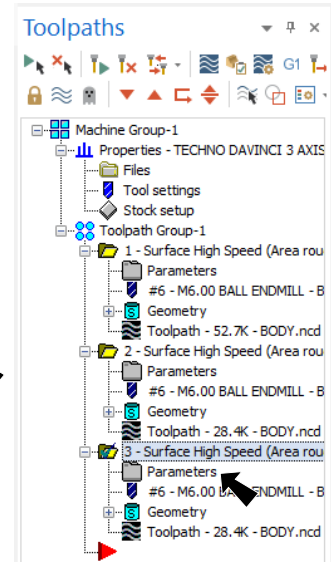


Fig. 39

### Finishing

### Raster Fig. 40.

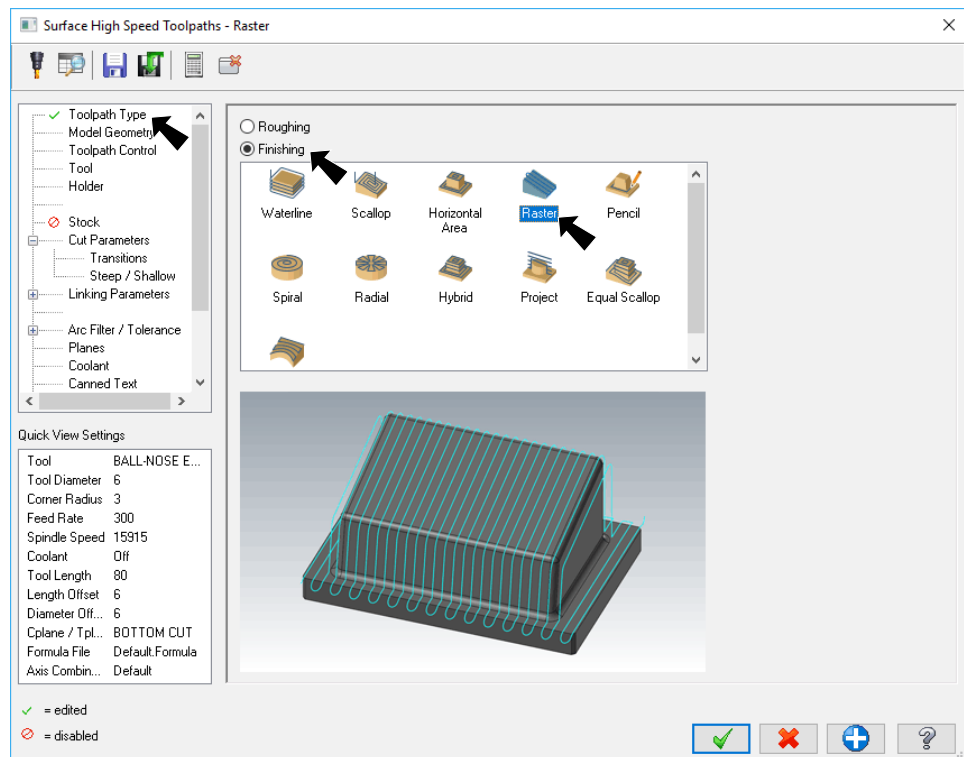
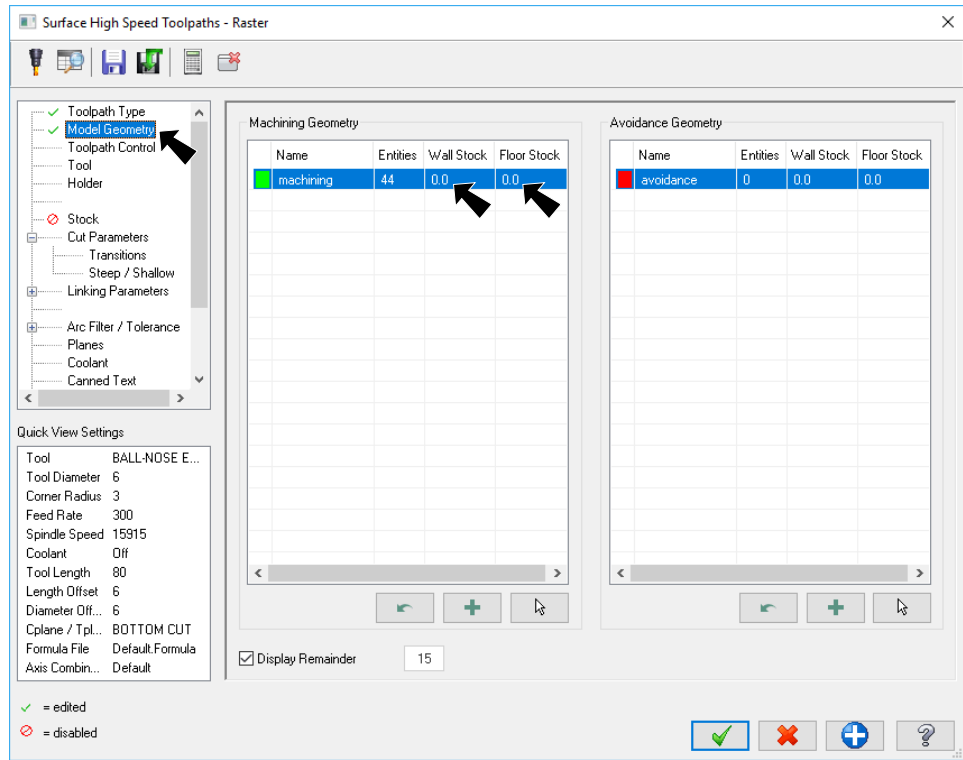


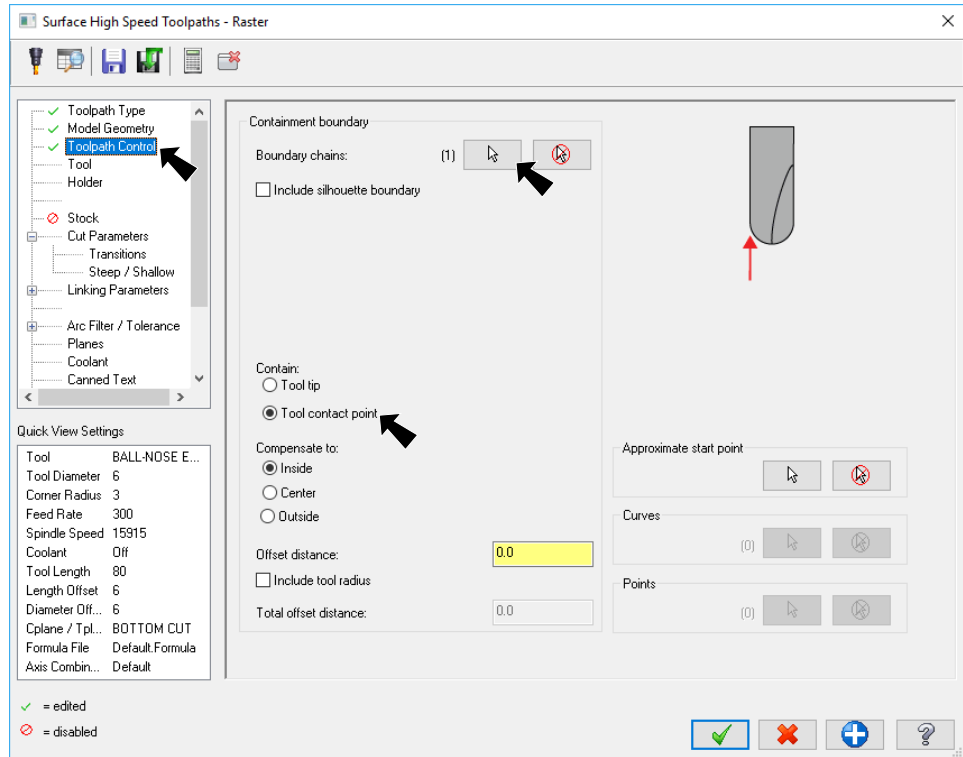
Fig. 40

Step 5. Select **Model Geometry** from the tree control and set:  
**Wall Stock 0**  
**Floor Stock 0**  
**Fig. 41.**



