



CAD/CAM Projects

Trinket Box Project



CAD SUPPORT BOOKLET



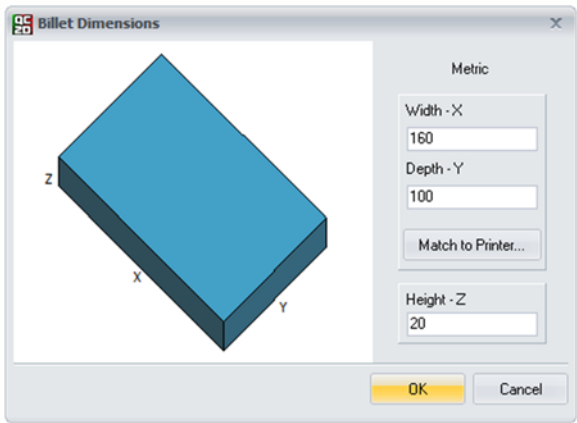
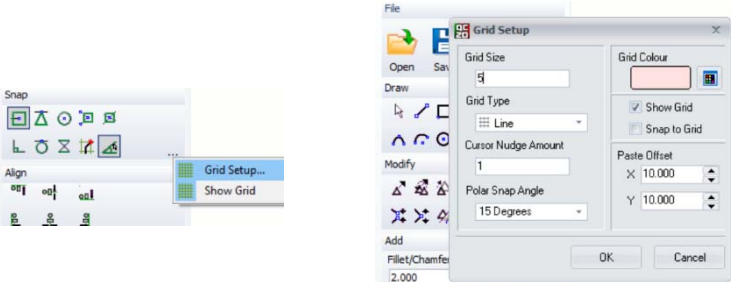
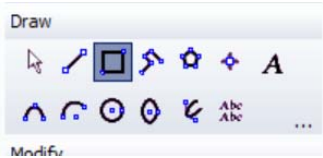
Denford: Trinket Box Project - Denford CNC Router

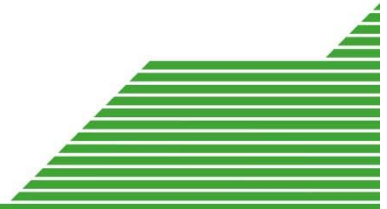
CAD Support Booklet

To draw this product in QuickCAM 2D, we will be designing in the following order. This is to ensure that all bodies will relate to each other, and will be fit for manufacture on the Denford CNC Router.

The process will be as follows:

1. Designing the Trinket Box
2. VR Milling Tool Setup
3. CAM Wizard
4. Creating the Cut Out for holding the Trinkets

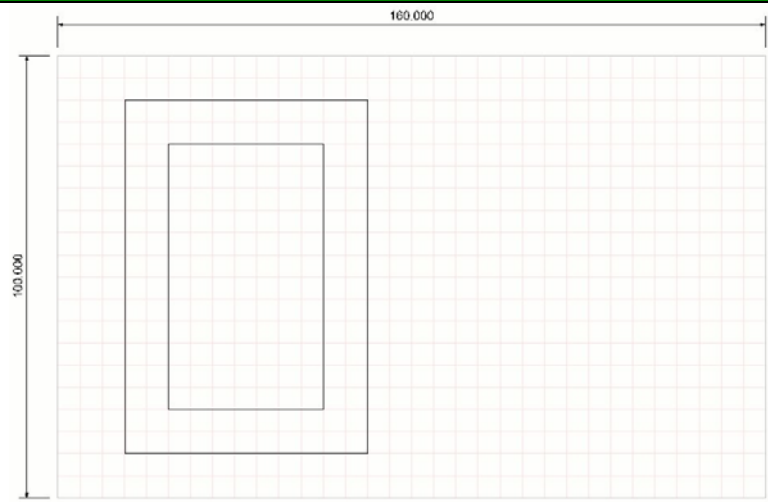
Designing the Trinket Box	
<p>In QuickCAM 2D:</p> <p>Start by making a billet size.</p> <p>Size of maple block:</p> <p>Width- 160mm Depth- 100mm Height- 20mm</p>	
<p>Set the Grid to 5mm.</p>	
<p>Select to draw a rectangle.</p>	



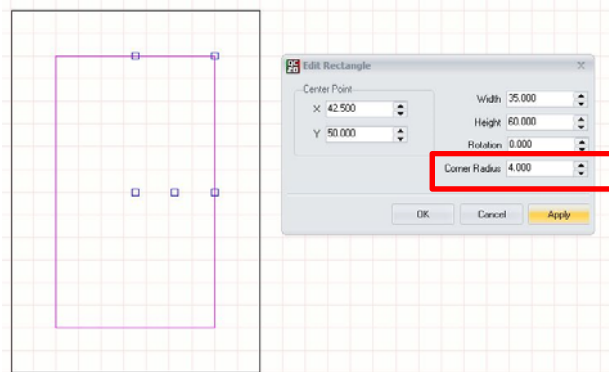


Designing the Trinket Box

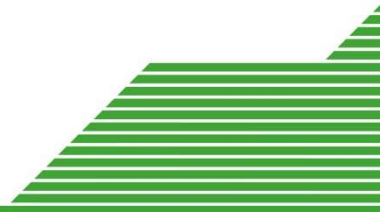
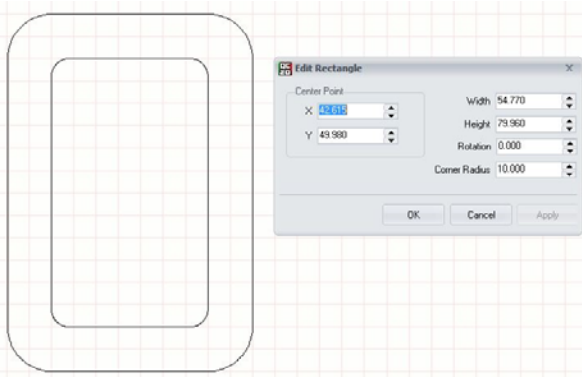
Draw an Outer and Inner similar to the image on the right



Double click on the rectangle and add a 4mm Radius to the inside corners



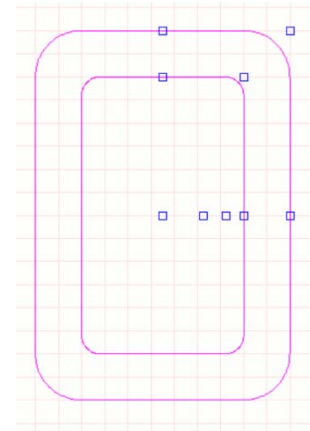
Same procedure as above but this time for the outer rectangle. Insert 10mm corner radius this time.



