QuickCAM 3D - Photo Tutorial
Overview

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This tutorial leads you through the process of converting a flat, two-dimensional picture, such as a bitmap, into a CNC program that will produce a three-dimensional photo.

The design can be machined onto thin plastic sheet - when the design is held in front of a light source, the fully detailed photo is "revealed"...

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QuickCAM 3D - Photo Tutorial
Introduction

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This tutorial is designed to show you how to convert 2D images into 3D designs.

The most common use for this process is producing 3D photographs. QuickCAM automatically converts the chosen 2D image into a 3D model, which in turn is converted into a CNC file. This file can then be transferred to a CNC machine and the design manufactured onto a thin piece of polystyrene sheet, as shown below...

Original 2D image.

to

Machined 3D photograph.

When viewed flat, the manufactured design appears to only contain a minimal level of detail - it just looks like a series of machined lines. However, holding the design up towards a light source reveals the full detail of the image, since the different thicknesses of plastic left after machining, allow different intensities of light to shine through, as shown below...

Machined 3D photograph on lightbox.

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QuickCAM 3D - Photo Tutorial
Before beginning the tutorial

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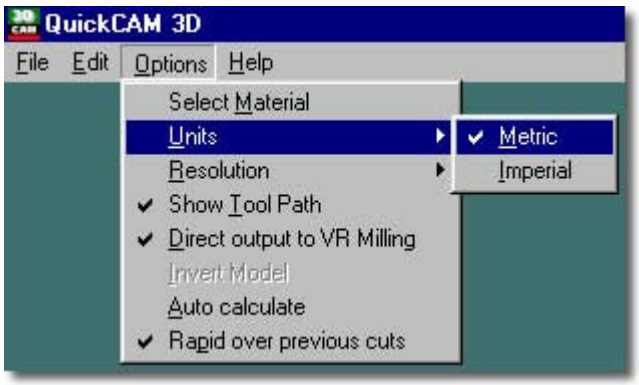
General layout of QuickCAM 3D

QuickCAM 3D opens at the "Select 3D or Image" screen - the first of nine separate stages. On each of these stages, the main QuickCAM 3D is always split into the same two areas:

1. A viewing pane, located on the left side and taking up the remaining two thirds of the main QuickCAM 3D window. This area is used for displaying graphic representations of the 3D model and billet. Currently this area will be blank, since no file is loaded.
2. An information pane, located on the right side and taking up around a third of the main QuickCAM 3D window. This area is used for entering and displaying any data relating to the stage being completed.

Setting the units of measurement

Before beginning the tutorial, set the QuickCAM 3D software to run using metric (millimetre) units. Click the "Options" menu, select "Units", then click the "Metric" text, if necessary, so a tickmark is displayed, as shown below.



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QuickCAM 3D - Photo Tutorial
Stage One - Select Image

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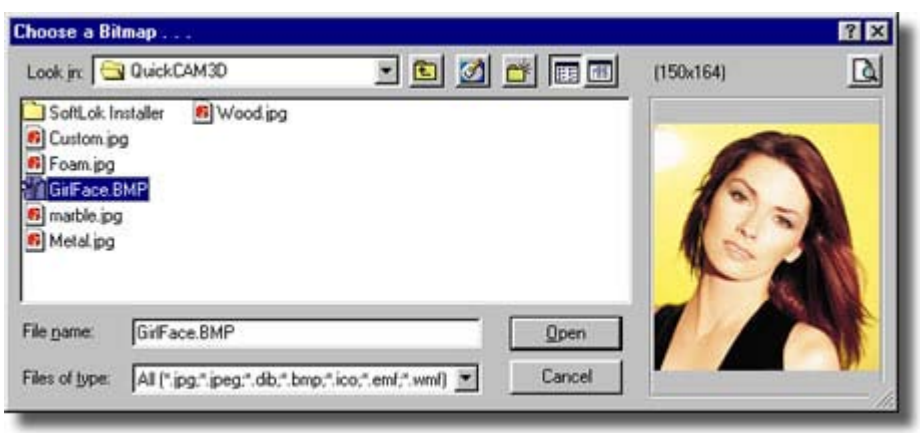
The "Select 3D or Image" stage allows you to load the 2D image file you want to convert.

Locate and load the image

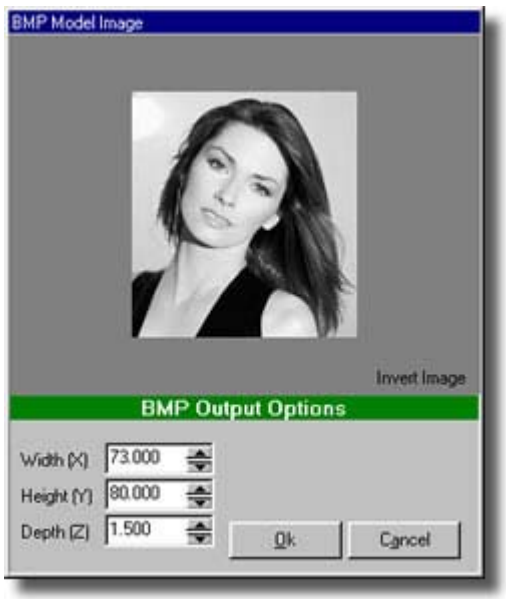
Click the [Image (BMP)] button. The "Choose a Bitmap..." window is displayed, as shown below.



Locate and select the file named "GirlFace.BMP". If QuickCAM 3D was originally installed using the default folders, this can be found at location...
C:\Program Files\Denford\QuickCAM3D
Notice that the image is previewed in the right pane of the "Choose a Bitmap..." window. Click the [Open] button to load the file.

Configure the image size

The "BMP Model Image" window is now displayed, as shown below. Notice that the original colour image has been automatically converted into greyscale. QuickCAM 3D assigns cutting depths to your image, according to the tonal values.