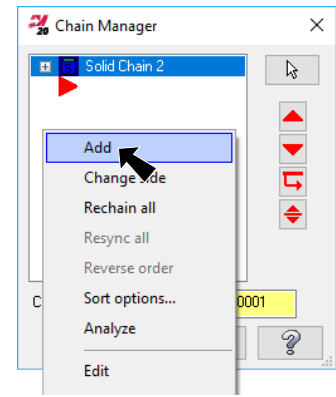
**Fig. 41**

Step 6. Select **Toolpath Control** from tree control and set:  
Under Contain select **Tool contact point**  
Click **Containment Boundaries** button  
**Fig. 42.**





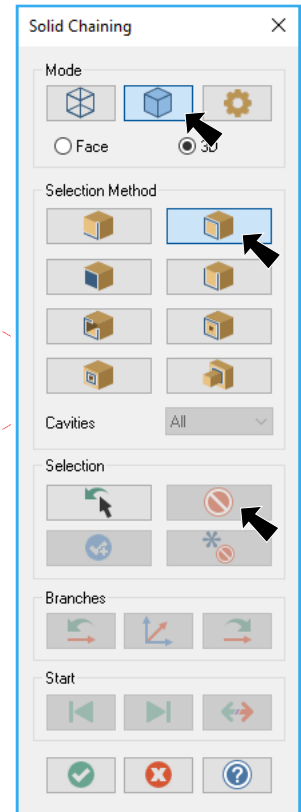
**Fig. 42**

Step 7. **Right click** in the Chain manager dialog box and click **Add** from menu, **Fig. 43**.



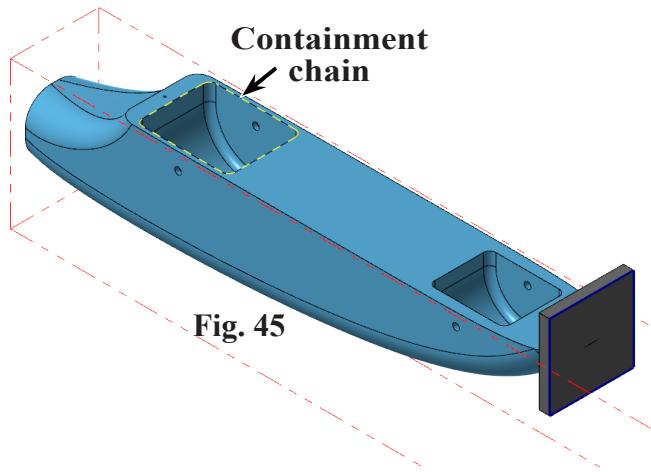
**Fig. 43**

Step 8. Select **Solids**  in the Chaining dialog box and under Selection Method click **Loop**  and unselect all others, **Fig. 44**.



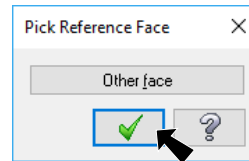
**Fig. 44**

Step 9. Click **edge of rear wheel shell**, **Fig. 45**.





**Fig. 45**

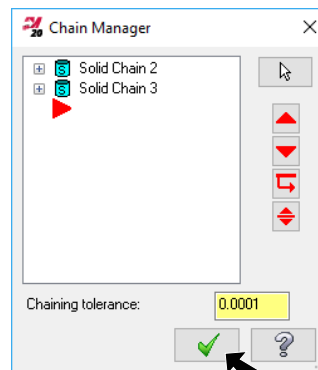
Step 10. Click OK  in Pick Reference Face dialog box, **Fig. 46**.



**Fig. 46**

Step 11. Click OK  in the Chaining dialog box.

Step 12. Click OK  in Chain Manager dialog box, **Fig. 47**.



**Fig. 47**

Step 13. Select **Cut Parameters** from tree control and set:

**Cutting method Zigzag**

**Stepover .5**  
**Fig. 48.**

Step 14. Select **Steep/Shallow** from tree control and set:

**Uncheck Minimum**

**Uncheck Maximum**

**Click Apply**

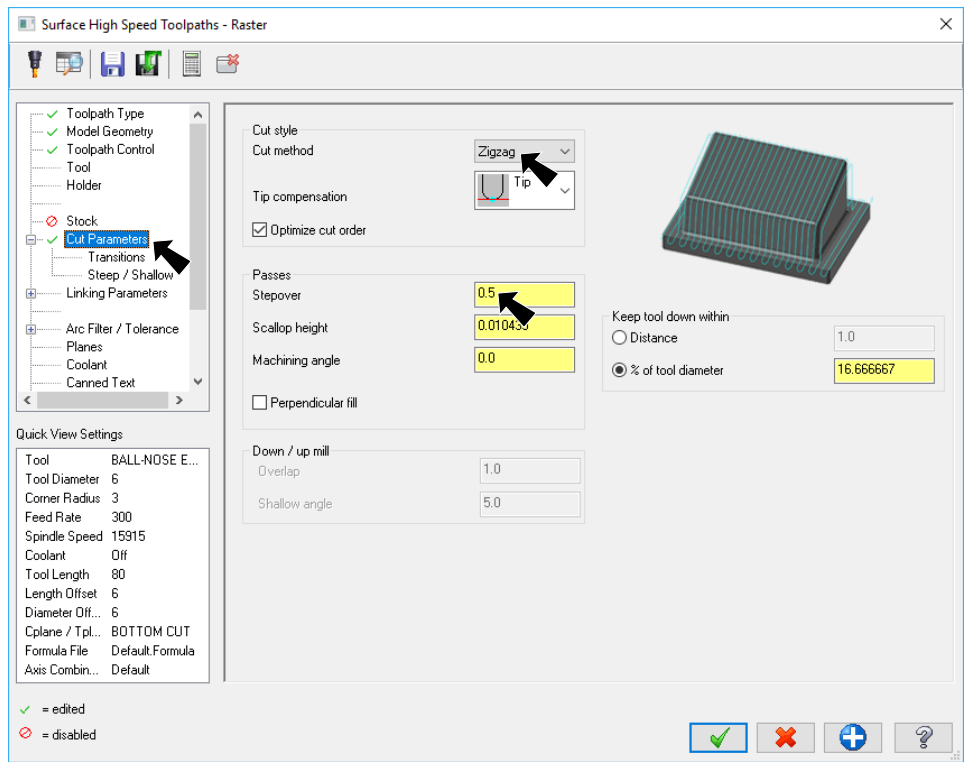


**Fig. 49.**

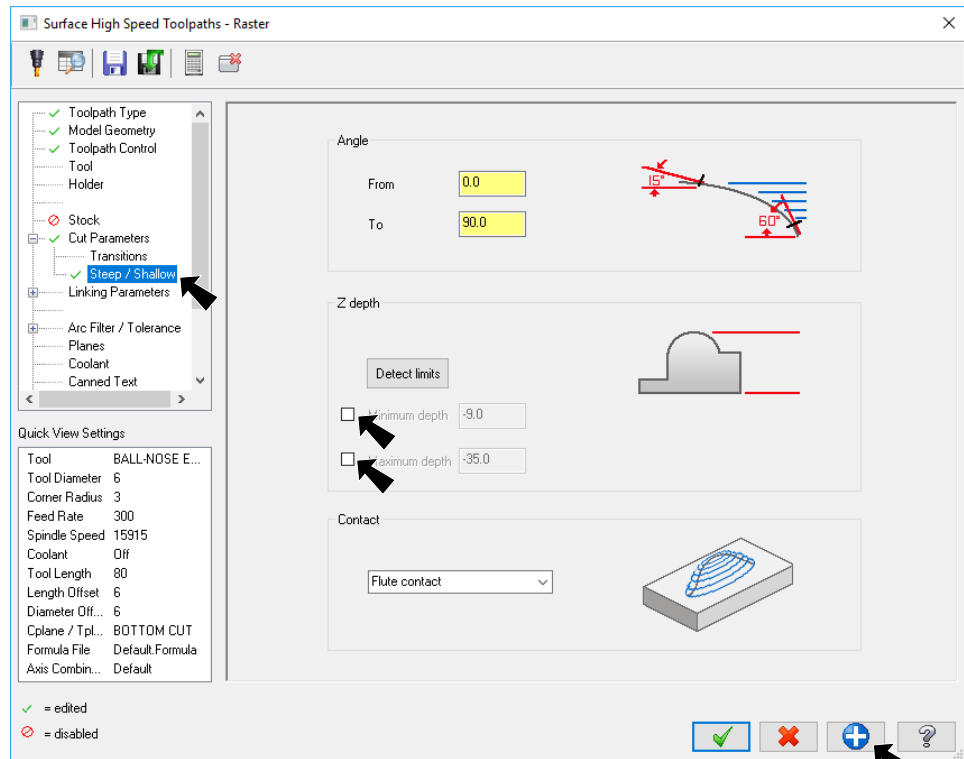
Step 15. Click **OK** in Raster dialog box.