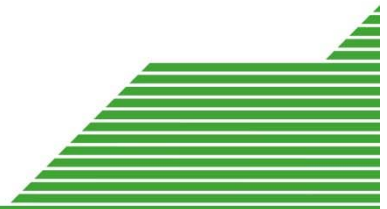
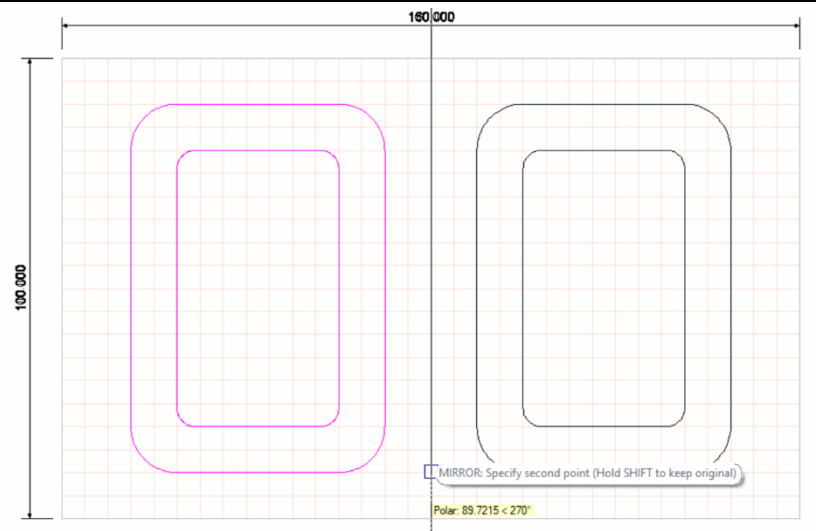


Designing the Trinket Box

Highlight both the inner and outer rectangles and select the Mirror Command.



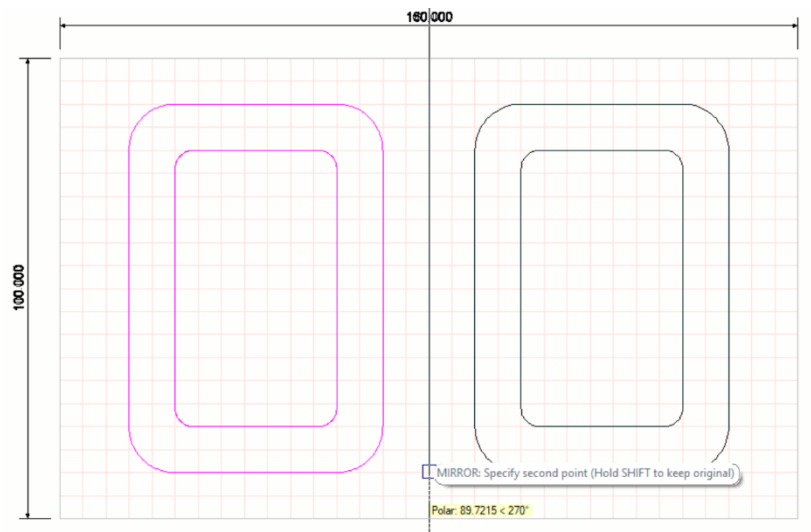
Using the Mirror Command, mirror the Trinket design using the centre line of the grid.



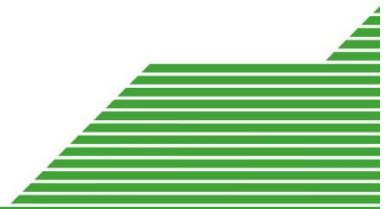
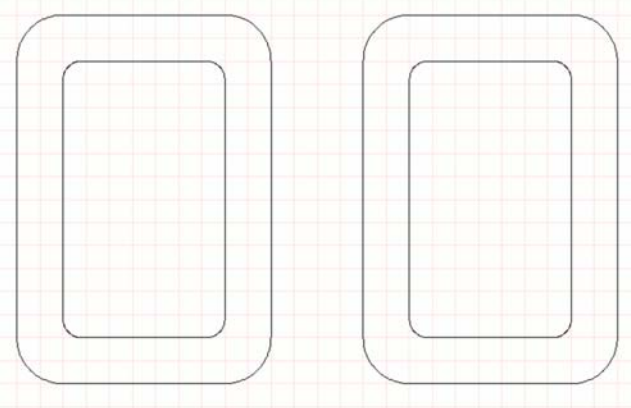


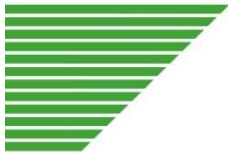
Designing the Trinket Box

Using the Mirror Command, mirror the Trinket design using the centre line of the grid.



Hold shift down when you are in position and that will keep the original design as well as the mirrored design.





VR Milling Tool Setup

In VR Milling:

Open up the Offsets and Tooling window.



Input the Denford Recommended Tooling Package Tool 1 to Tool 6.

