Getting Started With

PartWorks 3D

Tutorial 2
2 Sided Machining

Disclaimer

All CNC machines (routing, engraving, and milling) are potentially dangerous and because ShopBot Tools Inc has no control over how the software described in this manual might be used. ShopBot Tools Inc or any associated Resellers cannot accept responsibility for any loss or damage to the work piece, machine or any individual, howsoever caused by misusing the software. Extreme care should always be taken and the output from the software thoroughly checked before sending it to a CNC machine.

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Introduction

Many businesses use their CNC machine for simply cutting out flat letters and shapes from plastic sheet, or engraving standard badges and nameplates, which are all based on simple 2D machining strategies. Vectric PartWorks3D adds another dimension to your CNC machine, allowing it to be used for more interesting and often higher profitable projects that would normally only be possible using expensive CAD/CAM software.

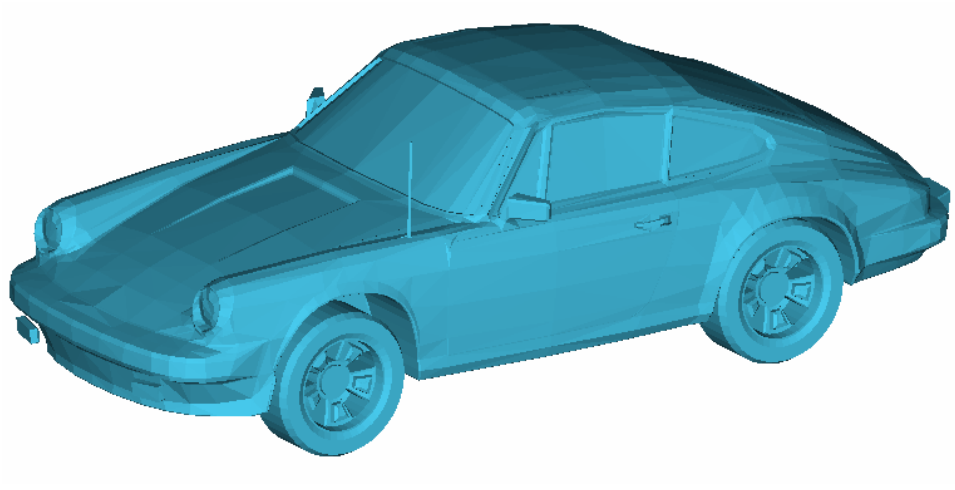
The manual takes you step-by-step through an illustrated tutorial that shows and explains exactly how to use the Software. Tips and tricks have also been included that will help you get the most from your CNC machine.

We hope you enjoy using the software.

What is PartWorks3D?

PartWorks3D has been developed specifically as a toolpath engine for machining 3D models that have previously been designed using another CAD or Graphics design product such as AutoCAD, Rhino3D etc.

The software calculates toolpaths that contain XYZ point data to move a cutter simultaneously in all 3 axes to cut the shape of a 3D model into the material being used.



Typical 3D Model designed using 3D Studio

What the software allows you to do

PartWorks3D can be used for the following applications,

Model making	3D models from foam, plastic, wood etc.
Rapid Prototyping	New product designs / Contract work
Sign making	Adding dimensional elements to signs
Wood Carving	Custom fireplaces, door panels
Engraving	Commemorative Brass plaques
Gifts	Personalised gifts
Stone cutting	Memorials, Commemorative engravings

What file formats can be used?

PartWorks3D will open 3D model files that have been saved in the following formats.

V3D	PartWorks3D and Vectric Cut3D files
STL	STL Mesh files - binary & ascii
V3M	Vector Art 3D files
3DS	3D Studio - binary & ascii
X	DirectX
DXF	AutoCAD 3D DXF
LWO	LightWave
TXT	MaxNC Digital Probe
SBP	ShopBot Digital Probe files
WRL	VRML
OBJ	Wavefront

Notes Although the design systems that are used to write the file formats all claim they output standard file formats, there are often many variations of each type. As a result Vectric cannot guarantee to read all of the file formats. There are many different file translation software products available from the internet that offers the tools needed to modify and convert 3D models into formats that are suitable for use with PartWorks3D.

For general file conversion and editing we recommend a product called AccuTrans 3D from Micromouse Productions. www.micromouse.ca

Getting Help

If you need assistance when using the software there are 5 primary places to look.

1. Program Help File - From the Main menu select Help or Press F1

2. Video Tutorials - These can be downloaded from the Vectric website.

3. User Forum - The Vectric user forum at www.vectric.com/forum is a very useful resource for information on all Vectric products along with materials, cutters etc. and also to share knowledge and experiences.

4. E-mail Support: - The PartWorks 3D Support Team at support@shopbottools.com

5. Frequently Asked Questions (FAQ) - The support area on the Vectric web site at www.vectric.com maintains a list of the most frequently asked questions along with the answers.

Watch the supporting tutorial videos

The video camera icon indicates there is a video file for that particular section of the manual.

Many of the tutorial documents have associated video footage that will make learning to use this software more interesting and enjoyable. These can be downloaded from the web site.

If you experience problems running these files or need assistance please visit the technical support area on the web site and follow the links.

Overview of the interface

The screen area is split into 5 main regions.

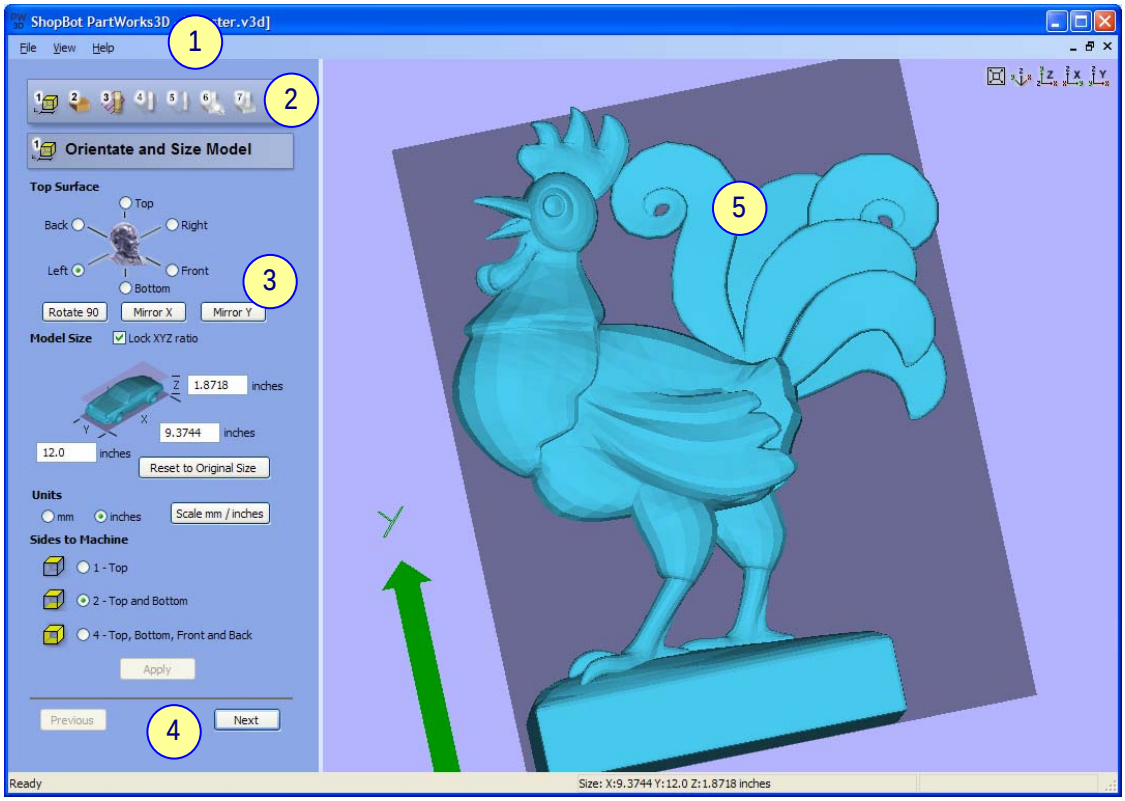
1. The Main Menu bar along the top of the screen provides access to the primary functionality such as File Open / Save plus the Help and License options.