Step 16. Save **(Ctrl-S)**.



**Fig. 48**



**Fig. 49**

## G. Verify Wheel Shells.

Step 1. In the Toolpaths Manager, click **Regenerate all selected operations**



, Fig. 50.

Step 2. Click **Toolpath Group-1** to select all **three shell toolpaths**, Fig. 51.

Step 3. Click **Verify**  in the Toolpaths Manager.

Step 4. Click **Play**  (R) in playback bar along bottom of the window.

Step 5. Note **Total Time** to run program (31min 13.32s), Fig. 53.

Step 6. Switch back to Mastercam (Alt-Tab).

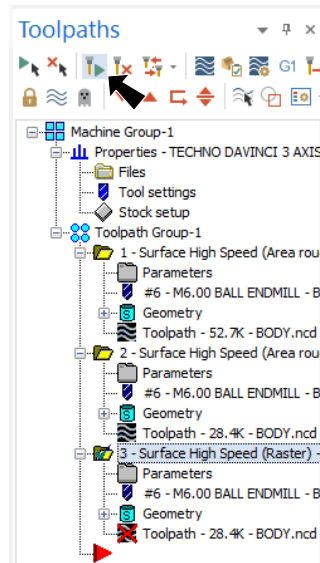


Fig. 50

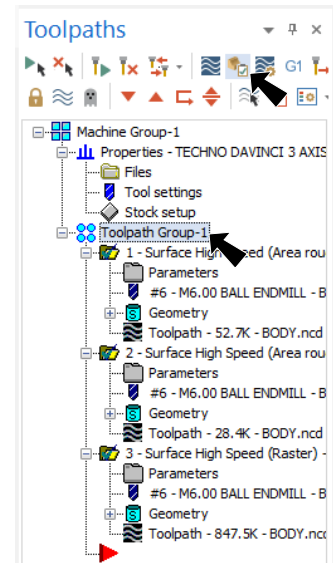


Fig. 51

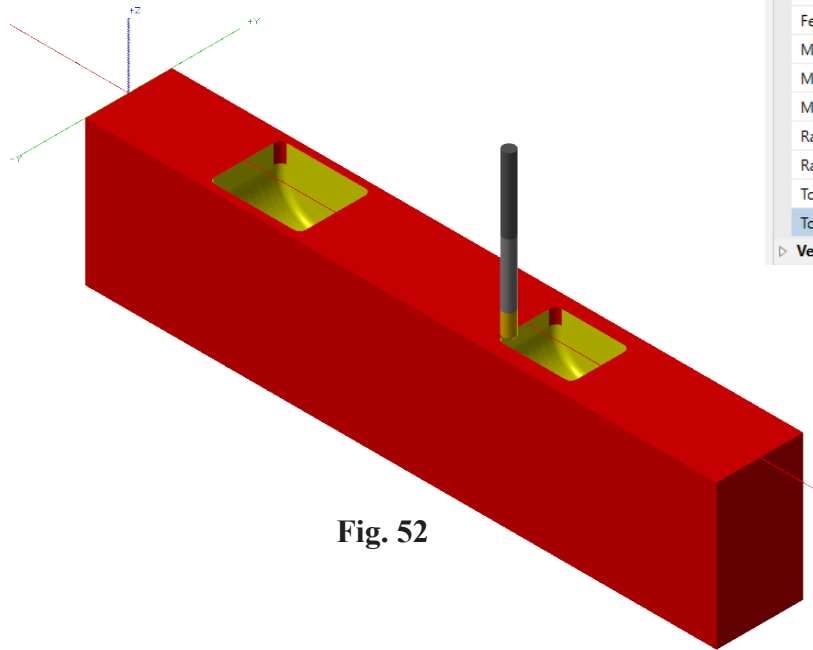


Fig. 52

Move List	
Move Info	
Toolpath Info	
Feed Length	8780.740
Feed Time	31min 13.01s
Min/Max X	59.034 / 224.968
Min/Max Y	-14.250 / 14.250
Min/Max Z	-30.021 / 0.000
Rapid Length	520.639
Rapid Time	0.31s
Total Length	9301.378
Total Time	31min 13.32s
Verbose	

Fig. 53

## H. Rename Toolpath Group WHEEL SHELLS.

Step 1. **Rename Toolpath Group-1 to WHEEL SHELLS** in the Ops Manager. To rename, click and hover over Toolpath Group-1 then key-in **WHEEL SHELLS**, Fig. 54.

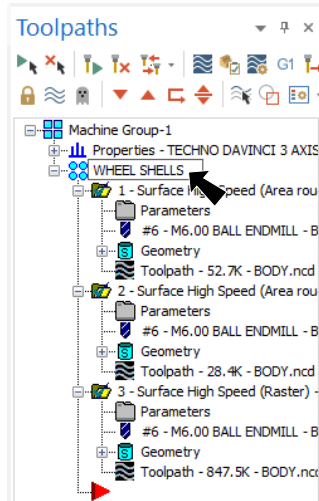


Fig. 54

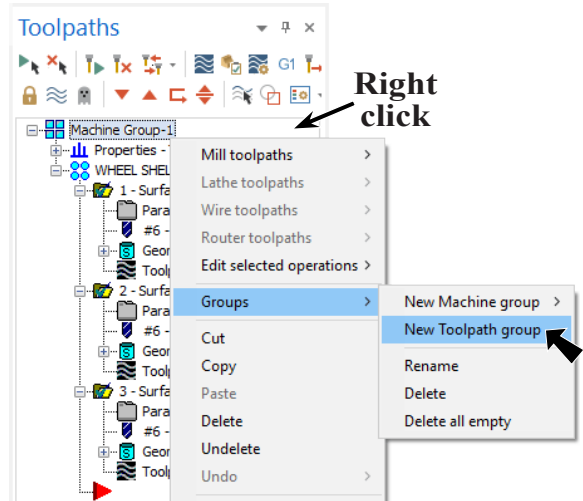


Fig. 55

## I. Insert LEFT CUT Toolpath Group.

Step 1. Insert new Toolpath group. To insert group, **right click Machine Group 1** at the very top of Ops Manager and click **Groups > New Toolpath group**, Fig. 55.

Step 2. Rename new Toolpath Group to **LEFT CUT**. To rename, click and hover over Toolpath Group-1 and key-in **LEFT CUT**, Fig. 56.

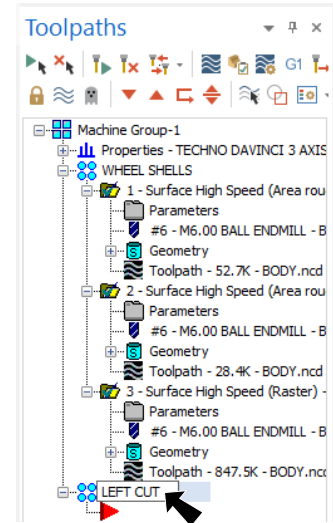



Fig. 56

## J. Switch to LEFT CUT WCS.

Step 1. Display the **Planes Manager**. To display, click **Planes** tab  at the bottom of Ops Manager.

Step 2. In the Planes Manager set:  
 under Name, Fig. 57  
 Click **LEFT CUT**  
 Click **Set All** .

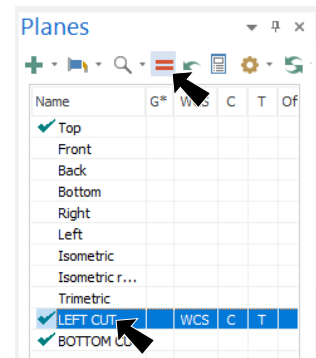



Fig. 57

Step 3. Change to the Isometric View. **Right click** in the graphics window and click  **Isometric (WCS)** (Alt-7).