No.	Description
1	1/4" Ballnose LS (6.35 mm)
2	1/4" Ballnose (6.35 mm)
3	1/4" Slot Drill (6.35 mm)
4	1/8" Ballnose (3.175 mm)
5	1/8" Slot Drill (3.175 mm)
6	V Cutter
7	
8	

Data for Tool 1

Tool 1
1/4" Ballnose LS (6.35 mm)

Diameter:

Tool offset:

Ball Nose

Length: Flute Length:

Data for Tool 2

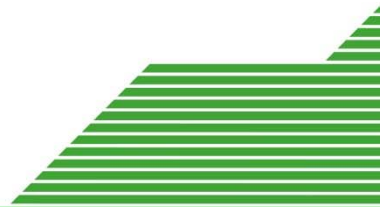
Tool 2
1/4" Ballnose (6.35 mm)

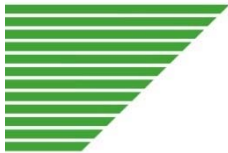
Diameter:

Tool offset:

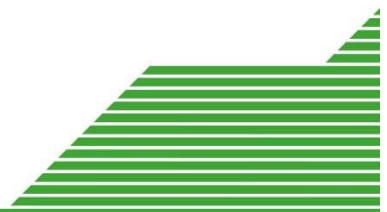
Ball Nose

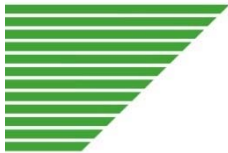
Length: Flute Length:





VR Milling Tool Setup		
Data for Tool 3		<div><div>Tool 3</div><div>1/4" Slot Drill (6.35 mm)</div><div>Diameter: 6.350</div><div>Tool offset: 35.000</div><div>Slot Mill</div><div>Length 50.000</div><div>Flute Length 40.000</div></div>
Data for Tool 4		<div><div>Tool 4</div><div>1/8" Ballnose (3.175 mm)</div><div>Diameter: 3.175</div><div>Tool offset: 30.000</div><div>Ball Nose</div><div>Length 50.000</div><div>Flute Length 40.000</div></div>
Data for Tool 5		<div><div>Tool 5</div><div>1/8" Slot Drill (3.175 mm)</div><div>Diameter: 3.175</div><div>Tool offset: 30.000</div><div>Slot Mill</div><div>Length 50.000</div><div>Flute Length 40.000</div></div>
Data for Tool 6		<div><div>Tool 6</div><div>V Cutter</div><div>Diameter: 12.700</div><div>Tool offset: 25.000</div><div>VCutter</div><div>Length 50.000</div><div>Flute Length 40.000</div><div>Angle 60.000</div></div>





CAM Wizard

Before we proceed, save your design.

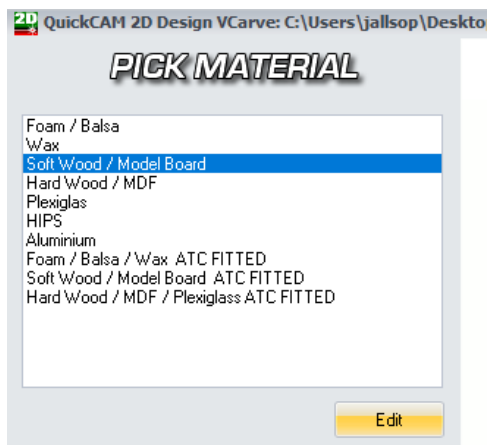
Now we are going to start the CAM process for the Trinket Box and to do this you need to click on the CAM Wizard.



This will then take you into the CAM side of the software to create a program to machine the Trinket Box.

A materials list page will be the first screen that pops up, once the CAM Wizard has been opened.

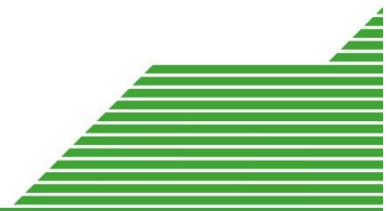
Select Soft Wood and then click on the edit button at the bottom of this bar.



This then opens up a window, which allows you to edit the speeds and feeds for the different materials.

The speeds and feeds are ok in this section. All that needs changing is the step down % which needs to be set at 30% to reduce the depth of cut. Once the step down has been altered, you can press 'OK' and then click the 'next' button at the bottom of the bar.

Material Name	Feed Rate	Spindle Speed	Step down (% of tool diam)
Foam / Balsa	5000.000	23000	300
Wax	1500.000	23000	150
Soft Wood / Model Board	2000.000	23000	30
Hard Wood / MDF	1000.000	23000	100
Plexiglas	800.000	23000	75
HIPS	1500.000	23000	150
Aluminium	400.000	18000	30
Foam / Balsa / Wax ATC FITTED	3000.000	23000	100
Soft Wood / Model Board ATC FITTED	1200.000	23000	60
Hard Wood / MDF / Plexiglass ATC FITTED	800.000	18000	50

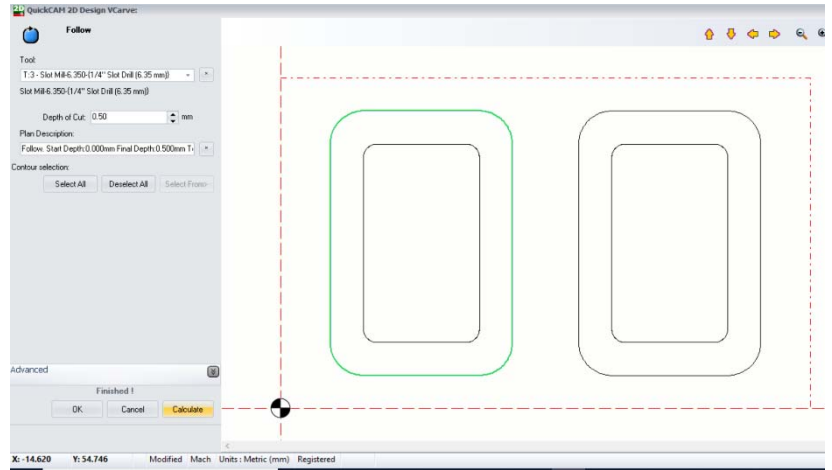




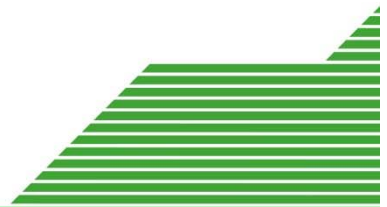
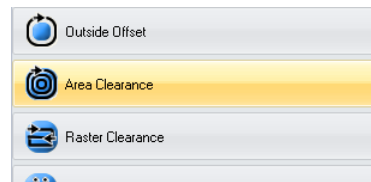
CAM Wizard

To start off we are going to use the 'Follow' option on the 'Machining Plan' window.