2. The Navigation Toolbar gives easy access to each of the steps when working.

3. The Step-by-Step Forms on the left side of the screen lead you through each of the steps.

4. The Navigation Buttons are used to step forward or backwards through each of the steps.

5. The 3D Window shows the 3D model, calculated toolpaths and the colour shaded machined preview of the model. In the top right corner of the 3D window is the 3D View Menu for selecting pre-set views of the 3D model.



The User Interface

The PartWorks3D Logic

PartWorks3D has been developed to make machining 3D models as simple as possible. The general work flow logic to apply to most jobs is explained in the diagram below.

1
Load a 3D Mesh Model and set the size and orientation for machining

2
Specify the Material Size and Machining limits

3
Optional
Calculate a Roughing Toolpath

4
Calculate a Finishing Toolpath

5
Optional
Calculate a Cut Out Toolpath

6
Preview the job in any material

7
Save the Toolpaths ready for running on the CNC Machine

View Controls

The View Control options available when working in the 3D Windows are,

	3D Twiddle	Click and drag **Left** mouse button in the 3D window
	Zoom	**Right** mouse button – Push / Pull Mouse with Middle Wheel – Push / Pull
	Pan	Click and drag **Right** mouse button + **Ctrl** Click and drag **Right** and **Left** mouse button
	Plan View	Looks directly down the Z axis onto the design in 3D window
	Isometric View	Shows the model in a 3D isometric view in the 3D window

Mouse with Middle Wheel can be used to interactively zoom in / out.

Tutorial 1 2 Sided 3D Machining

We recommend that you watch the **5 minute Video** for this Tutorial before proceeding. The video can be found on the installation CD or downloaded from the web site at www.vectric.com

We estimate that this tutorial should take you approximately **10 minutes** to complete.

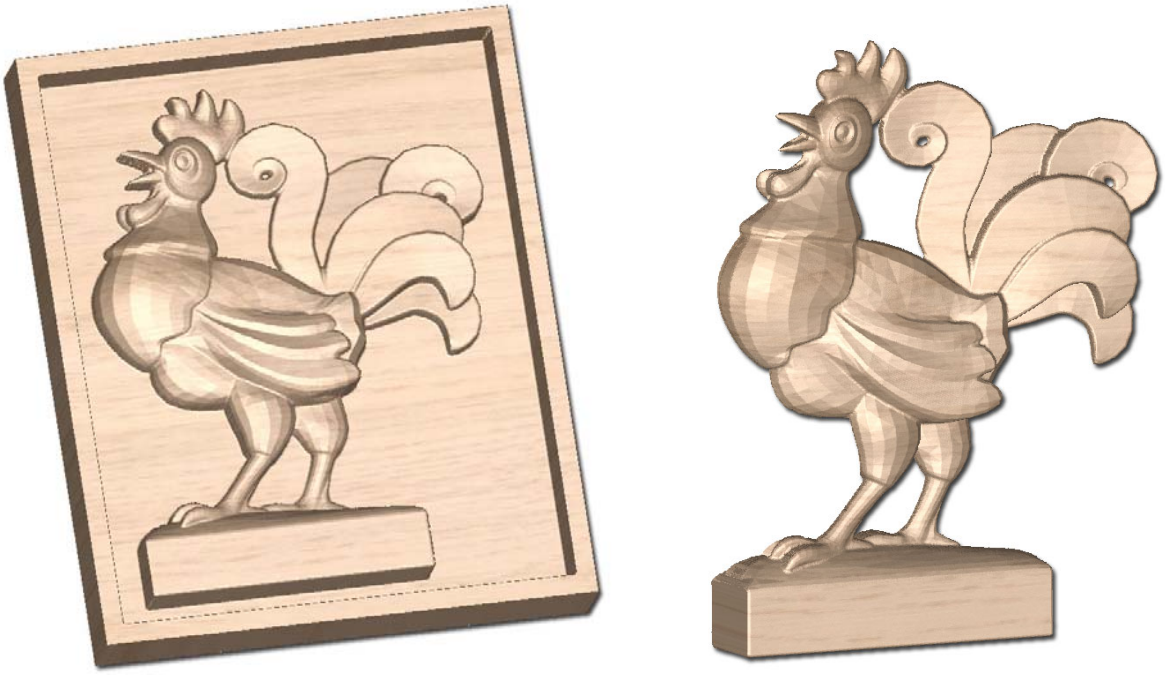
Introduction

This tutorial will show you how to 3D Machine a 3D Rooster into a piece of material that's approximately 11" x 13" x 2" thick using a 1/4" diameter End for roughing and 1/4" Ball nose cuter for finish machining.

Note The 3D model can also be scaled to suit whatever material and cutter sizes you have available.

This 3D model has be designed using 3D Graphics packages such as Rhino, 3D Studio, Silo, Strata, ZForm etc. and then saving the design as a Mesh format that can be opened in the software.

'The Rooster' has been designed by Dale 'Dasch' Shultz and more information about his work can be found on the Vectric Forum.