Step 4. Confirm Left Cut Origin, Fig. 58. Use **F9** to toggle axes.

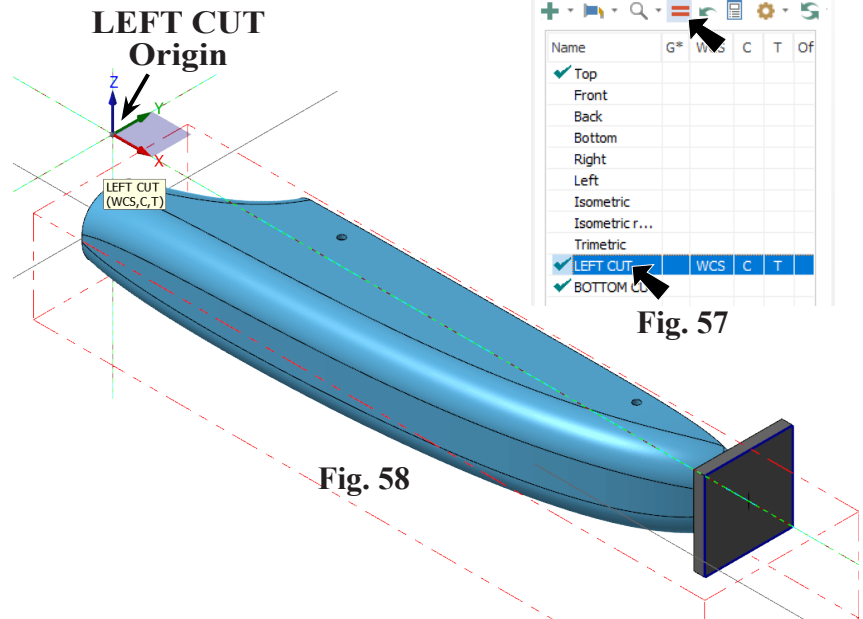


Fig. 58

## K. Left Cut Finish Equal Scallop Toolpath.

Step 1. On the Toolpaths tab **Toolpaths** in the 3D group click **expand gallery** button and click

**Equal Scallop**, Fig. 59.

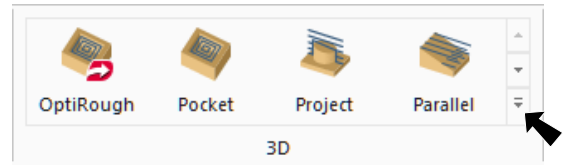
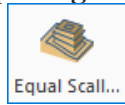


Fig. 59

Step 2. Select **Model Geometry** from the tree control and set:

Under **Machining Geometry** click **Select entities** button Fig. 60.

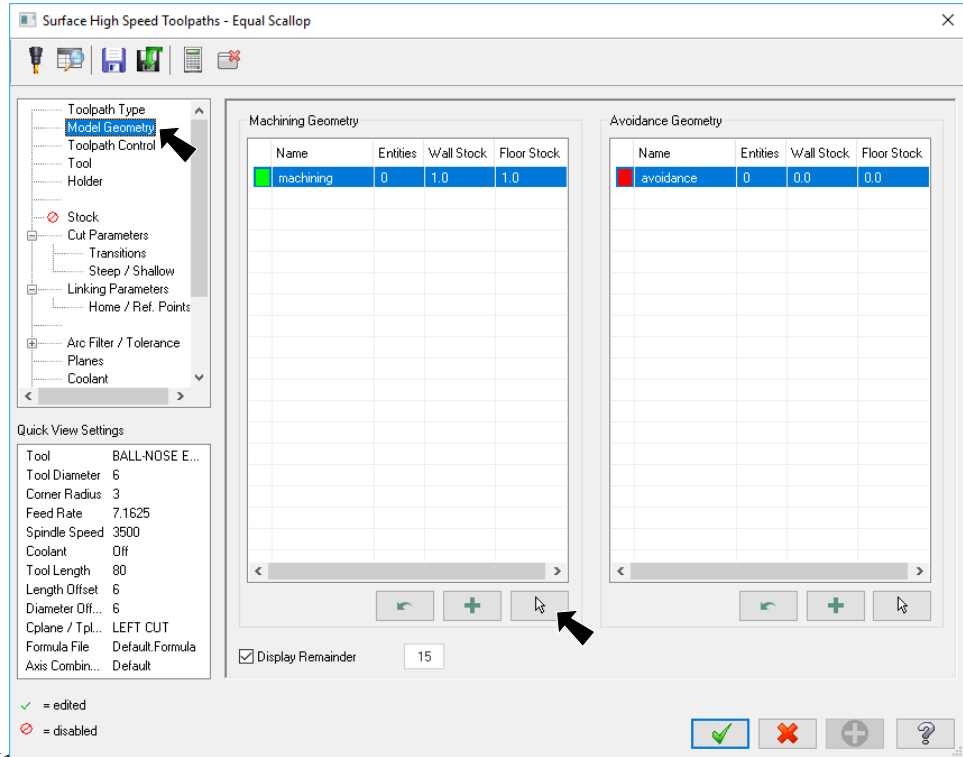


Fig. 60

Step 3. **Triple click the solid car body** to select as machine geometry and click **End Selection**

(ENTER), Fig 61.

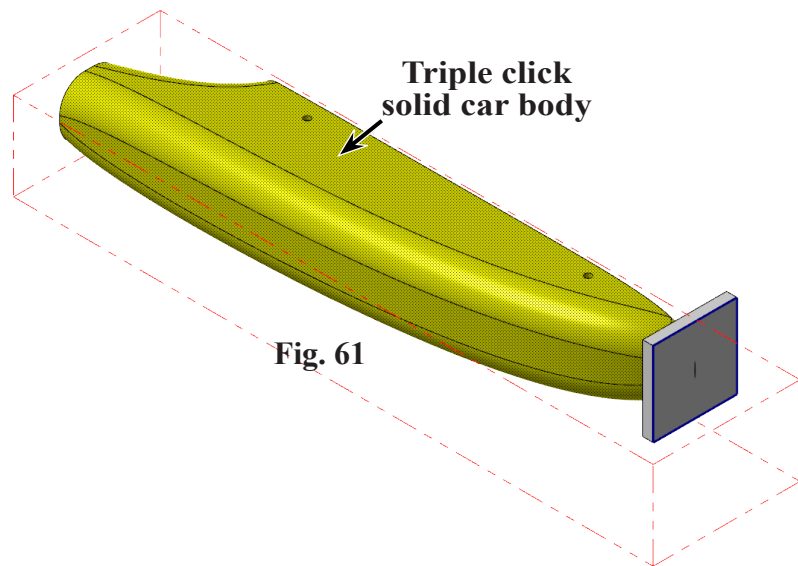
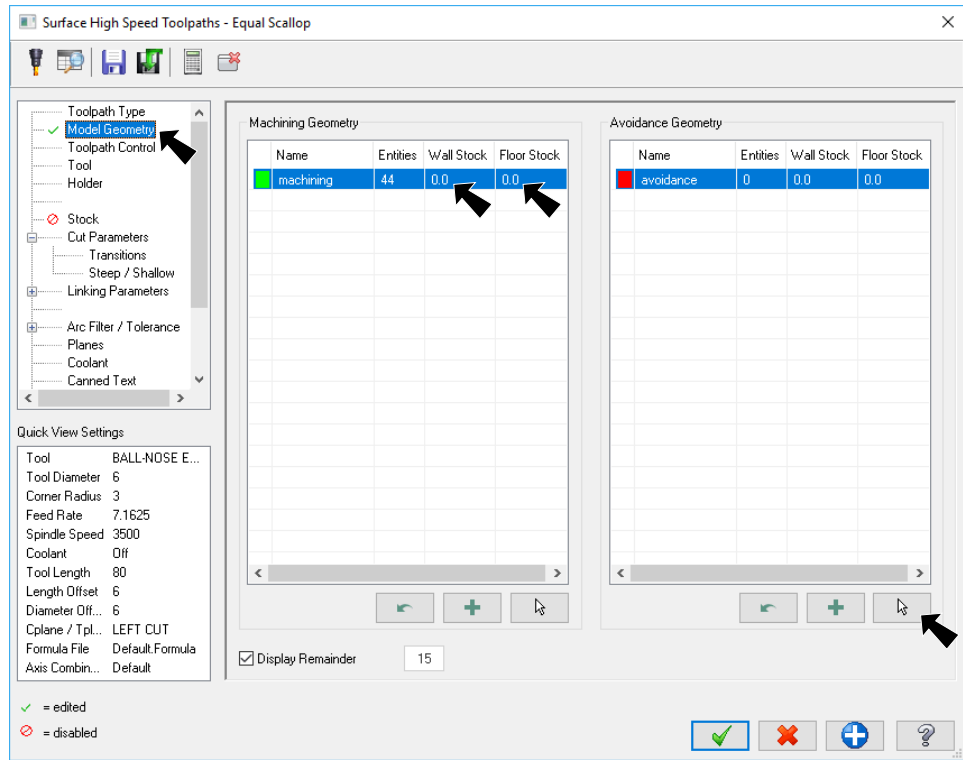