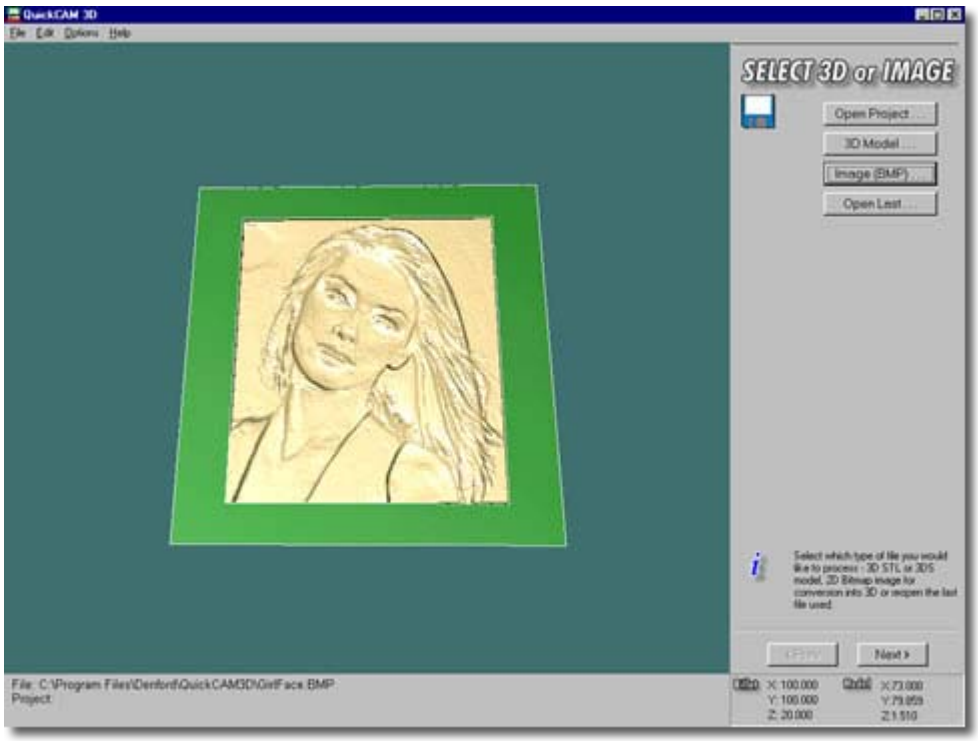


Dark (black) areas of the image will have zero depth. Light (white) areas of the image will have maximum cutting depth. Enter a maximum cutting depth of 1.500mm into the "Depth (Z)" dialogue box, using either the on-screen [Up] and [Down] buttons or by overtyping the original value.

We will use a 2mm thickness billet for this design. When machined, white areas of the design will be left with a thickness of 0.5mm - sufficient for light to shine through on the finished part...

Enter a value of 73.000mm into the "Width (X)" dialogue box. Notice that the "Height (Y)" value automatically changes to 80.000mm to keep the image in proportion.

Click the [Ok] button. The image is loaded into the viewing pane of the main QuickCAM 3D window. Notice that the image has now been converted into a yellow 3D model. Your QuickCAM 3D window should look something like the example shown below.



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QuickCAM 3D - Photo Tutorial
Stage Two - Orientate Model

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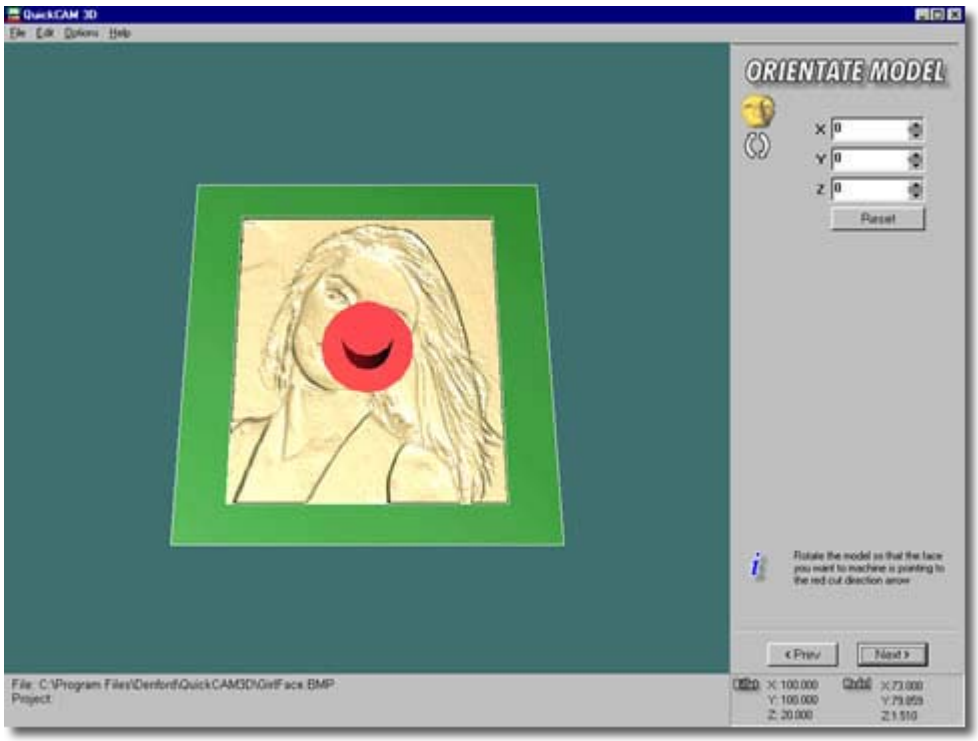
The "Orientate Model" stage allows you to set how the 3D model will be positioned relative to the working area of the CNC machine. Imagine the left pane as the view through the front window of your CNC machine.

Manipulating the view

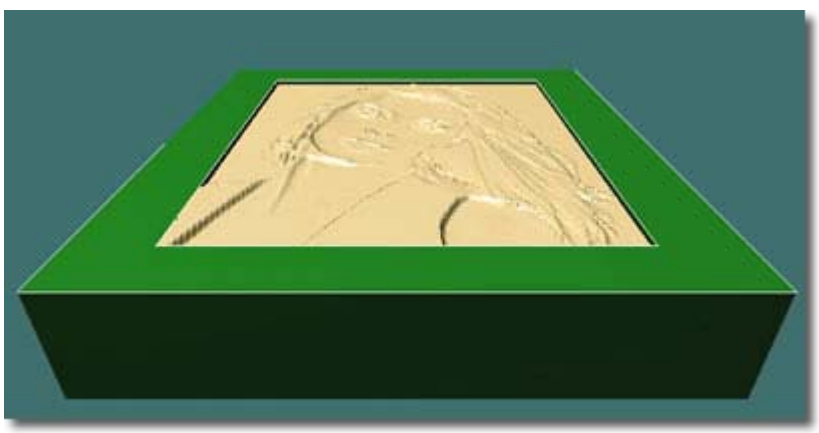
Change your view of the 3D model by zooming in and adding a bit more perspective, so you can see the red arrow pointing down. The red arrow represents the direction that the cutter will approach the billet, or in other words, the Z axis of the CNC machine. At the moment, you can't fully see the red arrow, since you are viewing directly down onto the 3D model, as shown below.



You can see the red arrow more clearly by manipulating your view of the 3D model, as described below.

To zoom in...
Using your mouse, right click on the 3D model and continuing to hold the right mouse button down, move the cursor upwards. This enlarges the view of the 3D model. Moving the cursor down will make the 3D model smaller. Size the 3D model to fit the viewing pane.

