

ArtCAM Pro 2010 Training Course

Delcam plc,
Talbot Way, Small Heath Business Park, Birmingham, B10 0HJ.
www.delcam.com

Important Notice

This document is supplied as part of a Delcam Training Course. It is not intended to be distance-learning material: rather as an aid for Tutors when presenting material to course delegates and as a subsequent aid memoir to those delegates.

Delcam does not accept responsibility for any personal belongings / valuables whilst on the premises. Delegates are advised to keep their belongings on their person at all times.

Delcam plc. has no control over the use of the software described in this document and cannot accept any responsibility for any loss or damage howsoever caused as a result of using the software. Users are advised that all results from the software are checked by a competent person in accordance with good quality control procedures.

The software described in this document is furnished under a license agreement and may be used only in accordance with the terms of such license.

Copyright © 2010 – Delcam plc. All rights reserved

UK Training Centre
Tel: 0121 683 1050
Fax 0121 7665511

UK Customer Support
Tel: 0121 683 1010
Fax: 0121 7665542

ArtCAM Pro 2010 Contents

<u>Chapter</u>	<u>Page No.</u>
1. Introduction	1-1 to 1-18
2. Generating Vectors	2-1 to 2-18
3. Vector Editing	3-1 to 3-20
4. Generating a Relief	4-1 to 4-30
5. Pictures	5-1 to 5-12
6 3D Blend and Fade Relief	6-1 to 6-6
7. Extrude, Spin, Turn, and Two Rail Sweep	7-1 to 7-18
8. Weaves	8-1 to 8-10
9. 3D Clipart and Texturing	9-1 to 9-14
10. Relief Layers	10-1 to 10-8
11. Relief Editing	11-1 to 11-16
12. Toolpath Options	12-1 to 12-2
13. Machining a Relief	13-1 to 13-24
14. 3D Cut Out Machining	14-1 to 14-8
15. Post Processing Toolpaths	15-1 to 15-8
16. Toolpath Templates	16-1 to 16-4
17. 2D Vector Machining	17-1 to 17-12
18. Engraving and Scribe Lines	18-1 to 18-6
19. Drilling	19-1 to 19-4
20. Projects	20-1 to 20-12

1. Introduction

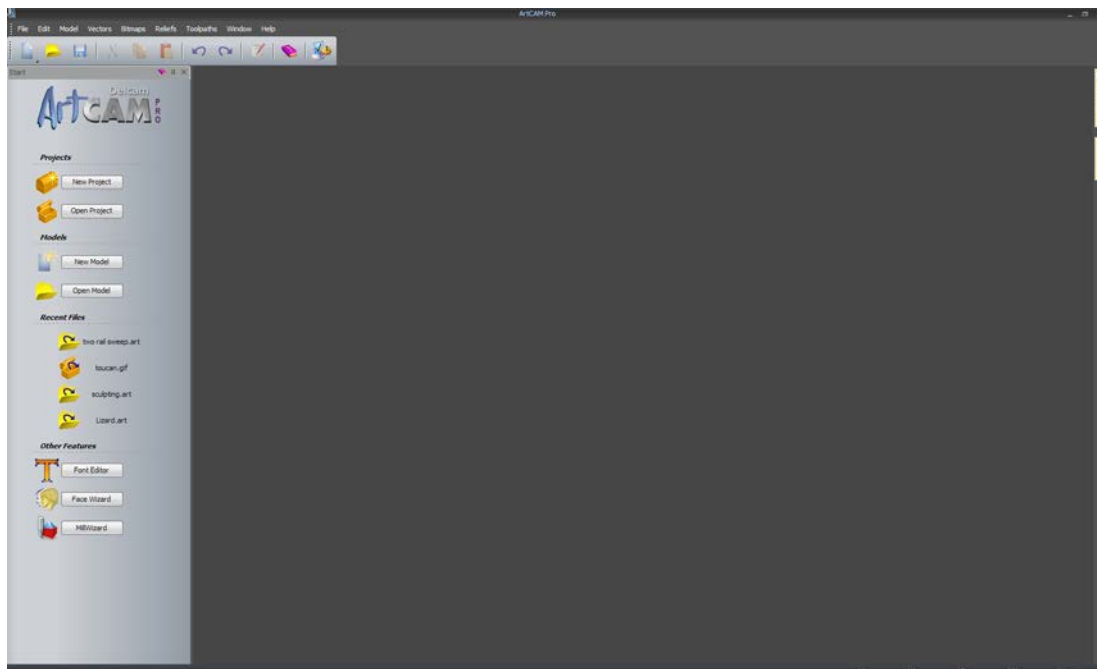
Introduction

ArtCAM Pro allows complex **Reliefs (ArtCAM 3D models)** to be created quickly and easily from **2D vectors (ArtCAM Wireframe)** or **bitmaps (Image files)**. These **vectors** and **bitmaps** can be generated within **ArtCAM** or imported from other systems. **ArtCAM** can also import **3D Surface** data, which is translated on entry or after as a **Relief** model.

ArtCAM Pro contains tools for editing the reliefs and combining stored reliefs. Once a 2D model or a 3D relief has been created, toolpaths can be generated to machine it. Multiple toolpaths are easily generated for roughing, finishing and engraving. The toolpaths can then be simulated to allow complete visualisation of the product before actual machining.

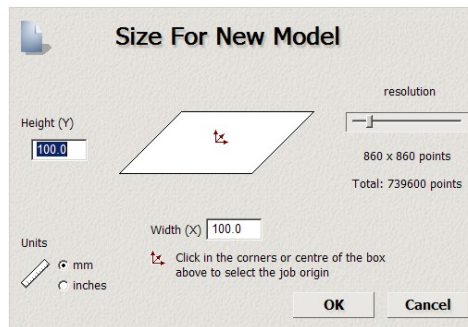
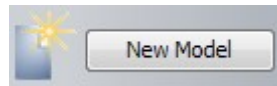
Starting ArtCAM Pro

- Double click the **ArtCAM** icon  on the desktop screen with the **left mouse button**.



The **ArtCAM** start up screen appears as shown above. To start working in **ArtCAM** the user must create a **New Model** or for more complex assemblies, a **New Project**. **Projects** will be covered later at a more advanced stage of the training course.

- Select **Create New Model**.



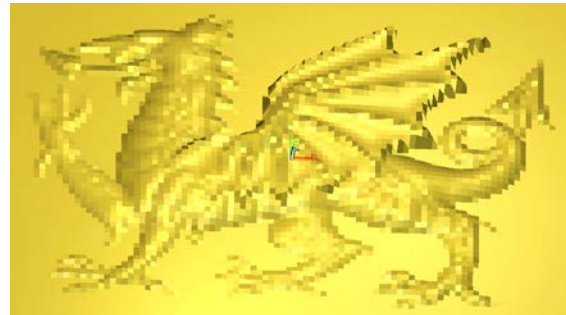
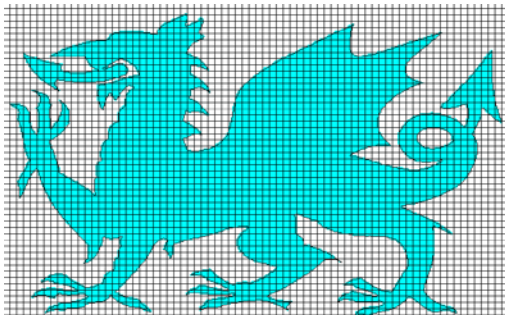
A **New Model** must have:

- A defined area in **Y** and **X** to work in;
- An **origin** (datum) position;
- A **resolution** (the total number of squares within the working area). Each square defined by the **resolution** will either, stay put or extrude up or down to produce a tiny part of the **3D Relief** form.

When working with **bitmaps** the **resolution** is inherited from the imported image file, as a result it is important to use as higher quality image as possible.

Resolution

The dragon model shows the **2D view** of the model broken up into a number of squares (pixels). Each square is given a height in **ArtCAM** dependent upon the command used. The first relief uses a low resolution, which means a loss of fine detail in the resulting **3D Relief**.

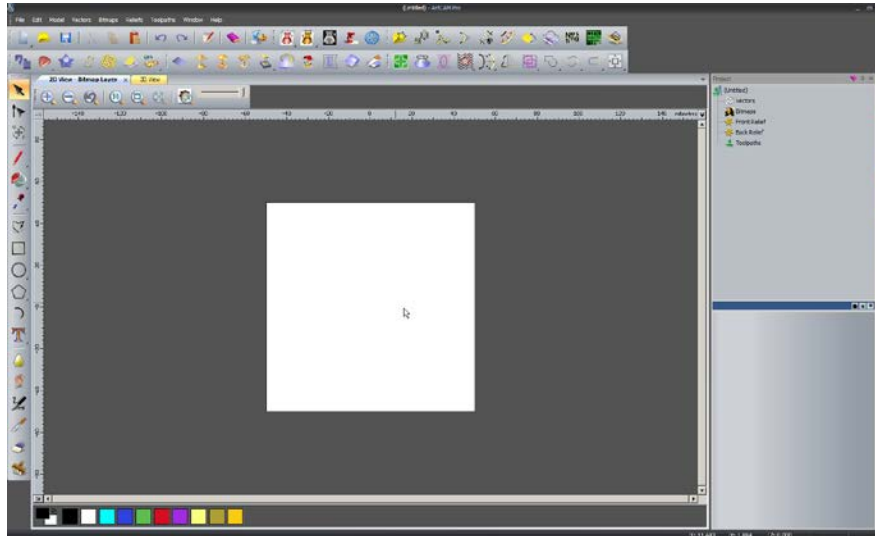




If a high **resolution** is applied, the model is broken into more pixels, which is in turn reflected in the definition and quality of the **Relief** model.



Note: The trade-off with having a high resolution can normally result in larger file sizes, calculation and machine cutting times.

- Set the **Height and Width** as **100** with **origin in the centre**.
- Ensure the **units are set to mm** and the **resolution as 796 x 796 points**.
- Select **OK**.



ArtCAM opens up displaying the **2D view**, with the **Relief** displayed in the **3D View**. You can toggle the views by selecting   (or **F2** or **F3** shortcut key).

The **2D view** is traditionally used for designing **vectors** (2D artwork) and **bitmaps** (images). **Reliefs** (3D models) created or generated from these entities can be viewed in 3D.

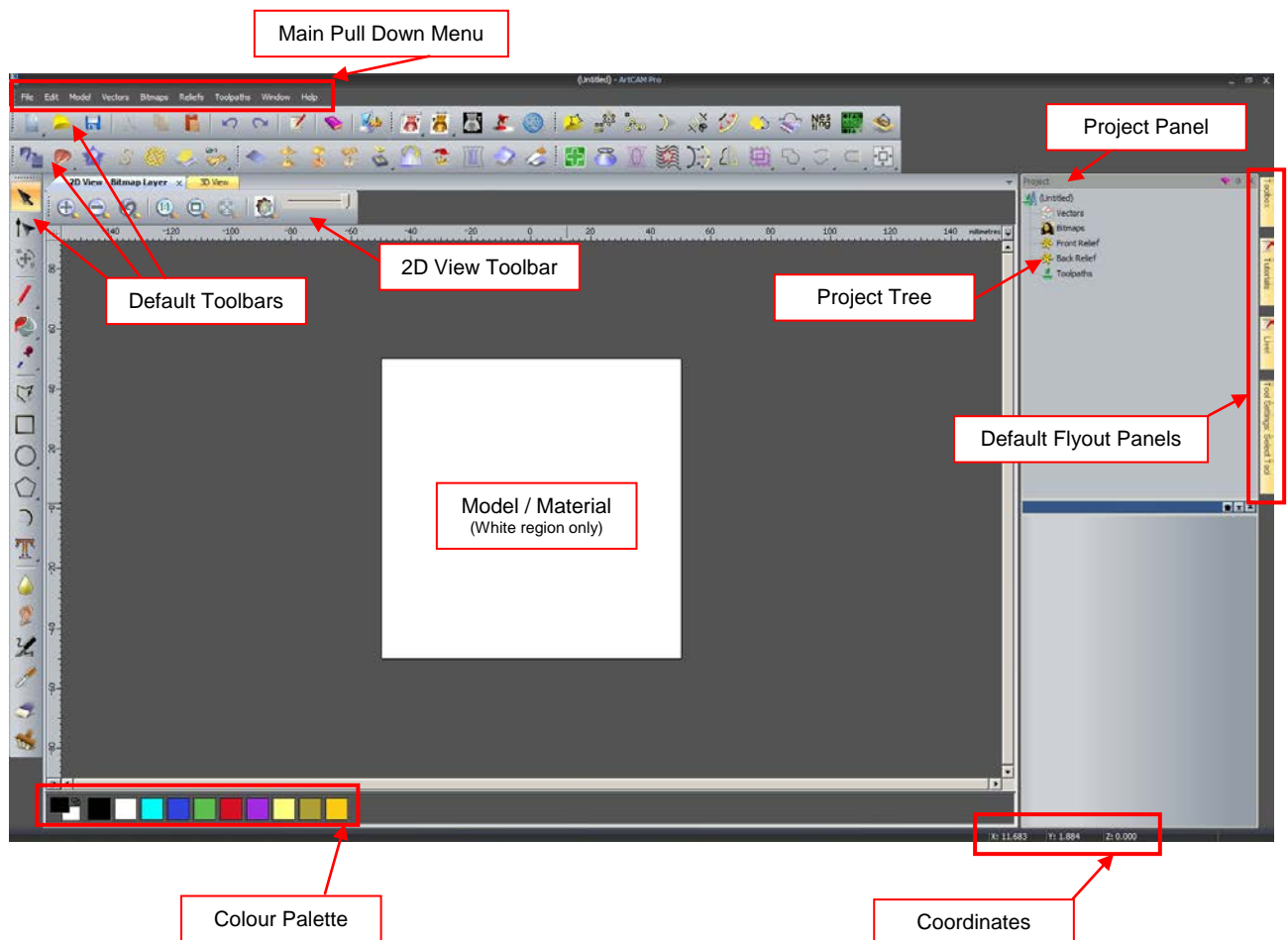
Promoting a more efficient design process, **ArtCAM 2010** now also allows direct modelling from vectors and bitmaps all within the 3D environment. This will be illustrated within forthcoming exercises.

The following pages will summarise the key areas and available functionality within the **default** 2D and 3D environments.

ArtCAM commands are accessed from the **drop down Menu Bar** options or directly from their respective **Toolbars**.

2D View Summary.

The following summarises the **key** 2D view area and functions (default settings).



Zoom In > Zoom in the 2D view.



Zoom Out > Zoom out the 2D view.



Zoom Previous > Zoom to the previous view.



Zoom 1:1 > Zoom to 1 image pixel = 1 screen pixel.



Window Fit > Fit the artwork in the view.



Zoom objects > Zoom to fit the selected object(s).



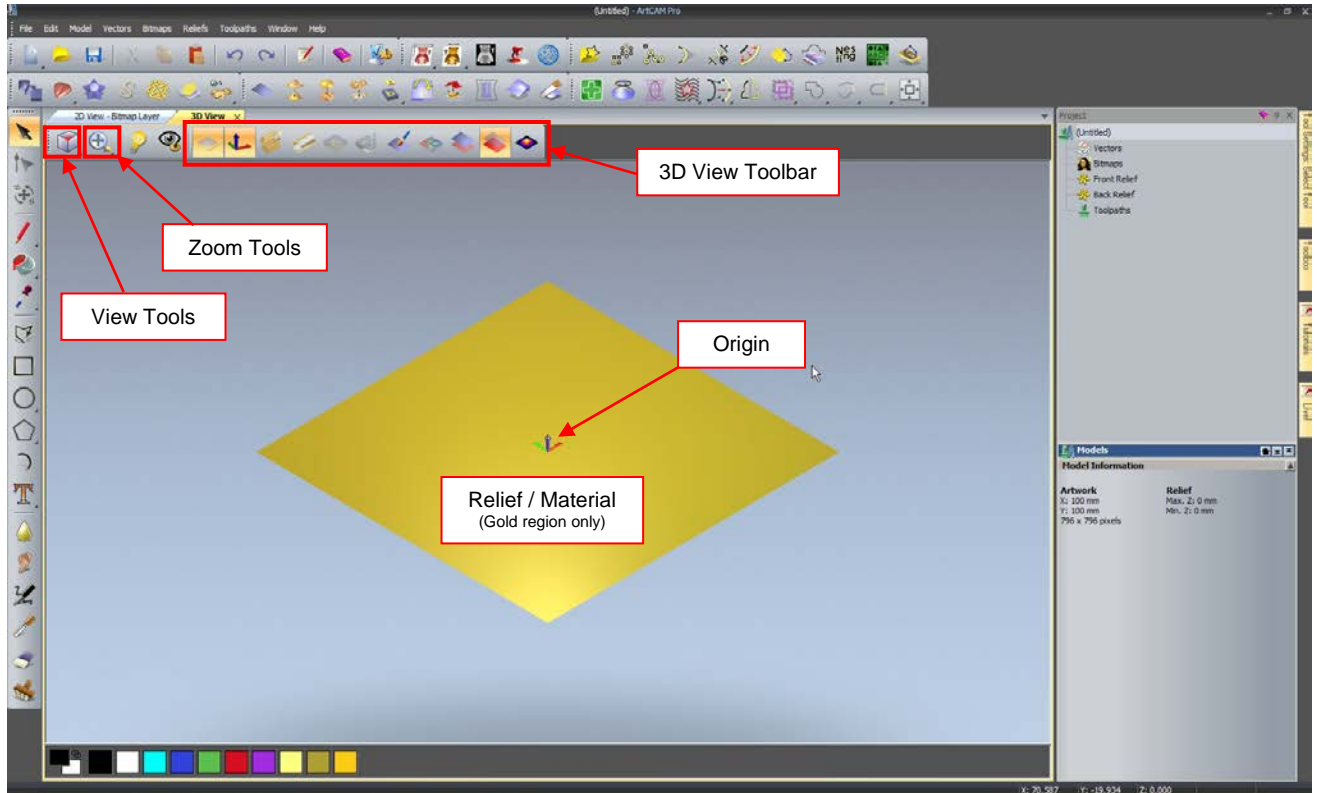
Preview Relief layer > Show a colour preview of 3D Relief in the 2D view.



Bitmap Transparency > Adjust transparency of Bitmap in the 2D view.

3D View Summary.

The following summarises the key 3D view area and functions (default settings).



Isometric View.



View along the X axis.



View along the Y axis.



View along the Z axis.



Zoom In.



Zoom Out.



Zoom to previous view.



Scale view to fit.



Objects to draw (view) dialogue box.



Control various 3D graphics options.



Toggle Z zero plane.



Toggle drawing of the origin.



Toggle visibility of root assembly (in project)



Toggles between displaying flat and rotary reliefs.



Toggles visibility of the defined material block.



Toggles visibility of the simulation block (from machining).



Toggles colour shading (bitmap)



Toggle display of the front relief.



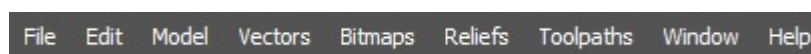
Toggle display of the back relief.




Toggle relief gradient analysis tool.

Main Menu Bar

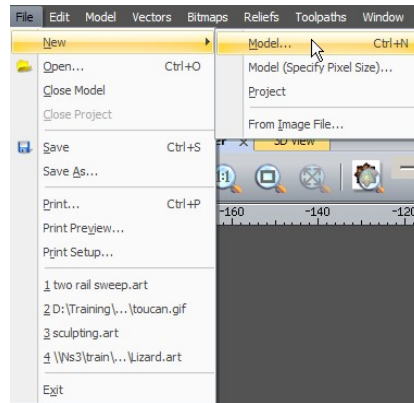
At the top of the **Main window**, there is a **Pull Down Menu Bar**.



Clicking on a menu item opens a pull-down menu that contains submenus and commands. If a menu item **does not apply** to the currently active view it will be **greyed out**.

Sub menus are indicated and selected via the arrow  at the right hand side (where applicable).

For example, the **File menu** expands to show the following.



A yellow bar highlights the function over which the mouse cursor passes. Left mouse button then activates the function.

On certain commands, the keyboard shortcut is listed next to the description. For example, the shortcut to create a new model would be to press the **CTRL** key and then the letter **N**.

Toolbars

The **default toolbars** are summarised below.

The **left hand side** of the ArtCAM interface is occupied by a Toolbar. This is the **Design Tools** Toolbar and contains four key design areas.



Selection Tools

This section contains tools that **change the vector** mode, such as the default **select** function, the **Node Editing** and the **Transform function**.

Bitmap Tools

This section contains the most common tools for painting and working with colours. Items such as paint brush, flood fill and pick colours are located here.

Vector Tools

This section contains all the main vector drawing tools. Available are the creation of Polylines, Squares, circles, ellipses, stars, polygons, arcs and text.

Sculpting Tools

This section contains all the available relief sculpting tools. These can be described as free form tools used for smoothing, smudging, depositing, carving, erasing and transferring.

File Toolbar



Contains the standard **Windows functionality** including the **Help reference** and **Options settings**.



New Model/New Project > Creates a new blank ArtCAM Model or Project (flyout).



Open > Open an existing ArtCAM file or image (.art, .bmp, .tif, .gif, .jpg, .rlf (relief)).



Save > Save the current ArtCAM model or Project.



Cut > Move the currently selected object to the clipboard.



Copy > Copy the currently selected object to the clipboard.



Paste > Paste the currently selected object into the model.



Undo > Undo the last command



Redo > Redo the last Undo command



ArtCAM Notes > Add written notes to the current ArtCAM file.



Help > Launch ArtCAM's online help.



Options > Change global settings for ArtCAM.

Model Toolbar



Includes tools to **modify** the **Model size, resolution, Origin, Position** and **Lighting (shading)**.

Vector Creation



Advanced creation tools for vectors including **Offset, Bitmap to vector and Nesting**.

Relief Creation



Tools to create Reliefs including **Shape Editor, Weave wizard and Paste relief from a file**.

Relief Editing




Tools to edit a current relief such as **Scale, Smooth, Invert, Mirror and Offset**.

Vector Editing



Tools to edit current vectors such as **Vector doctor, Wrap vectors, Clipping, and Mirroring**.

Flyout menus

Several icons have a **small arrow**  located at the **bottom right hand corner**. This indicates that this icon has further hidden functions which can be accessed from a flyout.

Select and hold the left mouse button over an icon (with the arrow) will reveal the functions in the flyout menu. Releasing the mouse over the desired function will activate it.

For example selecting the **Circle icon** from the **Design Tools Toolbar** reveals the ellipse.



Selecting Draw reveals the Paint and Paint selective functions.



Project Panel

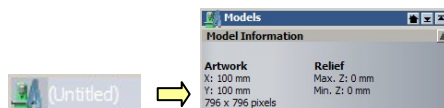
The right hand side of the ArtCAM interface is occupied by the **Project Panel** and several **Flyout panels**.



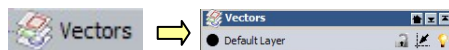
The **Project Panel** serves as a central area to manage the main design and machining aspects of the **ArtCAM model**.

When an item is highlighted, the lower half of the panel displays further information.

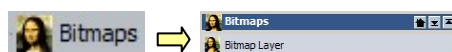
A summary is provided below.



Summarises the **Model information**.



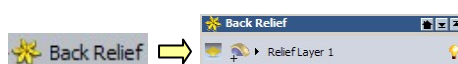
Displays the **Vector layers Toolbar**.



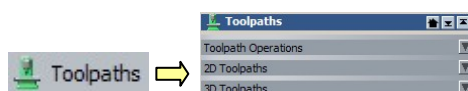
Displays the **Bitmap layers Toolbar**.



Displays the **Front Relief layer Toolbar**.



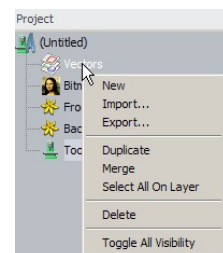
Displays the **Back Relief layer Toolbar**.



Access to all **2D** and **3D Toolpath** functions.

Right mouse selecting on an item in the Project Panel reveals the equivalent functionality (summarised above).

For example, Right mouse selecting the **Vectors** option reveals all the **Vector Layers functionality**.



The functionality above will be discussed in greater detail throughout the training course.


Note: Although the **Project panel** provides a central area, all individual functionality shown above can also be accessed from either the **top Pull down menu**, or their **specific toolbars**.

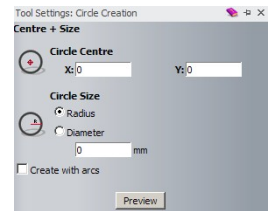
Flyout Panels

The four default hidden panels on the **right hand side** can be activated by simply **holding the mouse cursor** over the desired flyout tab.

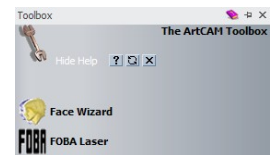


The **Tool Settings Panel** displays all the **settings and information** about the **current** or active function.

For example, If the **create circle** function  is selected, The Tool settings Tab will reveal the Circle Creation form where required sizes and coordinates can be entered. **Keyboard shortcut F6** also reveals this tab.




The **Toolbox Panel** reveals external **ArtCAM Plug ins** (applications) that have been created and are compatible with ArtCAM. For Example, the **Face Wizard** can be found here.



The **Tutorials panel** will provide a resource for Training materials and tutorials.

New to 2010, The **Live Panel** will provide access to an online database of **Training videos**. This area is subject to live updates and additional videos released by Delcam. **Note:** **Internet access** is required to obtain this resource.



Fly out Panels can be **fixed** (stay out) by selecting the **Pin icon**  at the **top right hand corner** of the panel.



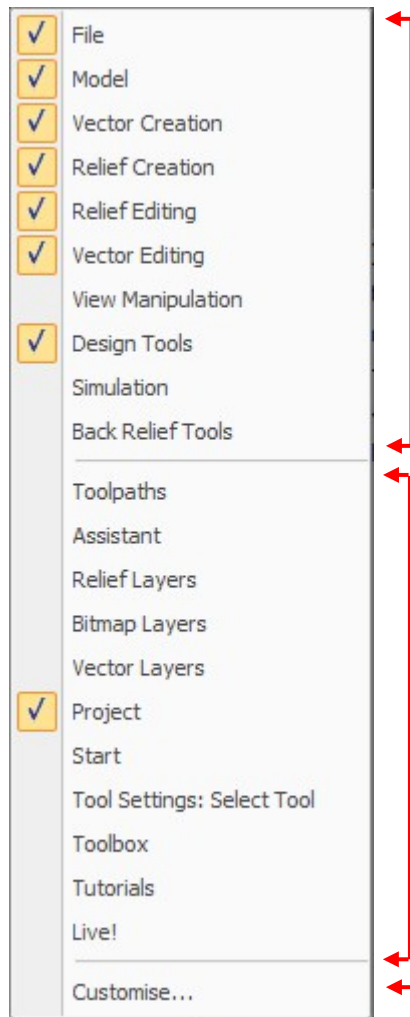
Reselecting the Pin will **hide** the panel. 

Selecting the **cross**  will **close and remove the panel tab** from the screen.

The following section will outline the ability of **ArtCAM 2010 to customise the interface** including **adding** and **removing** toolbars, **functions** and **Fly out panels**.

Interface customisation

Right mouse selecting in the **toolbars or grey border region** will present the following menu.



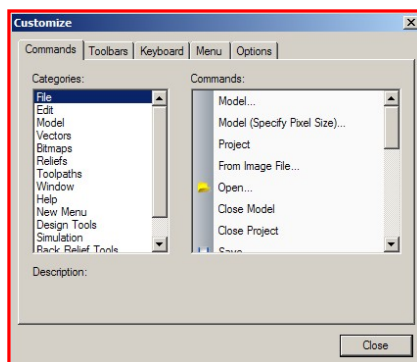
The **top half** of this menu lists all the **standard toolbars** available in ArtCAM. Items indicated by the **Tick**, ☒, are currently **visible**. Selecting or unselecting the option will toggle its visibility from the interface.

The **lower half** of this menu lists all **standard Fly out Panels** available in ArtCAM.

As above, selecting/unselecting the ☒ will toggle its visibility.

If a **Panel was closed** ☐ previously, it can be reactivated here.

Selecting **Customise** will present a **new menu** which allows extensive customisation of the layout. This is outlined below.



Commands All **Commands are listed** here. These can be **dragged and dropped** into existing visible toolbars.

Toolbars Toggles **Toolbar visibility** and ability to create a **new customised Toolbar**.

Keyboard **Keyboard shortcuts** can be assigned here.

Menu Options to **customise menu** including animation.


Options General Toolbar options including **Tool tips** and **icon size**.

Docking Toolbars

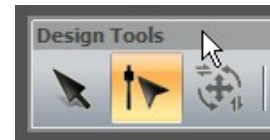
Toolbars can be **dragged** into the interface and allowed to 'float' in a desired location.

At the **end** or **top** of each toolbar there is a dotted line.




When the mouse cursor is placed over this line, it changes to a cross  at which point the toolbar can be selected and dragged.

Double Mouse clicking in the **top margin area** of the Toolbar returns it to the original fixed location.



Docking Fly out Panels

When a **Fly out** Panel is **fixed**,  it also can be **dragged (to float)** or **docked in a fixed position** at each end of the screen.

Select and Hold the **mouse cursor** in the top margin to drag the Panel into the screen.



Whilst **dragging**, the interface displays a **cursor pad** in the **centre and edges of the page**. Depending on which arrow the panel is moved over, the screen will display a blue region where the panel will dock. Release the mouse button to dock the panel in this location.

Panels can also be docked onto the top or bottom half of other fixed Panels. This is achieved by dragging a panel (as described above) onto another Panel to activate the 'cursor pad'.

Themes and Layout

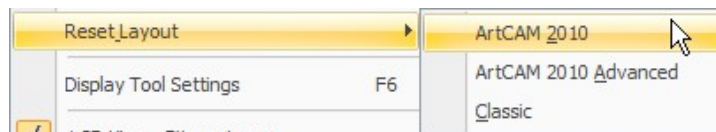
From the top **Window**  **drop down menu**, a number of interface options are available.

From **Window > Theme.....**

Select **Classic** to change the colour scheme from the **current 2010** theme a traditional ArtCAM background.