Once you have clicked 'Follow' your screen should look like the one opposite. You then need to select the part of your design which you intend the cutter to follow. In this case it is the outer rectangle. Once it is selected, it will turn green. Then select the tool, which you wish to machine with. We have used tool 3, which is a 6.35mm Slot Drill (1/4"). Alter the depth of cut to suit your design. For this design we have changed it to 0.5mm, as this slot is just for show. Then click 'Calculate' and the line should turn blue.



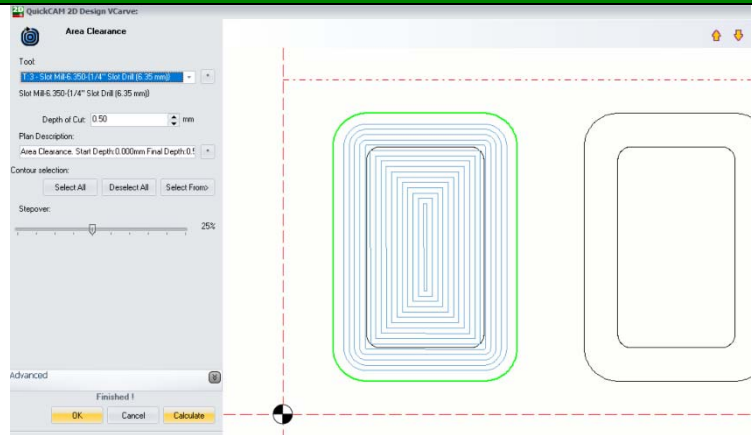
The next step is to remove the material from the inside the outer rectangle leaving a smooth top face. This is done as an 'Area Clearance'.



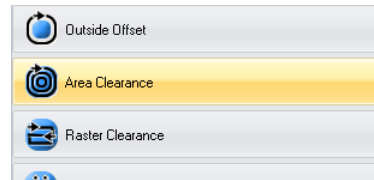


CAM Wizard

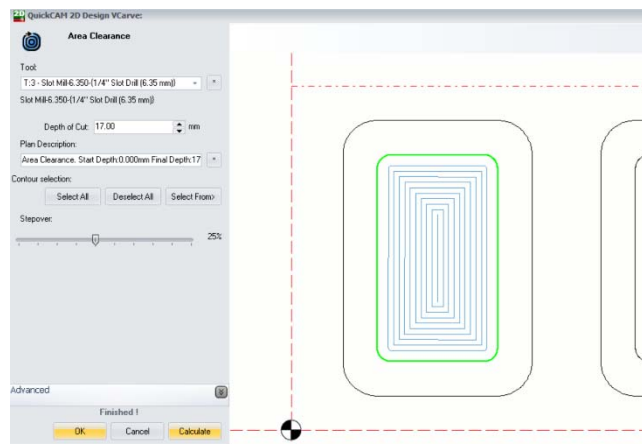
Using tool 3 again, with the depth at 0.5mm, as we are cutting through the material again, select the outer rectangle which will then turn it green and alter the step over to 25%. Click 'Calculate' and this will then put a blue cutter path on the inside of the rectangle. Click 'OK'.



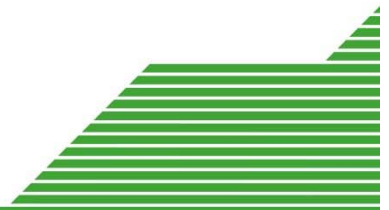
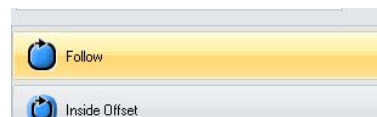
For our next Machining Plan, we will use another 'Area Clearance'



Using tool 3 again, with the depth at 17mm, as we are cutting through the material again, select the inner rectangle which will then turn it green and alter the step over to 25%. Click 'Calculate' and this will then put a blue cutter path on the inside of the rectangle. Click 'OK'.



Our next Plan will be to 'Follow' again.