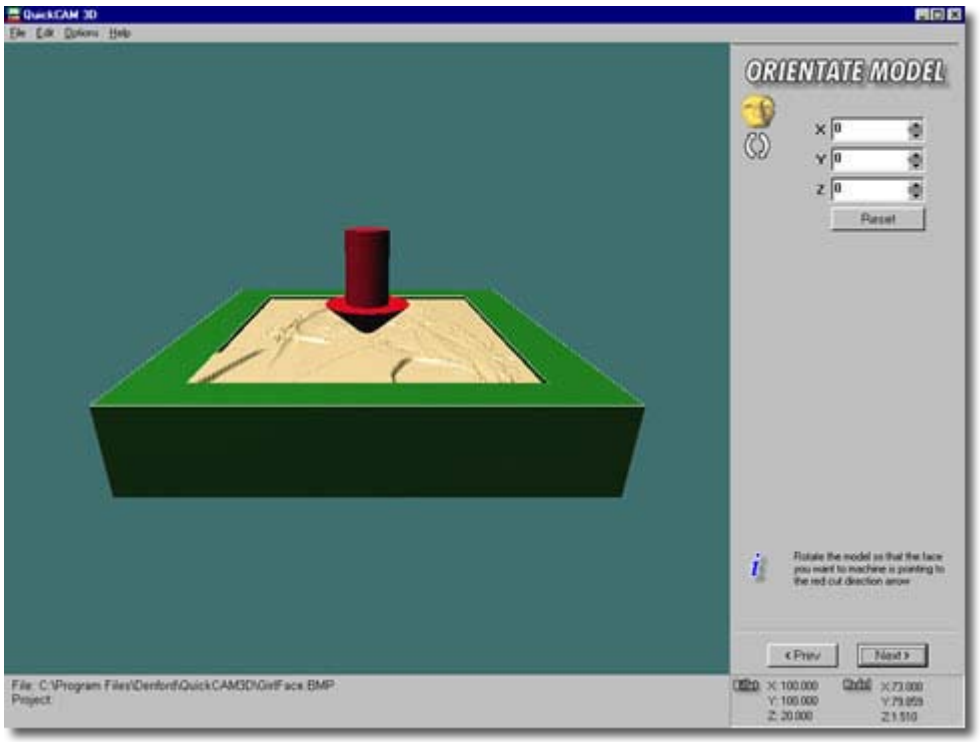
To add perspective...
You can also tilt the 3D model front to back and left to right. Using your mouse, left click on the 3D model. Continuing to hold the left mouse button down, move the cursor upwards. This tilts the back edge of the 3D model down. Moving the cursor down will tilt the front edge of the 3D model. Moving the the cursor left or right will tilt down the left or right edges of the 3D model.



Manoeuvre the 3D model so you can clearly see the front edge, as shown above. Notice that the lighter toned areas of the photo have a deeper cutting depth than the darker areas, as you would expect.
Tip: If you're unsure whether you needed to invert the tones in your original image, this is a good way of checking.

Now manoeuvre your view so you can see the front edge but a little more of the top surface of the 3D model.

Your QuickCAM 3D window should look something like the example shown below.



Setting the orientation of the 3D model

In this tutorial, you want the machinable part of the design (ie, the surface of the photo) orientated upwards and the bottom edge of the photo pointing towards yourself. The red arrow must be pointing down - this represents the cutting tool.

You don't need to enter any new orientation values, since the 3D model is correctly positioned with "X", "Y" and "Z" set to 0º.

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QuickCAM 3D - Photo Tutorial
Stage Three - Billet Definition

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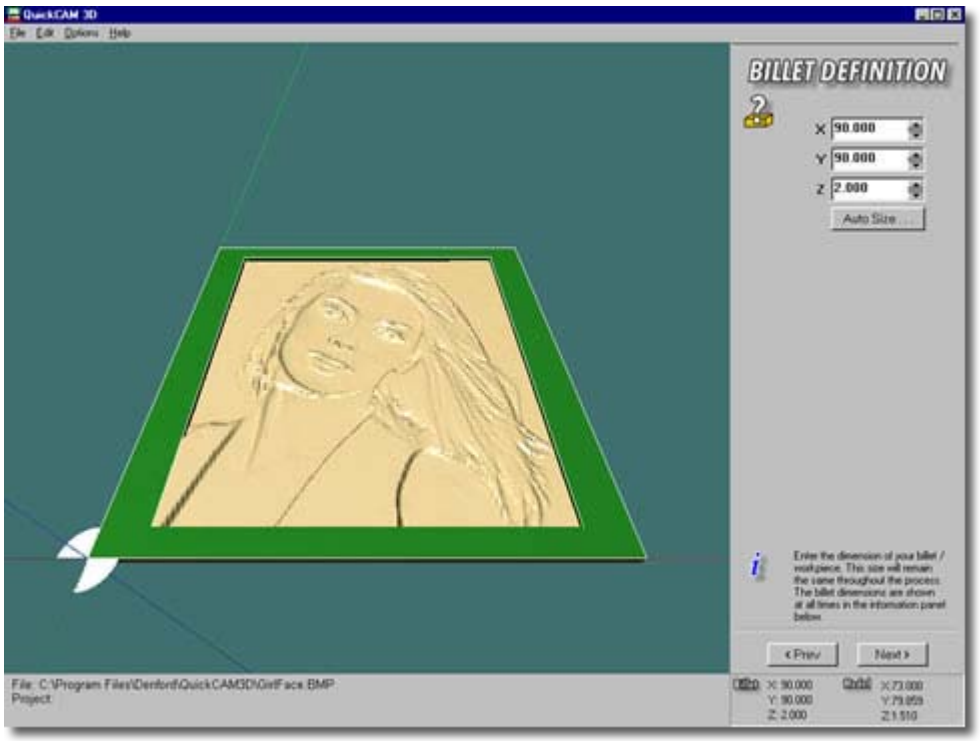
The "Billet Definition" stage allows you to set the size of the billet - the material used for machining the final design.



Entering billet sizes

Enter a value of 90.000mm into the "X" dialogue box. This is the length of the billet - parallel to the front edge of the photo. As you enter values, the billet is drawn using purple lines around the 3D model.

Enter a value of 90.000mm into the "Y" dialogue box. This is the width of the billet - parallel to the side edges of the photo.

Enter a value of 2.000mm into the "Z" dialogue box. This is the thickness of the billet. Remember that the 3D model has a maximum cutting depth of 1.5mm, so at the deepest parts of the design, 0.5mm should be left unmachined.

Using the dimensions data panel

Notice that both the billet and 3D model dimensions are listed in a data panel, located in the bottom right-hand corner of the main QuickCAM 3D window. The values in this panel should read as indicated below.

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Stage Four - Position & Size

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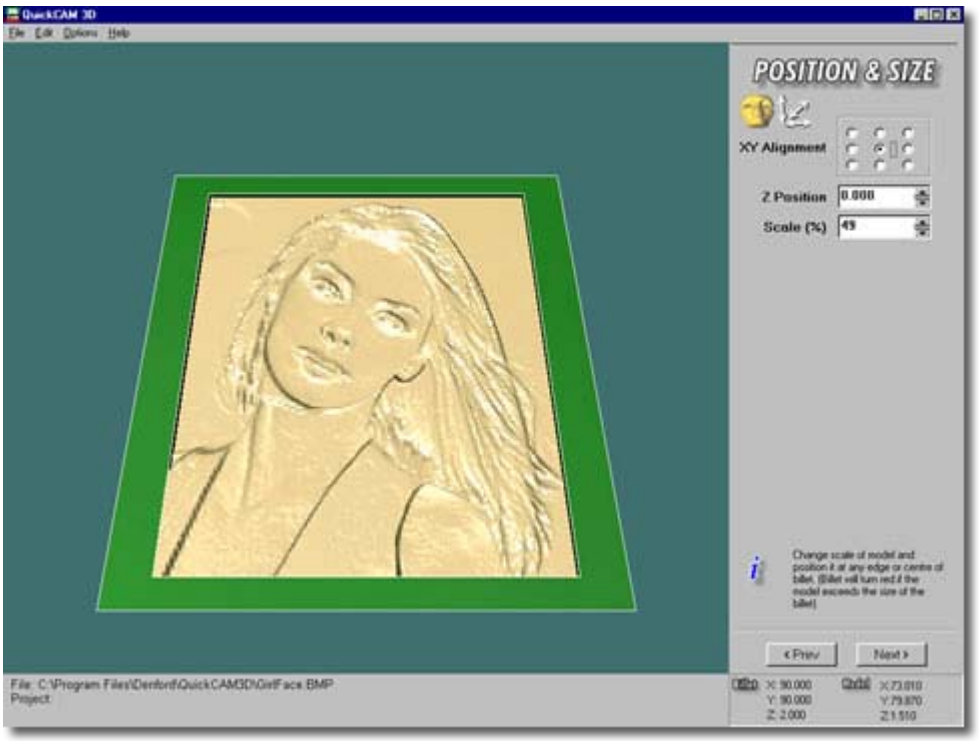
The "Position & Size" stage allows you to place the 3D model in a particular area of the billet and scale the 3D model up or down.