The finished 3D Rooster in a Picture Frame and machined on 2 sides

The key steps in calculating the toolpaths for this sample are,

1. Open the 3D Model and set the Size
2. Specify the Material dimensions and cutting depths
3. Calculate the Roughing toolpath - Optional
4. Calculate the Finishing toolpath
5. Calculate the Cut Out toolpath - Optional
6. Preview the completed job and Estimate the machining time
7. Save the Toolpaths ready for cutting

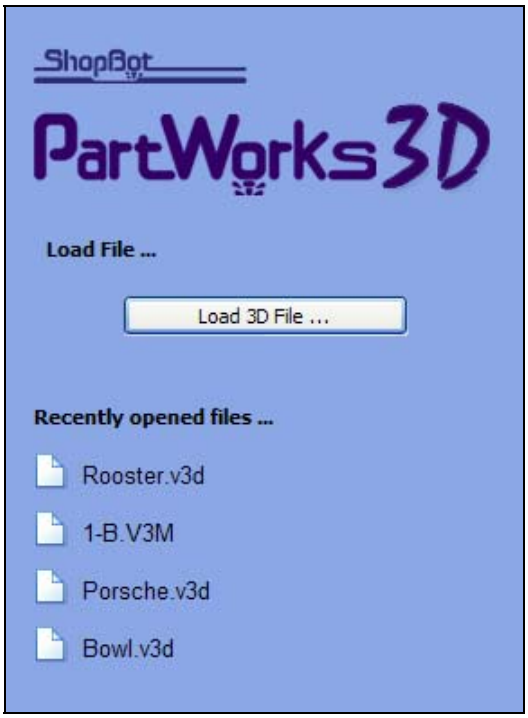
The file required for this tutorial are installed on your PC in the folder,

C:\Program Files\ShopBot\PartWorks3D\Samples\Rooster.v3d

1. Opening the 3D Model

1. On the **front page** click on the **Load 3D File** 

button.
2. Navigate to the folder - **C:\Program Files\ShopBot\PartWorks3D\Samples**
3. Select the file named – **Rooster.v3d** and click the **Open** button



The 3D model will be drawn in the 3D view as shown below.

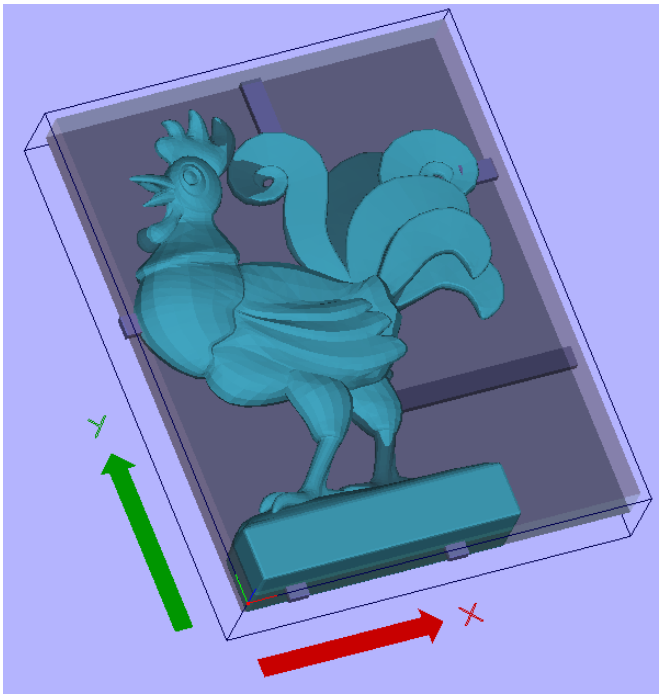
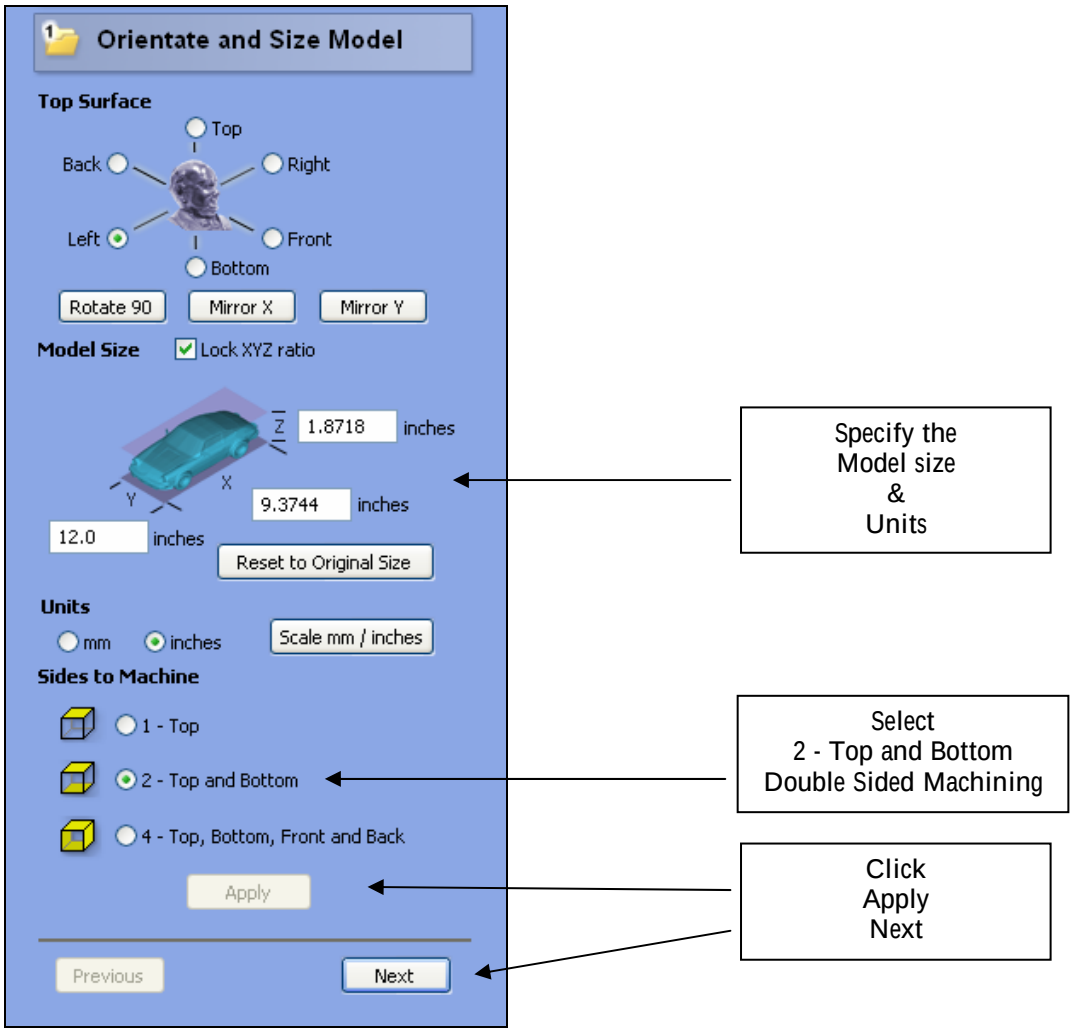


Figure 2 Original 3D Model

Note: Tabs have been added to this model and these can be edited / deleted inside PartWorks3D at Step 2

The arrows showing the X and Y axes that relate to the coordinates on the CNC machine. .The model is automatically positioned looking directly down the Z axis onto the XY plane.