From **Window > Reset Layout.....**



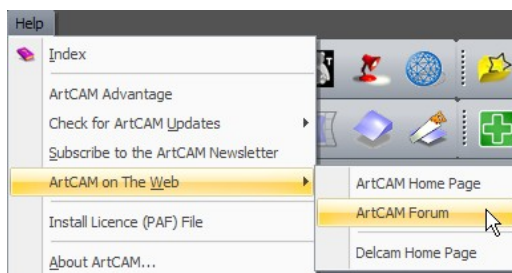
Select **ArtCAM 2010** to quickly **reset** the interface to **default settings**.

Select **ArtCAM 2010 Advanced** to change the interface to an **advanced setting** where all toolbars are switched off.

Select **Classic** to change the interface back to **ArtCAM 2009**.



ArtCAM Help

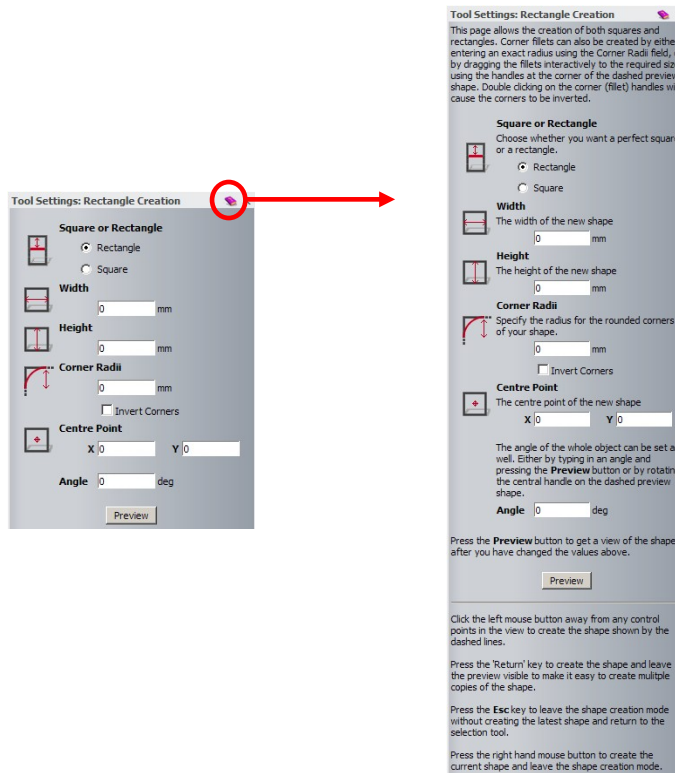
By selecting **Help > Index** from the top Menu bar (or by pressing the F1 shortcut key) a Help Page will open over the graphics area.



Further sources of information and help can be obtained from the **ArtCAM website** and dedicated **Forum**.

Individual function forms can be expanded to provide a detailed explanation of each available option/entry.

This is achieved by selecting the **Help icon**  in the top right hand corner of the active form. The example below applies to the **Rectangle creation** function. 



ArtCAM File structure

ArtCAM Models (*.art)



An **ArtCAM Model** will contain all entities created within the session such as **Bitmaps** (image files), **Vectors** (2D geometry) **Reliefs** (3D models) and **Machining data** (Toolpaths). This ArtCAM file is identifiable by having an **.art** extension and can be saved or exported as a whole.


It is also possible to save/export independent entity types from within the **ArtCAM Model**. These include the **Vectors** (mainly **.eps .dxf .dgg .pic** formats), **Reliefs (.rlf)**, **Triangle Models (.stl .dmt)** and **Machining Output (.tap)**.

For more advanced applications where it is required to create an assembled group of separate **Relief models (.rlf)**, an **ArtCAM Project** is first opened in which several **ArtCAM Models**


can be created and combined as required for an assembled item. When saved, the **Artcam Project** is identifiable by a **.3dp** extension. To enable the **Reliefs** to co-exist together, the individual components are converted within the **Assembly** as **Triangle Mesh** models. ArtCAM can also **import surface models** (e.g. **iges**) directly into an assembly.

ArtCAM Projects (*.3DP)



To allow greater freedom and complex 3D design, ArtCAM adopts a unique process of model making, where by all associated **files** or **components** are created and stored within a single **Project folder (*.3DP)**. The Project folder can be best described as a repository for all the finished components or **Assemblies**.  Each **Assembly** within this Project Folder can then be freely positioned, combined and manipulated (e.g. shaded, scaled) in 3D space.

Assemblies

Each of these **Assemblies**  is created from **ArtCAM** model or imported as a **triangular mesh replica (*.3da, *.stl, *.obj, *.dmt)** or alternatively **imported** directly as a **surface model** (all major 3D modeling formats including ***iges, *3dm, *dgn**).

Providing that a replica mesh has been created from an ArtCAM model stored as part of the same project, it also **hosts a link to the ArtCAM model file from which it originates**.

A single assembly hosts any number of replica meshes and/or gems or further assemblies along with their own associated replica meshes and gems. You can create a relief layer in an open **ArtCAM** model directly from a replica mesh, or an assembly providing that it has an associated replica mesh.

Assemblies are useful for a number of reasons. Firstly they are very useful for visualization, as they allow you to view both the front and back surfaces of a piece simultaneously. In addition, they can be replicated, scaled, positioned and rotated. Although an assembly can be manipulated in three-dimensional space, you cannot edit the actual shape of the assembly itself.

The main advantage of using this system of creating and storing is that it allows **assembly** of separate components. For example, gems, settings and a ring shank can be created separately but then assembled in the Project Folder to create a finished piece. This finished piece can then be machined as a whole using the powerful **Multi-Sided Machining Wizard**.

Design

ArtCAM Reliefs (*.rlf) or simply the 3D models are created from **2D vectors** or **bitmaps**. These **vectors** (2D artwork) and **bitmaps** (images) can be generated within ArtCAM or imported from other systems. **ArtCAM** can generate reliefs from an imported model. When dealing with bitmaps and Reliefs it is important to understanding **Resolution**, which will influence the overall surface detail of the relief and ultimately the final piece.

Manufacture

The final stage for most **ArtCAM Projects** is to manufacture the 3D relief as a real object. Currently there are two major routes to production: via **CNC** machining or **Rapid Prototyping**. **ArtCAM** can realise its models using either method.

ArtCAM can calculate the **toolpaths** required to machine the individual relief or final assembly. The calculated toolpaths can be then sent directly to the machine (via post-processing) ready for cutting.

Most Rapid Prototyping machines require a specific type of 3D model. These models are made up of a small triangular mesh, which defines its whole surface shape. This type of file is commonly known as an **STL**, file format. **ArtCAM** allows you to export the final assembly or relief in the **STL** format, ready for manufacture.

Mouse buttons application

Each of the **three mouse buttons** performs a different operation in **ArtCAM Pro 3D View (F3)**. By using the **ALT**, **Ctrl** or **Shift key** on your keyboard, these operations can be extended as the following details explain.

Left mouse button: Picking and selecting



This button is used for selecting items off the **main pull down** menus, inputting data and selecting parts of the model.

Middle mouse button or wheel: Dynamics



Zooming:

Scroll the **middle mouse** to Zoom IN/OUT of the model. This applies to the 2D and 3D view. Alternatively, Select the **SPACE BAR and Right mouse button** together and move the mouse to Zoom IN/OUT. This option applies to the 3D view only)

Panning:

Hold down the **Left and Right mouse buttons** and move the mouse, to move the view across the component.

Rotating/Twiddle:

Hold down the **middle button/wheel** and move the mouse. Alternatively Select the **SPACE BAR and Left mouse button** together and move the mouse. This option applies to the 3D view only)

2. Generating Vectors

Overview

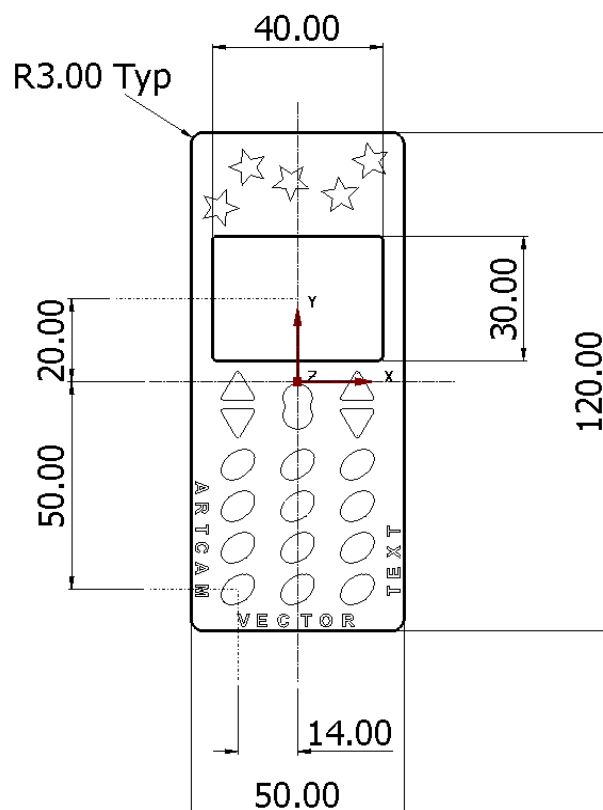
Vectors are mathematically defined shapes consisting of a series of points (nodes), which are connected by lines, arcs or curves (spans) to form the overall shape.

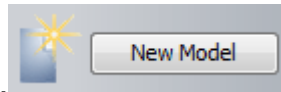
They can be:

- Generated directly within **ArtCAM** by using the **Vector Tools** in the **Assistant** page;
- **Rectangles, Squares, Circles, Polylines, Ellipses, Polygons, Stars** or **Text** that can be edited if necessary to generate the final **vectors** to create a **Relief** from;
- **Imported** from another drawing package, using the **File – Import** menu option, or copied and pasted from another package using the standard **Windows** commands.

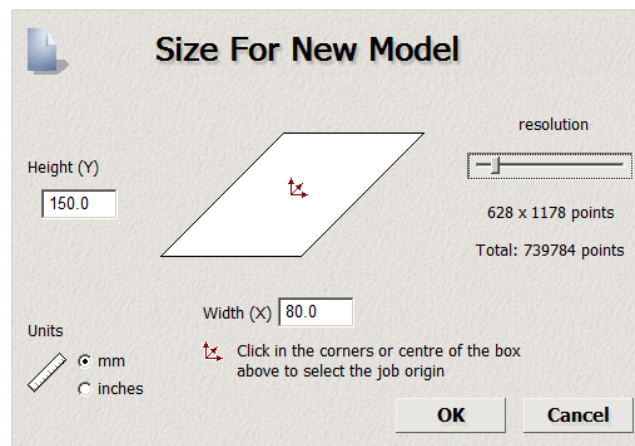
Mobile Phone Cover Exercise

In the following exercise you will generate a **Mobile Phone Cover** using the **Vector Tools**. Below is a drawing of the item including basic dimensions, so that you can get an idea of how the final product should look before working through the 'step by step' instructions.





- Select **New Model**.
- Enter a **Height** of **150mm**, a **Width** of **80mm**.
- Set the **Origin** to the **centre** of the model and a **resolution** of approximately **628x1178 points** (by moving the slider).



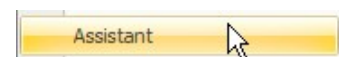
- A **new** ArtCAM Model (sheet) is generated based on the parameters defined above.

The vector creation tools (any many others) can be accessed in a number of ways.

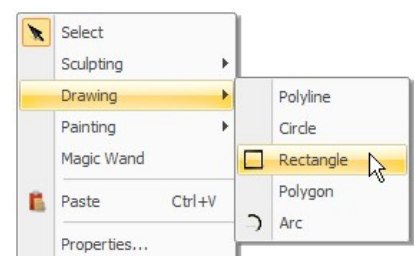
1. The default **Design Tools toolbar** on the left hand side.




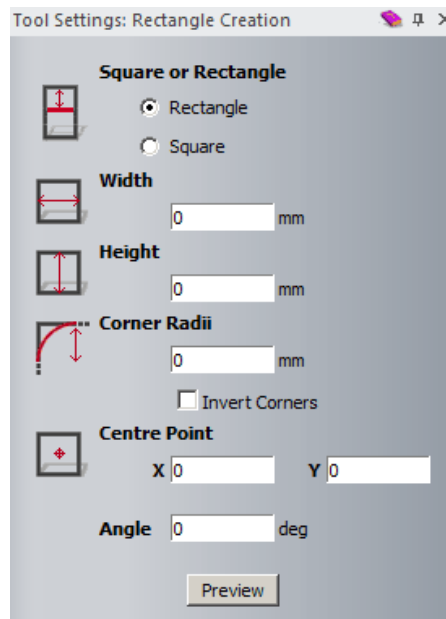
2. Activate the **Assistant Tab** by **right mouse selecting** in the **grey border**.



3. **Right mouse select** in the white model sheet and select the Drawing options.



- Using a method outlined above, Select **Create Rectangle**. 
- The **Rectangle creation** form appears in the **Tool settings** form.



Tool Settings: Rectangle Creation

Square or Rectangle

☒ Rectangle
☐ Square

Width 0 mm

Height 0 mm

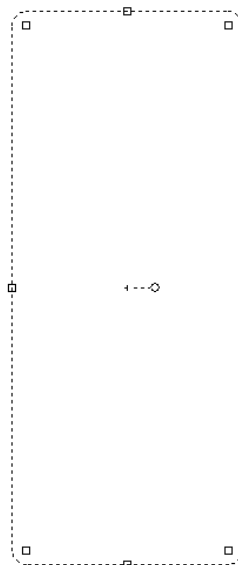
Corner Radii 0 mm
☐ Invert Corners

Centre Point
X 0 Y 0

Angle 0 deg

Preview

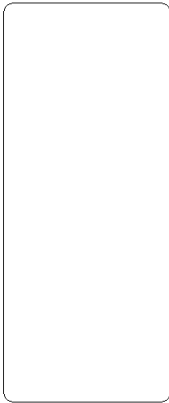
- Enter a **Width of 50mm**, a **Height of 120mm**, **Corner Radii of 3mm** and a **Centre Point of X 0 and Y 0**.
- Select **Preview** to view the proposed shape (represented as dashed lines)



- To **create the shape**, **single left mouse click** in the view area.

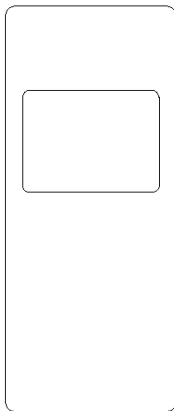
The rectangle is created on the model page whilst keeping the rectangular creation form open. This can be utilised to create a new rectangular shape.

Note: A single right-mouse click would create the shape, but close the vector creation form.




The outer **shape** of the phone **cover** is created.

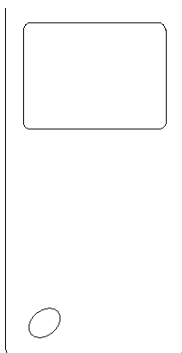
- In the Rectangle Creation form, change the **Width to 40mm, Height to 30mm, Corner Radii to 1mm** and the **Centre Point to X0 and Y20**.
- To create the shape, **single right mouse click** in the view area (and close the form)



This second **Rectangle** will represent the display window.

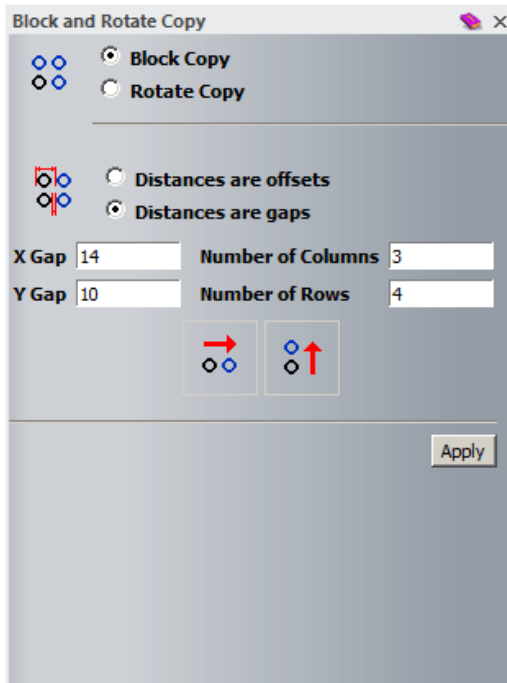
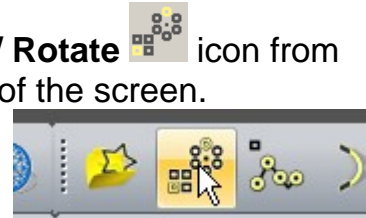
- Select **Create Ellipse**. 
- Enter a Start Point of **X -14 Y -50** with a **Height of 7mm, Width of 10mm** and an **Angle of 140 degrees**.

- **Right mouse click** to create the shape.



A **block pattern** of this single **Ellipse** can be created quickly to complete the keypad.

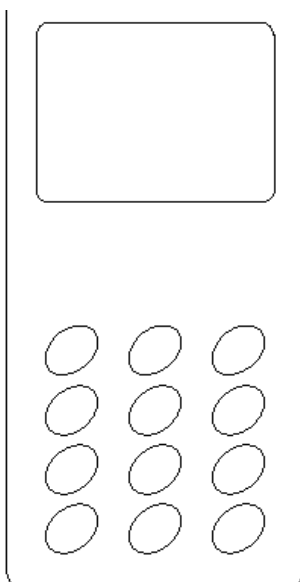
- With the **Ellipse** selected, click on the **Block Copy / Rotate** icon from the **Vector Tools** area on the **Assistant's** page or top of the screen.



The **Block and Rotate Copy** allows you to create a **block copy** in **X** and **Y** or a **rotated copy** around a point.

The distances can be set as an offset value or by a gap value between each item.

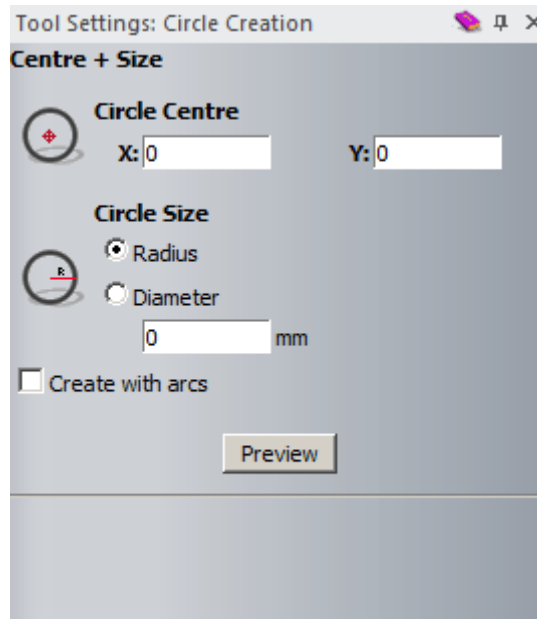
- Select **Block Copy** and **Distances are offsets** options.
- Select an **X Offset** of 14mm, with **Number of Columns** as 3.
- Select a **Y Offset** of 10mm, with **Number of Rows** as 4.
- Select **Apply**.



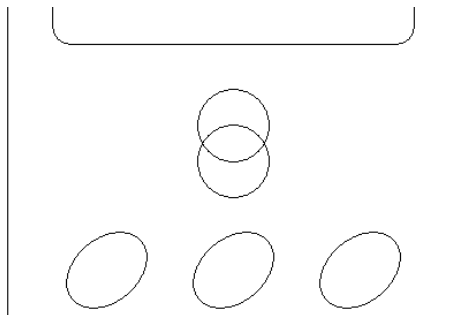
The keypad is created.

A centre 'menu' button will be created from two combined circles.


- Select **Create Circle**.



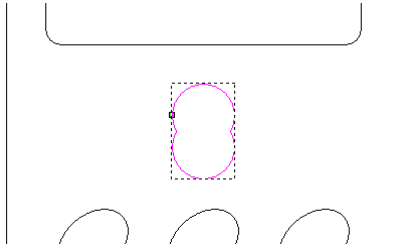
- Create a circle with centre at **X0 Y-4**, **radius as 4mm**.
- Create a second circle or **radius 4mm** but with centre at **X0 Y-8**.



The **Circles** will now be 'merged' into one.

- Select **both circles** and select the **Weld** button  from the **Position, Combine, and Trim Vectors** area on the **Assistant's** page.


By **welding** the two **Circle** vectors, a new single vector is created.

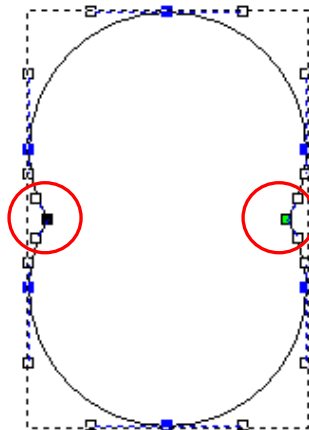


Note: The **Weld** command only works on two selected closed **vectors**.

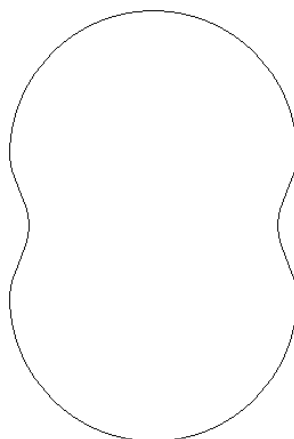
- **Zoom in** to see the vector more clearly.

Zoom either using the  tool or middle mouse cursor.

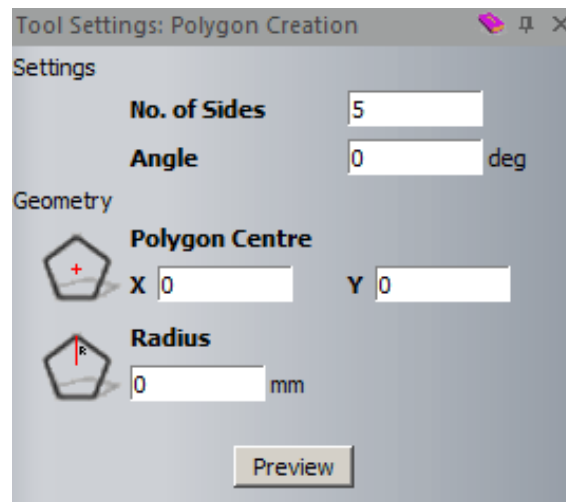
- With the new vector selected, select Node Editing. 
- Hover the mouse over a **left black node**, press the **right mouse button** and from the side menu select **Smooth Point** (or press **S** on the keyboard).



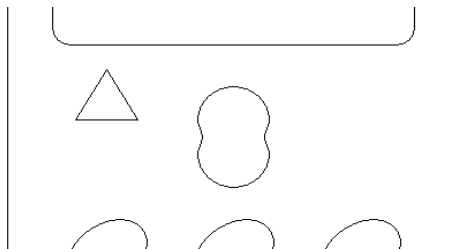
- Repeat for the other side to provide a shape with smooth inner corners.
- Press **N** to return to **Select** mode and click away from the vector.



- Select **Create Polygon**.

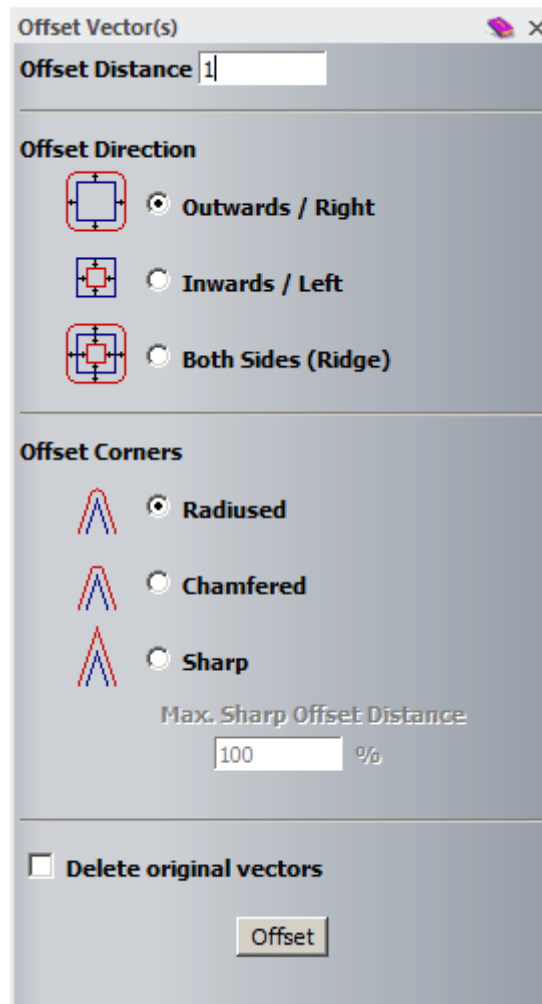


- Enter **No. of Sides** to be 3, **Angle** 0, **Polygon Centre** at X -14, Y -2 with a **Radius** of 4mm.
- **Create** the triangle shape (left/right mouse click)

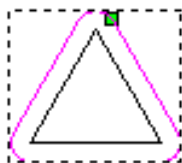


- With the Triangle vector selected, select **Offset Vector(s)**.





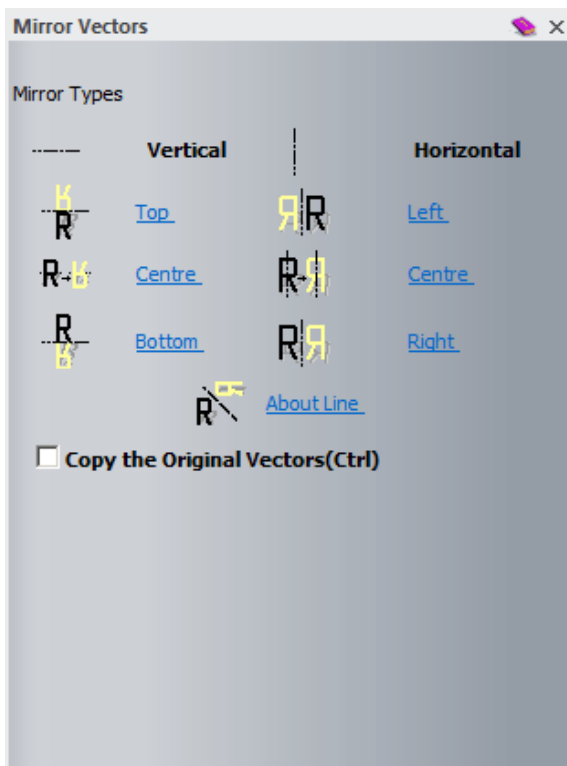
- Select an **Offset Distance** of 1mm, **Offset Direction** as **Outwards** and **Offset Corners** as **Radiused**.
- Select **Offset** to create the new shape.



The new **vector** is **Radiused** at the corners.



- Select the **original inner vector** and press **Delete** on the keyboard.
- Select the **new vector** and select **Mirror Vectors**.

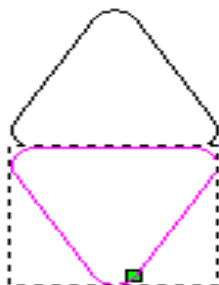




The **Mirror Vectors** page allows you to mirror the selected **vectors** about themselves or about a selected line.

Note: You must select the **mirror line** first before applying the **Mirror Vectors - About Line** option.

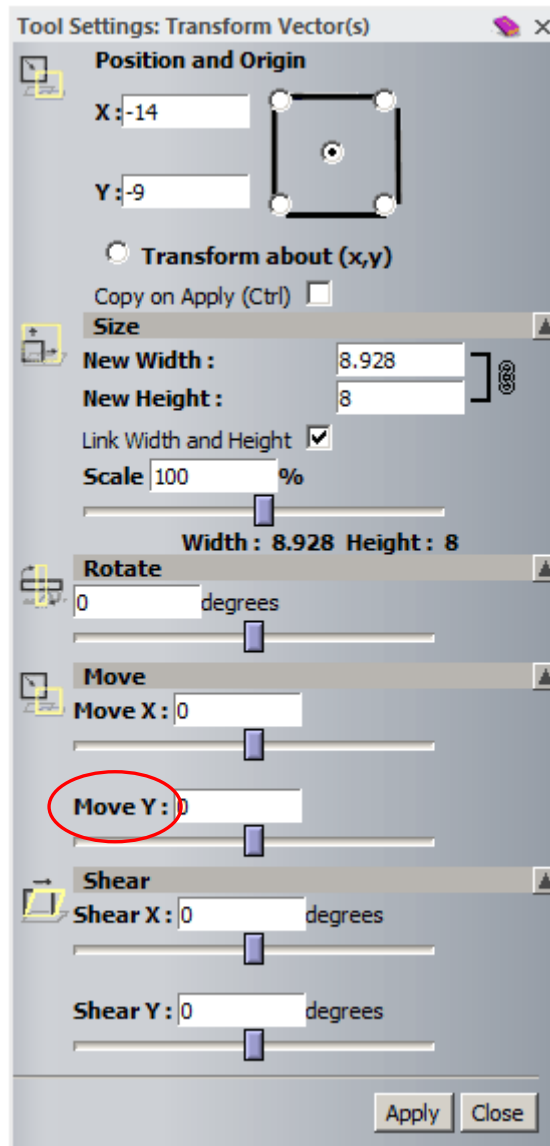
- Select  **Copy the Original Vectors (Ctrl)**,
- Select **Bottom**  to create the mirrored triangle.



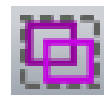
The **new vector** will be moved downwards. It can be nudged using the **down arrow** or moved more accurately by a value using the **Transform Vectors** command.



- Select **Transform Vectors** (or hit **T** twice on the keyboard).



- Enter **Move Y** as **-1**, select **Apply**.



- Select both **Triangular vectors** and then select the **Group** button.

The two items can now be treated as one.

A **polyline** will be created to use as a mirror line for this grouped feature..

- Select Create Polyline.



Tool Settings: Poly Line Creation

Next Point

X: 0 Y: 0

deg: 90 L: 0

dx: 0 dy: 0

Cursor Position

X: 17.134 Y: 9.359

Last Point

X: -40 Y: -75

Angle and Length

deg: 55.891 L: 101.886

Change in X Y

dx: 57.134 dy: 84.359

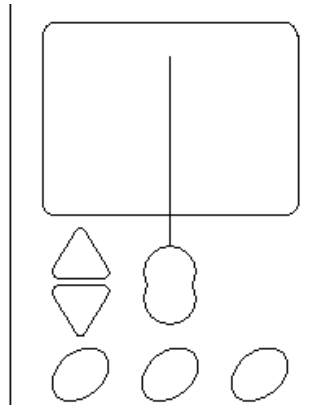
☐ Draw smooth polylines

Add

Polylines can be generated by entering **absolute co-ordinates** in the **X** and **Y** area, by angles and line length, as **relative co-ordinates** using the **dx** and **dy** (distance from last point) or by clicking with the cursor.