Positioning the 3D model in the billet

You want the photo to be machined in the middle of the billet, so check that the black marker dot is positioned on the middle circle in the "XY Alignment" panel, as shown in the example at the top of this page.

The "Z Position" should read zero. This leaves 5mm of billet material untouched, underneath the 3D model.

Scaling the 3D model

The "Scale (%)" value was automatically configured when you entered the dimensions of the image upon loading. This should read 49%.

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Stage Five - Tooling Setup

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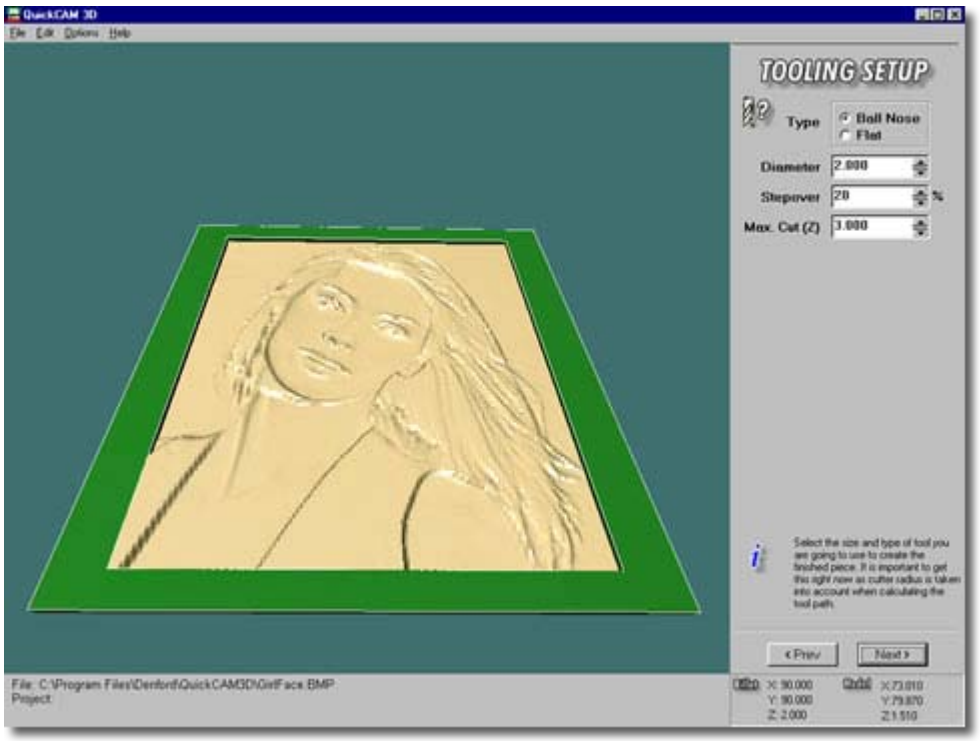
The "Tooling Setup" stage allows you to choose the type of cutting tool and how it will be used.



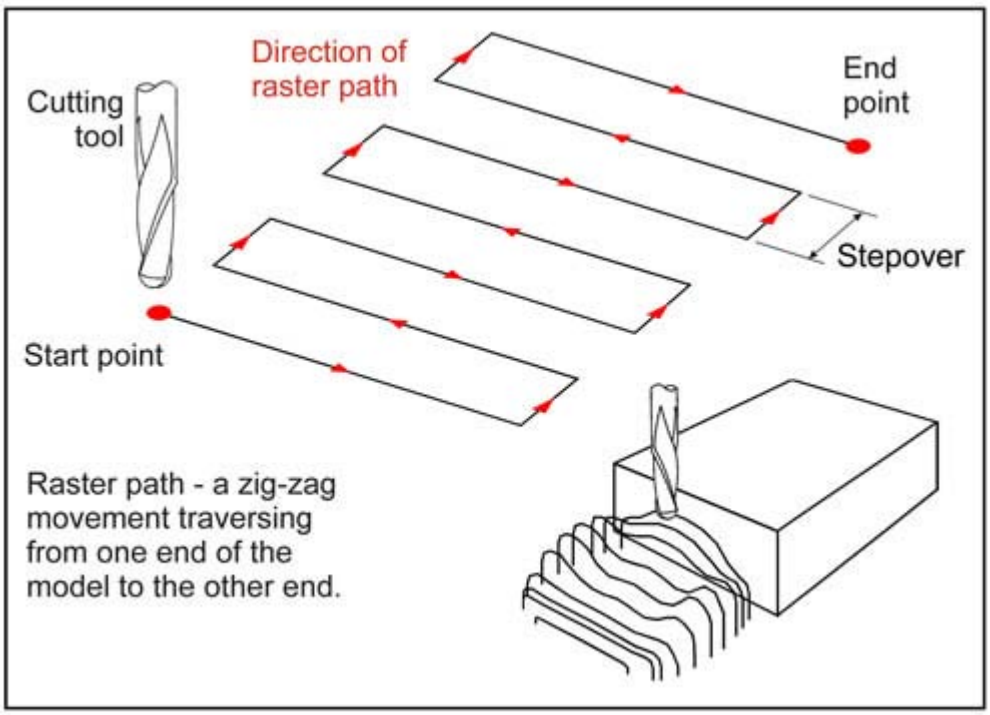
Configuring the type of cutter

For this tutorial, you will use a ball nose cutter. This gives a smoother edge on the changes between surface depths. In the "Type" panel, ensure that the black marker dot is positioned in the top white circle, next to the "Ball Nose" text.

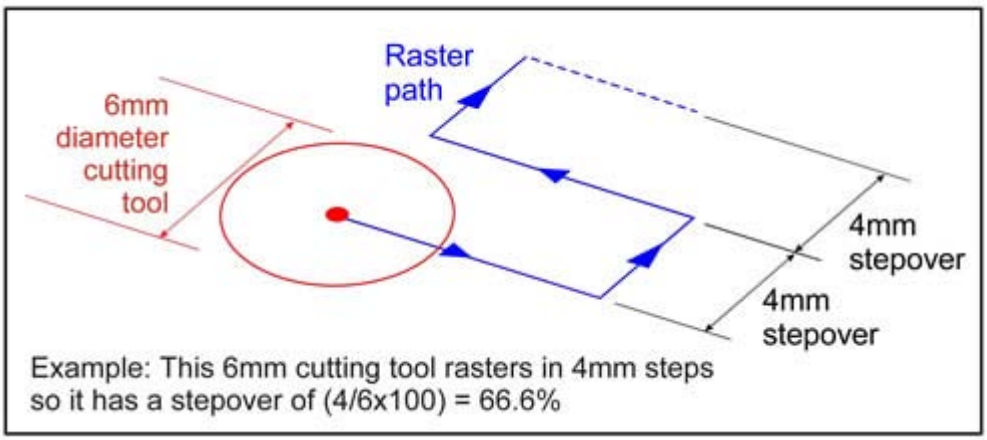
Set the diameter of the tool as 2mm, using the "Diameter" dialogue box.