Fig. 61

Step 4. Back in **Model Geometry** page set:

**Wall Stock 0**  
**Floor Stock 0**  
 To set, double click and key-in.

Under **Avoidance Geometry** click **Select entities** button  
**Fig. 62.**

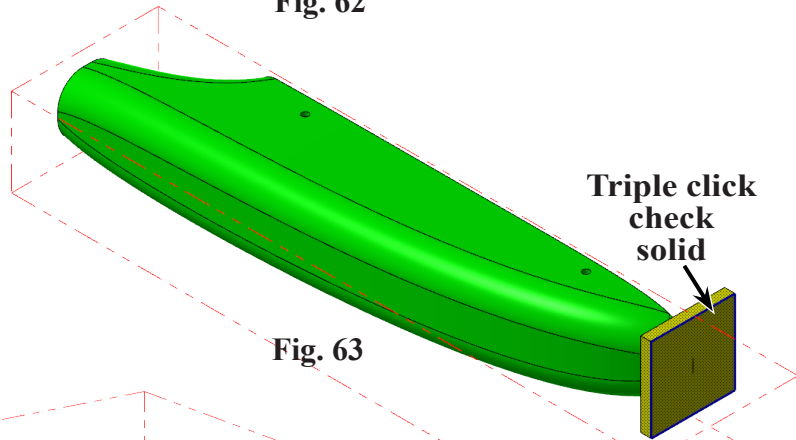


**Fig. 62**

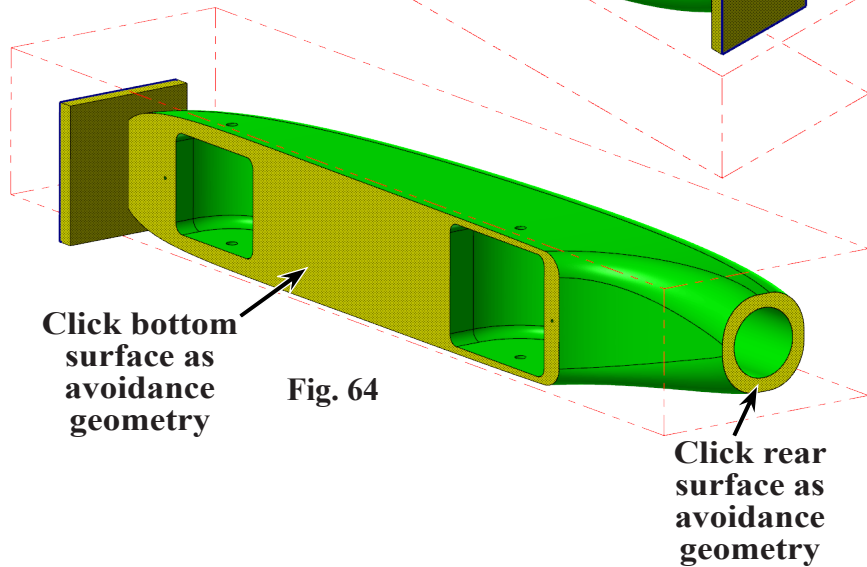
Step 5. **Triple click** the **check body** to select as avoidance geometry, **Fig 63.**

Step 6. Rotate view to view **bottom and rear surfaces**, hold down middle mouse button (wheel) and drag to rotate view, **Fig. 64.**

Step 7. Click **bottom and rear surfaces** to select as avoidance geometry and click **End Selection** (ENTER), **Fig 64.**



**Fig. 63**



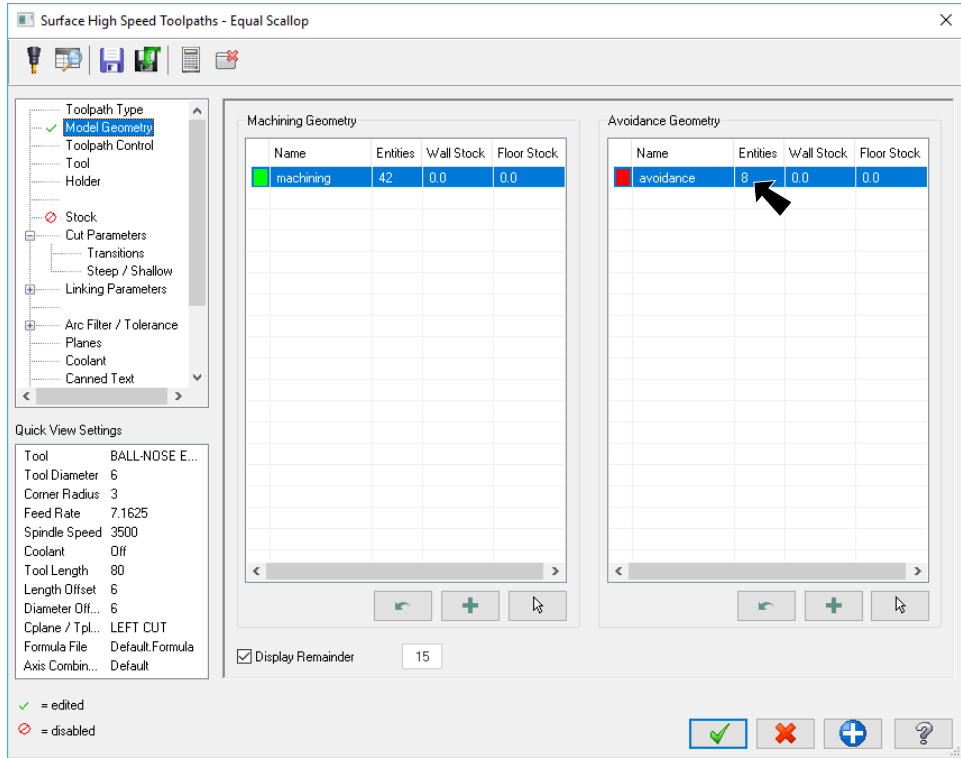
**Fig. 64**

Step 8. Back in **Model Geometry** page set:

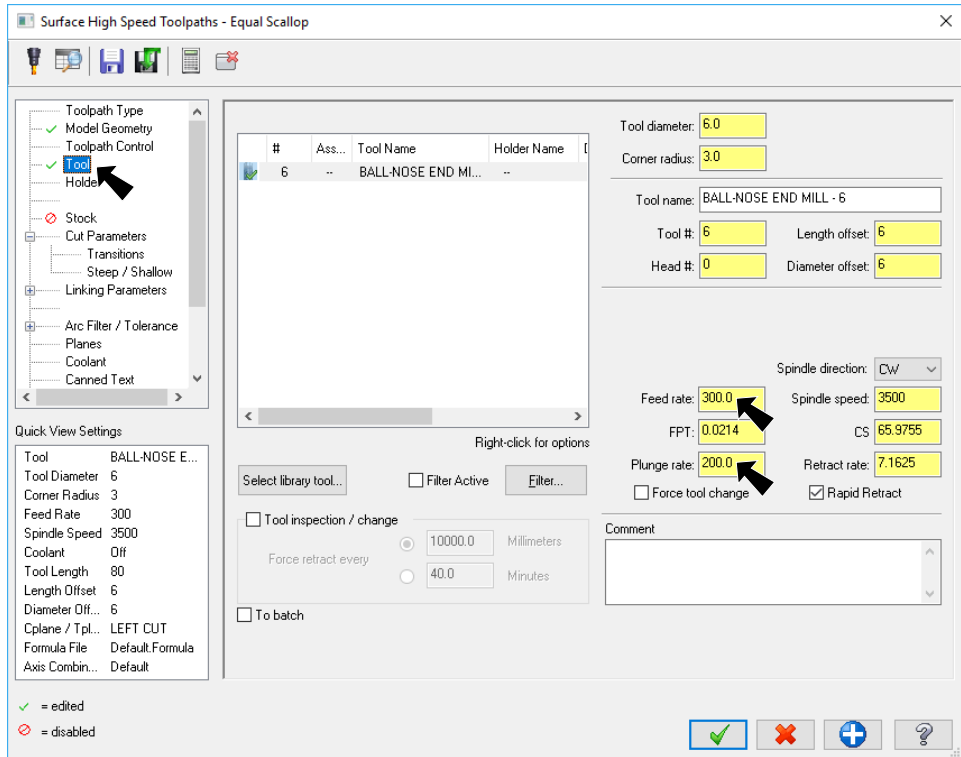
Confirm **8 Avoidance entities**  
**Fig. 65.**

Step 9. Select **Tool** from tree control and set:

**Feed rate 300**  
**Plunge rate 200**  
**Fig. 66.**



**Fig. 65**



**Fig. 66**

Step 10. Select **Cut Parameters** from tree control and set:

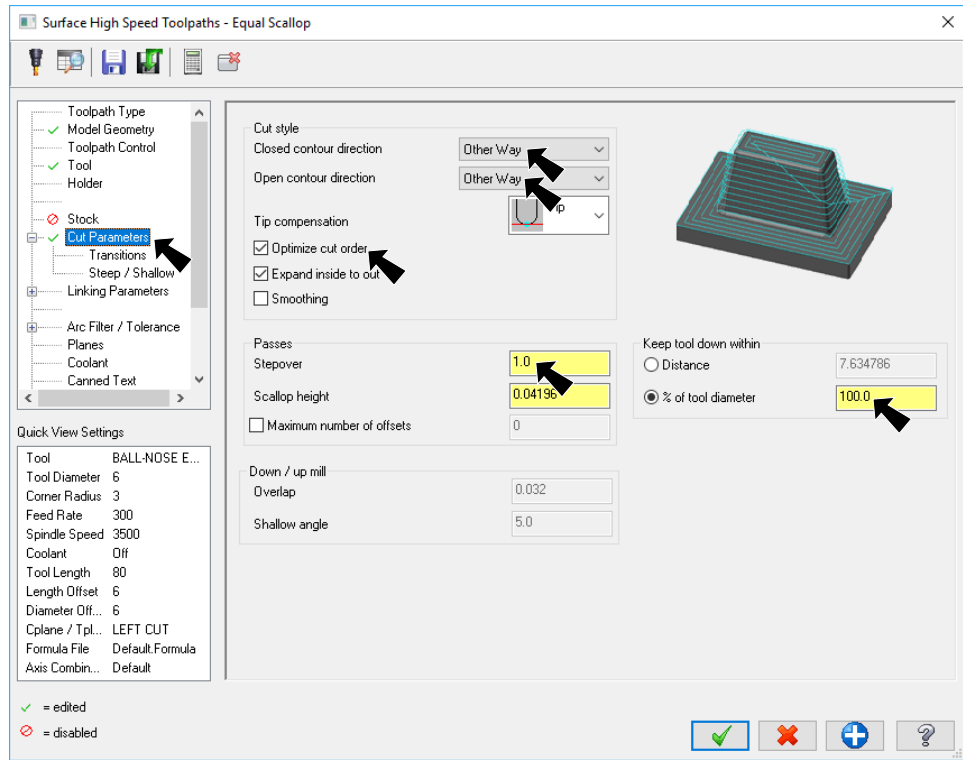
Cut style  
**Both to Other Way**

Check  
**Optimize cut order**

**Stepover 1**

**Keep tool down within 100%**

**Fig. 67.**



**Fig. 67**

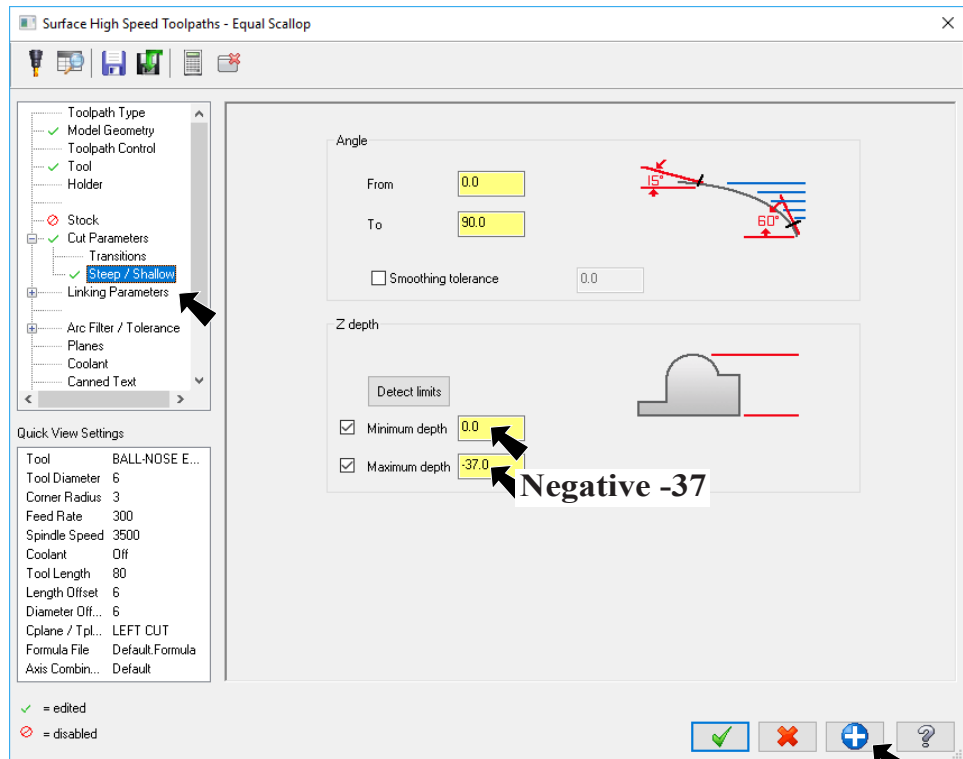
Step 11. Select **Step/ Shallow** from tree control and set:

Check  
**Minimum depth 0**

Check  
**Maximum depth -37**

Click **Apply**

  
**Fig. 68.**



**Fig. 68**

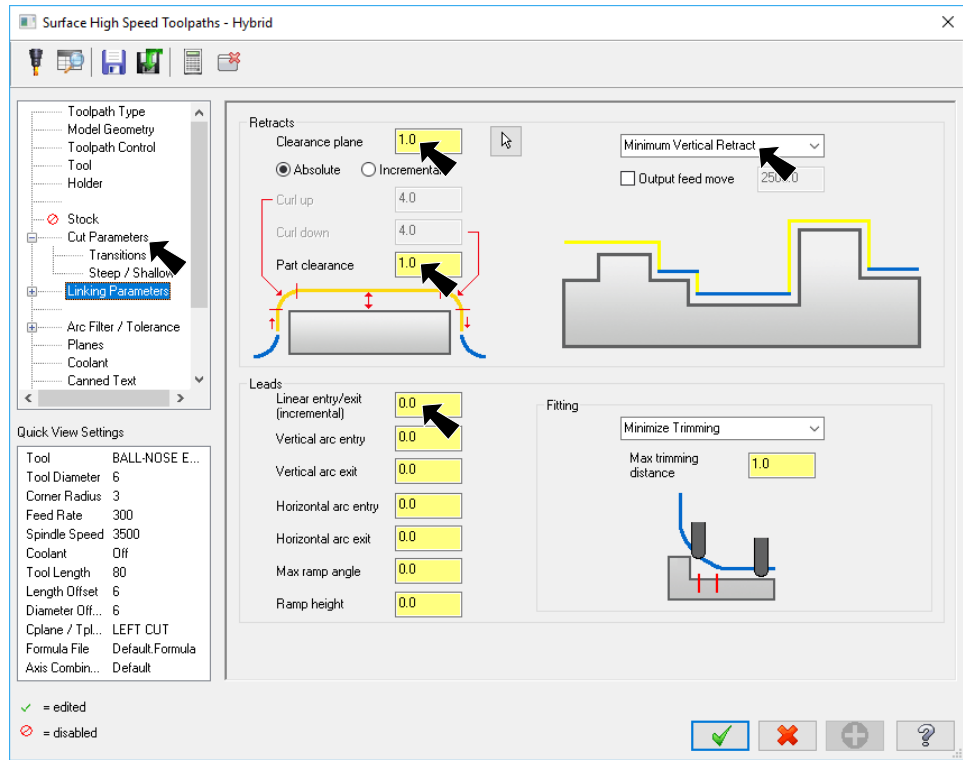
Step 12. Select **Linking Parameters** from tree control and set:

**Clearance plane 1**

Select **Minimum Vertical Retract**

**Part clearance 1**

**All Leads 0**  
**Fig. 69.**



**Fig. 69**

Step 13. Select **Arc Filter/Tolerance** from tree control and set:

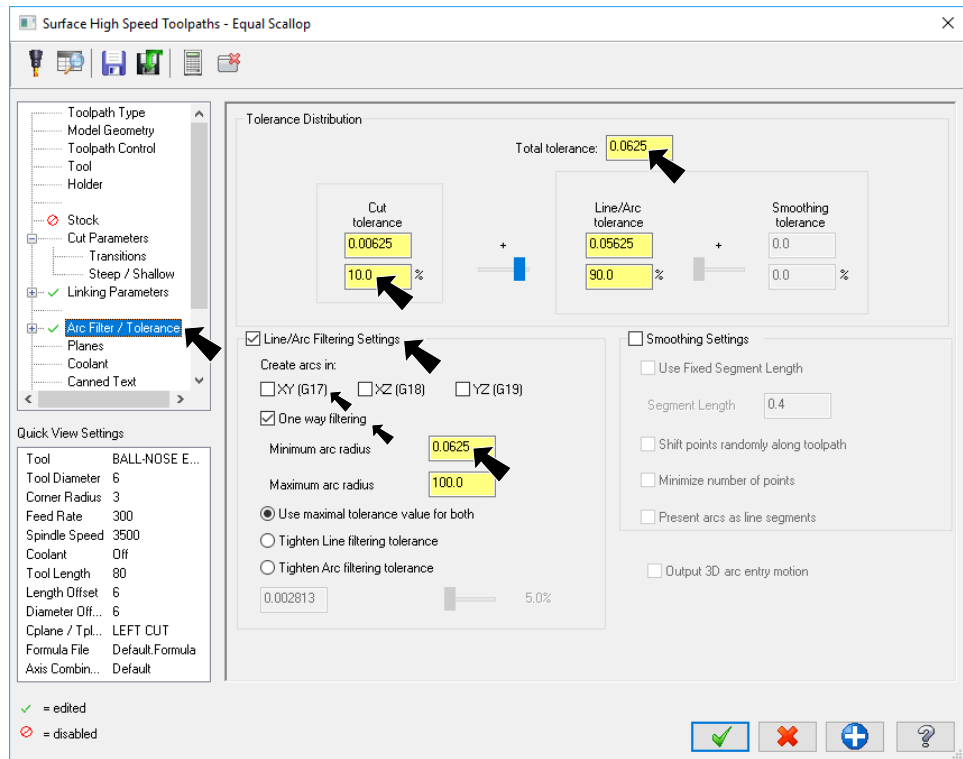
**Total tolerance .0625**

Check **Line/Arc Filtering Settings**

**Uncheck Create arcs in XY**


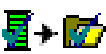

Check **One way filtering**

Set **Minimum arc radius .0625**



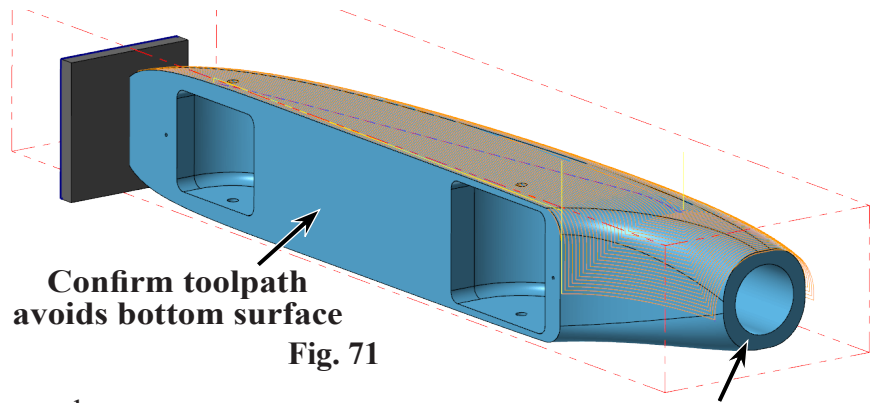
**Fig. 70**


**Cut tolerance 10%**  
**Fig. 70.**


Step 14. Click OK  in Equal Scallop dialog box. Allow Mastercam to calculate toolpath , then Save  (Ctrl-S).

## L. Verify Left Cut.

Step 1. Confirm **toolpath avoids bottom and rear surfaces**, Fig. 71. Use **Alt-T** to toggle on toolpath display. (I changed color of toolpath for clarity.)



Step 2. Change to the Isometric View. **Right click** in the graphics window and click  **Isometric (WCS)** (Alt-7).

Step 3. In the Toolpaths Manager click the **LEFT CUT Toolpath group** to select toolpath and click **Verify** , Fig. 72.

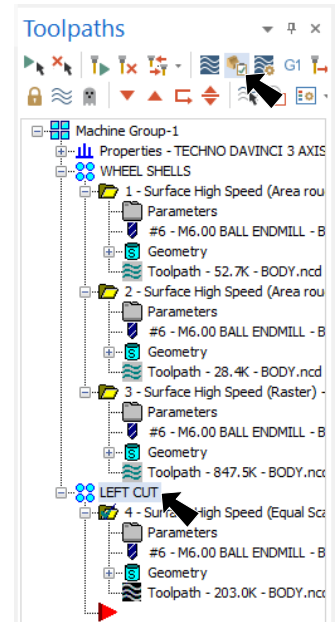
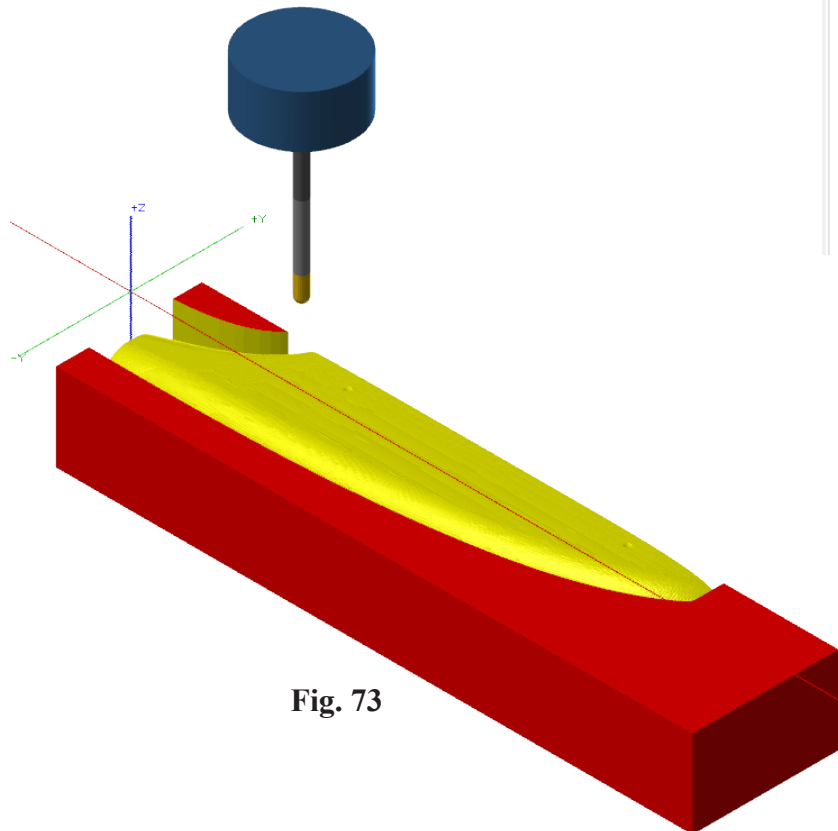


Fig. 72

Step 4. Click **Play**  (R) in playback bar.