Note: **Polylines** can also be created dynamically in the graphics area either by holding down the left mouse key while freehand sketching a curve, or by using the left mouse key to click individual points along the required route.

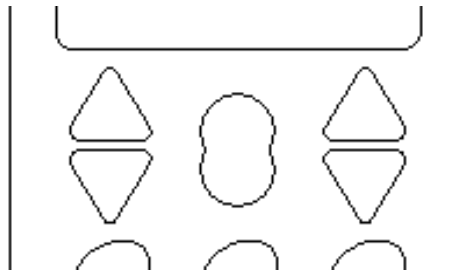
- Select **Add** (enters a point at 0, 0).
- Enter **30** in **dy** (**30mm** in **Y** direction), select **Add** and then **Close**.



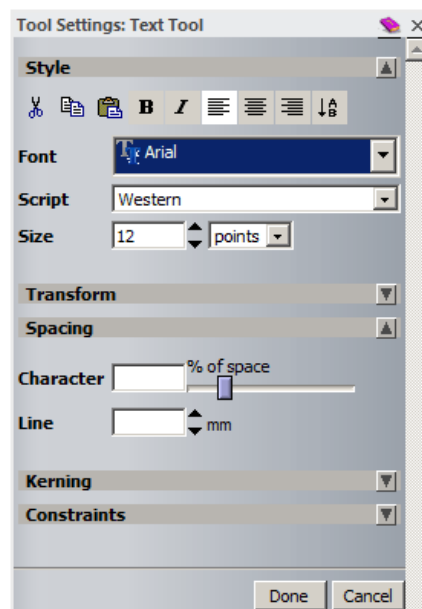
- Select the **Polyline** first and then **shift select** the **triangle group**.



- Select the **Mirror** button.
- Select ☒ Copy the Original Vector option.
- Select **About Line** to create the mirrored feature.
- Delete the **Polyline**.



- Select Create Vector Text.



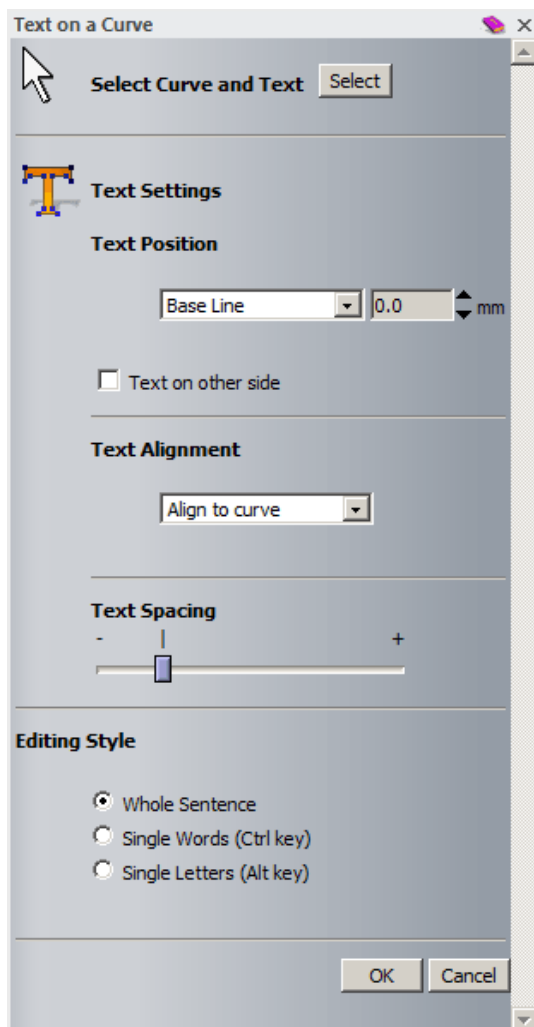
- Select Font as **Arial**, **Script** as **Western** and **Size** as **3mm**.
- Click at the bottom of the **2D View** and type **ARTCAM VECTOR TEXT**.
- Select **Done**.



ARTCAM VECTOR TEXT

This **Text** can be wrapped around the **outer vector**, with the text inside, using the **Wrap text round a curve** option.

- Select **Wrap text round a curve**.



The **Text on a Curve** page appears, which allows you to align an existing **Text Vector** to a **Curve Vector**.

Text Position includes options that control the relative, position of the **text** across the curve.

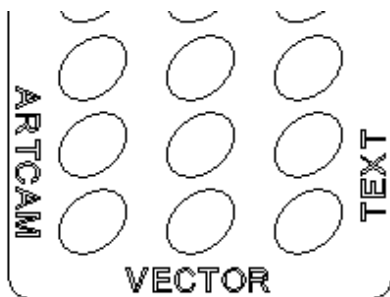
Text on other side puts it on the other side of the curve.

Text Alignment includes options that control the flow of the **text** along the curve.


Text Spacing allows you to vary the spacing between the individual characters.

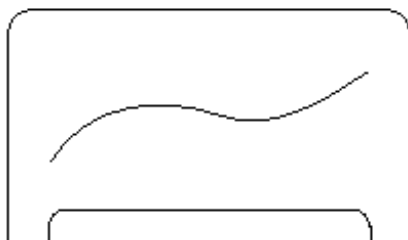
Editing Style allows you to set individual **Words** or **Letters** to be repositioned around the curve independently.

- Select the **Text** and shift select the **outer vector** and press **Select** in the **Text on a Curve** page.
- Select the **Text Position** option as **Specify** and enter **1mm**.
- Tick the option **Text on other side**. (if text is on the outside)
- Select the **Editing style** option as **Single Words**.
- **Dynamically Move** the **text** using the **cursor** to align on the **three sides** as shown below.
- Select **OK**



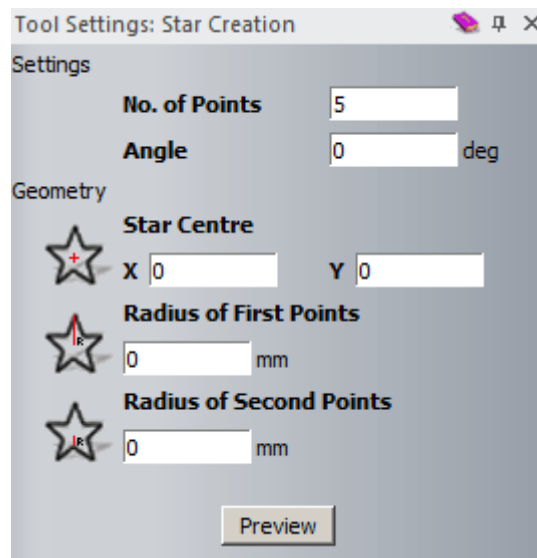
The **Text** is now **wrapped**.

- Select **Create Polyline**  and in the form select the option **Draw smooth polylines**.
- Left mouse click **5** suitably positioned **points** to create a **Smooth Polyline** similar to the one shown below.



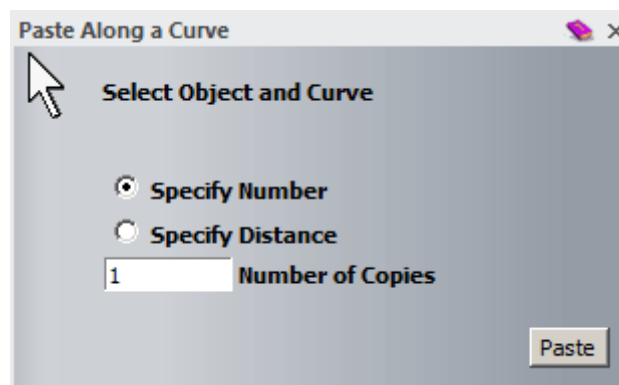
You will use this **Polyline** to **paste vectors along**.

- From the **Vector Tools** area, select **Create Stars**.



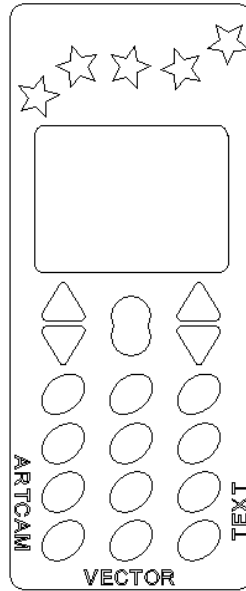
- Enter **No. of Points** as 5, **Star Centre** as X -28, Y 62, **Radius of first Points** as 4.5mm and **Radius of second Points** as 2mm.
- Preview** and **create** the star.
- Select the **Star** vector and **shift select** the sketched **Polyline**.

- From the Vector Tools area, select Paste along Curve.



The **vector** is pasted incrementally along the curve either by dividing the curve equally (**Specify Number**), or by a fixed distance, leaving any surplus at the end of the curve (**Specify Distance**).

- Select **Specify Number** and enter Number of **Copies as 5**.
- Select **Paste**.
- Delete the original **Star** vector and the sketched **Polyline**.



- Select **File - Save As**, browse:

D:\users\training\COURSEWORK \ArtCAMPro-Jobs and enter as File name - training-phone-cover.

- Select **File - Close Model**.

3. Vector Editing and Layers

Vector Editing

The following chapter will introduce several **Vector Editing** options.

Shield Design Exercise

- Create a **New Model** with a **Height of 20mm**, **Width of 20mm** and a resolution of approximately 1002 x 1002 points.
- Set the **Origin** to the **centre** and select **OK**.

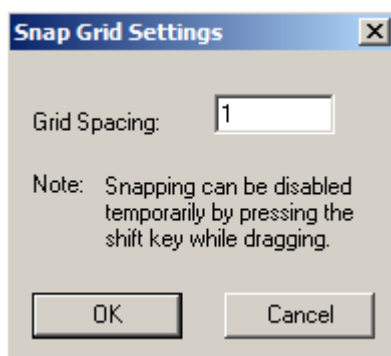
Note:

You can move the origin position by using the option **Set Model Position**.
This allows you to position the **zero datum** to the **Centre**, one of the **4 corners** or a typed **coordinate position**.



Vector input by snapping to a Grid

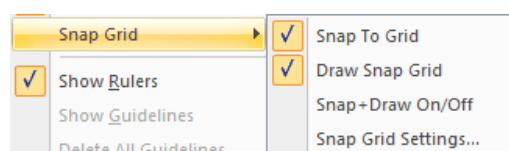
- From the top file menu, Select **Bitmaps – Views - Snap Grid - Snap Grid Settings...**

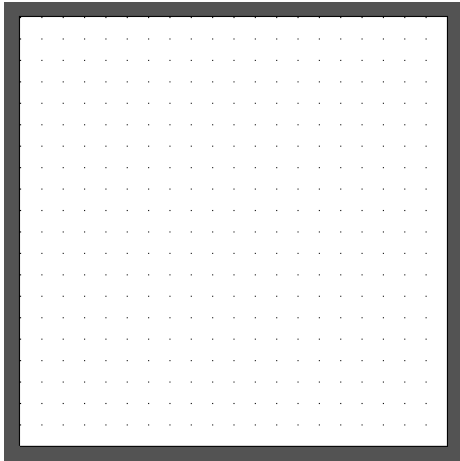


Grids provide **snap points** to assist in dynamically defining vector points. They are available from the **Bitmaps - Views** pulldown menu.

The selected grid spacing value is mainly dependent on the size and complexity of the component to be produced.

- Set the **Grid Spacing** to **1** and select **OK**.
- From the same top file menu, switch ON the options **Snap to Grid** and **Draw Snap Grid**.



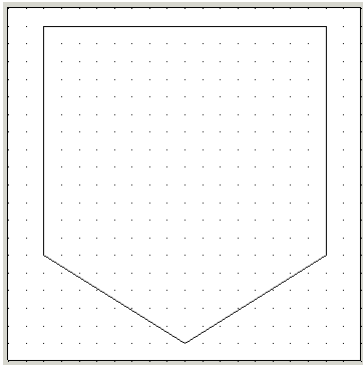


A grid is displayed in the view, with an even point spacing of 1mm.

- Select **Create Polyline**.



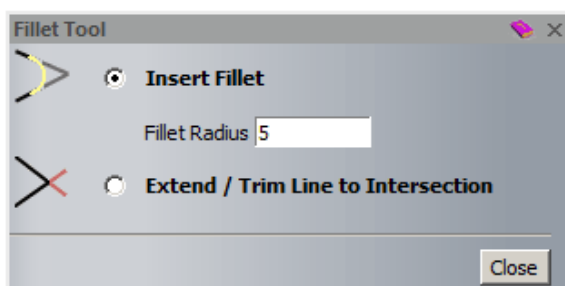
- Snap to the same **Grid points** as shown in the image below.



Note: The best position to **Snap** in a **vector point** is just to the lower, left of a **Grid point**.

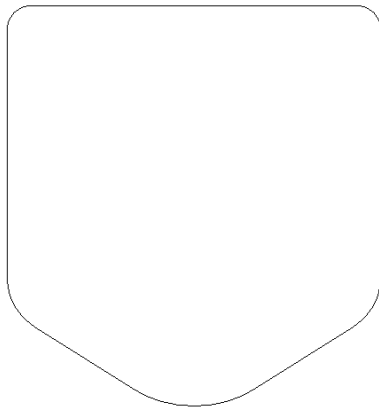
- Select File - Save As:
D:\users\training\COURSEWORK\ArtCAMPro-Jobs\train-shield.
- Switch **OFF** both **Snap to Grid** and **Draw Snap Grid**.

- Select **Fillet vector with an arc**.




The **Fillet** is generated at a node point or from two **Polylines** that would intersect.

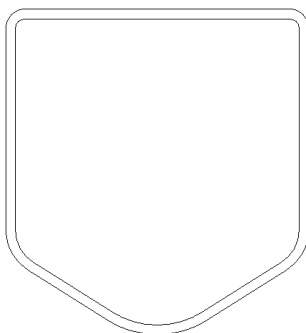
- Enter a **Fillet Radius** of **5mm** and select line **either side** of the **bottom point** to generate the fillet.
- Change the **Fillet Radius** to **1mm** and create a **Fillet** at the **top two corners**.
- Change the Fillet Radius to 2.5mm and create a Fillet at the bottom two corners.



The main shield **vector** is as shown.

- **Close** the form.
- With the **vector** selected, select **Offset Vector**. 
- Set an **Offset Distance** of **0.5mm**, select **Inwards** and **Radiused**.
- Select **Offset**, followed by **Close**.

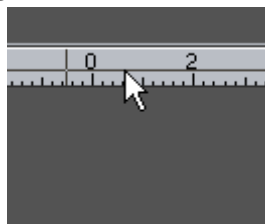
Vector input by snapping to Guidelines



You've created a constant **Offset**. For the middle part, instead of using **Grid lines**, **Guidelines**, you will input actual values.

Guidelines are pulled from within the rulers located around the border of the model. For accurate positioning they can be snapped direct to **Grid points** or if the **Grid** is switched off once created they can be precisely positioned via a **Position Guide** form.

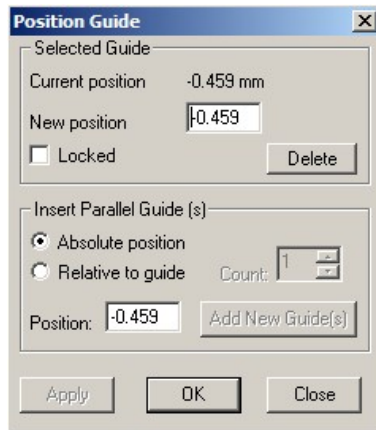
- Hold the **left mouse button down** within the **top ruler** (as shown) and drag down a horizontal **Guideline**.



- Release the **left mouse button**, when it is **near** to the **centre** of the model.

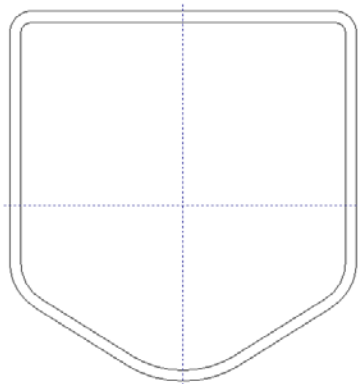


- **Right mouse click** on the **Guideline** to activate the position guide.



This form allows the guideline to be accurately positioned, deleted or further guides to be inserted.

- Enter a **New Position** of **0** and select **Apply**.
- Repeat the process to generate a **vertical Guideline** at **0** (by dragging it from within the **left ruler**.)

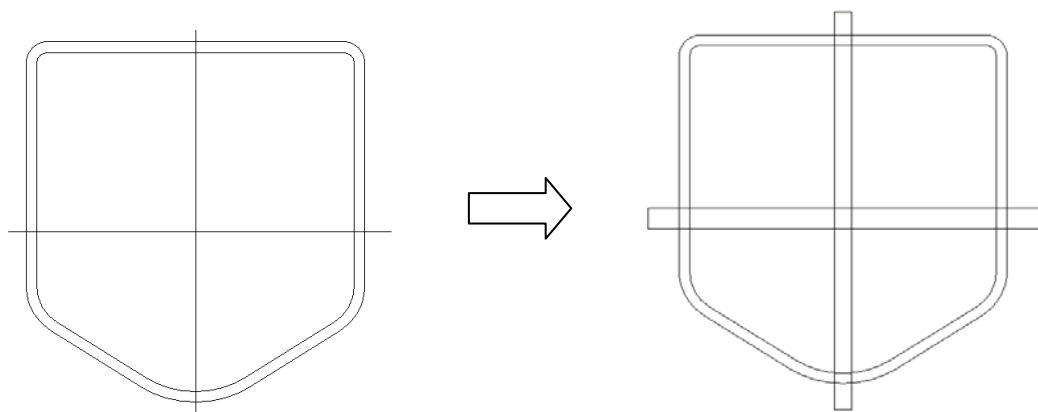


The two guidelines **intersect** at the origin. These guidelines can be snapped to, when creating or moving vectors or nodes.

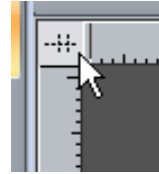
You can show or hide these Guidelines by clicking on the Guidelines icon in the top left corner of the rulers.






- Select **Create Polyline**.
- Snap on the Guidelines to create horizontal and vertical centrelines.

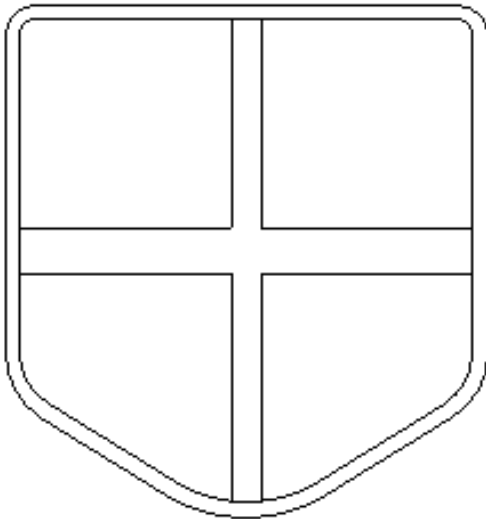


- Pick the top left corner icon in the 2D View to **switch off** Show Guidelines.



The **two new Polylines** will be used to create **Offset Copies** by setting the on **Both Sides (Ridge)** option.

- Offset  the horizontal Line vector **both sides by 0.5mm** selecting the **Both Sides (Ridge)** option.
- Offset  the vertical Line vector **both sides by 0.4mm**.
- Delete the **original Polylines** (if the **Delete original vectors** option was not set during the offset operations).
- Select **Trim vector to intersections**  and trim the **Polylines** to fit within the shield.



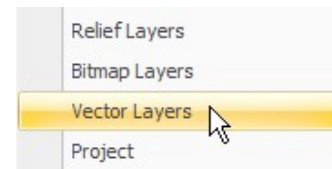
The completed **vectors** for the shield design are as shown.

- Select **File - Close Model** (do not save)

Vector Layers

Vector Layers provide a more ordered method of managing the **selection** and **display** of selected groups of **vectors**. In default mode **ArtCAM Pro** assigns all **vectors** produced to a layer named **Default Layer** (which cannot be **renamed** or **deleted**). Any additional **Vector Layers** can be **Renamed**, **Deleted** and **Merged** together. As new **Layers** are created specific **group of vectors** are assigned to them as required. The layers Tab also allows the user to **Open (Import)** and **Save (Export)** vector data.

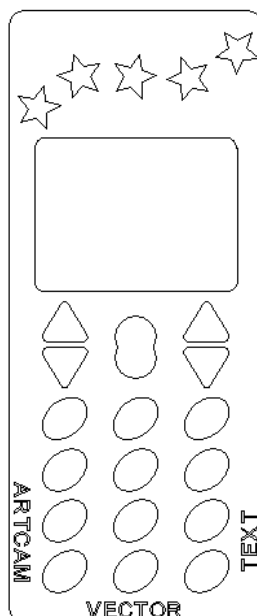
The **Vector Layer Toolbar** can be **activated** by right mouse selecting in the **Grey border** (Right hand side) and selecting **Vector layers**.



Vector Layers are controlled by this toolbar. The **default layer** is **highlighted** and any generated or imported vectors will be displayed, providing the layer is switched on (light bulb).

Phone Cover Exercise

- Open the model **training-phone-cover. art** from D:\users\training\COURSEWORK\ArtCAMPro-Jobs.



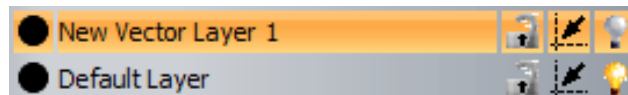
This exercise will show how to **import** vectors and also **move** or transfer existing vector data to other layers.

- Select the **stars vector** group.



Layers need to be generated before vectors can be placed into them. It is good practise to give the layer a sensible name.

- Select **New**  on the **Vector Layers** toolbar.



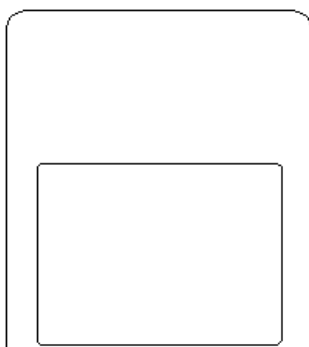
New Vector Layer 1 has been created. By double-clicking on the name itself, the name can be changed.

- **Double click** on **New Vector Layer 1**, overwrite as **stars** and select **Enter** (or mouse click away from the name) to confirm.



The **new level** is now named and switched on (denoted by the light bulb icon). 

- **Right mouse click** on the selected **star vector** group and select **Move Vectors To... > stars**.
- Switch off the **Layer stars** by clicking the **light bulb**.



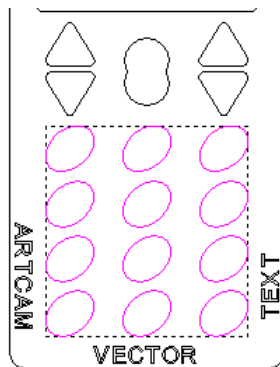
The **star vectors** are now **hidden**. The other vectors on the default level are still displayed.

Note: When a **Layer** is current (highlighted in colour) any vectors that are pasted are automatically placed on that layer.


- Create a **new Layer** and change the name to **buttons**.
- Create a **new Layer** and change the name to **holes**.



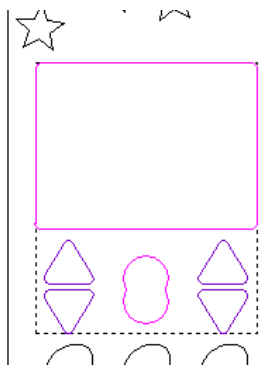
- Select the 12 Ellipse vectors.





The **selected vectors** will be transferred to another **Layer**.

Note: **Layers** can have the snapping facility  switched on or off. For example if you had vectors close together and wanted to be sure you snapped to the correct vector on a layers, then you would switch snap off for all the other layers.



- **Right mouse click** on the selected **button vector group** and select **Move Vectors to.....> buttons**.
- Select the **other shaped vectors** as shown.

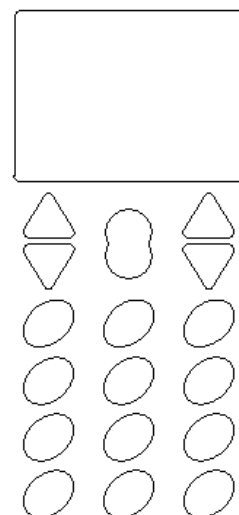


These selected vectors will be placed on another **Layer**.

Note: **Layers** can be locked,  so any vectors on that layer cannot be moved or edited until the layer is unlocked. 

- Right mouse click on the selected vector group and pick **Move Vectors to..... > holes**.

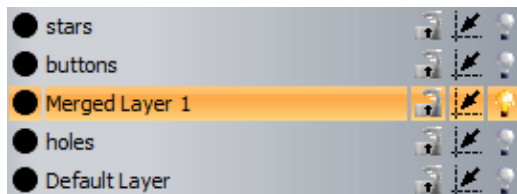
- Switch **off** the **Default Layer**,  leaving **on** the layers **buttons** and **holes**. 





The vectors displayed are going to be combined into the one current layer **Merged Layer 1**.

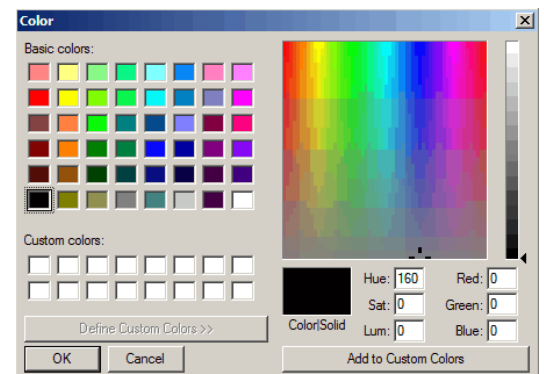
- Select **Merge Visible**. 





A new **Layer** called **Merged Layer 1** has been created with the visible data combined. The vectors on the layers can be coloured for identification.

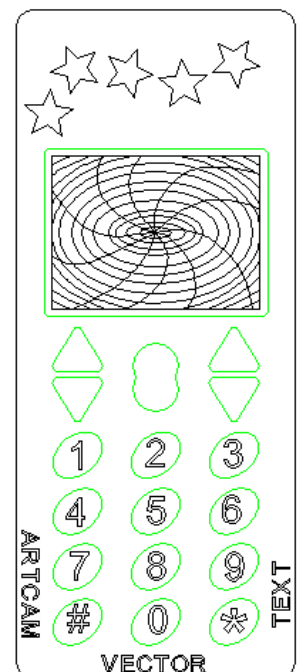
- Select the **black circle**  to the **left** of the **Layer** name **Merged Layer 1**.

The colour form appears. This allows you to select the colour for the vectors on that layer.

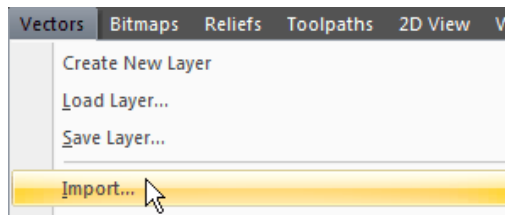


- Select any suitable colour and then **OK**.
- Switch on all the **Layers** using the **Toggle All Visibility**. 
- Select **Open**  from the **Vector layers toolbar**.
- From **ArtCAM Data**, select the file **tel-insert.eps** and select **Open**.

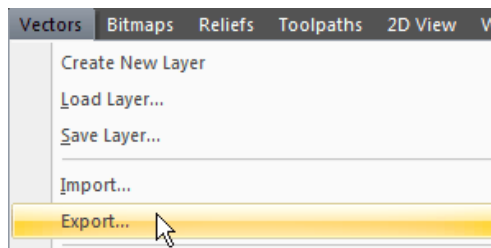
The vectors are **imported** as a group on a **new layer** (same as **filename**), so to use them individually, they need to be **ungrouped**.



Vectors can also be **imported** from the main menu by first highlighting the required vectors and then selecting **Vectors > Import....** from the top menu.



Similarly, vectors can also be exported by selecting the desired vectors and then selecting **Vectors > Export....** from the top menu.



Selecting  from the **Vector layers toolbar**, will **export all vectors on that layer**.


- Select **File > Save**.
- Select **File > Close Model**.

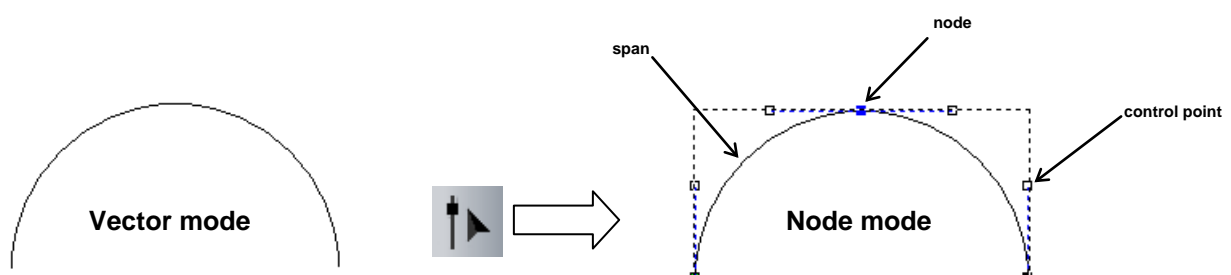
Node Editing

The structure and appearance of a vector can be changed using the **Node editing options**. **Vectors** are made up of **nodes** and **spans** which are displayed only when ArtCAM switches to

Node Editing Mode.





Upon **selecting a Vector**, **Node Editing** can be entered by selecting  from the **Design Tools Toolbar** on the left hand side, the **Right mouse select menu** or simply selecting **N** on the keyboard.




The following example illustrates the different options available for editing **nodes**, **spans** and **control points** within selected vectors.

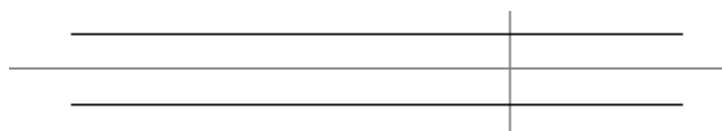
Enamel-Pin Exercise

- Create a **New Model** with a **Height** of **20mm** and **Width** of **60mm**. (Origin in centre)
- Create a **Guideline** at **X 0** and **Y 0**.