4. Specify the required orientation and size for the model to be machined.



Click Apply Button to set the model size and select the Single Sided Machining option

5. Click the Next button to go to Step 2 - Material Size and Margins

Notes The Model size should be set to fit inside the material you have available.

The Model can be scaled / squashed to fit into a specific material Thickness by,

Set the X Length and Y Height for the model
Uncheck the Lock XYZ ratio option
Enter the required Z thickness to fit the material

Clicking the Reset to Original Size button will return the model back to the original size.

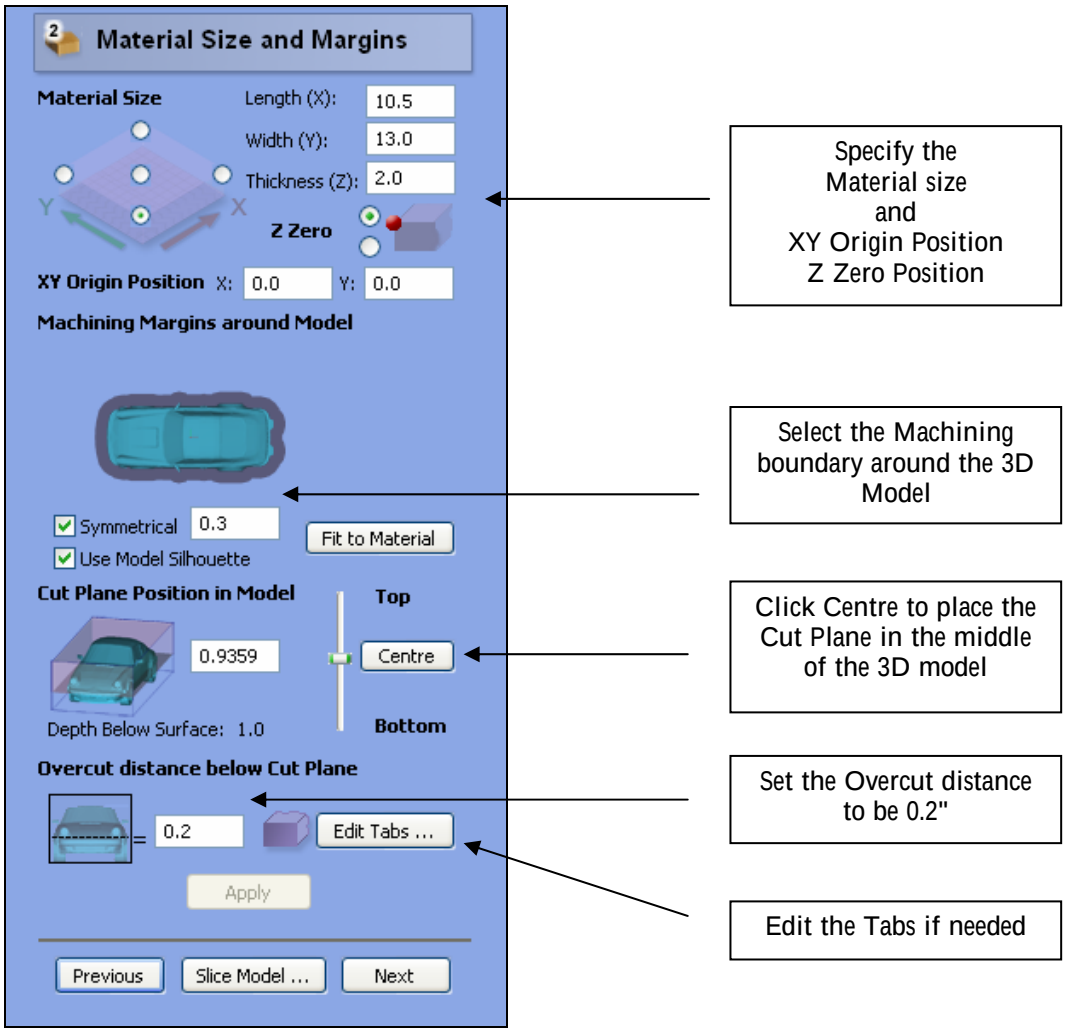
2. Material Size and Margins

Step 2 is where the actual material size and cutting depths are specified. For single sided machining the material dimensions are not critical, but for multiple (2 and 4) sided machining the material must first be machined to an exact size and thickness.

6. Enter the size for the material you are going to machine the design into.

7. Set the X0 Y0 to be the bottom left corner of the material block.

8. Complete the rest of the form as shown below.



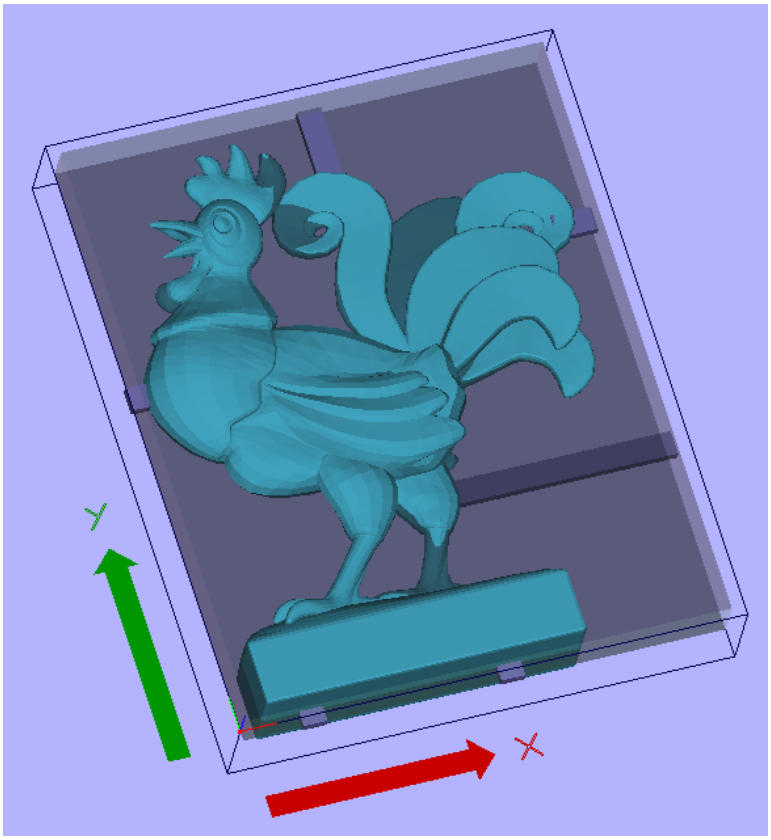
Notes: Click the **Apply button** to update the design settings in the 3D Window

8. Position the **Cut Plane Position** using the vertical slider or click Centre in model.

9. Click the **Apply button** to accept the settings on the form

10. Click the **Next button** to proceed to **Step 3 - Roughing Toolpath**

ⓘ In this example the Tabs have already been added to the design. They can very easily be edited to make them wider or thicker / thinner, deleted or add new tabs.