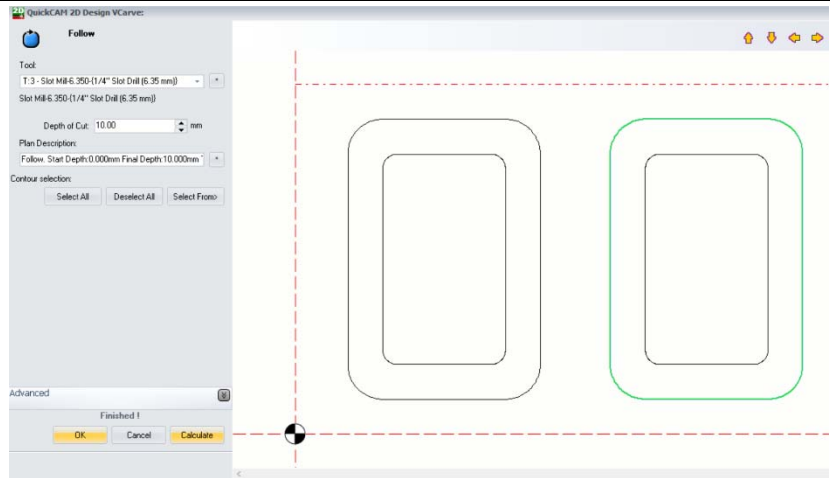




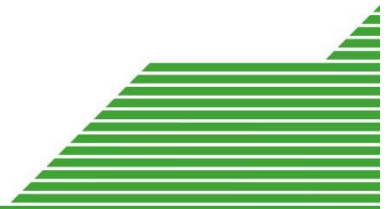
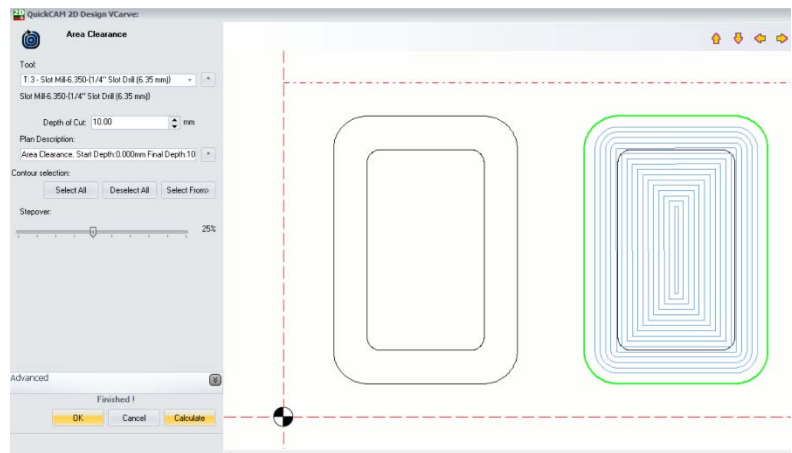
CAM Wizard

This time we are going to follow the Outer rectangle of the Mirrored part.

Using tool 3 again, select the outer rectangle of the second part and set the cut depth to 10mm.



Using tool 3 again, with the depth at 10mm, as we are cutting through the material again, select the outer rectangle of the Mirrored Design which will then turn it green and alter the step over to 25%. Click 'Calculate' and this will then put a blue cutter path on the inside of the rectangle. Click 'OK'.





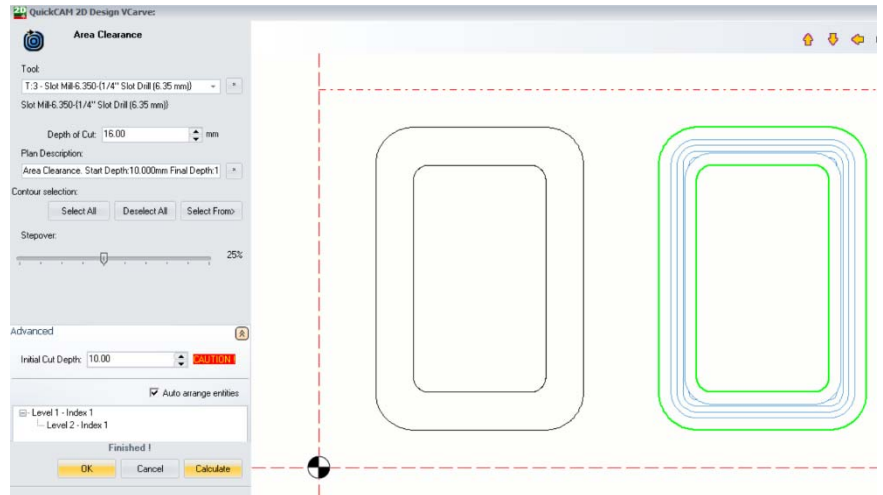
CAM Wizard

Using the Area Clearance again.

Use Tool 3 and select both the outer and the inner rectangles on the Mirrored design. Change the depth of cut to 16mm with the stepover set at 25%.

Using the Advanced Menu, change the initial cut depth to 10mm as this was cut in the previous step.

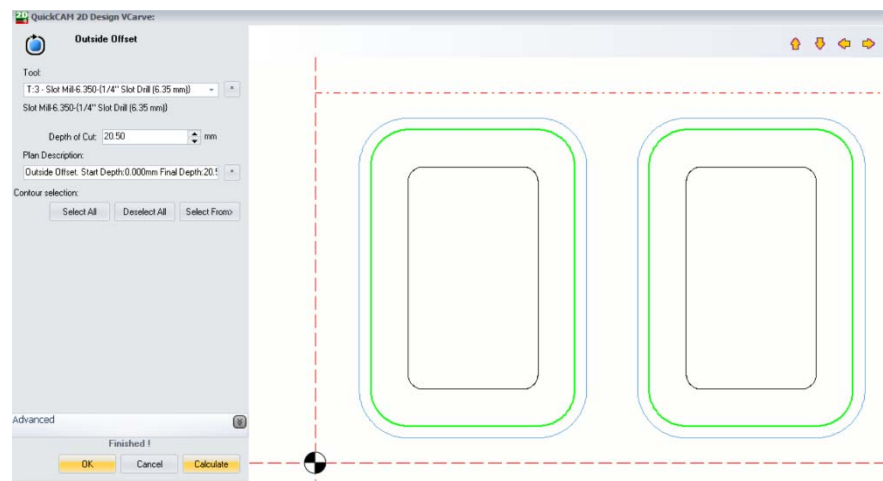
Once completed click 'Calculate' then 'OK'



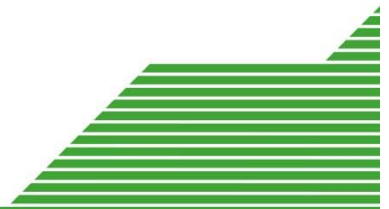
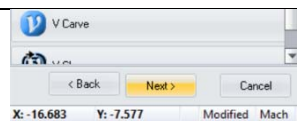
The next step is to cut around the outside of both outer rectangles.

This will be done using the Outside Offset path. Using Tool 3, set the depth to 20.50mm (cutting all the way through). Select the inner rectangles of both designs.