- Select **Create Polyline**. 
- **Untick** the **Draw smooth polylines** option.  **Draw smooth polylines**
- Enter **X** as **-25mm**, **Y** as **1mm** and select **Add**.
- Enter **dx** as **35** and select **Add**.

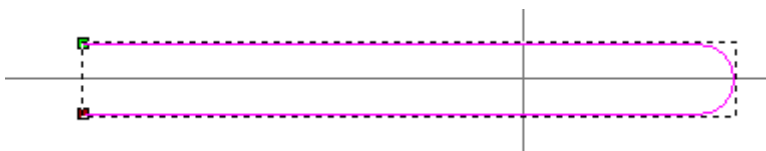
- Select **Create Polyline**. 
- Enter **X** as **-25mm**, **Y** as **-1mm** and select **Add**.
- Enter **dx** as **35** and select **Add**.

Note: Selecting the Spacebar will stop the Polyline creation at the last point. A new start point can then be created.




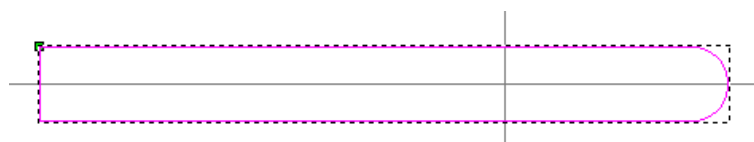
You can join these **two vectors** together with either an **arc**, **straight line** or by **moving** the **end points**.

- Select both vectors.
- Select **Join Vectors With A Curve**. 





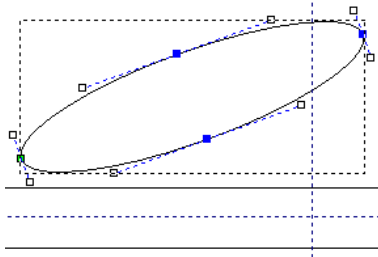
You've **joined** the **two vectors** together to make a **new vector**. You will **close** the **open vector**.

- Select the **new vector**.
- Select **Close vector with a Line**. 



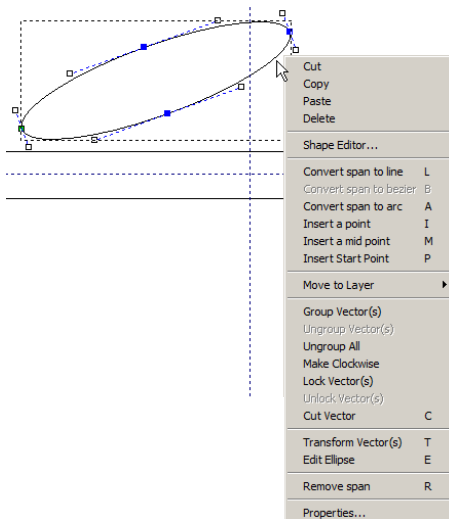
The vector has been closed. You will now modify an **Ellipse** to produce a **leaf shape**.

- Select **Create Ellipse**. 
- Enter a **Start Point of X -4mm Y 4mm**, an **Ellipse Height of 3mm** and **Width of 12mm** with an **Angle of 340 degrees**.
- Create the **Ellipse shape** (single mouse click on model sheet)
- **Select the Ellipse** and then **Select Node Editing**. 



By pressing **N** on the keyboard on a selected vector, you will switch between **Node Editing** mode and **Select Vectors** mode.

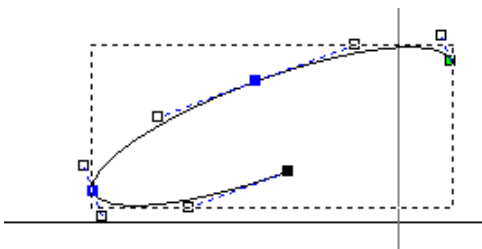
You will open up the **Ellipse** halfway by removing spans using the **right mouse button** menu.



The part of the vector between two node points is called a **span**. If a **span** was removed, the vector will become **open**.

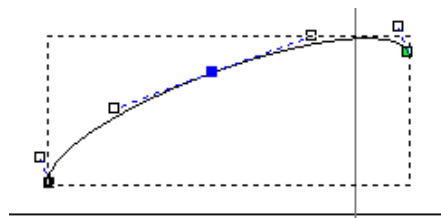
In **Node Editing** mode, if you move your mouse over a **node point** and click the **right mouse button** a local set of menus appears.

- **Right mouse click** over the **right bottom span** of the **Ellipse** and select **Remove Span** from the menu. (The span mode is indicated by ~)



The **Ellipse** vector is opened at the required area. You'll need to delete the other lower span.

- **Right mouse click** over the **left bottom span** of the **Ellipse** and select **Remove Span** from menu.

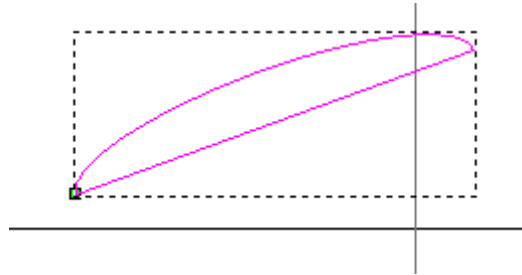


Only half of the original **Ellipse** remains. You will **close** this half **Ellipse** with a **line** in the **Select Vectors** mode.

- Select **Select Vectors.**



- With the vector selected, select **Close Vector with a Line.**



The vector is now closed. You will now create a **Polyline** to mirror the vector across.

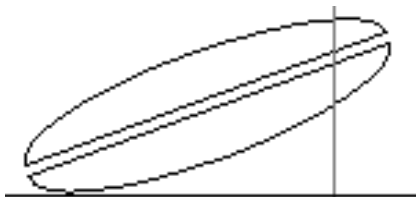
- Select **Create Polyline.**
- Enter **X** as **-10.3mm**, **Y** as **1.5mm** and select **Add.**
- Enter **X** as **3.6mm**, **Y** as **6.6mm** and select **Add.**



- **Shift-Select** the **Polyline**, the **leaf shape** and then **Mirror Vectors.**
- Tick the **Copy the Original Vectors** option and select **About Line.**
- **Close** the form.



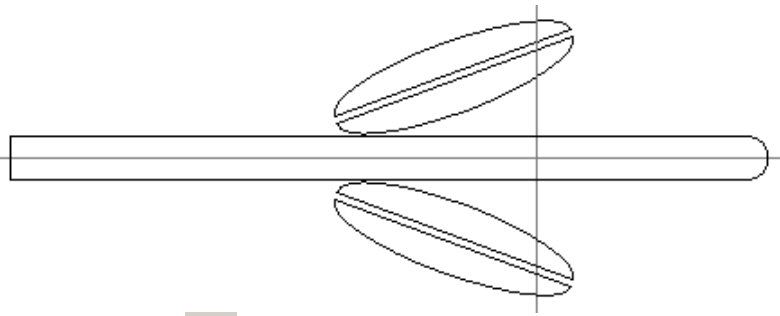
- Select the **Polyline** and select **Cut.**




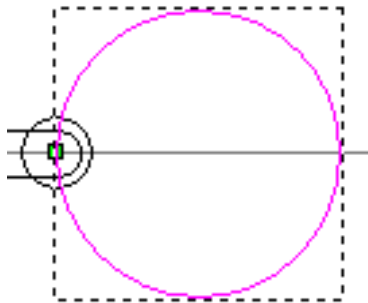
The leaf shape has been generated. This will now be mirrored to the other side.

- Select **Create Polyline.**
- Snapping to the **horizontal Guideline**, create a single line across the model.
- Select the **new horizontal vector** and the **leaf shapes.**
- Select **Mirror Vectors.**
- Select **Copy the Original Vectors** and the **About Line** option.



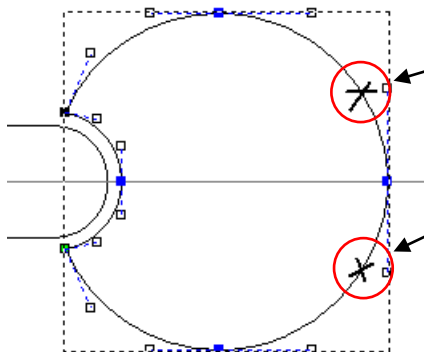


- Select **Create Circles.** 
- Set the **Circle Centre** as **X 10mm Y 0**, select **Radius** and enter **1.5mm**.
- Deselect **Create with arcs**, before **creating the circle**.
- Create a new **Circle** with **Centre** at **X 16mm Y 0**, and **Radius** of **6mm**.
- Select **Create** followed by **Close**.

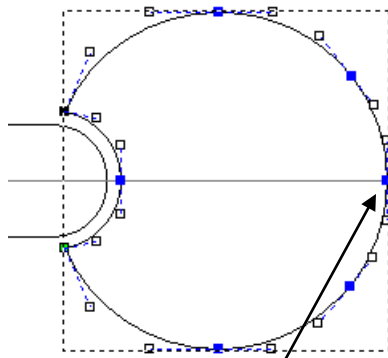


The **smaller circle** will be subtracted from the **larger circle**.

- Select the **larger circle** and then **shift select** the **smaller circle**.
- Select **Subtract vectors.** 
- Select **Node mode.** 

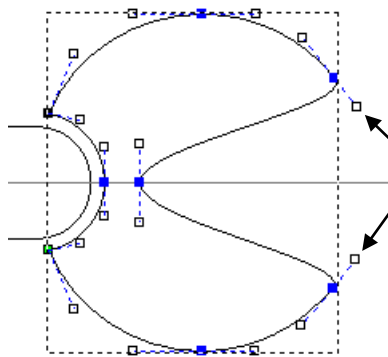


- Move the mouse over the **top marked area** and from the **right mouse menu** select **insert a point**.
- Move the mouse over the **bottom marked area** and from the **right mouse menu** select **insert a point**.



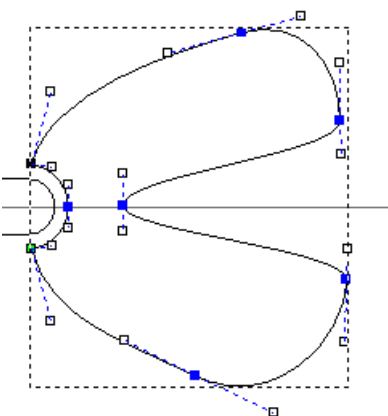
The addition of these extra node points will allow you to move the node point in between the new points and it will only stretch the vector within that region.

- Select the **middle node**.
- Drag the point **along the horizontal vector** (towards the origin) and **release** the mouse at a suitable position as shown in the image below.
- **Delete** the horizontal vector.



The **two control points** can be dragged to produce a more realistic curve.

- Select each **control point** and move around as shown in the image below.

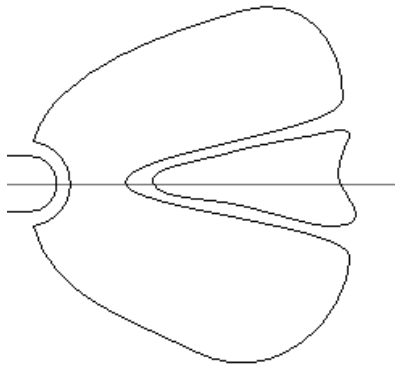


The shape is complete. You'll have to create another **Polyline** to build the inner part, using the smooth option.

- Select Create Polyline.



- **Tick the Draw smooth Polylines** option.
- Select **several points** on the model to make the shape roughly as shown.





The last point is not smoothed when it is joined. You can smooth it in the **Node Editing** mode.

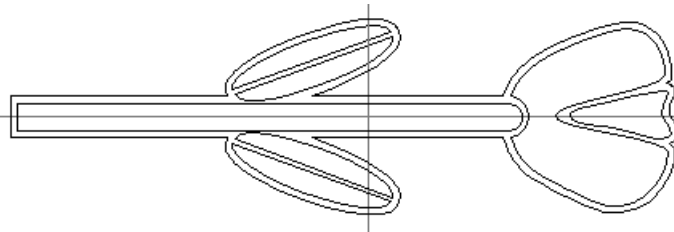
When you are in the **Node Editing** mode the smooth point shows as **blue** and a non-smooth point shows as **black**.

You can now **Offset** all of the **vectors**.

- Click on the **start point** to complete a single closed vector.

- Select Vectors. 
- Select **all** the **vectors**.

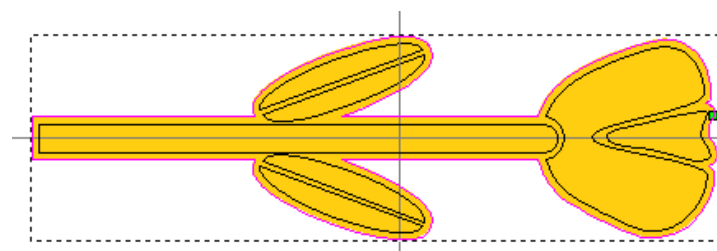
- Select **Offset Vectors**. 
- Select an **Offset Distance** as 1mm, **Offset Direction** as **Outwards/Right** and **Offset Corners** as **Radiused**.
- Select **Offset**, followed by **Close**.





The design is complete.

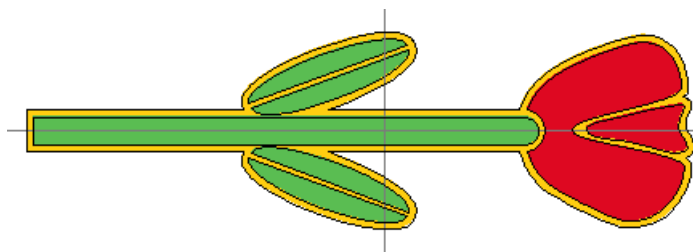
You can fill in the **closed vectors** with **bitmap colour** to give an idea of what the design will look like before the **Relief** is made.

- With the **new offset vector** highlighted, **select** the **gold coloured square** from the palette at the bottom of the **2D View** with the **left mouse button**.
- Select **Flood Fill Vectors**. 



The whole inside of the vector is filled with the selected colour. (The colour is a bitmap). You can select other vectors and fill them in to overwrite the colour.

- Select the **leaf and stalk vectors** and select the **green coloured square** at the bottom of the 2D View.
- Select Flood Fill Vectors. 
- Select the **petal vectors** and **select** the **red coloured square** at the bottom of the **2D View**.
- Select Flood Fill Vectors. 

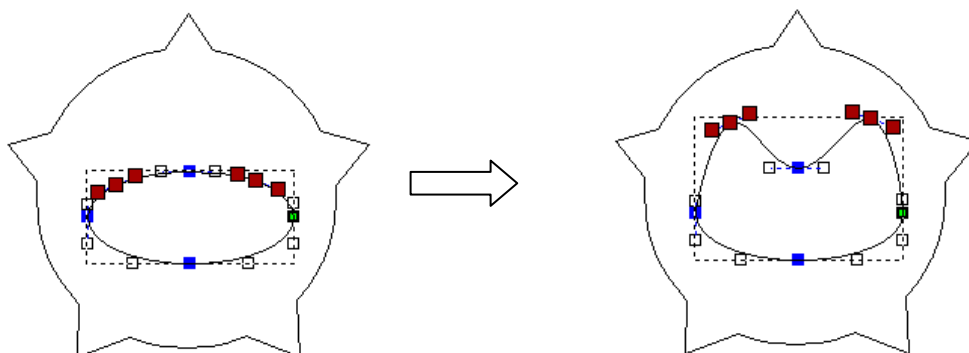


If the vectors were altered, the colours need to be recreated.

- Select **File - Save As** with the File name - **train-flower** in D:\users\training\COURSEWORK\ArtCAMPro-Jobs.

Selected Node Editing

When a node is selected it turns red and can be moved dynamically. Shift and select allows the user to select several nodes in a curve, ctrl and select allows the user to pick individual nodes, to be moved simultaneously.




Selecting X on the keyboard edits the selected points with the X coordinate of the last node.

Selecting Y on the keyboard edits the selected points with the Y coordinate of the last node.

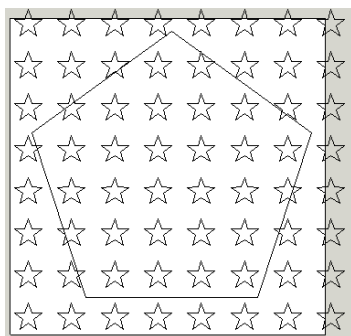
Vector Clipping and Slicing

Vector Clipping  is used to trim a **group of vectors** within a defined **vector**.

Vector Slicing  is used to split a **vector** across a selected cutting **vector**.

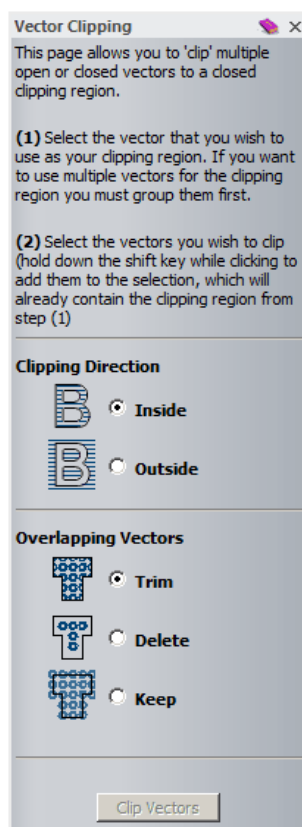
Vector Clipping Exercise

- Create the following vectors in a **New Model** of size **100 x 100** and **Origin** at the centre.



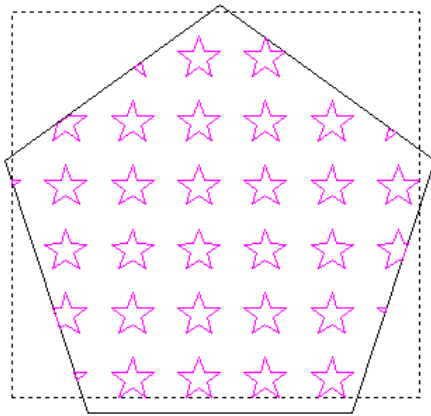
The sizes do not really matter as long as there are a few stars within the pentagon.

- Select **Vector Clipping**. 



The vector clipping form appears with instruction on how to use the command and the different results available with the options given.

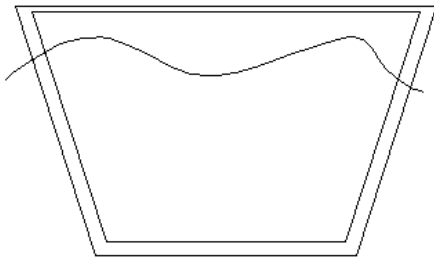
- Select the **Polygon** and then **shift – select all** of the other **vectors** (can drag a box).
- Select Clipping Direction as **Inside** and **Overlapping Vectors as Trim**.
- Select **Clip Vectors**.



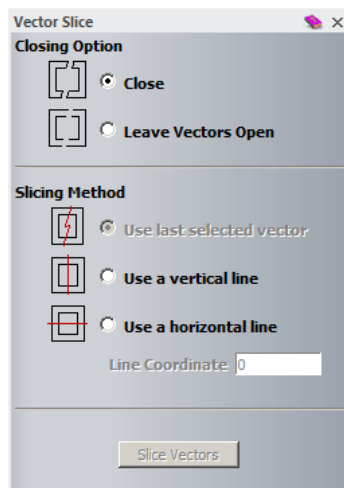
The stars that are whole within the polygon are retained and those that cross the polygon are trimmed back as shown.

Vector Slicing Exercise

- In a **New Model** of size **100 x 100** and **Origin** at the centre sketch the following **vectors**.

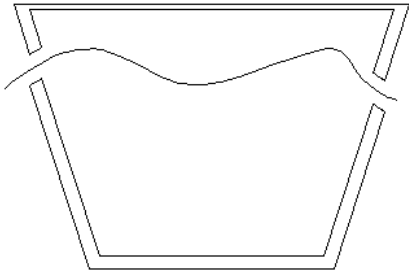


- Shift - Select** both the closed vectors followed by the open (slicing) vector.
- Select **Slice Selected Vectors**.



The **Vector Slice** page appears displaying the options available. The **Use last selected vector** option is only available when more than one vector is selected. Otherwise it will be greyed out.

- Select the options **Close** and **Use last selected vector**.
- Select **Slice Vectors**.
- Nudge the **two new vectors up** and **down** using the keyboard up and down arrow keys to see the result.



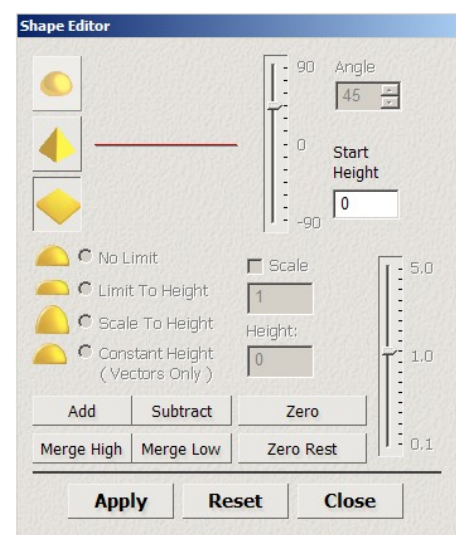
The vectors have been sliced and rejoined.

4. Generating a Relief

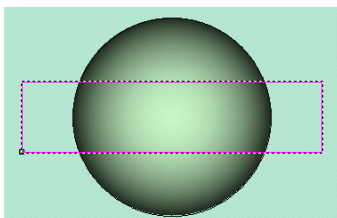
Introduction

A **Relief** is the **ArtCAM 3D model** created either from **vectors**, **bitmaps**, imported **CAD surface models** or existing stored **Reliefs**. One set of options operates by building a **Relief** from one or more **closed vectors** using the **Shape Editor**. **Double clicking** on the selected **vector/s** or pressing the **F12 shortcut key** will open the **Shape Editor** form.

There are three main **3D forms**: **Domes**, **Pyramids** and **Flat Planes**. By selecting one of the **3D Relief** icons the relevant options become active in the form. The **Relief** form can only occur within the defined **model area** and is effectively formed by the individual bitmap squares (**Resolution**) moving up or down in **Z**. The **Shape Editor** is the original method for creating a **Relief**. As **ArtCAM** has evolved, a selection of more specialised and advanced options have been added to the **Relief Tools** area of the **Assistant**.



There are **6 options** to control how the **Relief** is combined with the existing **ArtCAM** model. These comprise **Add**, **Subtract**, **Merge High**, **Merge Low**, **Zero** and **Zero Rest**.



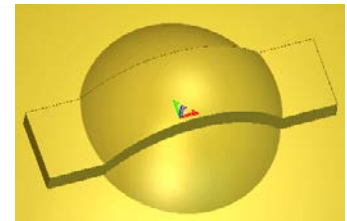
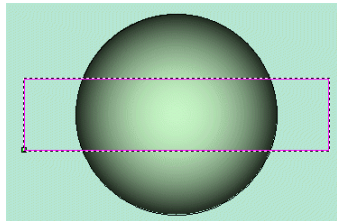
This **2D View** shows the **Dome Relief** already made from a **Circle** vector and the **Rectangle** selected for the **new Relief**.

This simple example will be used to help illustrate the result of using the 6 control options.

Add

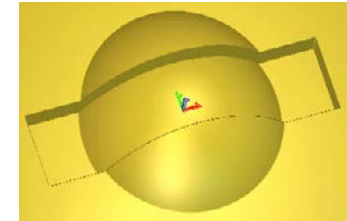
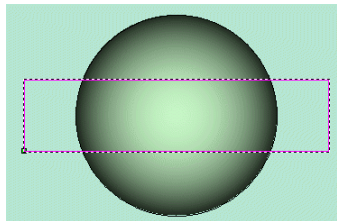
This method **Adds** the new **Relief** on top of the **current Relief**, producing the result as shown right.

In this case a **Plane** of a **Start Height** of **1mm** was **added** to the **Relief**.

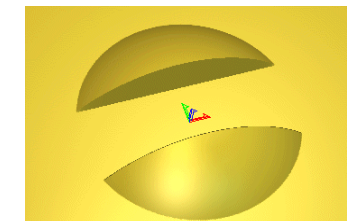
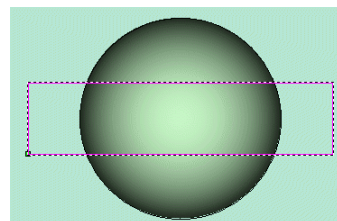
**Subtract**

This method **Removes** the new **Relief** from the current **Relief**, giving the following effect.

In this case a **Plane** of a **Start Height** of **1mm** was **subtracted** from the **Relief**.

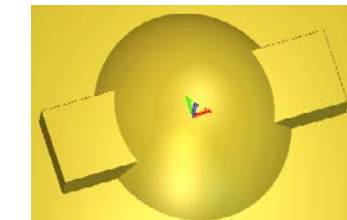
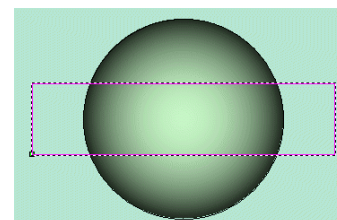
**Zero**

By applying **Zero**, the **Relief** inside the vector will have **Z height** of **Zero**.

**Merge High**

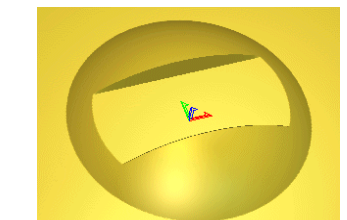
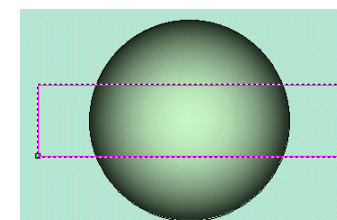
The new **Relief** is **Merged** along **Z** through the existing **Relief**.

In this case a **Plane** of a **Start Height** of **1mm** has been **Merged High** through the **Dome**.

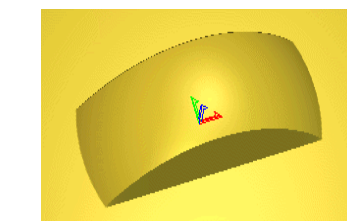
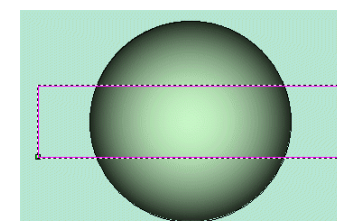
**Merge Low**

The new **Relief** is **Merged** through the existing **Relief** and any of the original **model** form above it is removed.

In this case a **Plane** of a **Start Height** of **1mm** was **Merged Low** through the **Dome**.

**Zero Rest**

The new **Relief** is flattened to the **Zero plane** outside of the vector area.



Reliefs are displayed in the **3D View** and can be **Exported** from **ArtCAM** as individual **(.rlf)** file. (to be discussed later)

The smoothness of a **Relief** is dependant on the **Resolution**.

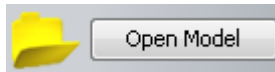


Selecting **Preview Relief layer** from the **2D view Toolbar**, will **display the Relief as a shaded image** in the 2D view.

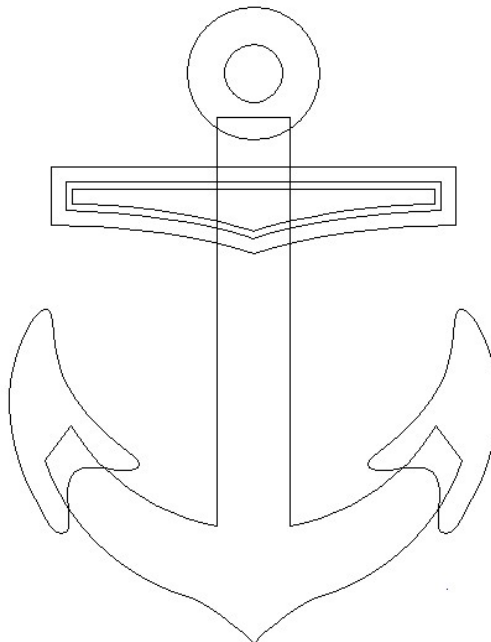
Reliefs can be calculated from vectors from the **2D View** or directly within the **3D View**.

The following examples show how to create a relief by selecting vectors within the **3D View**.

Anchor relief



- Select **Open Model**.
- Open the model **anchor.art** from: **D:/users/training/ArtCAM Data**.



The vectors are displayed in the 2D view.

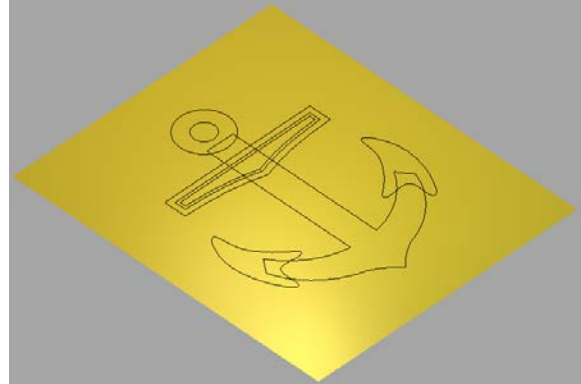
- Select the **3D View** tab or press **F3**.

The vectors are by default not displayed in the 3D view.

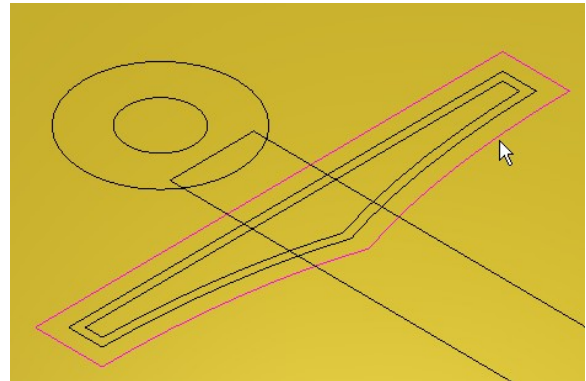
- From the **3D View toolbar**, select **Toggle Vector Visibility**.



The vectors are displayed on the 3D View.