The Black Wireframe represents the Material Block

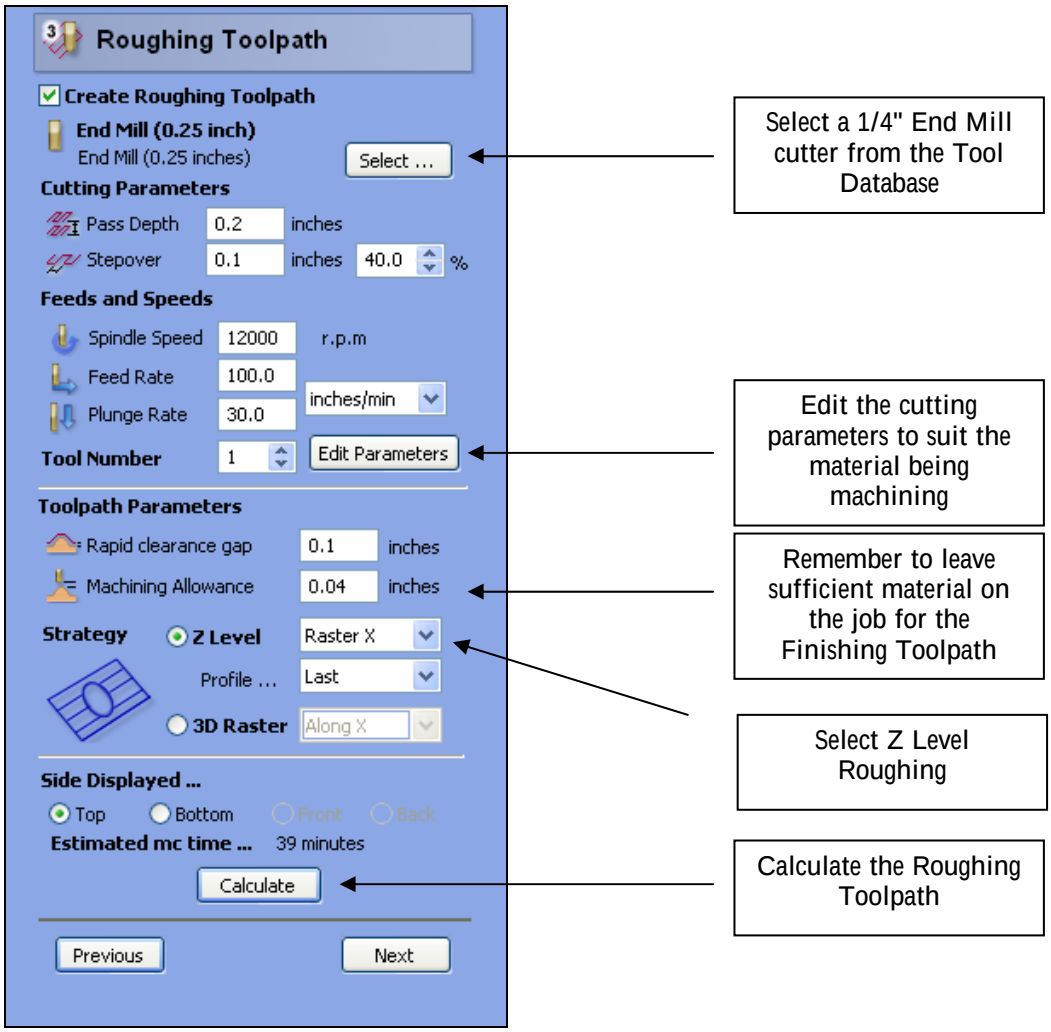
3. Roughing Toolpath

A Roughing Toolpath is optional and will only be needed when machining hard materials and the finishing cutter cannot be used to cut to full depth in a single pass.

11. Click the option to calculate a Roughing Toolpath

12. Click the Select... button and select a suitable cutter for Rough machining the design.

13. Complete the Roughing form as shown below,



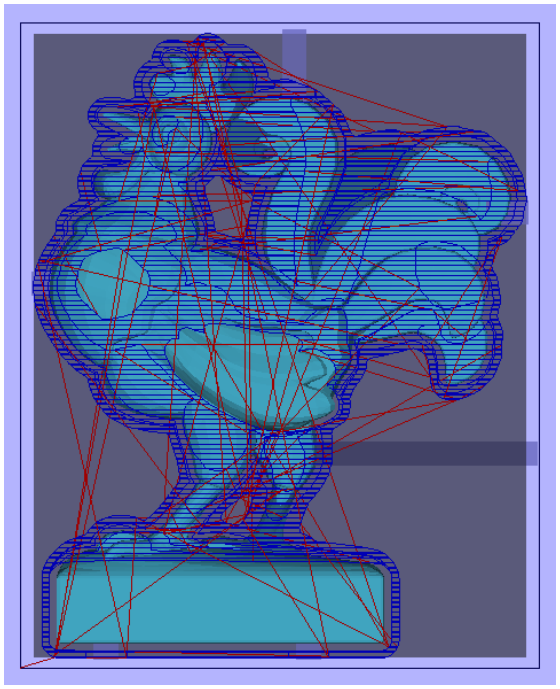
Notes

This model could be Rough and Finish machined using the same 1/4" Ball Nose

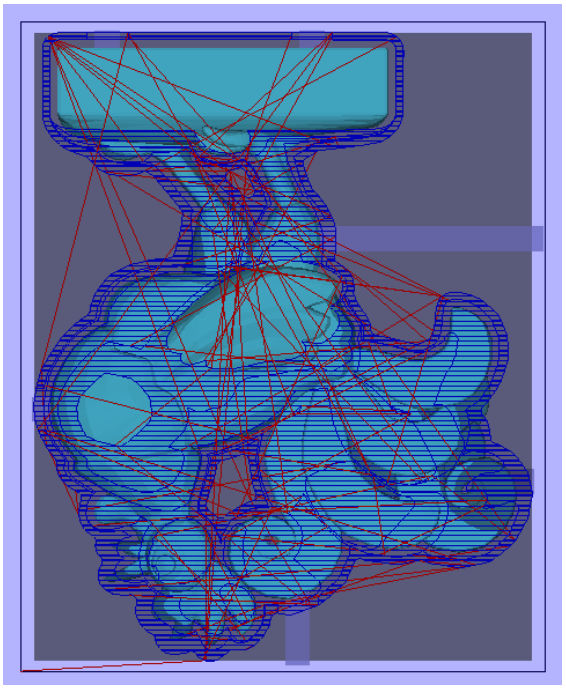
The Cutting parameters and Spindle Speed / Feed rates shown above are for general guidance only and should be set to suit the material you are cutting. Clicking the Edit Parameters button allows the values to be changed. Depending upon what material is being machining, you may wish to run faster or slower and with deeper cuts.