Setting a value for the stepover

The 3D photograph will be machined using a raster path - a series of parallel zig-zag lines followed by the tool, as shown in the diagram below.



"Stepover" determines the spacing between these lines, creating a coarse cut (such as 95%) or a fine cut (such as 5%). The stepover value is a percentage of the tool diameter value, as shown in the diagram below.



A fine cut gives excellent definition to detail but at the expense of long machining times, since there are more tool path lines. Enter a value of 20% into the "Stepover" dialogue box.

Tip: A stepover of 20% gives a good compromise between detail definition and machining time.

The maximum amount of material that can be removed by the cutting tool in one pass is configured using the "Max. Cut (Z)" dialogue box. Set this value as 2.000mm.

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Stage Six - Cutting Plane

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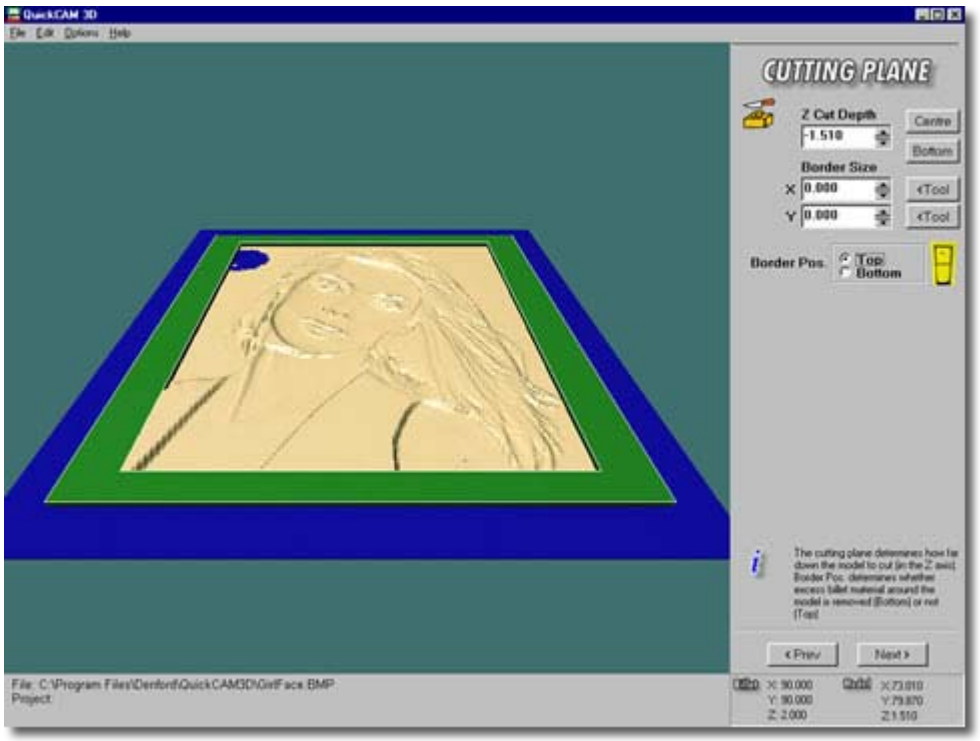
The "Cutting Plane" stage allows you to determine the maximum depth the cutting tool will machine into the billet.

Positioning the cutting plane



Click the [Bottom] button. This positions the cutting plane at the bottom of the 3D model, ensuring the full depth of the 3D model can be machined.

When you click the [Bottom] button, the value in the "Z Position" dialogue box changes to -1.510. The value is negative to indicate that the cutting plane lies 1.510mm under the top surface of the billet (the Z zero position).

Configuring a border

The "Border Pos." panel allows you to determine whether to leave the area of billet material surrounding the 3D model untouched, or machine all this remaining material down to the depth of the cutting plane. For this tutorial, you want to leave a plain border around the machined 3D photograph. Ensure that the black marker dot is positioned in the top white circle, next to the "Top" text.

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QuickCAM 3D - Photo Tutorial
Stage Seven - Machining Strategy

The "Machining Strategy" stage allows you to set the feedrate and spindle speed, together with the direction of the raster tool path.

Entering feedrate and spindle speed values

Both the feedrate and the spindle speed can be influenced by a number of factors, including:

- The material being machined.
- The type, size and condition of the cutting tool.
- The type, capabilities and condition of the CNC machine.

The "Feed" dialogue box is used for setting the value of the feedrate, measured in millimetres per minute (mm/min). Values entered must be suitable for machining high density polystyrene sheet. Enter a value that matches the Denford CNC machine you intend to use or consult your CNC machine manual:

- Micromill - 150
- Novamill - 300
- Triac - 300
- Triton - 300
- Microrouter - 500

The "Spindle" dialogue box is used for setting the value of the spindle speed, measured in revolutions per minute (RPM). Values entered must be suitable for the capabilities of your CNC machine. Enter a value that matches the Denford CNC machine you intend to use or consult your CNC machine manual:

- Micromill - 2,000
- Novamill - 2,000
- Triac - 2,000
- Triton - 2,000
- Microrouter - 5,000

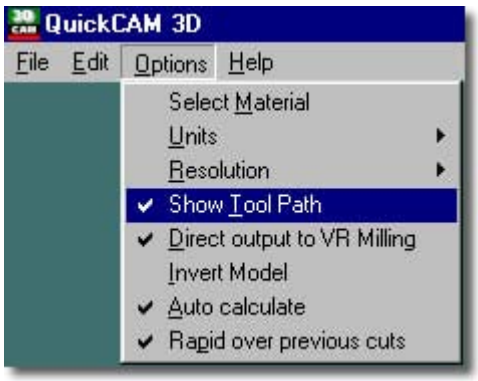
Choosing a raster tool path direction

The number and direction of the raster tool paths is set using the "Cutting Axes" panel. For this tutorial, you want to machine just one raster path parallel to the sides of the billet - this will be the Y direction. Ensure that the black marker dot is positioned in the white circle next to the "Y" text, as shown in the example at the top of this page.

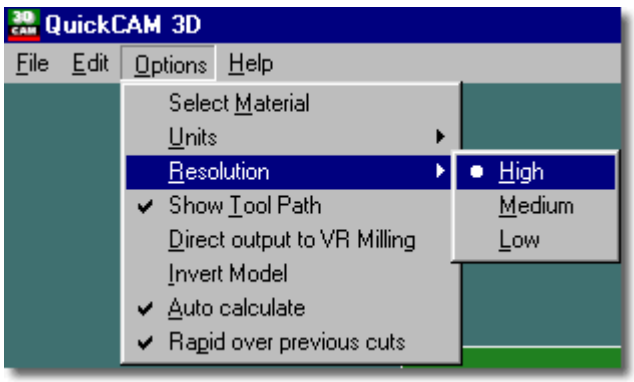
Tip: Rastering in both X and Y directions will create the most detail. However, this will take twice as long as performing a single raster path in one direction only. When using just one direction for a raster path, rastering parallel to the longest edge of your design produces your model in quickest time.