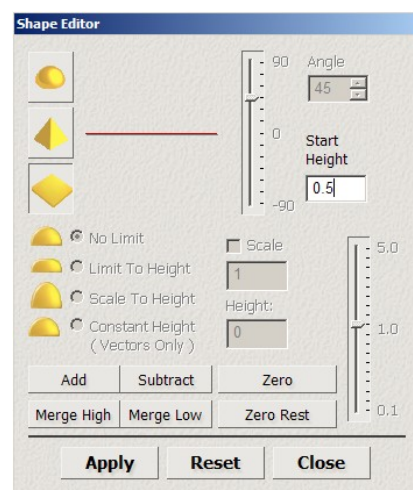
- Double left mouse click on the vector shown below (indicated by the arrow) to raise the **Shape Editor** form.



- Select a **Flat Plane** shape with a **Start Height** of **0.5mm**.

For a Flat Plane, The Start Height indicates the very top Z level.

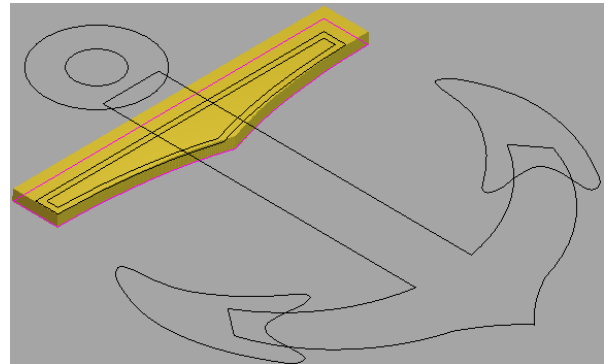
- Select **Add** on form to generate the shape.



- From the **3D view toolbar**, Select **Draw Zero Plane**  to **hide** the **Z zero plane**

The bar is produced as shown. If you place the mouse on the Relief, the Z height at that point (0.5mm) will be displayed in the information box at the lower right of the graphics area.

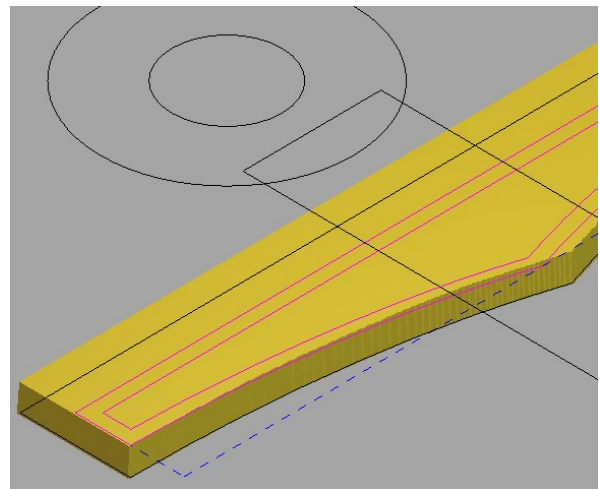
X: 14.170 Y: 18.201 Z: 0.500



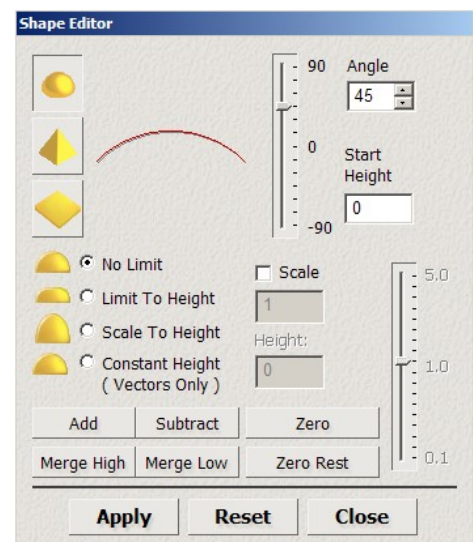
- De-select the **bar vector** by selecting in empty space.

- Hold down the **shift** key and select the **two inner vectors** as shown.

A Relief will now be generated **inside** the two selected vectors.

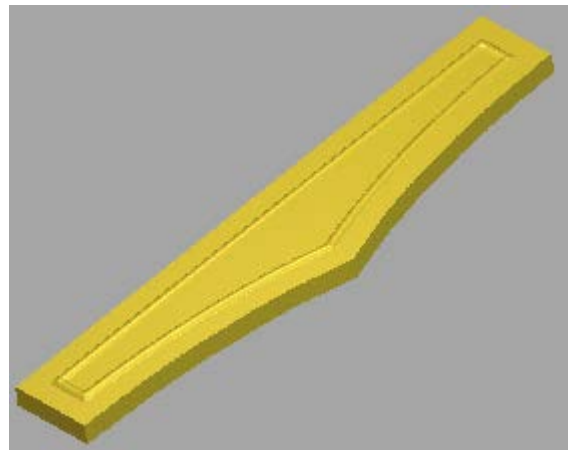


- Press **F12** on the keyboard to raise the **Shape Editor** form.
- Select a **Dome shape** with an **Angle of 45 degrees** and **No Limit** with regard to overall height.
- Set the **Start Height** at **0** and select **Add**.



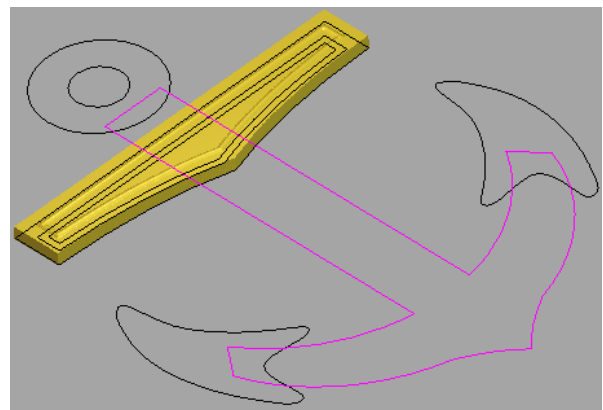
A **Dome shape of 45 degrees** has been created within the selected vectors. The **final height** of the dome was dictated by the defined angle (as No limit was selected)

By Selecting **Add**, the new relief 'added' to the bar relief below.

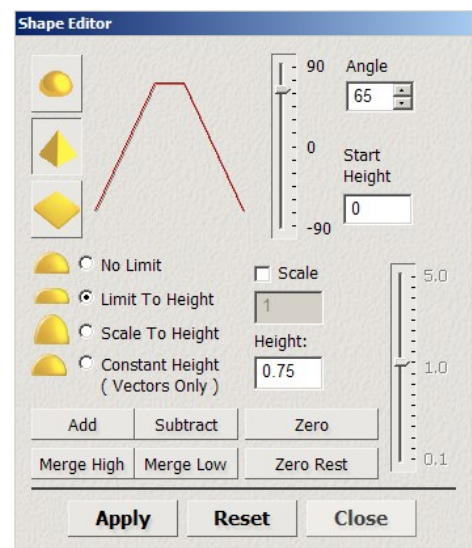


The main body of the Anchor will now be created and merged into the current Relief.

- Select the **main anchor vector** as shown highlighted.

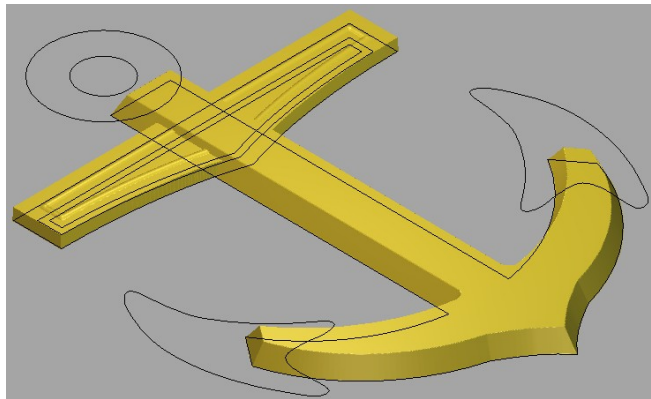


- Select a **Pyramid shape** with an **Angle of 65 degrees**.
- Select **Limit to Height** and Enter a **Height value of 0.75 (mm)**.
- Select **Merge High**.

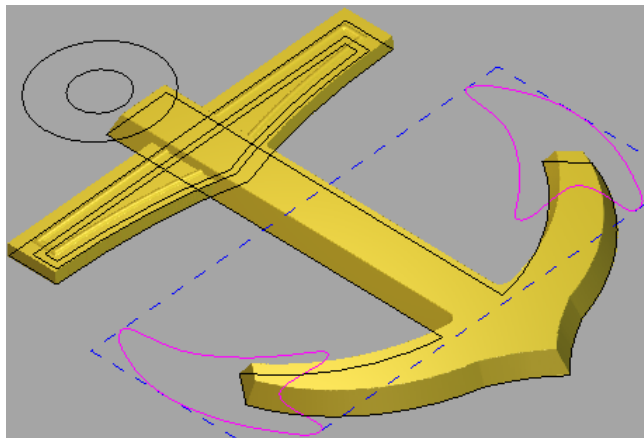


The main anchor shape is created and merged with the bar relief.

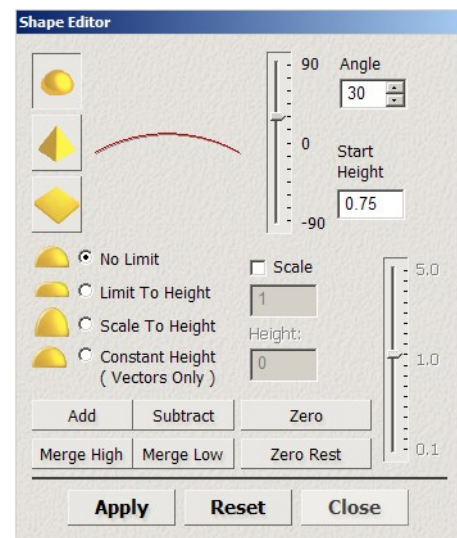
This shape was produced from the vectors extruding as a triangular shape of 65 degrees. As it reached a height of 0.65mm, it 'levelled off'.



- Shift Select the two **hook vectors** as shown.

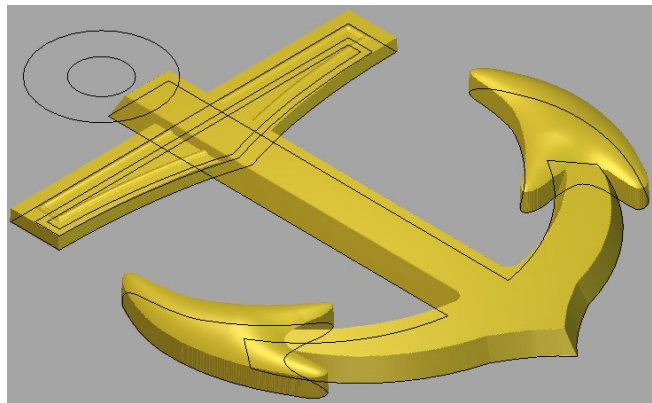


- Select a **dome shape** with an **Angle of 30 degrees**.
- Enter a **Start Height** value of **0.75** (mm).
- Select **Merge High**.

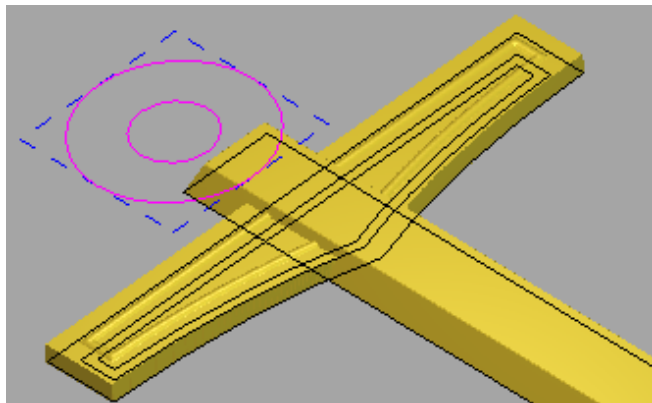


The '**hook shapes**' have been created and **merged** with the **main body**.

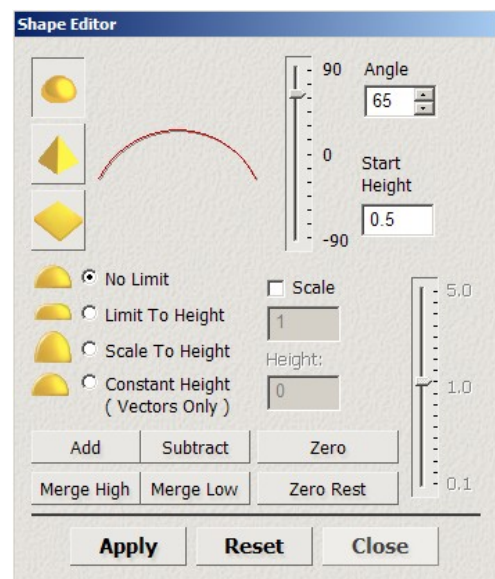
The Start Height provided a 'platform' of 0.75mm before a dome shape of 30 degrees was applied.



- Shift Select the two **Circle vectors** as shown.



- Select a **dome shape** with an **Angle of 65 degrees**.
- Enter a **Start Height value of 0.5 (mm)**.
- Select **Merge High**.



- From the **3D View toolbar**, select **Toggle Vector Visibility**.

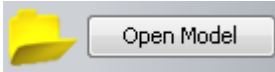


The Vectors are hidden, and the final result can be seen.



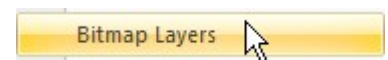
- Select **File - Save As** naming the model as **training-anchor** in: **D:\users\Training\COURSEWORK\ArtCAMPro-Jobs.**
- Select **File – Close Model**.


Tin Lid relief

- Select **Open Model**. 
- Locate and **Open** the model **tintop.art** from: **D:\users\training\ArtCAM Data**.



- **Activate** the **Bitmap Layers Fly out** panel by **Right mouse clicking** in the **graphics area border**.



- Select **Toggle Bitmap layer Visibility**  to **switch off** the Bitmap.

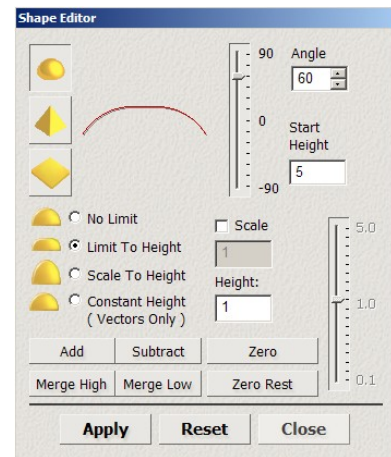


- Select **Toggle All Visibility** from the **Bitmaps** layer menu.

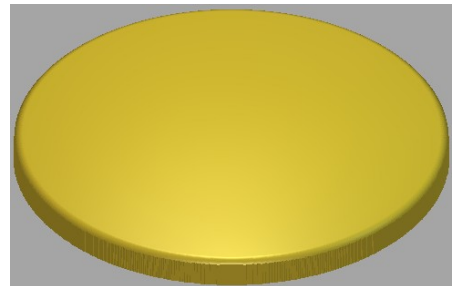
This switches off the **bitmap** so that any **vectors** can be seen more clearly and as a result will be easier to work with.

- Select the **outer circle** vector and press **F12** to raise the **Shape Editor** form.

- Select a **Dome Shape of Angle 60 degrees** with a **Start Height of 5**.
- **Limit to Height of 1mm.**



- Select **Add** to generate the Shape.

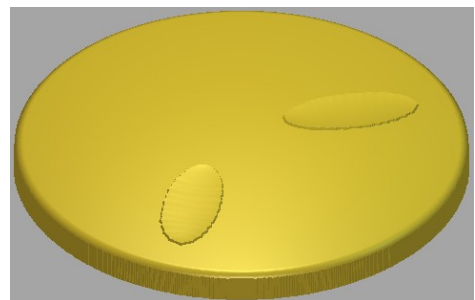


- Select both of the **leaf vectors**.
- Select a **Dome** shape with an **Angle of -8 degrees** and a **Start Height of 0.5mm**.



- Select **Add** from the **Shape Editor** form.

(Note: A negative value and Add is the same as entering a positive value and selecting subtract)



- Select **both** of the **leaf vein vectors** and Enter **Shape Editor**.

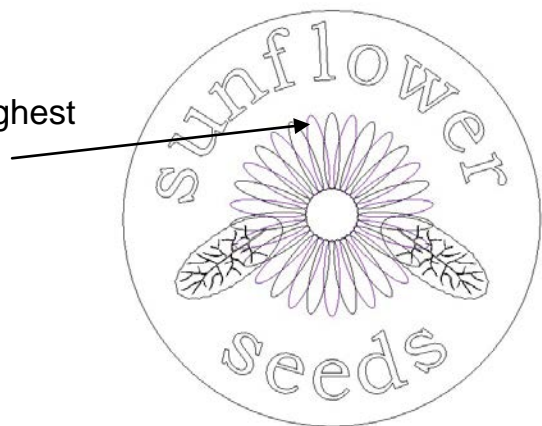


- **Add a dome shape of 10 degrees.**

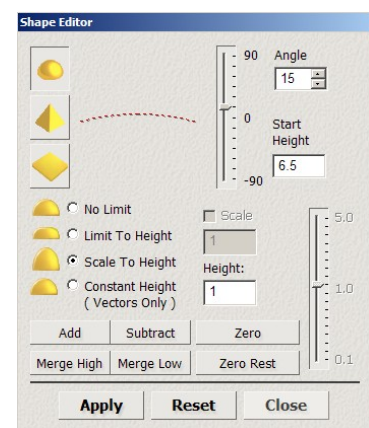
The subtle detail can be seen if zoomed in to that region.



- Select the **petal group** to the left of the highest petal.



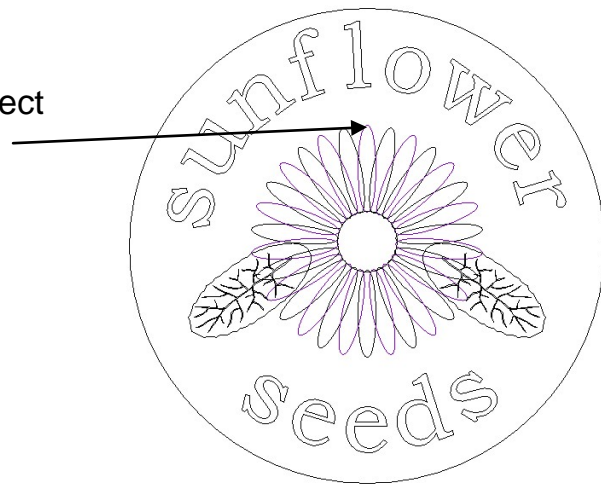
- Enter a **Dome shape of 15 degrees** and **Start Height of 6.5 degrees.**
- Select **Scale to Height** with a **distance of 1mm**
- Select **Merge High**.



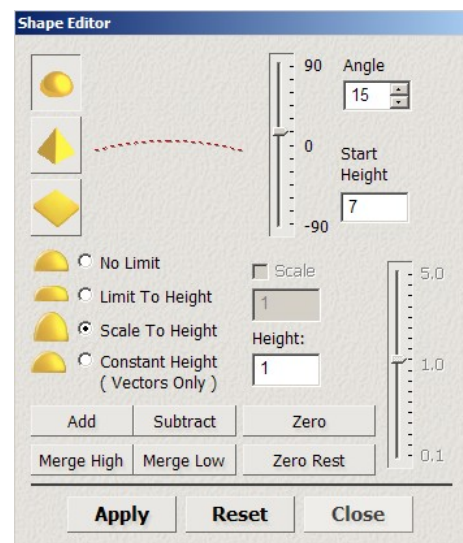
The Start Height value is the actual height from the Z0 of the Relief. By setting the value higher than the leaves, the petal forms are raised above. Using Merge High, the petals are blended into the surrounding Relief.



- Select the other **petal group** to select the **higher group**.



- Enter a **Dome shape of 15 degrees** and **Start Height of 7 degrees**.
- Select **Scale to Height** with a **distance of 1mm**
- Select **Merge High**.



This petal group is higher than the other group (by 0.5mm), so that the petals in the front are full petals and the petals below are only partial petals.



- Select the **small circle vector** (in the centre of the flower).
- **Merge High** a **Dome shape** with an **Angle of 25 degrees** and a **Start Height of 7mm**.

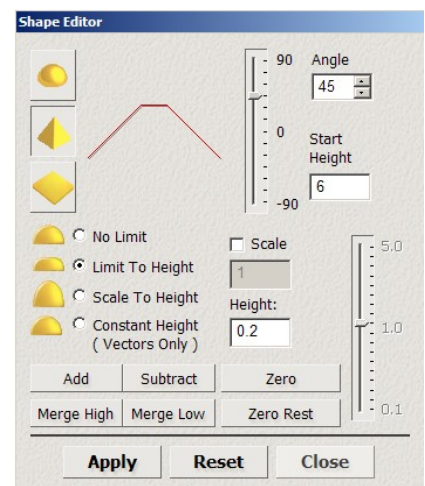


The centre of the flower has been merged into the petals.

The text will be added next.



- Select the **'Sunflower'** and **'Seeds'** text.
- Select an **Angle of 45 degrees** and a **Start Height of 6mm**.
- Set **Limit to Height** at **0.2mm**




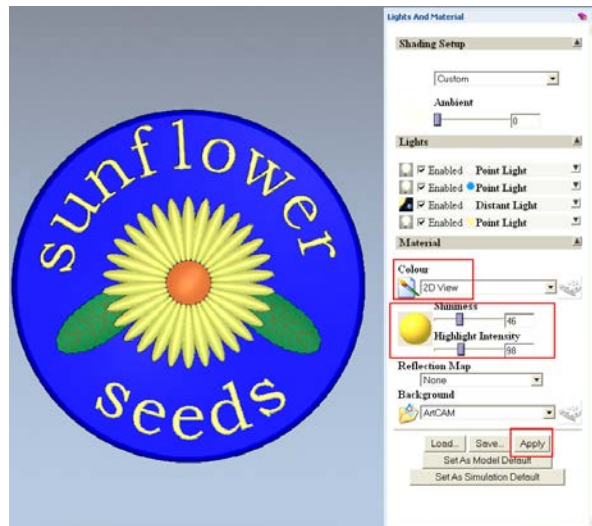
- Select **Merge High** from the **Shape Editor** form, followed by **Close**.

The Text has been produced with a chamfered edge and a flat top making it stand out.

The Relief can be shown in alternative shaded colours or the same as the original Bitmap.



- From the Top Model Toolbar, Select **Lights and Material** .
- Select the option **2D View** under the **Colour** area.
- Move the sliders to select the desired **Shininess** and **Reflection Map**.
- Select **Apply**.
- Close the form.

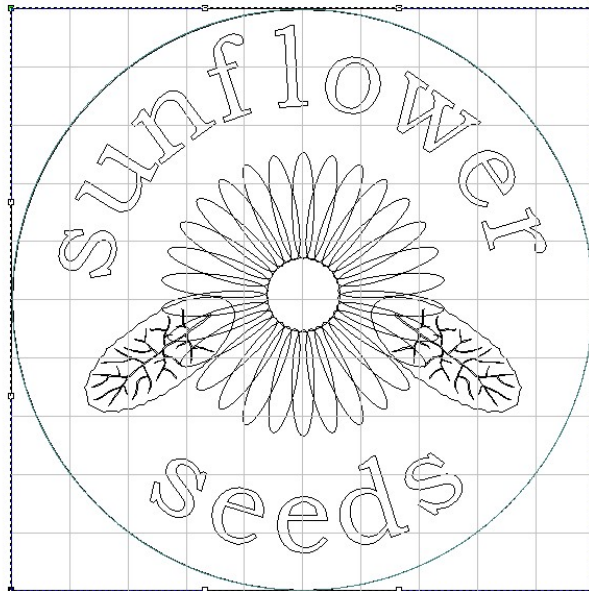


- Select **File - Save As** and enter a File name as **train-tin-lid** in: D:\users\training\COURSEWORK\ArtCAMPro-Jobs.

Envelope Relief Distortion

In ArtCAM you can use a selected vector to distort the final Relief, allowing you to interactively shape the final Relief.

- From the 2D view, select the **outer circle vector**.
- Select **Relief Envelope Distortion** from the **Relief Editing Toolbar**.



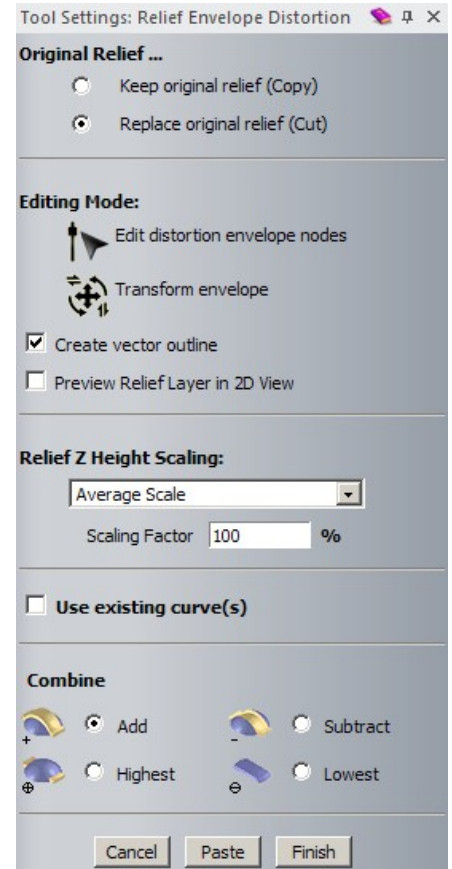
The **selected vector** is displayed within a special, **gridded vector box** (called the Envelope) with **Nodes** displayed at each corner.

The Nodes can be manipulated with a view to 'stretching' and 'squeezing' the Relief.

Additional Nodes and the Envelope vector can be edited by using normal vector commands.

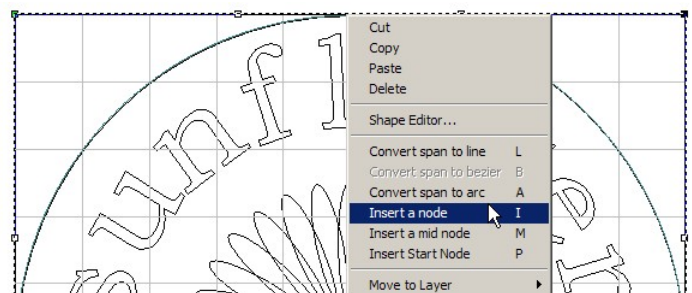
When a Relief is distorted, the Z height can be altered, if required or kept the same.

- From the right toolbar (or F6), select the **Tool Settings** to display the **Relief Envelope Distortion Toolbar**.
- Select the option **Replace Original Relief**.
- Select **Create Vector Outline** and set **Relief Z Height Scaling** as **Average Scale** at **100%** (a Rectangular vector appears as the outer limit).

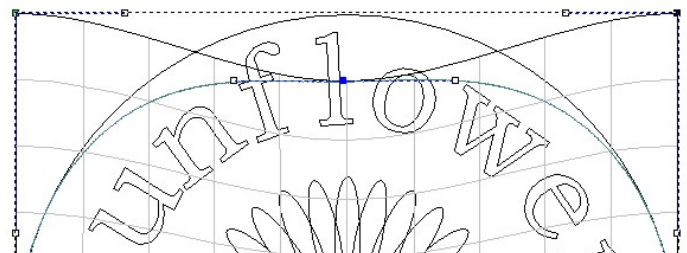


- Ensure the option  **Edit distortion envelope nodes** is selected.

- Place the mouse in the middle of the top span, right mouse click and select **Insert Node** from the menu.

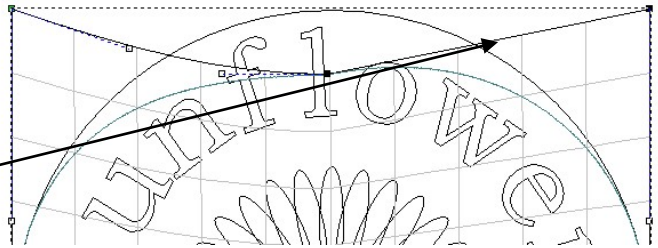


- Select the **new point** and **move it down** in the **Y** until it is **halfway** down the text letter **I**.



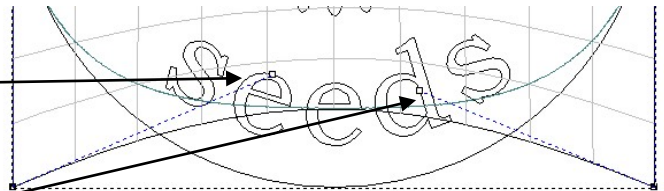
- Move the **left angle node** down.

- Select the **right span** across the top and press **L** to convert to a line.



- Move the bottom **left angle node** until it snaps on the letter **e**.

- Move the **bottom right angle node** until it snaps on the letter **d**.



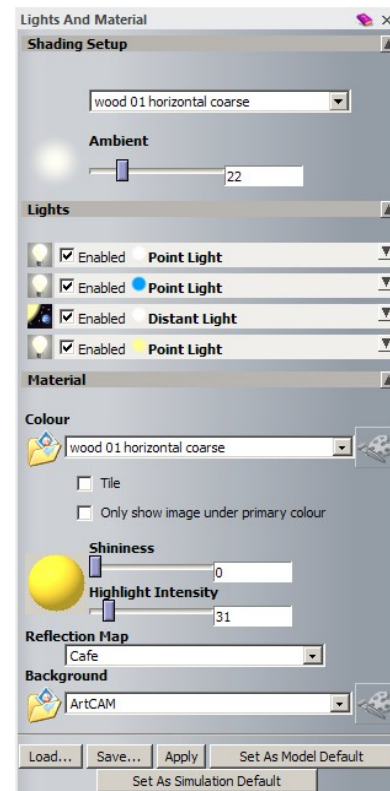
- Select **Add** from the **Combine** area of the form.
- Select **Paste** to recreate the **Relief** and **Finish** to accept.
- View in 3D.



- Select **Lights and Materials** from the top toolbar.



- Set the options as shown.
- **Select Apply** and then **close the form**.



- The **Original relief** has been distorted and replaced with the new relief.

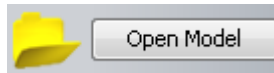


- Select **File - Save As** and enter a File name as **Tin Top** in:
D:\users\training\COURSEWORK\ArtCAMPro-Jobs
- Select **File – Close Model**.

Teddy Bear Relief

This example takes the user through the creation of a Teddy bear Relief model mainly using the Shape Editor in addition to the specialised Angled plane and ISO-Form lettering Relief options.

- Select **Open Model**.