14. Click the Calculate button and the progress bar will run along the bottom of the screen to indicate that the toolpath is being calculated.

15. Click the View Down Z button in the Top Right corner of the 3D window. 



Multiple Z Level Roughing



Bottom view selected

remove

Z Level Roughing will very quickly machine planar passes around the model to the unwanted stock.

Profile passes before or after each roughing pass may not always be necessary, especially when cutting soft materials.

The Red lines show where the cutter will retract and move at rapid feed rate.

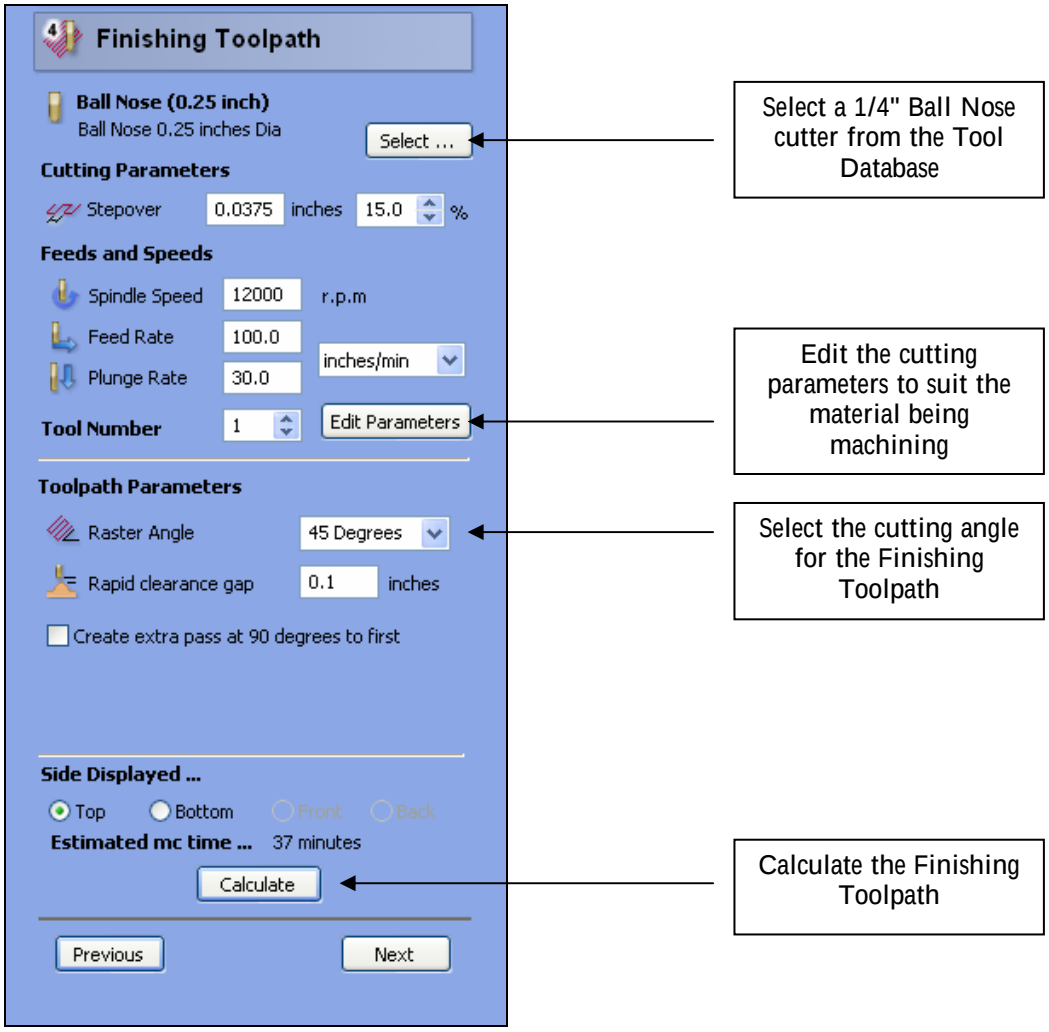
16. Click the Next button to proceed to Step 4 - Finishing Toolpath

4. Finishing Toolpath

The Finishing Toolpath machines the model to the required size using a Ball Nose cutter. A Raster toolpath will run over the specified area to be machined, along the X axis, the Y axis or at 45 degrees.

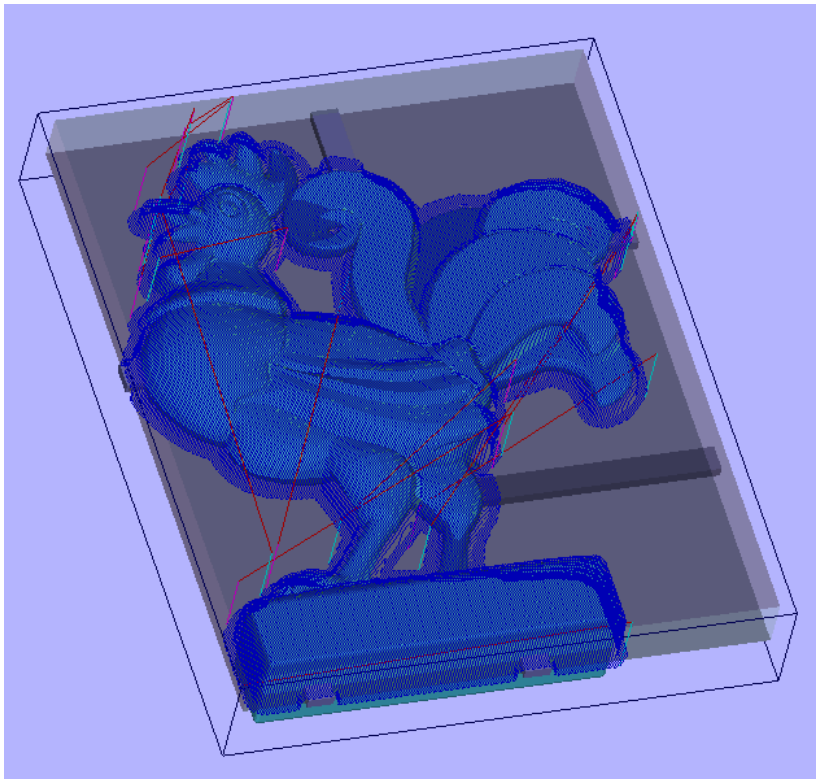
17. Click the Select... button and select a suitable cutter for Finish machining the design

18. Complete the Finishing Toolpath form as shown below,



Notes Cutting at 45 degrees will help produce better surface finish on the vertical walls of the base on the particular model.