Then click 'Calculate' and 'OK'



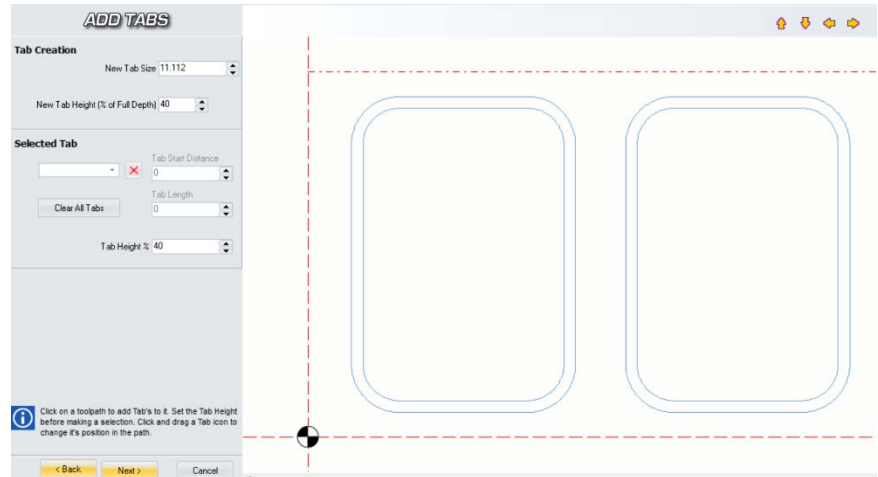
All tool paths are now complete, select 'Next'



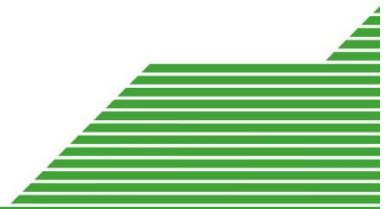
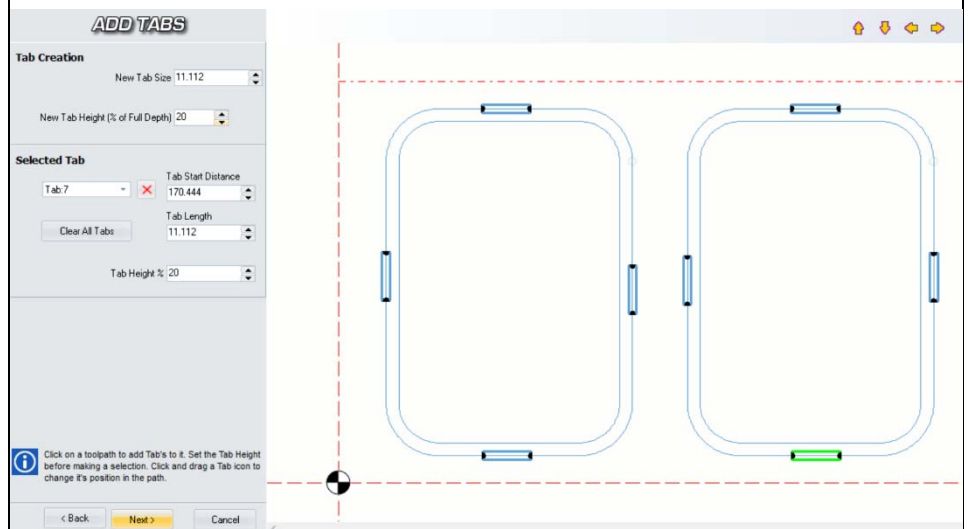


Creating the cut out for holding the Trinkets

Once we have clicked 'Next' a screen will appear asking if we would like any tabs adding to the design. We would, otherwise the design would fall straight through and would damage the end product and the cutters.



So, to add tabs just click on the outside line in 4 places on both designs like the image on the right. Then on the left-hand side change the 'Tab Height' to 20. And then click 'Next'.

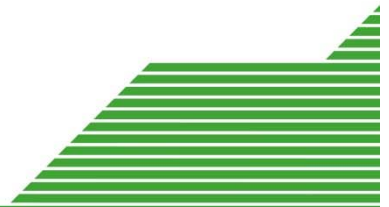
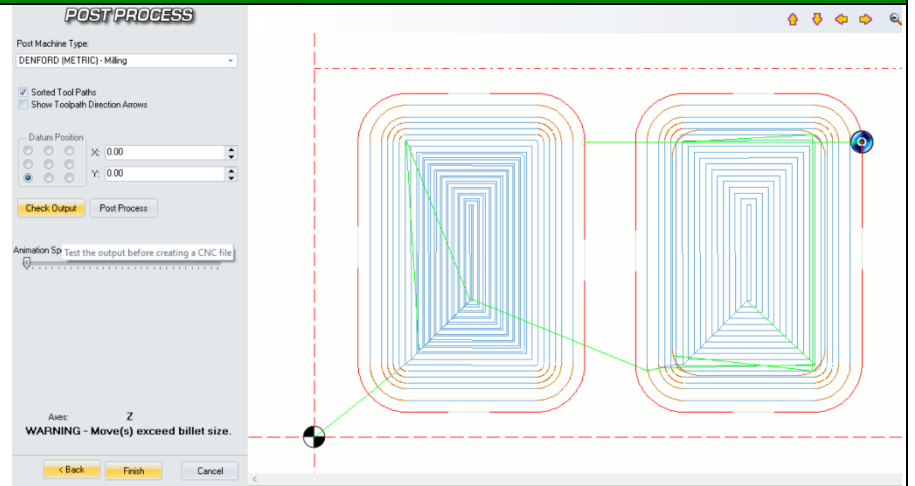




Creating the cut out for holding the Trinkets

Once 'Next' has been clicked this image should be the next screen, which allows us to check the cutter paths. If you click 'Check Output' it will show the program from start to finish.

Once you are happy with this, it is complete, and you can click 'Post Process'. It will ask you to save the program, so save it somewhere you will remember.





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CAD/CAM Projects

Trinket Box Project



TEACHER SUPPORT GUIDE



Denford: Trinket Box Project - Denford CNC Router

Teacher Support Guide

This Project takes the form of design and manufacture of a saleable product. Students are tasked with designing and making a trinket box. Students have free reign on the shape and function of the design.

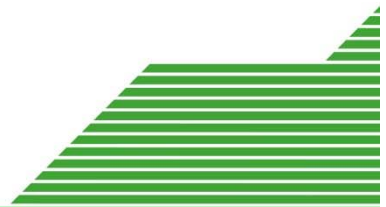
The only limits are that the box must be manufactured using maple wood on a Denford CNC Router, and the design must be made in 2 halves and slotted together when finished.