- Browse to: D:\users\training\ArtCAM Data and select the model **Teddy.art**.

- In the **3D View**, Select **Toggle Vector Visibility**

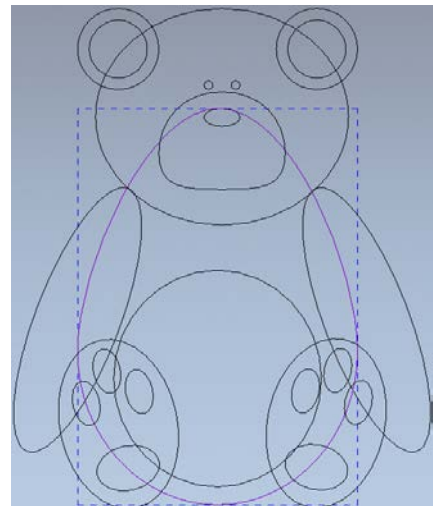


to display the **vectors**.

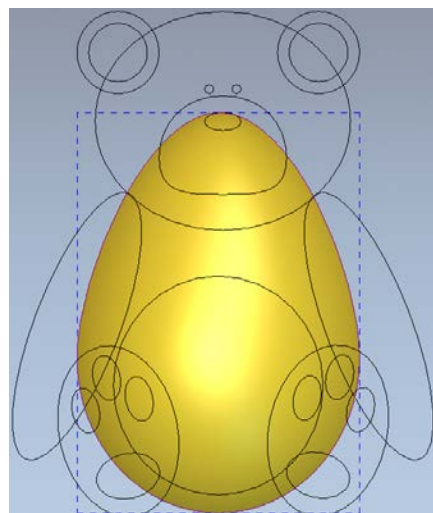
- Select **View Along Z**.



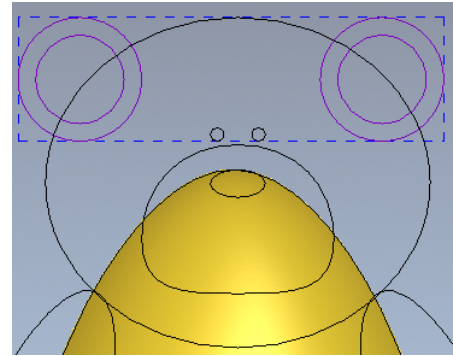
- Select the **body** vector using the left mouse button.
- Double click the **selected vector** to Enter Shape Editor.



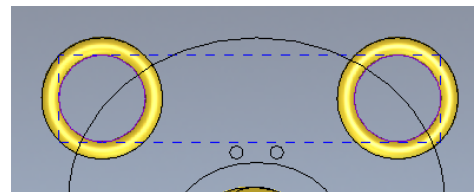
- Select a **Dome** shape, with an **Angle** of **45 degrees** with **No Limit** followed by **Add**



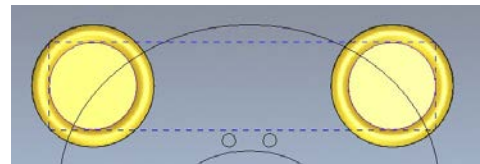
- Using the **left mouse button**, select the **outer ears vectors**, then hold down the **Shift** key and select the **inner ears vectors**.



- From the **Shape Editor** form, select a **Dome** shape with **No Limit**, an **Angle** of **45 degrees** with a **Start Height** of **0.5mm** followed by **Add**.



- Select **only** the **inner ear** vectors.
- Select a **Flat Plane** with a **Start Height** of **0.5mm** and select **Merge High**.

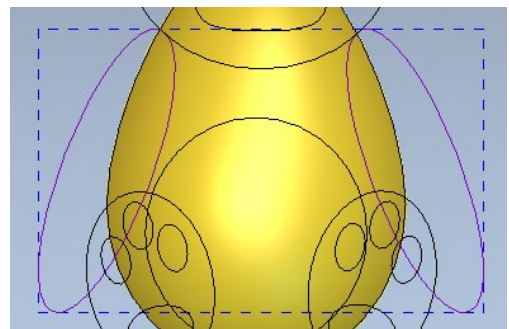


The **inner ears** have merged with the **outer edge**.

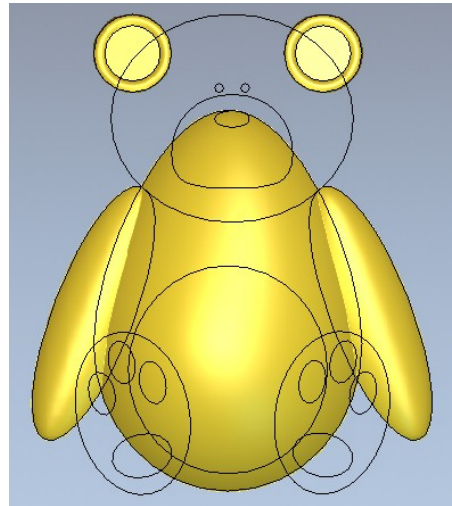
- Select the **arm** vectors.

If the arms were **added** to the body, then a bulge would appear where the arm and body vectors overlap.

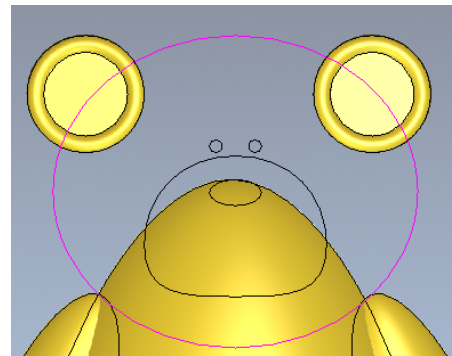
Therefore, the arms need to be Merged High.



- Select a **Dome** shape, with an **Angle** of **45 degrees** with **No Limit** and select the **Merge High** button.

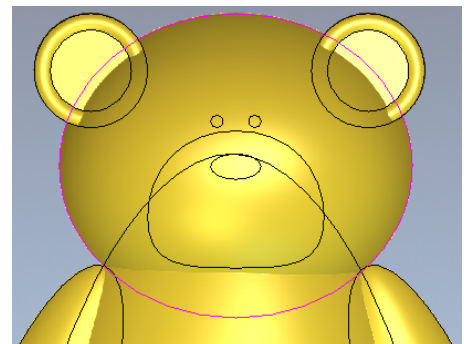


- Select the **face vector**.

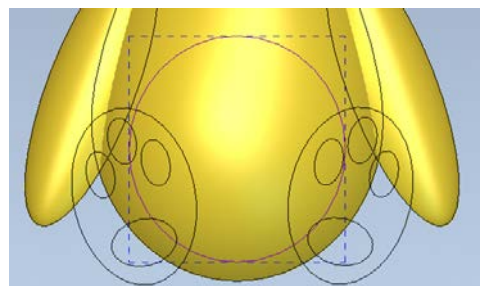


- Select a **Dome** shape with an **Angle** of **60 degrees** with **No Limit** and select **Merge High**

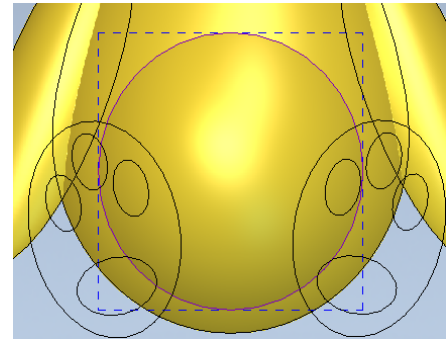
The face has **merged** into the current **Relief**.



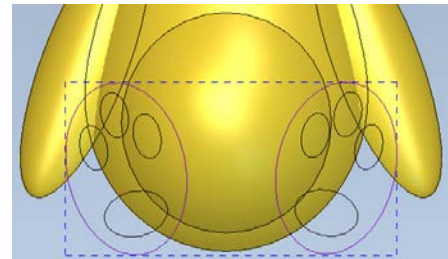
- Select the **circle** 'stomach' vector.



- Select a **Dome** shape of **15 degrees** with a **Start Height** of **0**, **No limit** followed by **Add**.
- Close the **Shape Editor** form



The Relief from the **feet vectors** will be generated using an **angled plane**. This will slope the feet at a specified angle making the toes point forwards and the heels lean back.



- Select the **feet** vectors.

- Select **Create Angled Plane** from the **Relief Creation** toolbar.



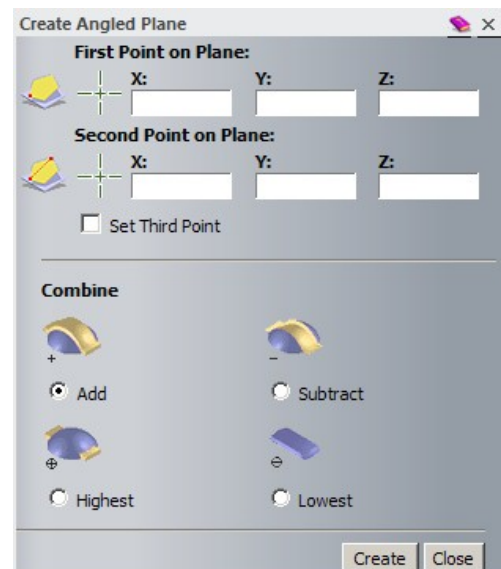
This allows an angled plane to be generated from the heights of upto 3 points.

A minimum of two points must be selected to generate an Angled Plane at a fixed angle to the XY axes.

A maximum of three points for a plane aligned to a compound angle to the XYZ axes.

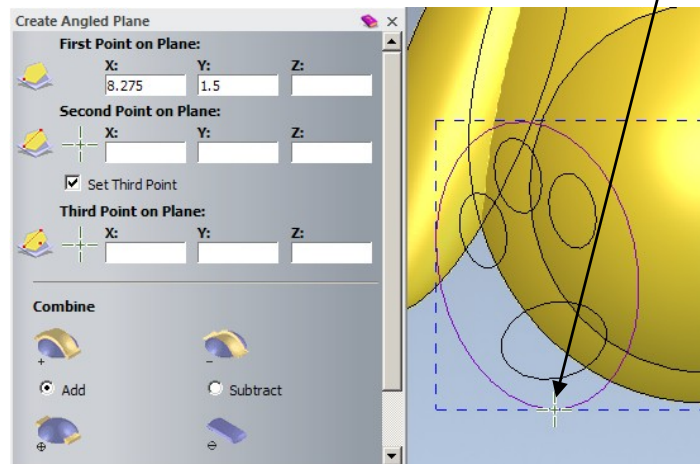
After the points are selected, the Z heights can be edited in the form before the Relief is created.

The final Relief is generated with Add, Subtract, Highest or Lowest (Merge)



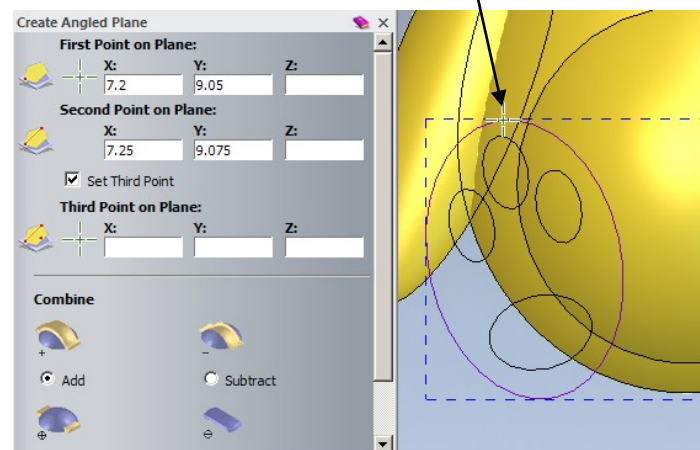
- Tick the **Set Third Point** option to reveal the **coordinate** boxes.

- With the **Left mouse button**, **Drag and Drop** the icon  under **First Point on Plane** to the **bottom** of the **left foot** as shown below.



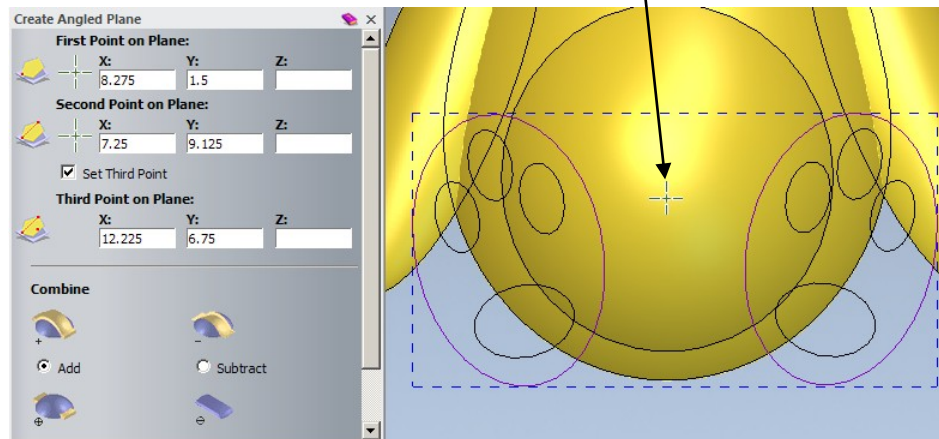
The X any Y coordinates are updated to reflect the selected position.

- With the **Left mouse button**, **Drag and Drop** the icon  under **Second Point on Plane** to the **top** of the **left foot** as shown below.



The X any Y coordinates are updated to reflect the selected position.

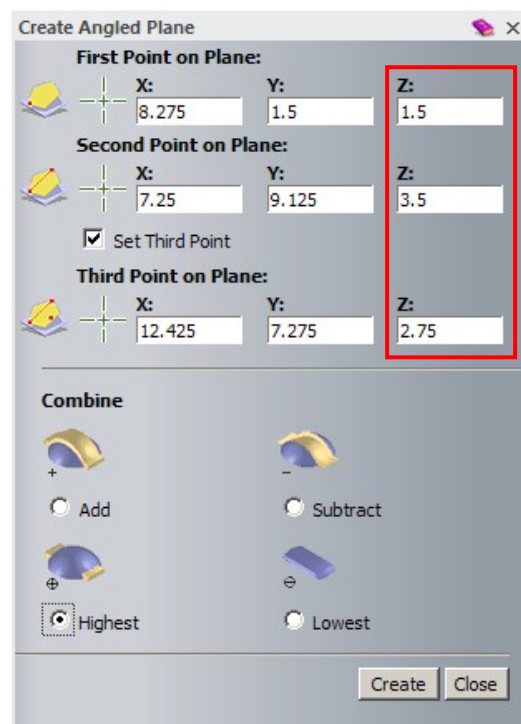
- With the **Left mouse button**, **Drag and Drop** the icon  under **Third Point on Plane** to the **centre region** of the 'stomach' as shown below.



The X and Y coordinates are updated to reflect the selected position.

The Z coordinates will now be entered to define the height of the Plane at these points

- Enter the **Z coordinates** for the **three points** as highlighted.

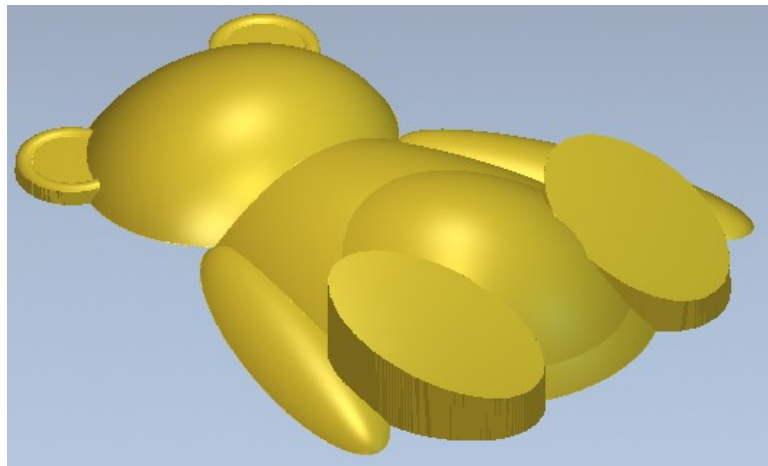


- Select **Highest**, followed by **Create**.

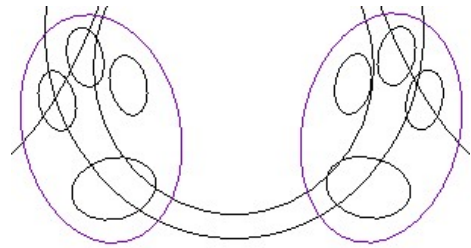
- In the **3D View**, Select **Toggle Vector Visibility**  to **switch off** the **vectors**.

The angled 'feet' are merged into the body.

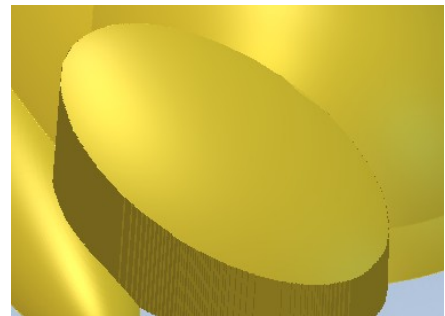
The final features will be added.



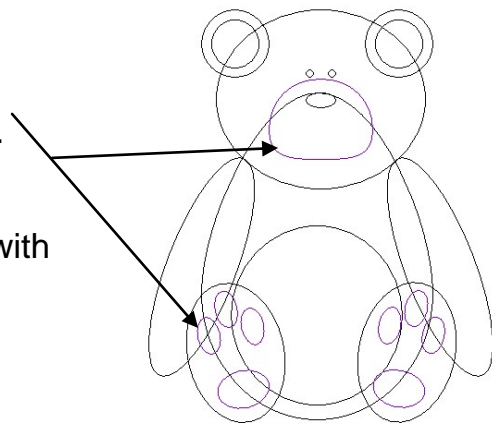
- In the 2D view select the **feet vectors only**



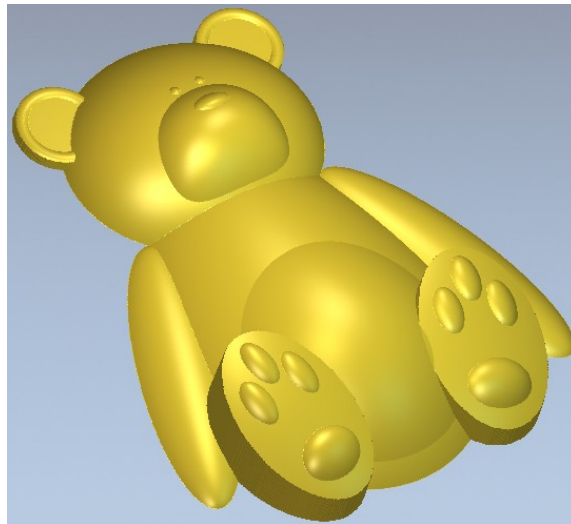
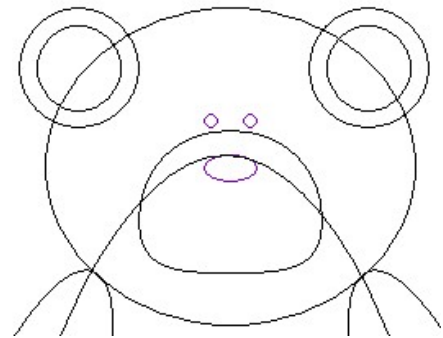
- In Shape Editor, Select a **Dome** shape with an **Angle** of **15 degrees**, **No Limit** and select **Add**.



- In the 2D view select the **paw vectors group** which also includes the 'snout'.
- In Shape Editor, Select a **Dome** shape with an **Angle** of **45 degrees**, **No Limit** and select **Add**.



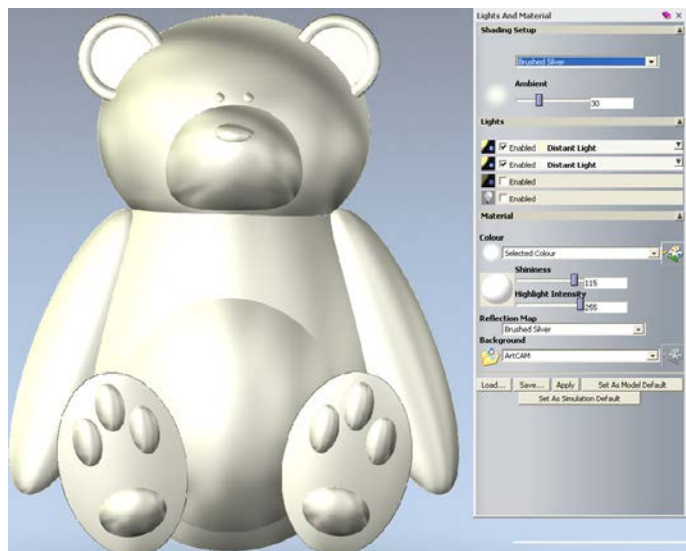
- In the 2D view, Select the **eyes** and **nose vectors**.
- Select a **Dome** shape with an **Angle** of **45 degrees**, **No Limit** and select **Add**.
- Select **Close** on the **Shape Editor** form to dismiss it.



- Select **Lights and Materials** from the top toolbar.



- Select **Brushed Silver** in the **Shading Setup** area.
- **Close** the form.



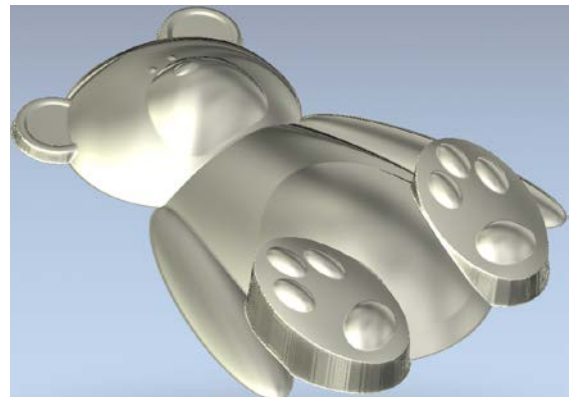
The Teddy will be completed by smoothing intersecting edges and creating text relief on the body

- Select **Smooth Relief**  from the **Relief Editing** toolbar.


- Select **Whole Layer**, enter the number of **Smoothing Passes** as **3** and select **Apply**.
- Select **Cancel** to close the form.



Sharp edges (such as arms to body) have been smoothed.



Constant Height Letters


The **Constant Height Letters**  function provides a **constant height** set by the user, whereas text created using the **Shape Editor** can sometimes result in **thin parts of the letters being lower than the rest of the Relief**.

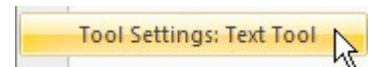
Constant Height Lettering will be added to the teddy's stomach region.

- In the **2D View**, Select **Preview Relief Layer**  to display the underlying Relief.

The **higher** the **Relief** the **lighter shade** it appears.

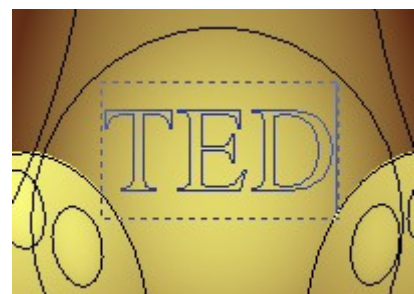


- Select **Create Vector Text**  from the **Design Tools Toolbar**.
- If not already visible, activate the **Tool Settings fly out Panel** by **Right mouse selecting in the grey border** (or press F6).



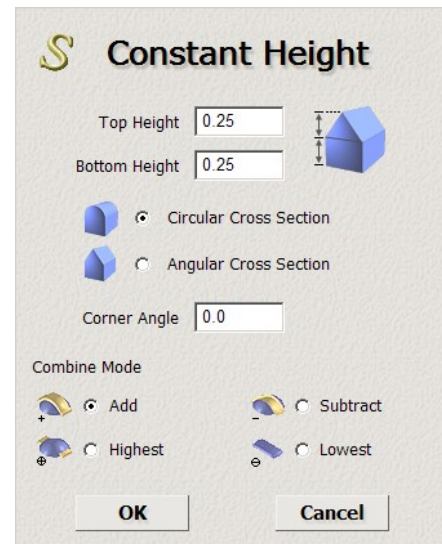
This reveals the Text Tool form

- Set the **Font** as **Times New Roman** and a **Size** of **2mm**.
- **Type** the word **TED** and position as shown.
- Select **Done** on the form to close it.



- With the **Text** highlighted, select **Constant Height Letters**  from the **Relief Creation Toolbar**.

- Set a **Top Height** of **0.25mm** and a **Bottom Height** of **0.25mm**.
- Select **Circular Cross Section**, followed by **Add** and **OK** to close the form.



- View the final results in 3D.



- Select **File – Save As**.
- Browse to: **D:\users\training\COURSEWORK\ArtCAMPro-Jobs** and enter the name as **train-ted**
- Select **File – Close Model**.

5. Pictures

Introduction

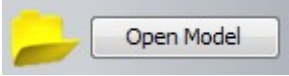
Coloured Pictures can be generated or edited within **ArtCAM** using the **Bitmap toolbar** or they can also be imported using any of the following formats **bmp**, **.tif**, **.pcx**, **.gif**, and **.jpg**.

The coloured areas of a **Picture** can be used directly with the **Shape Editor** to create a **Relief** instead of using **vectors**. As with **vectors** the enclosed coloured area is formed of tiny squares, which are given a height. In this case the smoothness of the **Relief** is directly, dependant on the **resolution** of the **picture**. Where coloured areas are used the smoothness of the **Relief** is not improved by changing the **model resolution**, as the number of **bitmap** squares is inherent in the **picture**.

ArtCAM can also generate **vectors** around a **selected colour**. The **vectors** can in turn be smoothed using such techniques as **splining** and **Node Editing** after which the actual **model resolution** is used to control the smoothness of the **Relief**. **ArtCAM** has the power to temporarily link colours together, which enables the user to combine different coloured areas, without changing the original picture. This is called **Colour Linking**.

Colour linking - Spider Coin Exercise

In this exercise a bitmap has already been opened, modified and saved as an **ArtCAM** model.

- Select **File > Open** or 
- Load in the model **train-spider.art** from: **D:\users\trainingArtCAM Data**.



The picture is made up of several colours, displayed at the bottom of the **2D View**.

Similar to **vectors**, you can assign each **colour** a **shape**. **Colours** can be temporarily combined using **Colour Linking**. This is a **temporary way of creating larger areas of similar colour that does not permanently change the original picture**.

The Bitmap is loaded with the associated colours displayed on a palette at the bottom of the screen.



- Single **left mouse button** click on the **yellow square**.

Yellow has now been assigned as the **primary** colour.



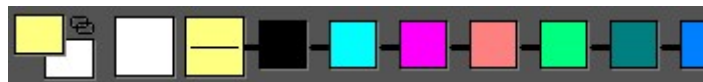
- Select the **white square** using the **right mouse button**.

This is now assigned as the **secondary** colour.

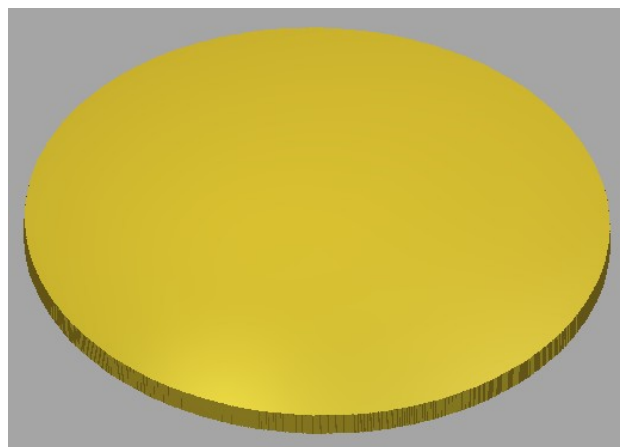


- From the top pull down menu, select **Bitmaps > Colour > Link All Colours**.


This will temporarily **change all colours to yellow** (except the **Secondary colour - white**). This has reflected on the bitmap itself and indicated on the palette with smaller coloured icons and connected lines. The main area of the coin (yellow) can now be raised as one unit.



- Double click with the **left mouse button** the **yellow colour** in the **2D View**.
- In the **Shape Editor**, select a **Flat shape** with a **Height** of **1.5mm**, followed by **Add**. Select **Close**.




The 'coin' shape has been generated. To produce the Rim, the colours need to be unlinked and then re-linked to include only the purple text.

- From the top pull down menu, select **Bitmaps > Colour > Reset All Links**.
- Double **right mouse click** on the **dark purple** square  at the bottom of the **2D View**.

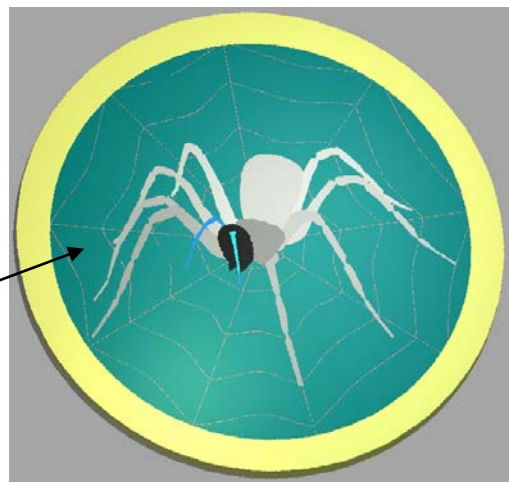
Double clicking with the **right mouse button** makes the colour become the secondary, and links it to the primary. So in this case the dark purple text becomes yellow.



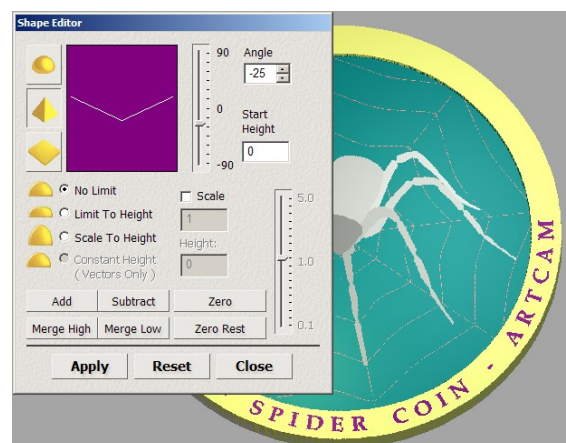
- Switch to the **3D view** and from the **3D view toolbar**, toggle on **Colour shade**. 

The bitmap image is applied to the Relief.