19. Click the Calculate button and the progress bar will run along the bottom of the screen to indicate that the toolpath is being calculated.

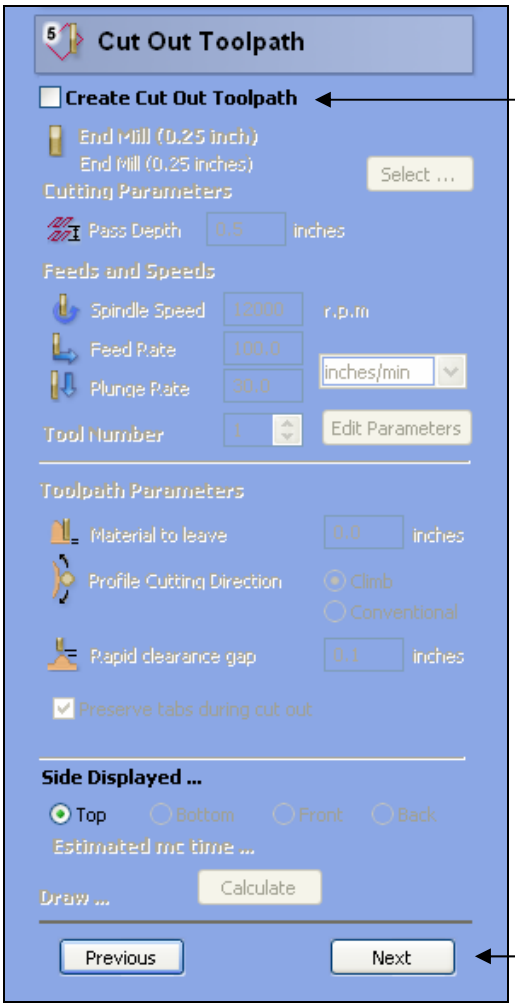


Finishing Toolpath machines to the model boundary

20. Click the **Next button** to proceed to **Step 5 - Cut Out Toolpath**

5. Cut Out Toolpath

In this example the Cut Out Toolpath is not required because the design can be cut from the material manually using a small saw to cut through the Tabs.

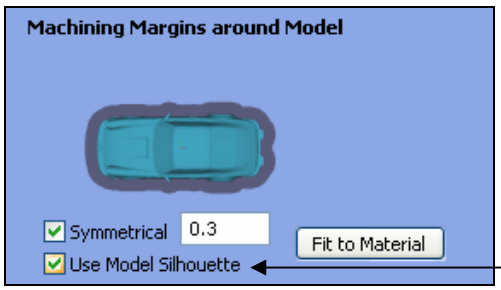


If a Cut Out Toolpath is required then click to switch the form On

Click the Next button to continue

Notes the

To machine around the boundary silhouette of a 3D model first select the option on Material setup form in Step 2.



If a Cut Out Toolpath is required then click to switch the form On

By default the Cut Out Toolpath will machine to the base of the material - Z0.

To leave a 0.020" skin on the bottom of the job — Material to leave = 0.020"

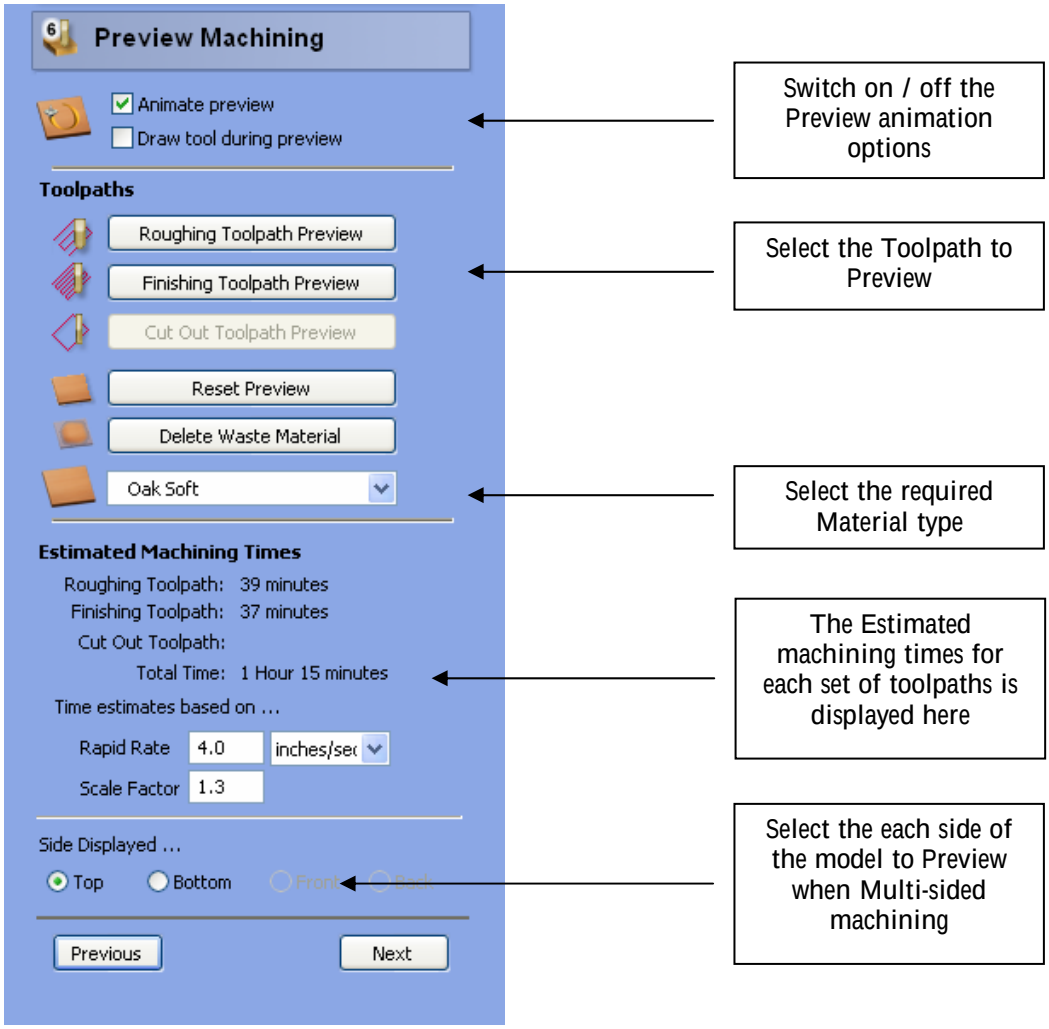
To cut 0.020" through the material — Material to leave = -0.020"

21. Click the Next button to proceed to Step 6 - Preview Toolpaths

6. Preview Toolpaths

After calculating toolpaths the **Preview Machining** form can be used to simulate each of the toolpaths in turn. The material type can also be selected to create realistic screen images.