Step 5. Note **Total Time** to run program (51min 40.33s), Fig. 74.

Step 6. Switch back to Mastercam (Alt-Tab).



Move List

Move Info

Toolpath Info

Feed Length	15500.914
Feed Time	51min 40.18s
Min/Max X	-0.718 / 246.997
Min/Max Y	-17.284 / 35.477
Min/Max Z	-37.563 / 1.000
Rapid Length	246.786
Rapid Time	0.15s
Total Length	15747.700
<b>Total Time</b>	<b>51min 40.33s</b>

Verbose

Fig. 74

## M. Insert RIGHT CUT Toolpath Group.

Step 1. Insert another **Toolpath group**. To insert group, **right click Machine Group 1** at the very top of Ops Manager and click **Groups > New Toolpath group**, **Fig. 75**.

Step 2. Rename new Toolpath Group **RIGHT CUT**, **Fig. 76**.

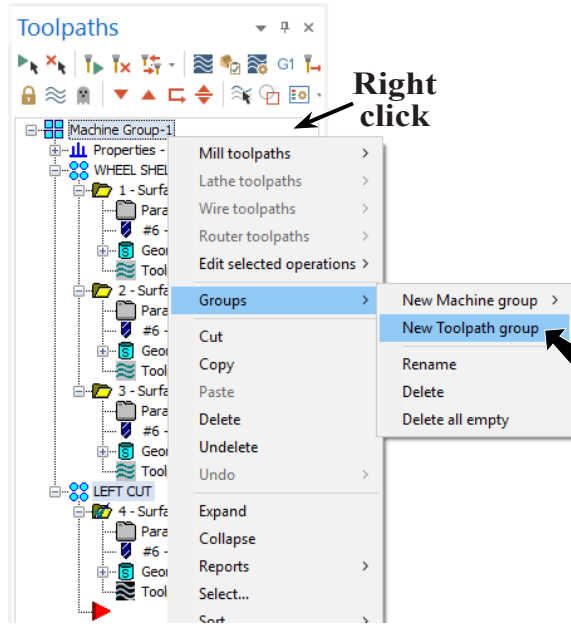


Fig. 75

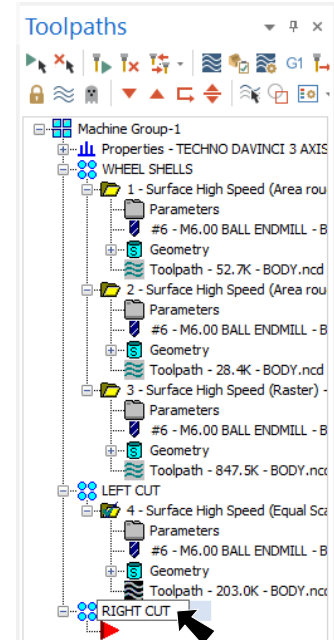
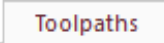
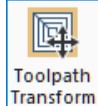


Fig. 76

## N. Mirror LEFT CUT to RIGHT CUT Toolpath.

Step 1. On the Toolpaths tab  click **Toolpath Transform** 

Step 2. In the Transform Operation Parameters dialog box:

under Type, **Fig. 77**

select **Mirror**

under Source

select **NCI**

under Source operations

in **LEFT CUT** toolpath group select **Surface High Speed (Equal Scallop)**.

Step 3. Click the **Mirror** tab at top of dialog box, **Fig. 78**.


under Method

select **Mirror about X axis** 

Click OK



Step 4. Allow Mastercam to calculate tool-path.

Step 5. Save  (Ctrl-S).

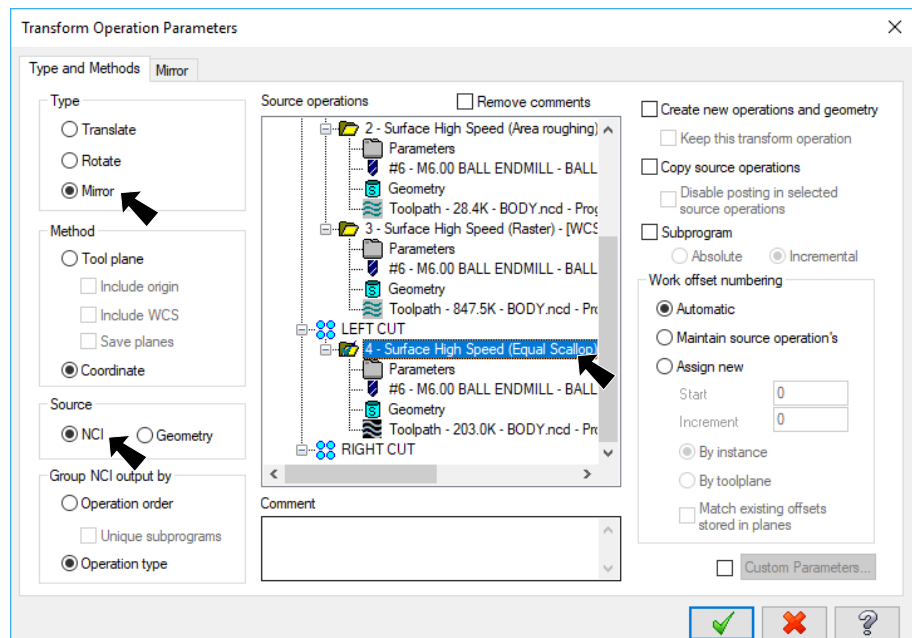


Fig. 77

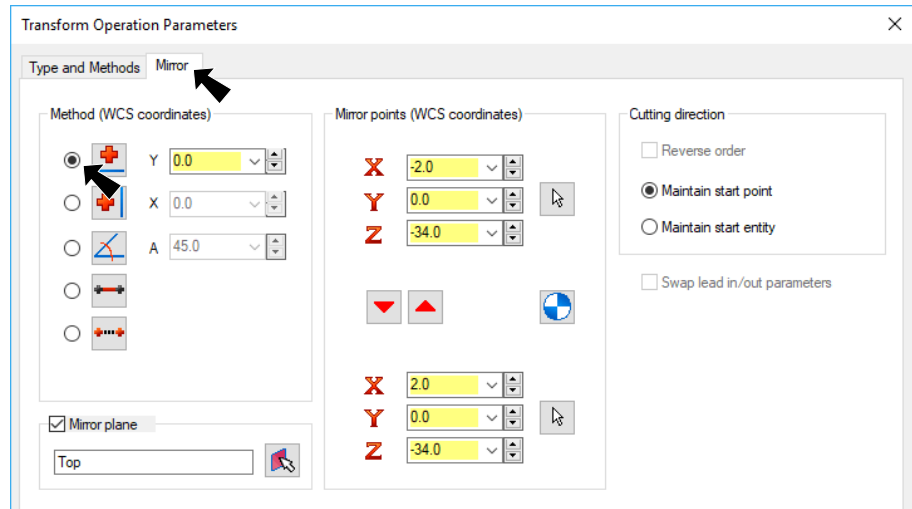




Fig. 78

## 0. Verify Right Cut.

Step 1. In Toolpaths Manager, click the **Transform/Mirror** toolpath, **Fig. 80**.

Step 2. Click **Verify**  in Toolpaths Manager.

Step 3. Click **Play**  (R) in playback bar.

Step 4. Click **Close**  to close Mastercam Simulation.