Calculating the tool path

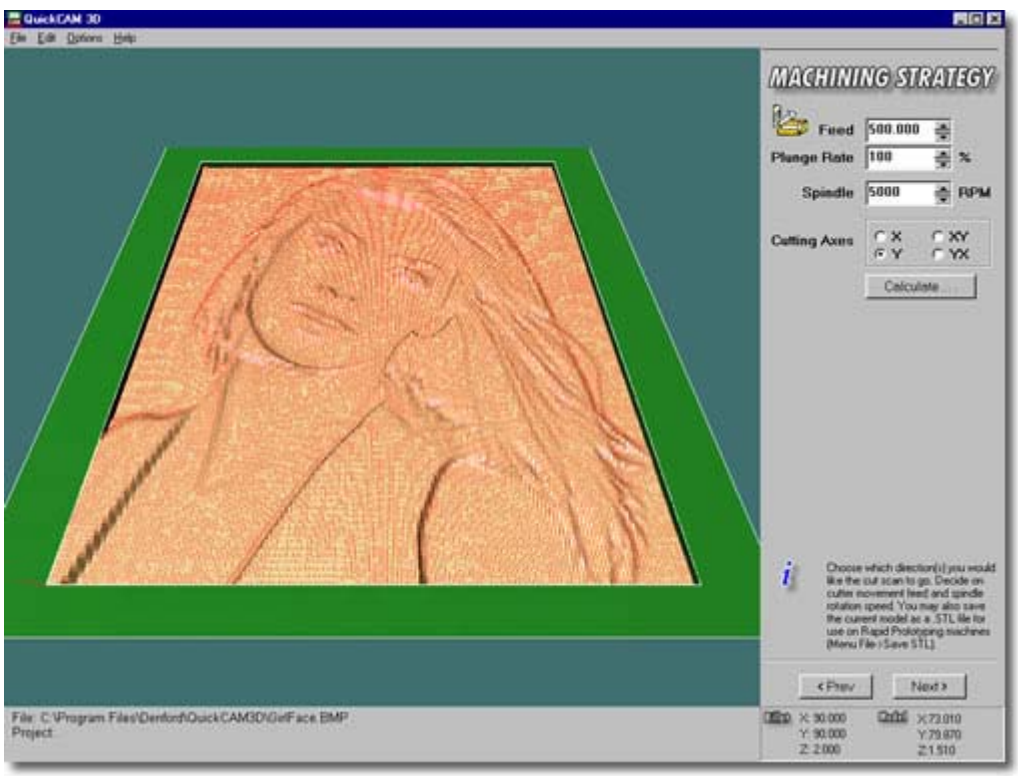
Before calculating the toolpath, switch on the show tool path feature. Click the "Options" menu, followed by the "Show Tool Path" text, if necessary, so a tickmark is displayed, as shown below.



For this type of detailed model, it is advisable to set resolution to **high**. This will give the generated toolpath more detail:



Click the [Calculate...] button to calculate the tool path for your 3D photograph. The raster tool path lines are plotted on the 3D model in red at the end of the calculation sequence.



QuickCAM 3D - Photo Tutorial
Stage Eight - 3D Simulation

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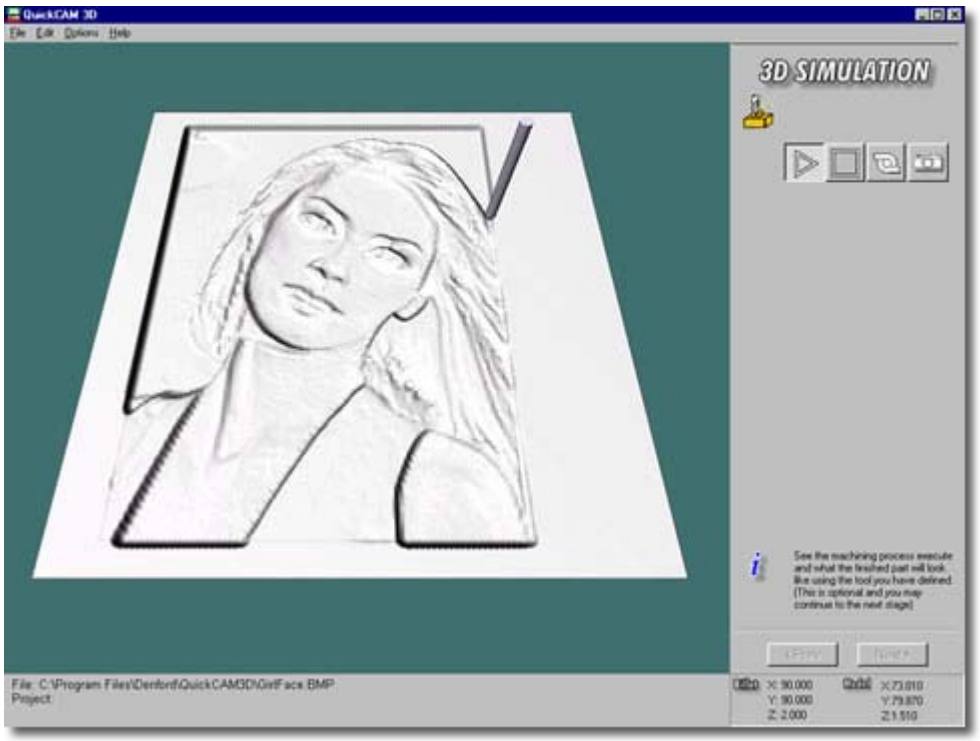
The "3D Simulation" stage allows you to simulate the machining of the 3D photograph, using the values set in all the previous stage screens. You can then examine the machined part and if not happy with the result go back to the previous stages and change values accordingly.



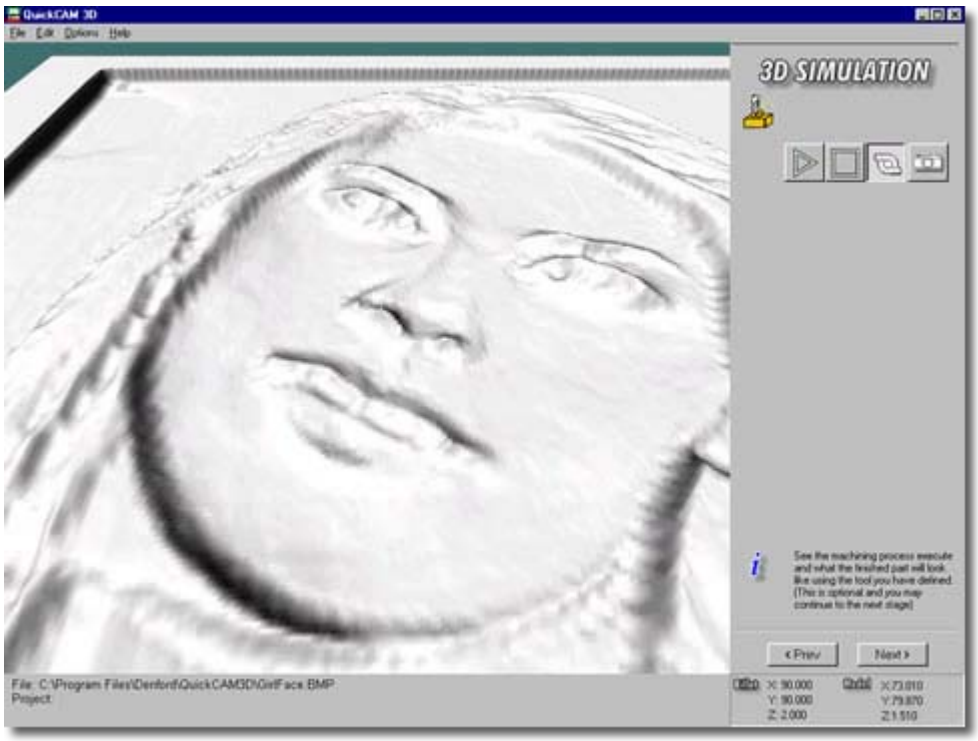
Running a simulation

The controls for running the simulation, listed from left to right are:

- [Play] button (triangle graphic) - Click this button to begin the simulation.
- [Stop] button (square graphic) - Click this button to stop the simulation.
- [Turbo] button (turbo graphic) - Click this button to increase the speed of the simulation.
- [Snapshot] button (camera graphic) - Click this button to capture the current view of the machined part as a bitmap.

Using the simulation results

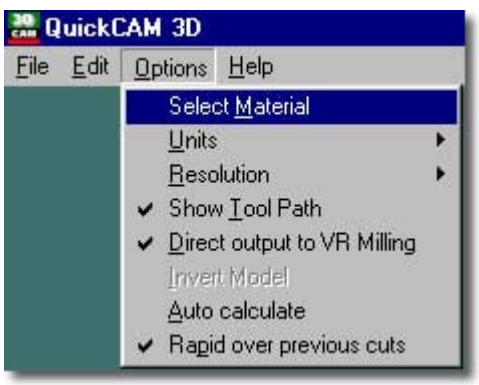
Remember, you can still zoom into the viewing window to view specific areas of the machined part in closeup, as shown below.



Move the mouse cursor over the graphic of the machined part, then click and holding the right mouse button down. Move the cursor upwards to zoom in or down to zoom out.

Rendering the 3D Model in Realistic Materials

At this stage of the process, the billet can also be rendered using realistic materials. To select the material type, click the "Options" menu, followed by "Select_Material".



The "Material Selector" window is displayed, as shown below.

The design will be manufactured on a thin sheet of white high density polystyrene.
Click the [Plastic] button to set the material.
Click the [Colour...] button and select white as the colour.
Click the [Ok] button to close the window and apply the material choices.

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QuickCAM 3D - Photo Tutorial
Stage Nine - CNC File Output

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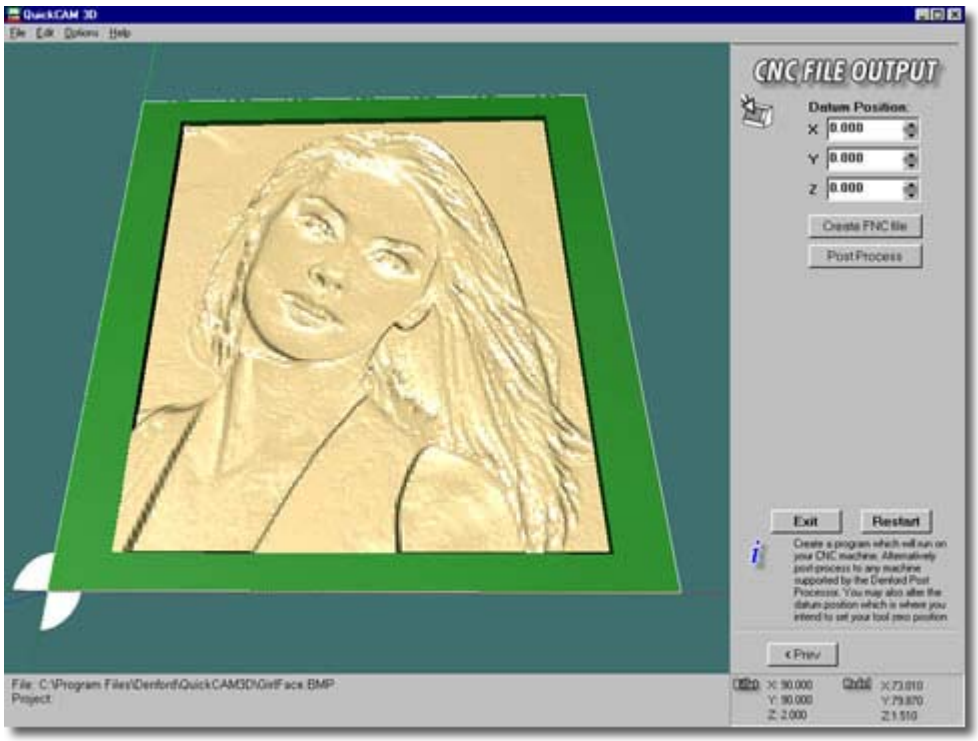
The "CNC File Output" stage allows you to set the position of the CNC program datum, then process and save the CNC file, ready to transfer to a CNC machine.

Configuring the datum position



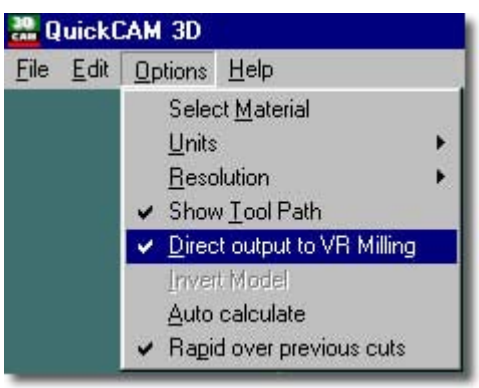
The datum you can set in this stage refers to the zero co-ordinate position of the CNC program, indicated by the circle graphic, split into four segments. In the example above, the datum symbol can just be seen in the bottom, left corner of the screen.

In the tutorial example, you must set the datum to the front(Y), left(X) upper(Z) corner of the billet.

The "Datum Position:" panel contains three dialogue boxes, "X", "Y" and "Z". Enter a value of zero in each of the three dialogue boxes - this will configure the datum in the positioned suggested above.
Tip: Always try to set the datum in a position you will be able to find again on the real billet. When you place the real billet in your CNC machine, you must configure the machine offsets (effectively shifting the zero datum of the CNC machine) to align with the datum position you are currently setting for your CNC program.

Creating the CNC file

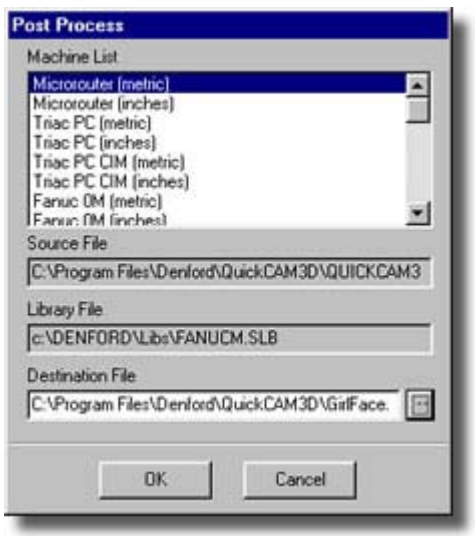
If Denford VR CNC Milling software version 2.14 or above is installed on your computer, you can configure QuickCAM 3D to automatically start VR Milling and load the newly created CNC file. Click the "Options" menu, followed by the "Direct output to VR Milling" text, if necessary, so a tickmark is displayed, as shown below.