22. Click the **Roughing Toolpath Preview** button and watch the Preview in the 3D window.



Notes will

If the toolpaths cut all the way through the material the Delete Waste Material button remove the excess material from around the remaining 3D model.

Clicking the **Reset button** returns the Preview model to a solid block.

ⓘ The estimated Machining times are based on the CNC machine running at the actual programmed feed rates. This is often not possible when cutting 3D work because the control systems and hardware work more slowly when computing the 3D moves.

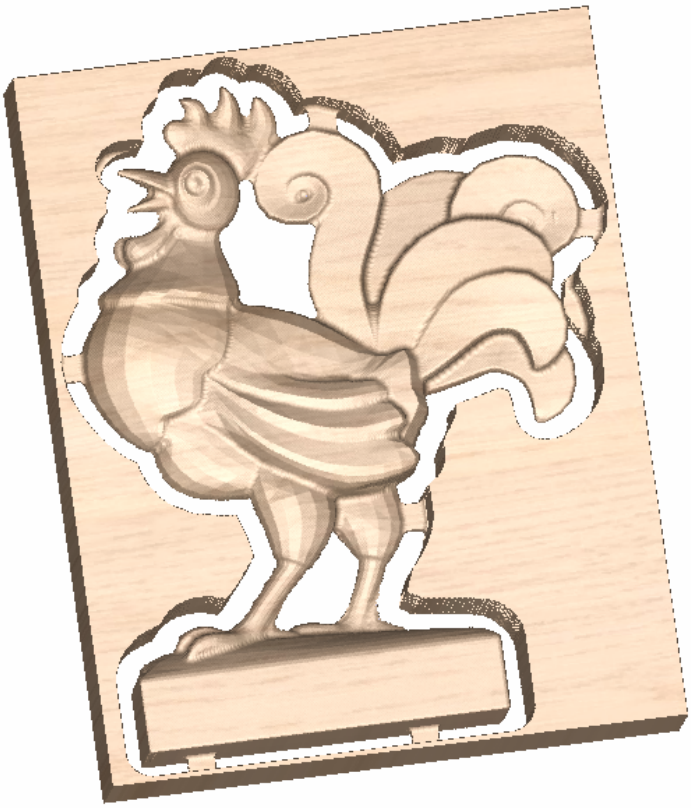
The Scale Factor allows the estimates to be more accurate and this value is remembered by the software for subsequent jobs.

ⓘ The content of the 3D Window can be saved as an image file at any time by selecting from the main menu,

File > Save Shaded Image

23. Click the **Next button** to proceed to Step 7 - Save Toolpaths

Preview of the Z Level Roughing Toolpath



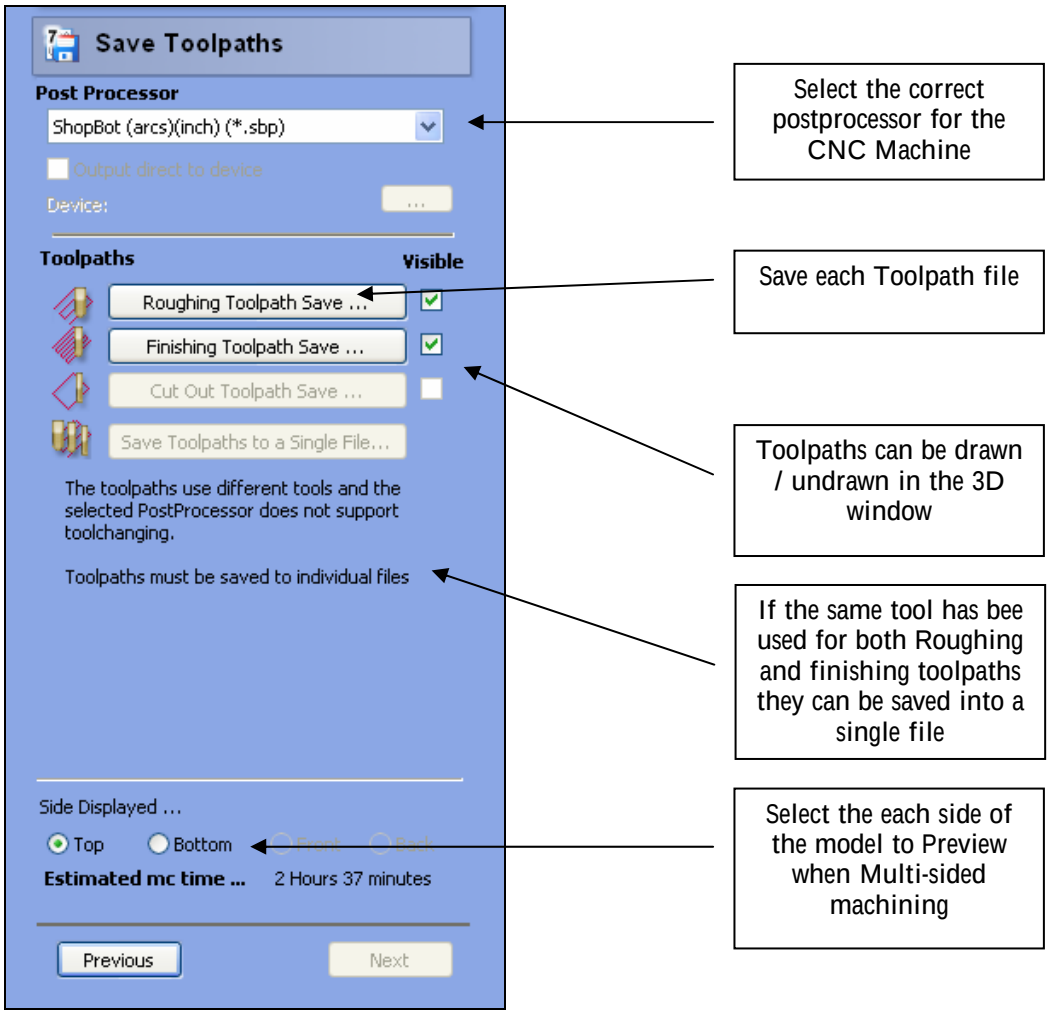
After Preview the Toolpath from both sides

7. Save Toolpaths

The Toolpaths are now ready to be saved using the appropriate postprocessor for your CNC machine.

24. Click the pull-down list of **Postprocessors** and select the one for your machine.

25. Click the **Save Toolpath** button and enter a name to save the toolpath with.



ⓘ Take extreme care to ensure the material and cutter are setup correctly before using the toolpath.

8. Tool Database

The default Tool Database is preloaded with a selection of standard cutter sizes. This database can be modified to add New Tools, plus Copy or Delete existing cutters.

Important The Cutting Parameters should be set for the material you are cutting

Click the Edit button to modify the cutting parameters to match the tooling you are using