In addition to the colour palette, Reliefs can also be created from the colours selected directly from the Relief.

- Double left mouse click on the yellow colour in the 3D View. 
- In the **Shape Editor**, select a **Flat shape** with a **Height** of **2mm**, followed by **Merge High**. Select **Close**.
- From the top menu, select **Reset All Links**.


- Double **left mouse click** on the **dark purple** colour in the **2D View** and the **Shape Editor** will display it.
- In the **Shape Editor**, select a **Pyramid** shape with an **Angle** of **-25 degrees**, **Start Height** of **0**, followed by **Add**. Select **Close**.



- Toggle Colour shade  to switch OFF the bitmap.

The raised rim edge and 'V' grooved text is clearly shown on the coin.



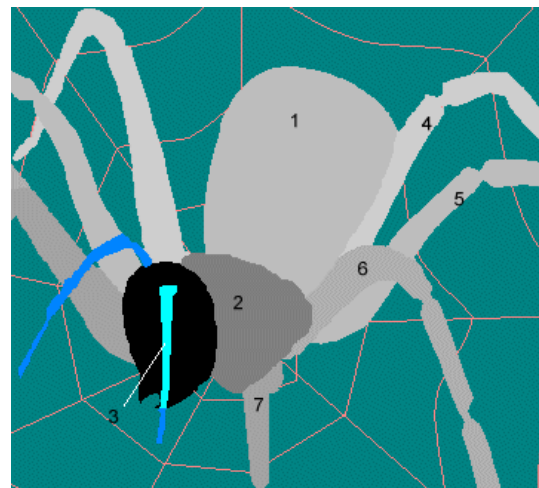
- Double left mouse click on the dark green colour  in the palette.
- In the **Shape Editor**, select a **Dome shape** with an **Angle** of **-10 degrees**, **Start Height** of **0**, followed by **Add**.
- Select **Close**.

The **Relief** now includes curved indentations between the web detail and the spider outline. You will now **add** the actual **spider** and **web detail** to the **Relief**.




The following steps will apply a relief to the areas indicated by a number as shown.


Note: The antenna is currently made up of two colours (light blue and purple). These colours will be combined (linked) so the area (3) can be treated as one.





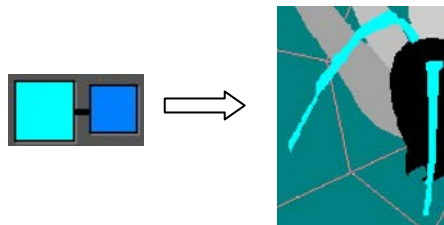
- Toggle Colour shade  to switch ON the bitmap.
- Double **left mouse click** on colour 1.
- In the **Shape Editor**, select a **Dome** shape with an **Angle** of **24 degrees**, **Start Height** of **0**, followed by **Add**.
- Double **left mouse click** on the colour 2 in the **2D View**.
- In the **Shape Editor**, select a **Dome** shape with an **Angle** of **24 degrees**, **Start Height** of **0**, followed by **Add**. Select **Close**.

The **black** will be linked with the light blue to provide a single coloured area for the whole of the head.

- **Single left mouse click** on the **black** area in the **2D View** to assign as the **primary**.
- Double **right mouse click** on the **light blue** square at the bottom of the **2D View** to link it to the **primary black colour**. 
- In the **Shape Editor**, select a **Dome** shape with a **Start Height** of **0**, an **Angle** of **30 degrees**, followed by **Add**. Select **Close**.
- From the top menu bar, select **Reset All Links**.

Link the **dark blue** with the **light blue**, to make all of the antennae area have the same colour.

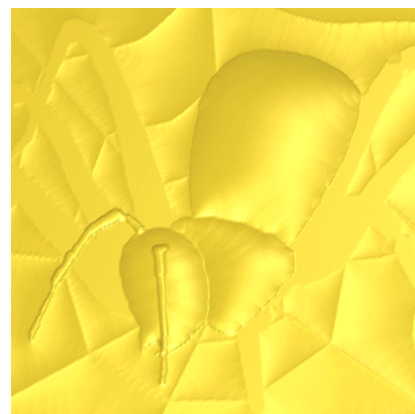
- Single left mouse click on the dark blue area in the 2D View.
- Double **right mouse click** on the **light blue** square at the bottom of the **2D View**.



- In the **Shape Editor**, select a **Dome** shape with an **Angle** of **45 degrees**, **Start Height** of **0**, followed by **Add**. Select **Close**.

The antennae are **added** to the current relief.

- From the top menu select **Reset All Links**.




- Double **left mouse click** on the area labelled **4** in the **2D View**.
- In the **Shape Editor**, select a **Dome** shape with an **Angle** of **45 degrees**, **Start Height** of **0**, followed by **Add**. Select **Close**.
- Repeat the process for areas labelled **5**, **6**, **7** and the **pink** area (webbing).




The coin is now complete.

- Select **File > Save As Coin** in:
D:\users\training\COURSEWORK\ArtCAMPro-Jobs.

Bitmap to Vector - Toucan Link Exercise

Colour linking can be used to **highlight areas** to **obtain vectors**, using the **Bitmap To Vector**  feature. This allows you to calculate the **vector boundary** of the selected **primary colour** in the **bitmap image**.

The following exercise will show the application of this feature.

- Select **Open Model**. 
- Select the folder: **D:\users\training\ArtCAM Data**, and change **Files of type**: to **Bitmap Files**.
- Select the file **toucan.gif**, followed by **Open**.
- Leave the **Set Model Size** dimensions as **default**, and select **OK**.
- Left mouse click on the first green colour in the colour palette (make primary)




- **Double right mouse click** on the next **5 green colours** (to link to primary)
- Double right mouse click on the **red** and **yellow** colours.




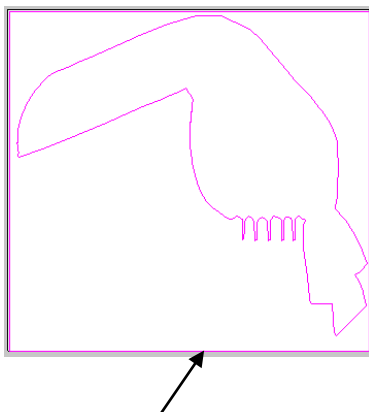
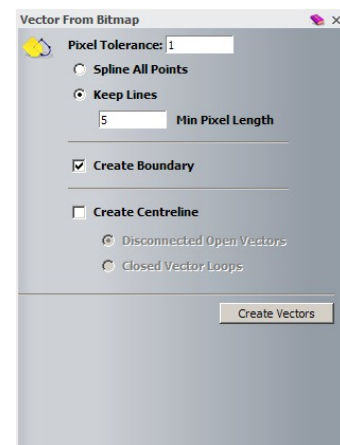
The **toucan** is now surrounded by a single **green colour**.

For the **body part** of the toucan, the **feet** and the **red beak** are not required, so they were also linked to the green.

A single **vector** from the **boundary** of the **Primary** colour will now be created.





- From the **Vector creation toolbar** at the top of the screen (or assistant tab) select **Bitmap to Vector**. 

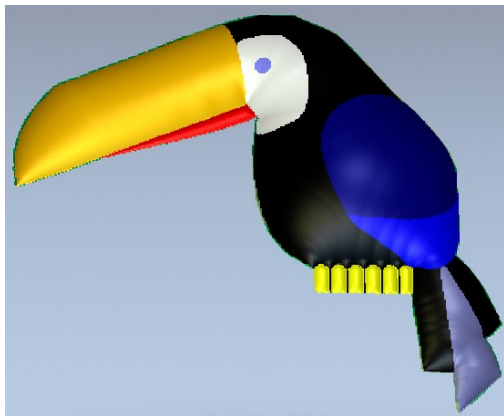
- Enter a **Pixel Tolerance** of **1**, select the option **Keep Lines** and enter a **Min Pixel Length** of **5** and select **Create Boundary**.
- Select **Create Vectors** and **close the form**.
- **Toggle Bitmap visibility**  in the **Bitmap Layers Tab** to hide the Toucan image.



A single closed vector has been generated on the primary colour(s) boundary. **Adjusting the pixel tolerance** will define how close the vector will follow the primary colour boundary.

- Delete the square outside vector. Double left mouse click on the bird vector to open the Shape Editor.
- Select a **Dome shape** with an **Angle** of **45 degrees**, followed by **Add**. Select **Close**.

- Select **Reset All Links**.
- Select the **Yellow colour** using the left mouse button (make Primary)
- Select Bitmap to Vector,  followed by Create Vectors (to create the feet).
- Select the **Red colour** using the left mouse button.
- Select Bitmap to Vector,  followed by Create Vectors (to create the beak)
- **Toggle Bitmap visibility**  in the **Bitmap Layers Tab** to show the Toucan image.
- Shift Select the new **toes** and **beak vectors**.
- **Select a Dome shape** with an **Angle of 45 degrees**, followed by **Add**. Select **Close**.
- **View** the results in the **3D view**.
- **Select Colour shade**  to apply the bitmap.



The example will be completed by **subtracting** the **white coloured area** to generate the **eye**. The **wing** will also be **added**.

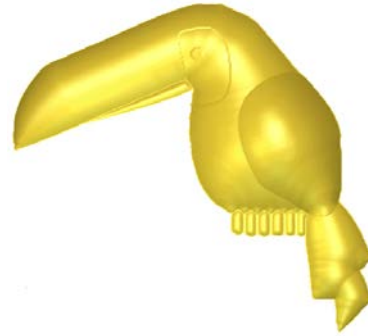
- Double left mouse click **the white colour** directly from the relief.
- Select a **Flat** shape with a **Start Height** of **0.5mm** and select **Subtract**.
- Single mouse select the blue colour defined at the bottom of the main wing (to make primary).
- Double right mouse click the dark blue colour (in palette) defined as the top part of the wing.

The two blue colours are linked to create a single colour for the wing.



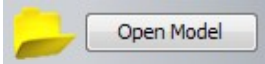
- Double left mouse click the blue wing colour and set a Dome shape with an Angle of 25 degrees.
- Select **Add**, followed by **Close**.

- Toggle Colour shade  to confirm the results.

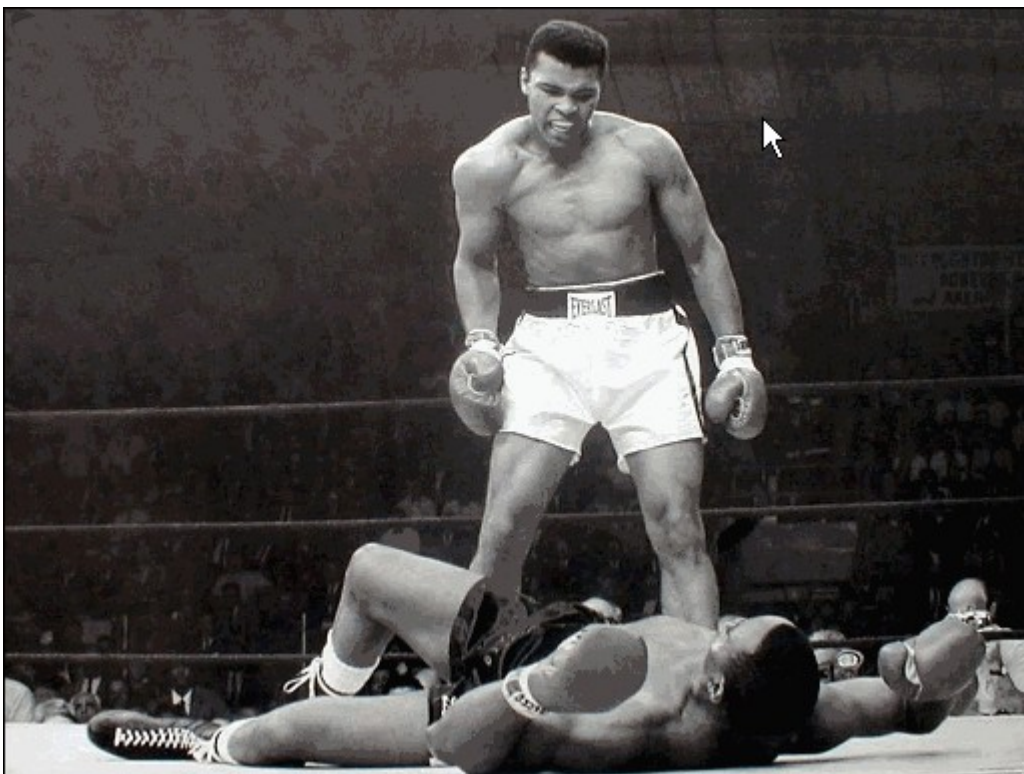


Create Relief Layer from Bitmap Layer

ArtCAM can create a **Relief layer** from an **Imported Image**.

- Select. 
- Select the folder: D:\users\training\ArtCAM Data.
- Select Files of type to be Bitmap Files (*.gif).
- Select the file **Knockout.jpg**, followed by **Open**.
- Change the origin to the centre and leave the dimensions as default.
- Select **OK**.

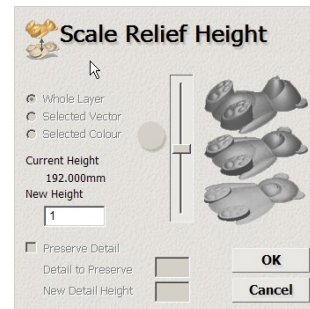
The option Scanned d.p.i. (dots per inch) allows the model size to be changed by defining the required resolution.



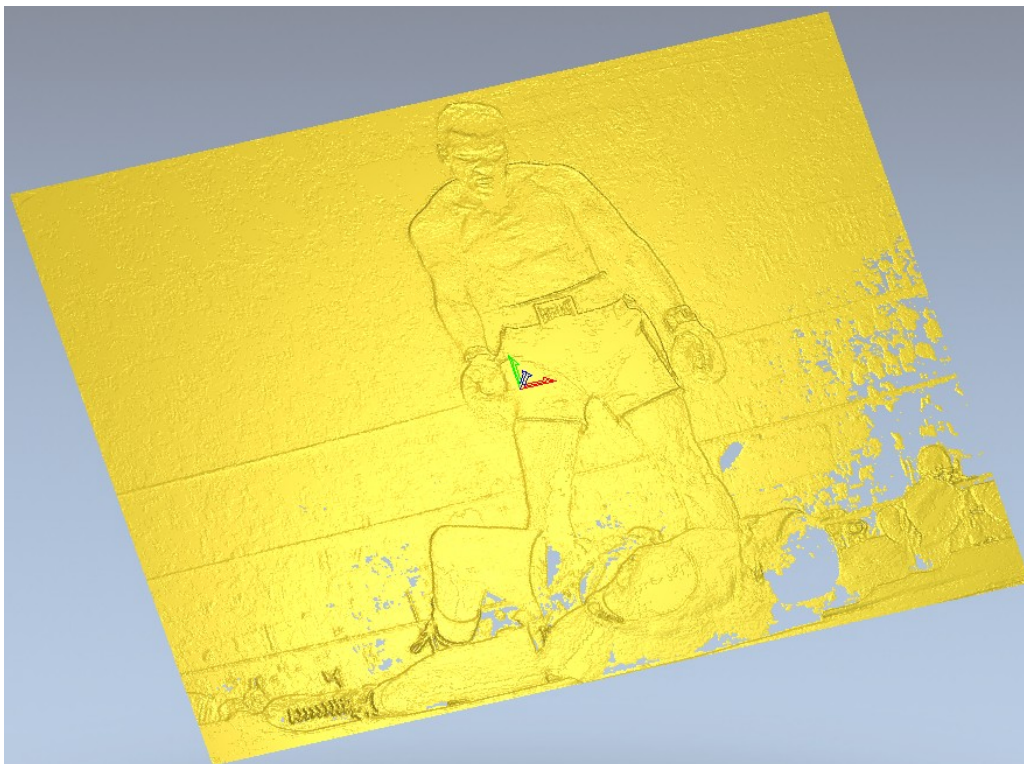
- From the **Bitmaps layers tab**, select **Create Relief Layer**.



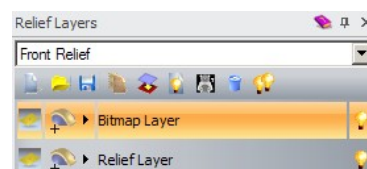
- In the Scale Relief Height form, enter a **New Height** of **3mm**.
- Select **OK**.



- View** the new **Relief** in the **3D View** window.



A new Relief layer has been created from this Bitmap named **Bitmap Layer**.



This **Scale Relief Height** has limited the height of the **Relief** to 3mm. The Relief generated varies in height according to the bitmap pixel colour below it. The relief height will be at the **highest level** in the **lighter** coloured areas and **lowest** in the **dark areas**.

The relief therefore varies in height between Z 0 and Z 3mm. Areas of no relief are evident as the bitmap in these areas are black in colour. **Note: Draw Zero Plane is off.**

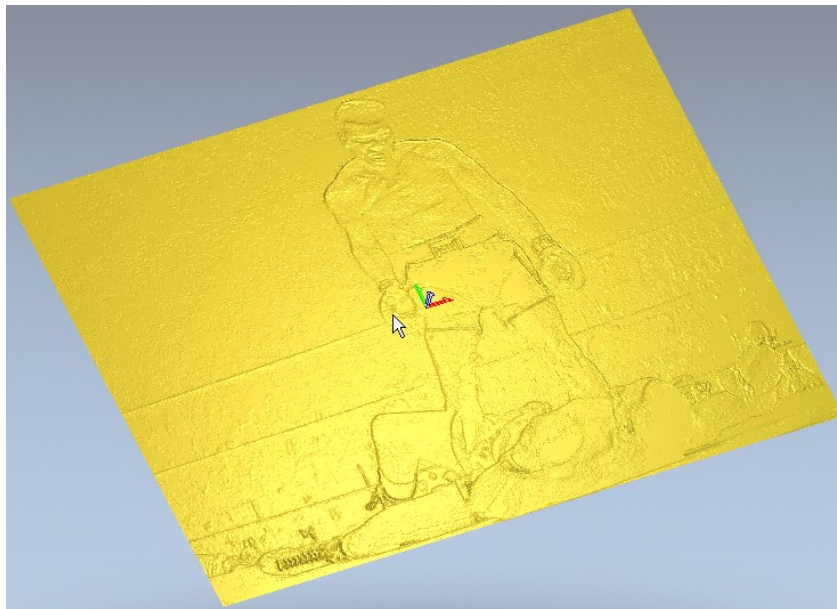


- Create a rectangle of size of **Width 1024mm** and **Height 768mm** with **Centre Point at X0 Y0**.

This rectangle vector defines the border edge of the image.

- In the **Shape Editor**, select a **Flat shape** with a **Height of 1mm**, followed by **Add**. Select **Close**.

A 1mm base has been added to the Relief eliminating the zero relief areas. To complete the Relief a smoothing pass will be applied to reduce the surface irregularities.



- From the **Relief Editing Toolbar**, Select **Smooth Relief**.

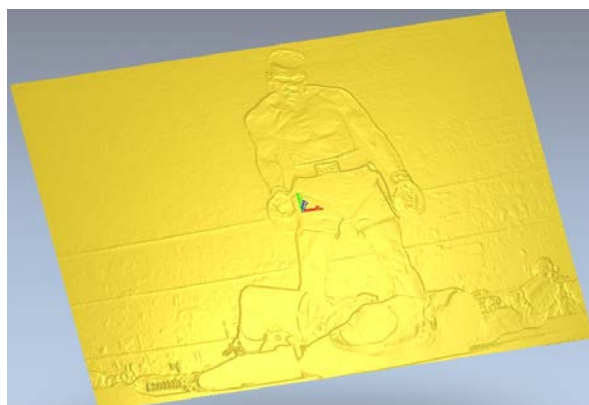


- With the **Whole Layer** option ticked and **Smoothing Passes as 2**, select **Apply**.



The Model is complete.

- Save the Model and close.



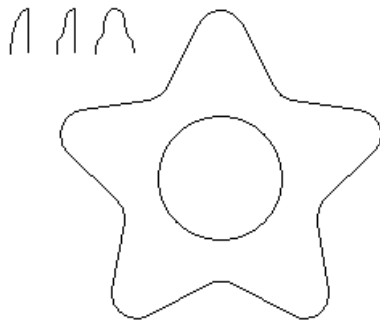
6. 3D Blend and Fade Relief

Overview

The **3D Blend** creates the **Relief** form either inside a **closed vector** or **between two closed vectors**. The **height** and **shape** across the void is controlled by a series of standard, **cross sectional forms** or a user defined **Z modulation curve**.

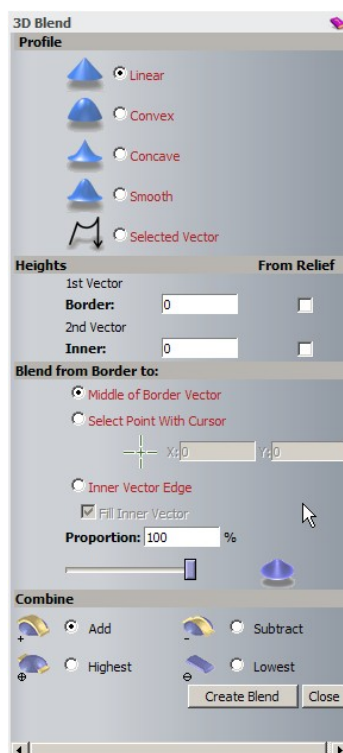
Star Exercise

- Open the model **star-blend.art** from: D:\users\training\ArtCam Data.



This model contains various vectors to demonstrate the **3D Blend Relief** options.

- In the **Relief Tools** area, select **Create 3D Blend**.

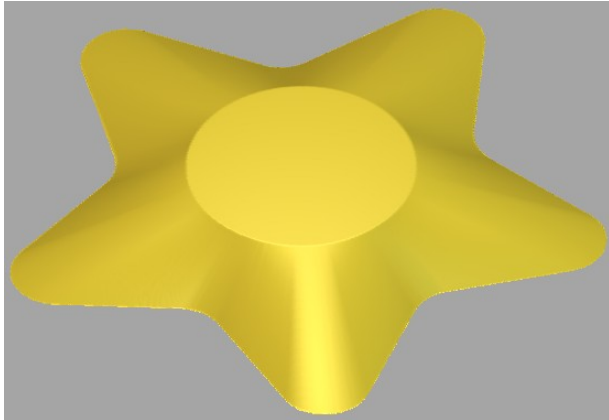


The **3D Blend** assistant page appears providing a comprehensive range of the options. The **3D blend Relief** is either generated from a single **vector** to a **central** or **user defined** point, or across to an inner **vector** using one of the **Profile** types, displayed in the page.

The final shape of the **Relief** is controlled by a combination of the type of **Profile** and **Height** definitions selected.

The above options combined with **Add**, **Subtract**, **Highest** and **Lowest**, provides you very powerful commands.

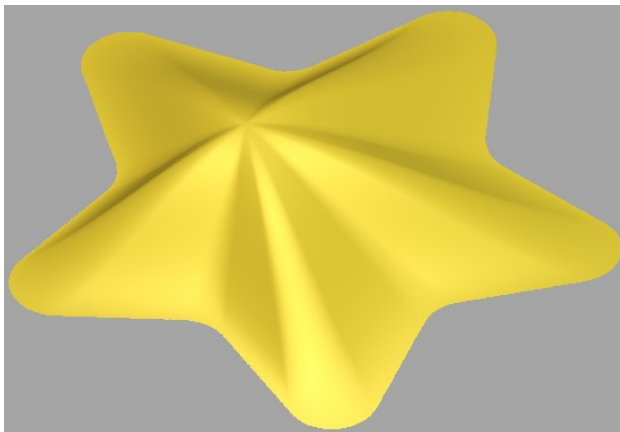
- Select the **Star vector** and shift and select the **Circle** as well.
- Select the **Linear Profile** option.
- Enter a **Border Height of 0** and an **Inner Height of 5mm**.
- Select **Inner Vector Edge** and select the option **Fill Inner Vector**.
- Select **Add**, followed by **Create Blend**.
- Press **F3** to view in 3D.



The **Relief** has a **Linear** blend from the **outer** to the **inner vector**. It then continues at constant height (5mm) across the area inside the **inner vector**.

If **Fill Inner Vector** was unchecked, the circle would be open (no relief).

- Select **Undo** (Ctrl + Z).
- Select the **outer star vector only** with the **Smooth Profile** option selected.
- Select the option **Select Point With Cursor** and enter **X0** and **Y10**.
- Select **Add**, followed by **Create Blend**.



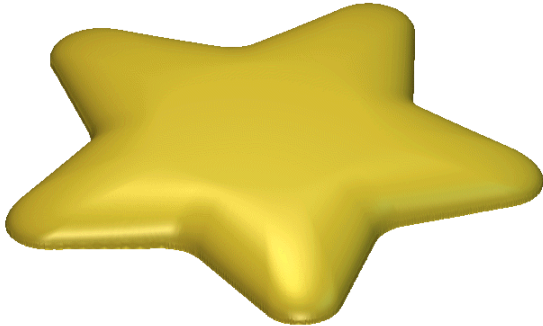
A **smooth blend Relief** is produced with an **offset vector blend** producing an **offset centred star shape**.

The next part of the chapter will compare the addition of different cross sectional, **Selected Vectors** numbered 1 to 3 as shown.



Each vector will produce a different shape when scaled across the relief to the defined heights. The **Selected Vector** is always picked last.

- Select **Undo** (Ctrl + Z).
- Select the **outer** followed by the **inner vector** and with the **3D Blend** page open, select the **Profile** option **Selected Vector**.
- Hold shift and select the cross section **vector 1** from the **2D View** window.
- **In Blend from Border to:** set **Inner Vector Edge** and tick the box **Fill Inner Vector**.
- Select **Add**, followed by **Create Blend**.



A new **Relief** is created from cross section, **vector 1** scaled between the **inner** and **outer vectors**. It then continues at constant height (5mm) across the area inside the **inner vector**.

- Select **Undo** (Ctrl + Z).
- Select the **star vector**, shift select the **circle vector** and then the cross section, **vector 2**.
- Select **Highest**, followed by **Create Blend**.



The new **Relief** has been produced as the scaled **vector 2** between the **inner** and **outer vectors**. It then continues at constant height (5mm) across the area inside the **inner vector**.

- Select **Undo** (Ctrl + Z).
- Select the **star vector** and shift select the cross section, **vector 3**.
- Select **Middle of Border Vector**.
- Select **Highest**, followed by **Create Blend**.



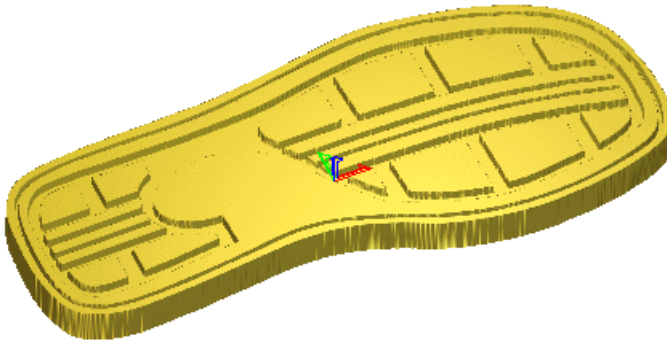
The shape of the **Relief** is controlled by cross sectional, **vector 3** running from the **outer star vector** inwards as well as from the **centre** outwards. The maximum height (5mm) occurs exactly half way between the outer **star vector** and the **centre**.

Fade Relief

This command will reduce a relief down by a percentage (100% is down to zero) within a specified area.

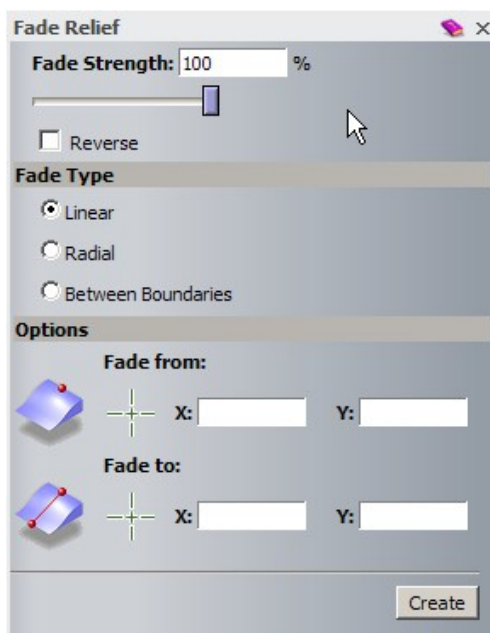
Shoe Sole Exercise

- Open the model **shoe-tread.art** from: **D:\users\trainingArtCam Data.**



This **shoe sole Relief** was generated from **vectors**, created by opening a picture file. The sole needs to be **faded** to generate a better design.

- Select the **2D View**.
- From the **Assistant's** page, select **Fade Relief**.




Fade Strength can be set anywhere from 1 to 100%, with 100% being faded down to 0 and 50 % down to half the current height in Z.

The **reverse** option allows you to fade upwards instead of downwards.

Linear Fade, with fade the whole relief between the start and end of a line.

Radial Fade will produce a radial fade from a central position.

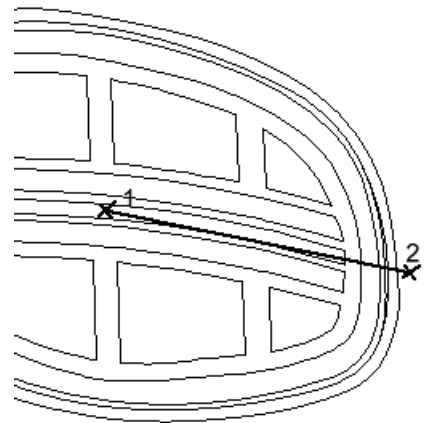
Between Boundaries will limit the fade area between two selected vectors.

- Ensure **Fade Strength** is set at **100%** and **Fade Type Linear** is selected.
- Using the **left mouse button**, **Drag and drop the cross hair**  below **Fade from:** into the location as shown below as number 1.