Project Timeline Summary

It is anticipated that learners will spend a total of approximately 8 hours in producing the work for this project (each session being around 1 hour). Learners will be expected to have had previous experience in using QuickCAM 2D design software.

Throughout this project, learners will need to apply problem-solving and designing skills, developed in earlier years, in order to achieve a successful outcome.

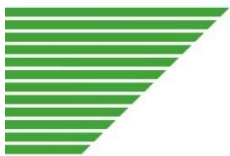
Session	Focus	General Content
1	Product Analysis & Design	Analysis of the design problem / understanding the context of their product / start to generate initial sketches.
2	Designing & Developing a Final Solution	Finish initial sketch ideas to satisfy the requirements of the problem / sketch final design in 3D form, both assembled and exploded.
3	CAD Design	Using QuickCAM 2D Design, draw the outlines of the two parts of your design. Save the design.
4	Create the Cutter Paths	Using the CAM Wizard, select the material and create the tool paths for machining both parts of the trinket box.
5	Post Processing	Simulate and then post process the cutter paths to create the G&M Code CNC Program for both parts, ready for output to the Router.
6	Manufacture, Assembly & Finishing	Using VR Milling and the Denford CNC Router, machine out both halves of the part.
7		Glue and assemble the trinket box, sand and wax to finish.
8		



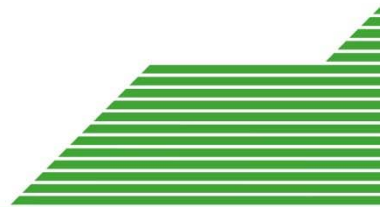


Project Delivery Session Detail

Session	Focus	Session Content
1	Product Analysis & Designing	<p>Start the session off with a discussion of what items students can put in a trinket box.</p> <p>Ask students to read through the design problem, then - working individually - ask students to make a rough sketch of their box (or a neighbour's box). Ask them to measure and note critical dimensions such as the width and thickness of the box.</p> <p>Now get students to look at examples of boxes that have already been created and start to sketch up their own ideas. There is an area for each idea, with each having room for a front and back of their design. This is to allow understanding of how it will be made.</p> <p>There is space for students to create 4 initial ideas. They are not expected to finish these all by the end of this session.</p>
2	Designing & Developing a Final Solution	<p>Students will need to finish their sketched ideas, then decide on one design, or elements of some to take forward to their final idea.</p> <p>On the Design Realisation page, get students to sketch out their final idea in two ways: the first needs to be a complete assembled design and the second an exploded view.</p> <p>IMPORTANT: You can only machine the front face of each part, so students need to ensure that they create the cut-out on the front face of the back piece.</p>



Session	Focus	Session Content
3	CAD Design	<p>Using Quick CAM 2D, follow the CAD Support Booklet to draw the trinket box ready for manufacture.</p> <p>Design both the front and rear halves of the trinket box.</p> <p>Students can use the CAD Support Booklet to support them in self-guided learning.</p> <p>By the end of this session, it is expected the students will have their design finished.</p>
4	Create the Cutter Paths	<p>Using the CAD Support Booklet, Students will use QuickCAM 2D to set up machining programmes for the front and back part of the trinket box.</p> <p>It will be necessary for students to select the material, set up the tool strategies, depths of cut and tools to be used.</p>
5	Post Processing	<p>Once the cutter paths are defined, they can be simulated and then both parts are post processed to produce the G&M Code CNC Program (.fnc file)</p>
6	Manufacture, Assembly & Finishing	<p>The next three sessions will be used to machine the parts on the Denford CNC Router.</p>
7		<p>The Teacher/Technician will need to set up the Router with a sacrificial bed, as the tool will have to machine deeper than the billet thickness to cut the part out.</p>
8		<p>Open the two programs in VR CNC Milling V5, and machine them.</p> <p>The tooling and work offsets for this project will need to be pre-set. This will be covered in training, but you can also check your Denford VR CNC Milling V5 Training Guide for guidance on how to do this.</p> <p>Once students have both halves of their box machined, they will need to assemble the two halves together.</p> <p>Once slotted together, students can then sand with the glass paper (or use a power tools where available) and seal with wax.</p>





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CAD/CAM Projects

Trinket Box Project



Project Duration: 8 Hours

STUDENT WORKBOOK



Denford: Trinket Box Project - Denford CNC Router

Student Workbook

DELIVERY PLAN (HOURS)

1. Product Analysis & Design
2. Designing & Developing a Final Solution
3. CAD Design
4. Create the Cutter Paths
5. Post Processing
- 6-8. Manufacture, Assembly & Finishing

DESIGN PROBLEM

Students are tasked with a project to design and manufacture a trinket box.

The Design Emphasis will focus on designing to ensure good aesthetics.

MACHINE

Denford CNC Router
Router Tooling Package –
BI00846

MATERIALS

1 x 160mm x 100mm x 20mm
Maple Wood Blocks –
BI03509G Class Pack of 50

FINISHING MATERIALS

Glass Paper for finish
Wax to finish

EXTRA INFORMATION

The product is one complete unit and will be manufactured using the Denford CNC

Router in two separate halves, then slotted together to complete the box.

It is expected that the box will be finished with wax. However, there are opportunities to embellish the design with accent colours.

IMPORTANT – *When machining you can only machine one face of each block. This MUST be considered in your designing.*

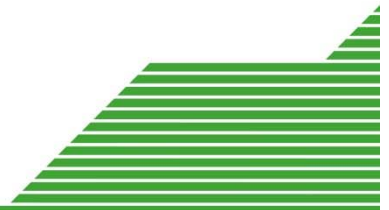




What's out there already?