To create the CNC file, click the [Create FNC file] button, then save the file using the name "GirlFace.fnc" in the appropriate hard drive folder or floppy disk.

Post processing the CNC file

To post process your design, click the [Post Process] button to display the "Post Process" window, as shown below.



Select the required CNC machine from the "Machine List", then post process and save the file using the name "GirlFace" in the appropriate hard drive folder or floppy disk.

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Machining your 3D Photograph

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Materials and equipment required

In order to manufacture your 3D photograph on a CNC machine, using the data supplied in this tutorial, you will need:

1. A 2mm diameter, ball nose cutter.
   Tip: If your CNC machine is equipped with imperial tooling, metric collets are available from Denford Limited.
2. A high density polystyrene billet, 90+mm x 90+mm, 2mm thick.
   Tip: For 3D photographs, a white coloured billet gives the best results.
3. Access to a CNC machine.

Holding the billet

The easiest method of holding your plastic billet into the working area of the CNC machine is by using a temporary machine table, usually a sheet of MDF or laminated board, as shown below...

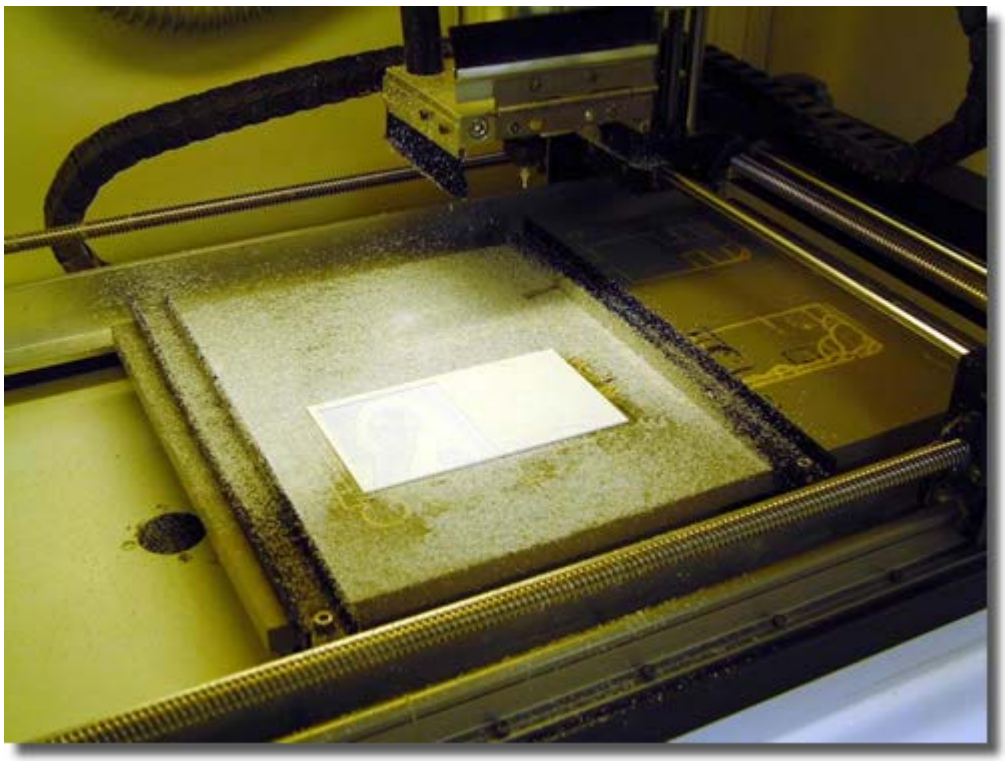
Above: Temporary machine table held using miteebite clamps on a Denford Novamill.

This has the added advantage of being sacrificial - if a mistake is made or you machine completely through the billet by accident, you won't damage the CNC machine! Ensure the material used for your temporary machine table is completely flat. Hold the temporary machine table in the CNC machine using clamp rails, miteebite clamps or nut/bolt assemblies.

Ensure the temporary machine table is positioned"square" to the actual machine table. Use an engineers square and any reference edges (such as the front edge of the actual machine table) as a guide.

Hold the billet onto the temporary machine table using sufficient strips of double sided tape. Again, ensure that you place the billet "square" onto the temporary machine table.

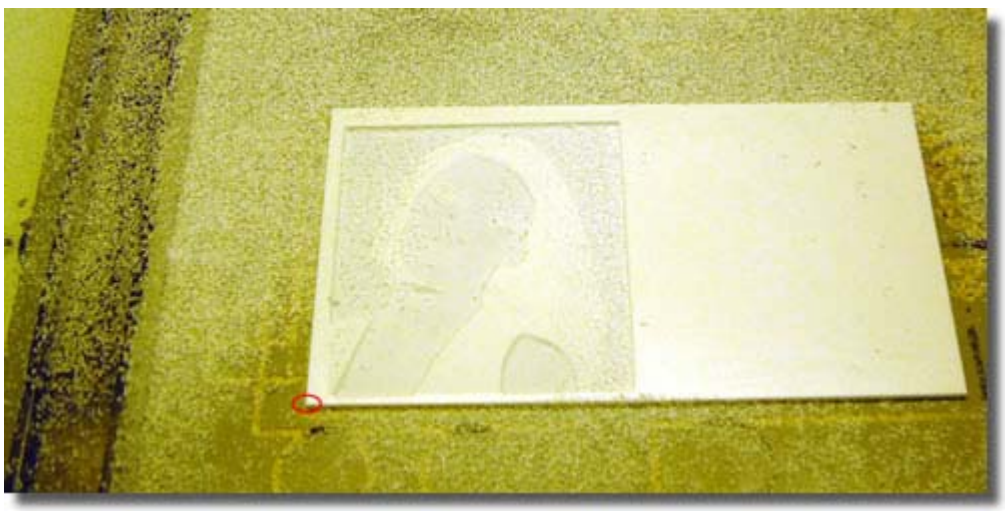
Tip: Use vinyl rather than tissue formed double sided tape, since this will be much easier to remove from the billet after machining. If your plastic billet is supplied with a protective carrier film, use this side to attach the tape.



Above: Temporary machine table held using clamp rails on a Denford Microrouter.

Configuring the Offsets

Configure your machine offset to align with the front, left, upper corner of the billet, since this is the datum (zero position) used by your CNC file, as shown below...



Above: The red ellipse indicates the offset position on the plastic billet.

Ordering materials from Denford Limited

All the items required to complete this tutorial can be ordered from Denford Limited, if required. For further information, regarding current pricing, availability and ordering, please contact the Denford Sales Team. Telephone Denford Sales: 01484 717282

Fax Denford Sales: 01484 718229
E-mail: sales@denford.co.uk
Sales Department Hours: Monday to Friday 8.30am - 5.00pm GMT
For international dialing: +44 and remove first 0 from each city code.

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