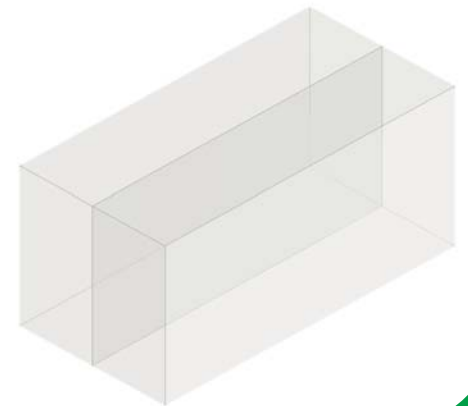
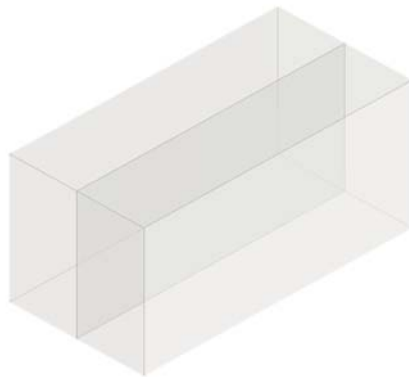
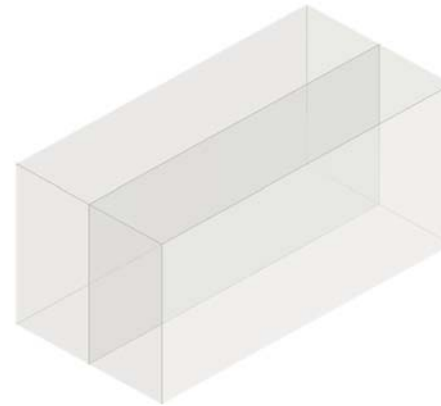
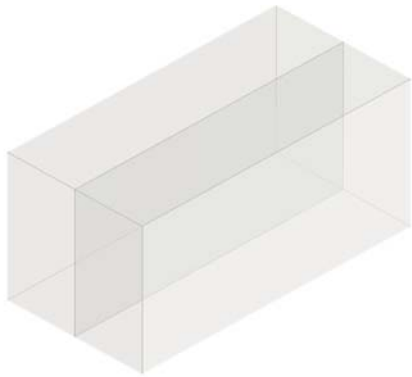
Above are research images that are associated with the function of this product. These are to help you in your designing.





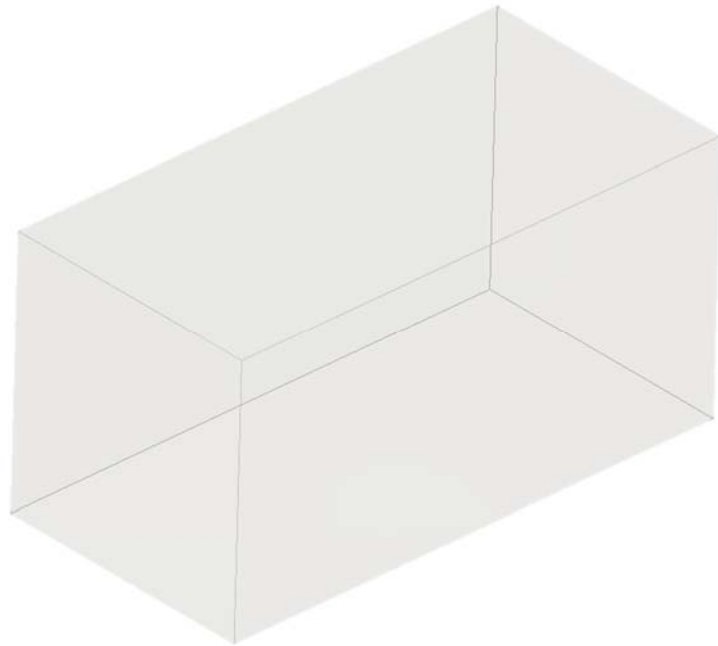
Design

Using 3D Sketching generate some ideas to resolve the problem.
Sketch your ideas over the shaded blocks and add annotation to help explain them!

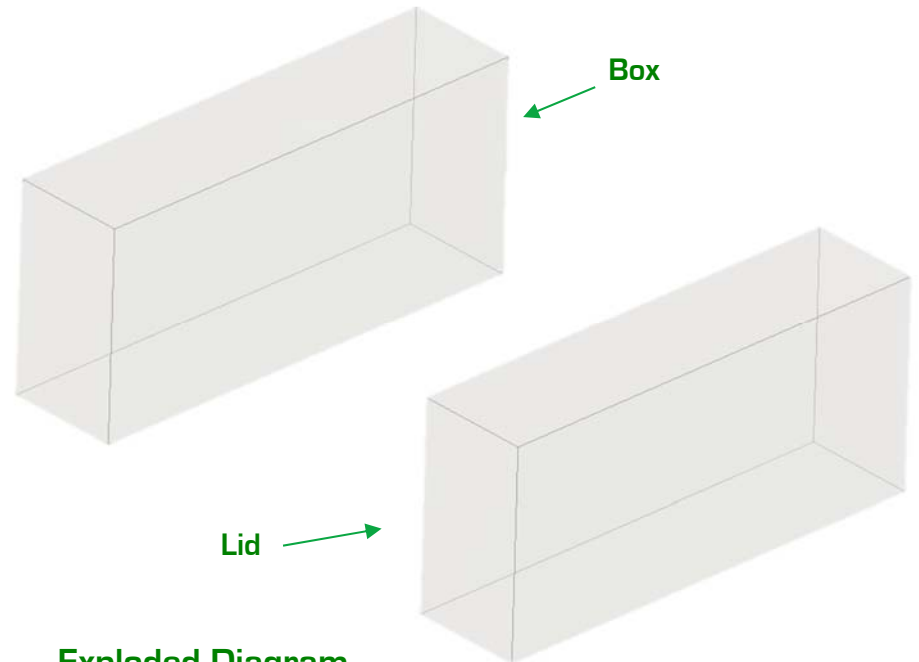


Design Realisation

Bring your favourite idea forward from the previous page and produce two separate sketches, one final 3D sketch, and one exploded sketch showing the two halves of the dock to be manufactured. Add dimensions to help with your CAD drawing



3D Sketch



Exploded Diagram



Your Final CAD Design

Export a final copy of your CAD Design and attach to this sheet.





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