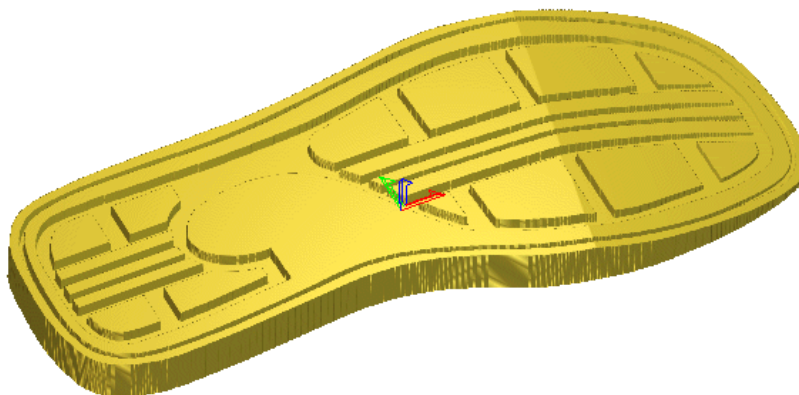
The X and Y coordinates are updated to reflect the position,


- **Repeat the above** and **drag the cross hair**  below **Fade to:** to the number 2 position shown below.

Position 1 shows where the **Fade** is going to start and the **Position 2** where it will end (to Z=0)



- Select **Create**.
- Select **F3**.



The toe region has faded. The **X** and **Y** values are kept even after undo,  to allow different options.

The **Fade** is parallel to the line, so if angled points were selected, the fade would also be angled.

7. Extrude, Spin, Turn and Two Rail Sweep

Overview

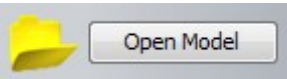
Extrude, Spin, Turn and Two Rail Sweep are commands that create **Reliefs** from cross sections along **Vectors**. These functions can allow the creation of complex and free form shapes quickly. A Relevant example will be used to demonstrate each of these functions.



Extrude Relief

An **Extruded Relief** is produced using **two or more vectors**. The **Relief** is produced as a swept form of the **Start Profile vector** along the **Drive Curve vector**. If you use a different **End Profile vector**, the **Relief** will change shape from one end of the drive curve to the other. A fourth curve known as a Z modulation curve determines the shape of the swept relief in the **Z direction**.

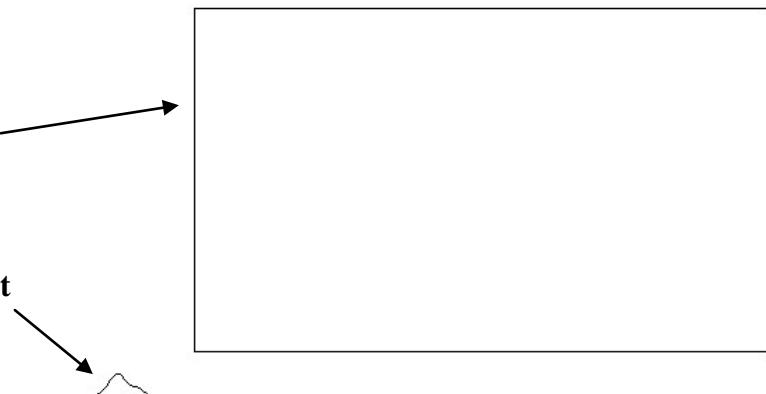
Extrude Relief Exercise – Picture Frame

- Select **File > Open** or 
- Load in the model **Picture frame.art** from: **D:\users\trainingArtCAM Data**.

The model contains two vectors.

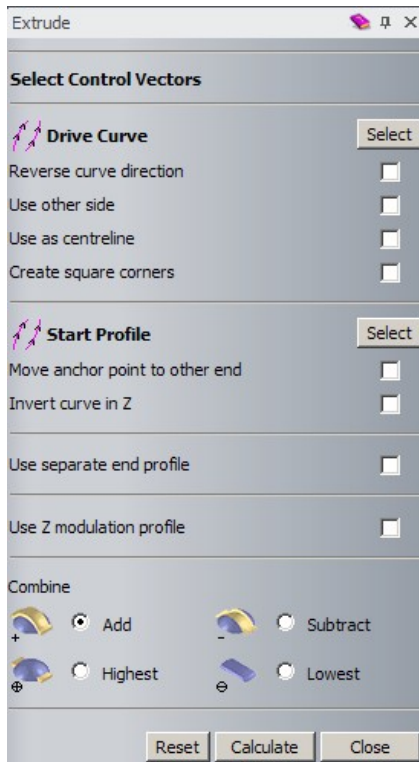
The **rectangle** represents a **drive curve**. This curve can be **open** or **closed** (as in this case).

The small vector shape is the **Start Profile (section)**.



Note: The profile vector is the exact size that is required and can be located anywhere in the **2D View**. Also it must be a **single open vector** (not Grouped).

- Select **Extrude**  from the **Relief Tools** tab.



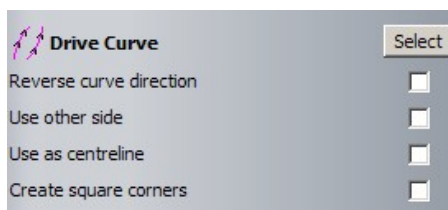
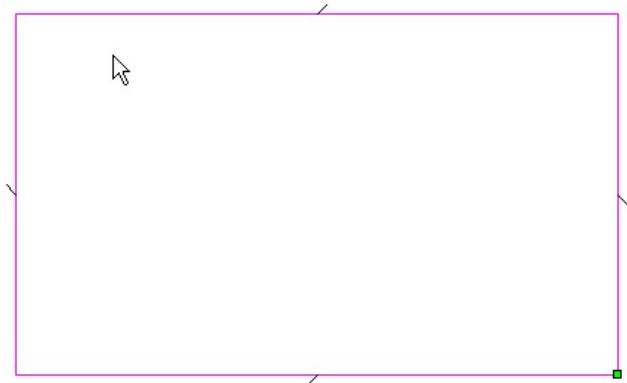
The **Extrude** page provides the options for the user to create the required **Extruded Relief** shape.

- Select the Rectangle vector with the **left mouse button**, followed by **Select** in the **Drive Curve** section of the form.

The **Drive Curve** vector is highlighted.

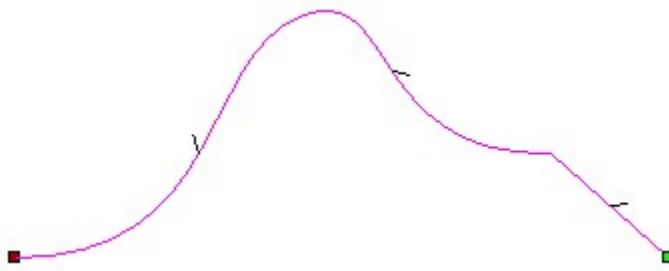
The small **green square** indicates the **Start** of the **Curve**, where the **Start Profile** will be located.

The small lines running off the sides **indicate** which side of the **vector** the sectional profiles will be extruded along. These options can be changed by ticking the relevant boxes as shown below.



- Select only the option to **Create square corners**.

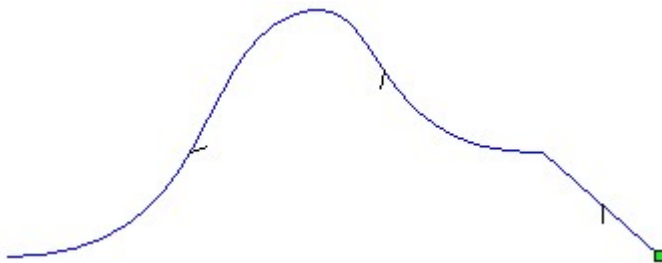
- Select the small open vector with the **left mouse button**, followed by **Select** in the Start profile section of the form.



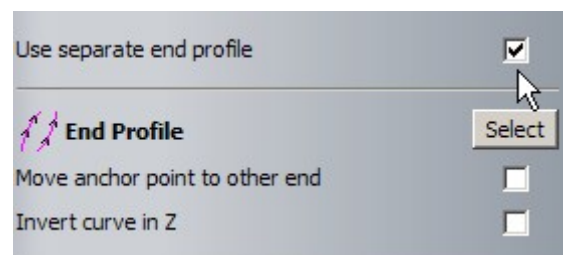
The **Start Profile vector** is highlighted. As before, the **Green** square indicates the **Start** of the section. The small lines running off the curve indicate whether the **Relief** would be **positive** (ticks inside) or **negative** (ticks outside). For this exercise, a positive **Relief** is required.

The anchor point is critical in this case as it will dictate which part of the profile is on the outside of the picture frame. A comparison is shown below.

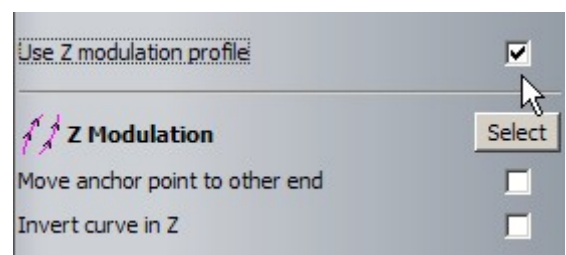
- Leave the anchor point in its current position, but select **Invert Curve in Z** to create a **positive relief**.



This option can be selecting if an **End Profile** of a different shape to the **Start Profile** is required. By default the **End Profile** is the same as the **Start Profile**. If an **End Profile** is required, the **Use separate end profile** field must be **selected** to provide access to the required selection options.

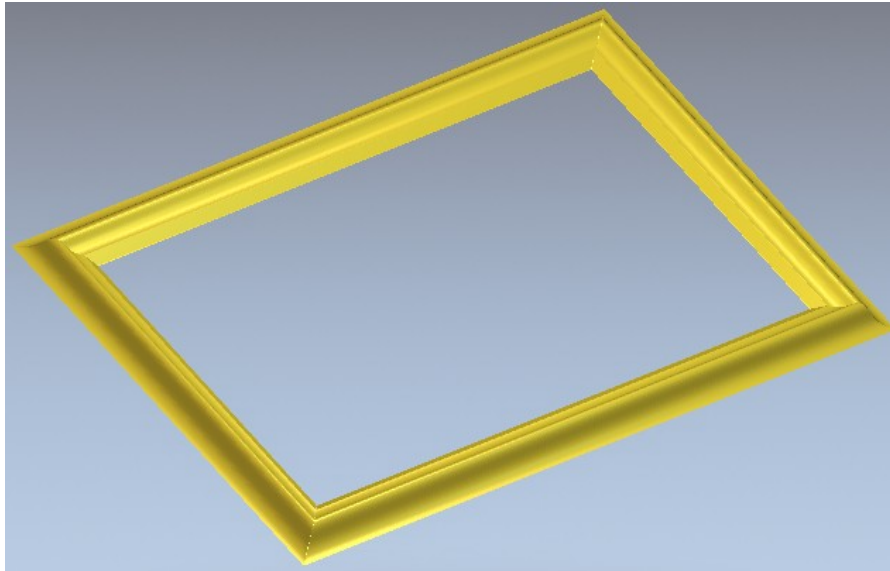
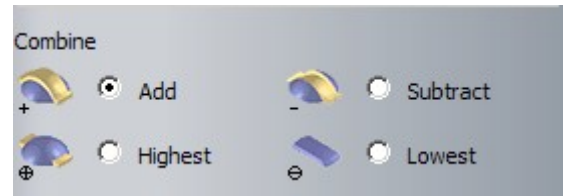


This area of the page enables you to include a **Z modulation Vector**. This controls the **Relief Height** along the **Drive Curve**. As above, this must be selected to reveal the selection options.

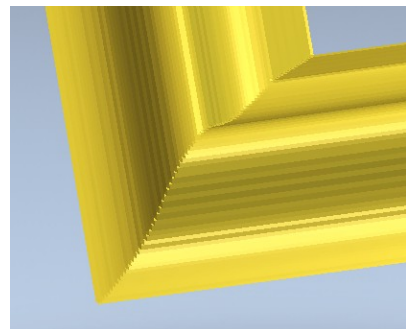


Similar to Shape Editor, this page controls the method to combine the shape with the existing **Relief**.

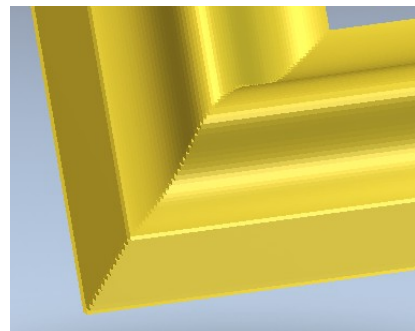
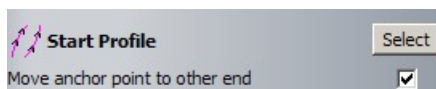
- Ensure **Add** is selected.
- Select **Calculate** to create the relief.
- **Close** the form and view the results in 3D.



Square corners have been created because the option was selected in the Extrude form.



If the option **Move anchor point to other end** was selected, then the **profile vector would be reversed** during the extrusion. The result would then be as shown to the right.

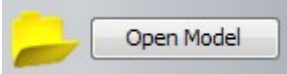


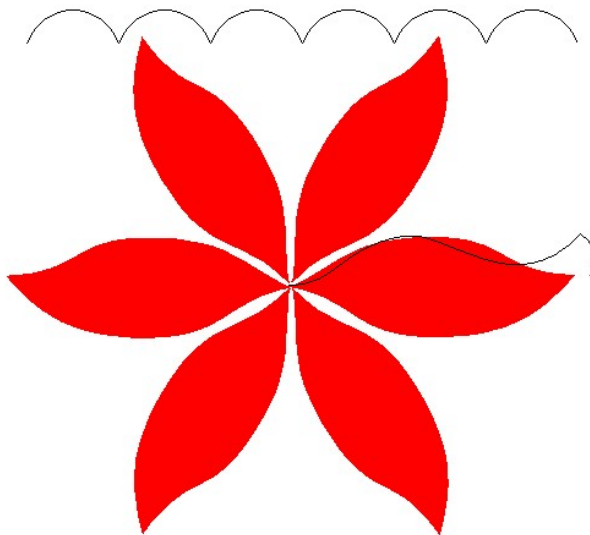
- Select **File - Save As**, enter the **File name** as **training-PictureFrame** and save it in: **D:\users\training\COURSEWORK\ArtCAM Pro-Jobs**.

Spin Relief

A **Spin Relief** is produced, by spinning a single **Cross Sectional vector** around its own start point (green square). Spin Relief also allows the inclusion of a separate end profile and Z modulation vector.

Spin Exercise – Leaf shape

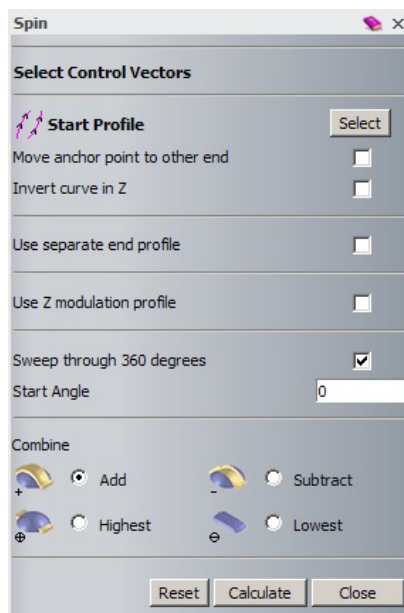
- Select **File > Open** or  **Open Model**
- Load in the model **Spinleaf.art** from: **D:\users\trainingArtCAM Data**.



The model includes two vectors and a bitmap of a leaf shape.

This **Polyline** will be spun around its own start point (shown as a green square) to generate a Relief. The **Polyline** or **Start Profile** determines the actual size of the model and has to be a single joined **vector**.

- Select **Spin**  from the **Relief Tools** area.



The profile by default will be swept a full circle (360 degrees). Unticking this option will allow the start and end angles to be specified.

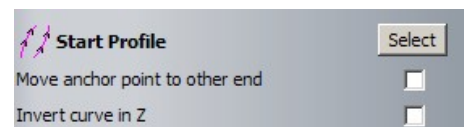
- Select the **profile vector** with the **left mouse button**.
- On the **Spin** page, click **Select**.


A **positive Relief** is required therefore the indicator marks should point inwards as shown.



The start point green square is on the left hand side indicating the anchor point at which this profile will spin around.

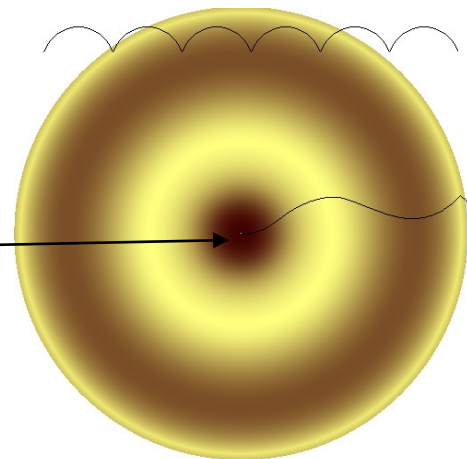
If necessary, both options can be changed by selecting the relevant box.



- Ensure **Add** is selected.
- Select **Calculate** to create the relief. **Close** the form.
- From the 2D view tab, select **Preview Relief Layer**. 

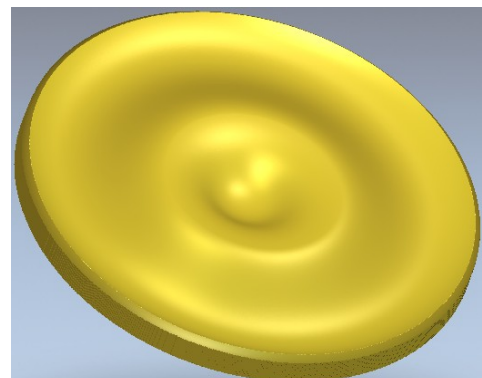
The Relief Layer is displayed in the 2D view.




The result shows how the profile was swept full circle around the anchor (start) point.



Switch to the 3D view to see the results.

This process will be repeated to include the **Z modulation vector**.



- From the **Relief Editing Toolbar**, select **Reset Relief**. 
- Return to the 2D view and **Switch off Preview Relief layer**. 
- Select **Spin**  from the **Relief Tools** area.
- **Reselect the profile vector** as the **Start profile**
- Tick the option **Use Z modulation profile**, to reveal the further options.
- Select the curved vector, followed by **Select** in the **Z modulation** section of the form.

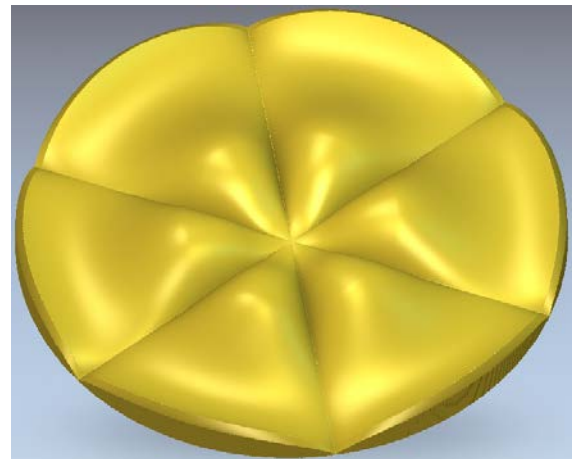



- Select **Calculate** to create the relief. **Close** the form.

Switch to the 3D view to see the results.

The six curve profile has scaled the Relief in the Z-axis (along its length).

The final leaf shape will now be completed.



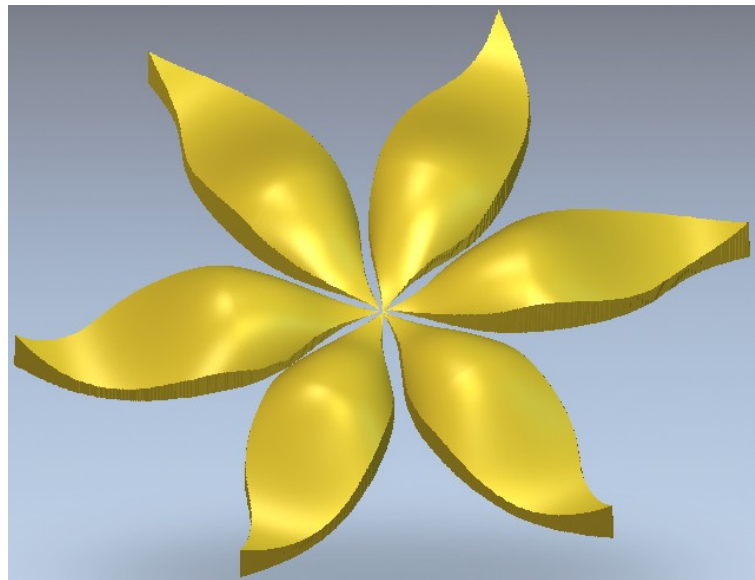
- From the colour palette, ensure **Red** is selected as the **Primary colour**. 
- From the top menu. Select **Reliefs > Keep under colour**.

This will reset all areas of the Relief **NOT** under the primary colour (red).

*Note: Selecting **ZERO REST** in **Shape Editor** would give the same result.*

- View the result in 3D.

The leaf pattern has been created from the original swept relief.



- From the top menu, select **Bitmap>Colour>Reset All Links**.

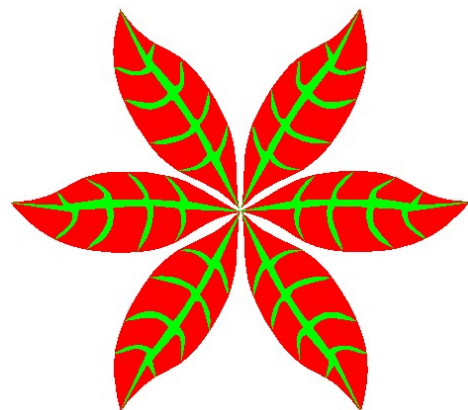
The previously linked green colour has been reset. This has exposed the leaf 'veins'.



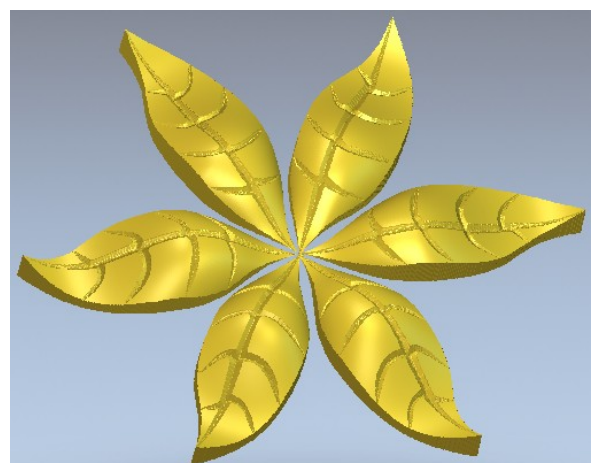
- Enter **Shape editor** using the **green colour** (double left mouse click directly in the view or palette)

- **Subtract** a triangular feature using a **45 degrees angle**.

Note: subtracting a 45 degree angle is equivalent to adding -45 degrees.



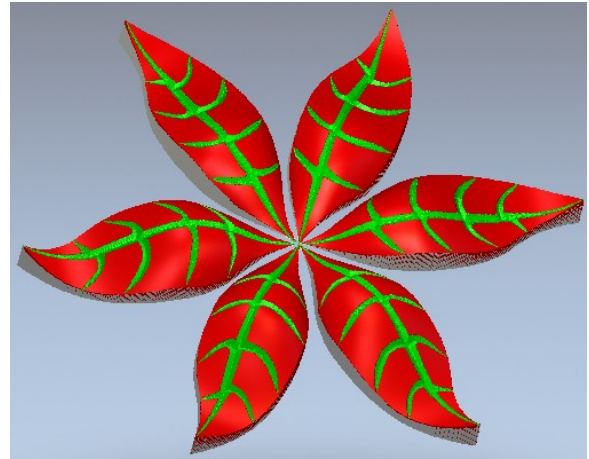
The 'veins' have been added to the final relief.



- From the 3D view tab, **select Colour Shade.**



The original bitmap has been applied to the underlying relief.




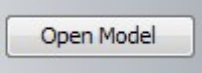
- Select **File - Save As**, enter the **File name** as **training-SpinRelief** and save it in: **D:\users\training\COURSEWORK\ArtCAM Pro-Jobs.**

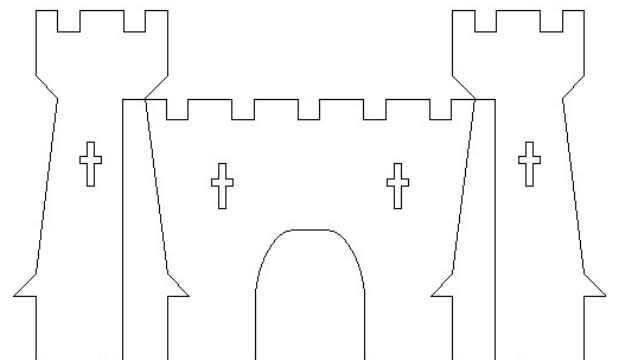
Turn Relief

The **Turn** command takes a **vector (cross section)** and **rotates** it over itself to generate a **Relief**.

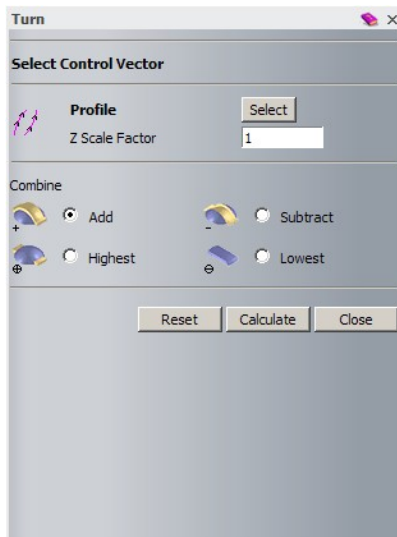
The axis of rotation is defined along the line between the start and end points of the **vector**.

Turn Exercise - Castle

- Select **File > Open** or  
- Load in the model **Castle turn.art** from: **D:\users\trainingArtCAM Data.**

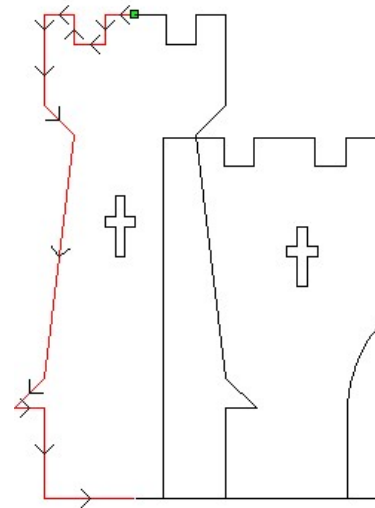


- Select **Turn**,  from the **Relief Tools** area.



The **Turn** page provides an option for **vector selection (Profile)**, **Z Scale Factor** for the **Z Height** and **Combine Relief** creation method.

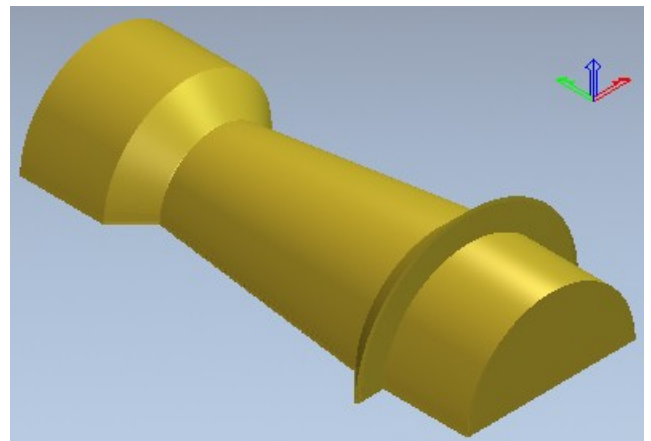
- Select the 'left tower' **vector** as shown with the **left mouse button**.
- On the **Turn** page, click **Select**.



- Select **Add**, followed by **Calculate**. Select **Close**.
- View the results in 3D.


The **Relief** is turned out (180 degrees) on the page. The Z height of the Relief was dictated by the size of the vector profile itself.

This will be repeated but a scale factor will be applied.




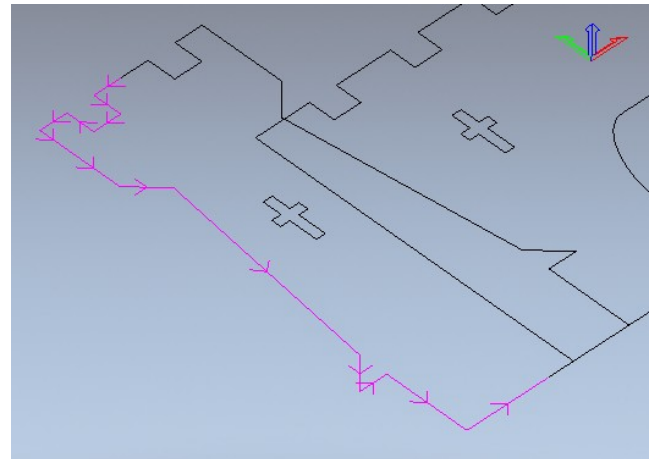
- From the **Relief Editing Toolbar**, select **Reset Relief**.



- Select **Toggle Vector Visibility**,  from the **3D view Toolbar**.

The 2D vectors are displayed in the 3D view. The remainder of the castle will be created within the 3D view.


- Reselect** the same 'left tower' vector and then **Spin**  from the **Relief Tools** area.

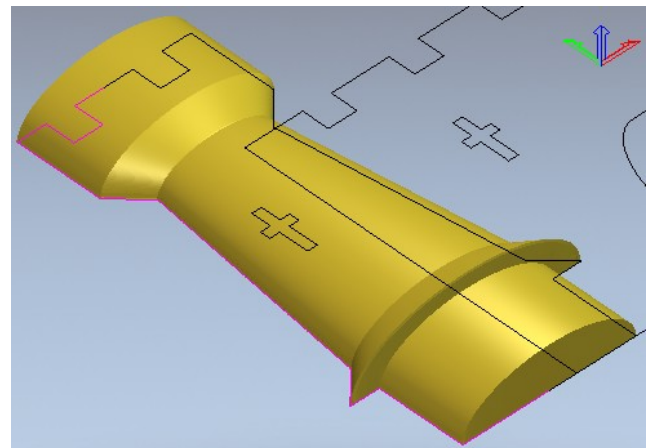


- Change the **Z Scale factor** to **0.5**.
- Select **Add**, followed by **Calculate**. Select **Close**.

Without changing the X and Y parameters, the Relief height (Z) is now **reduced by 50%**.

This can be repeated to create the **second identical tower**. However for this example, the **Mirror**

Merge Relief  function will be shown.

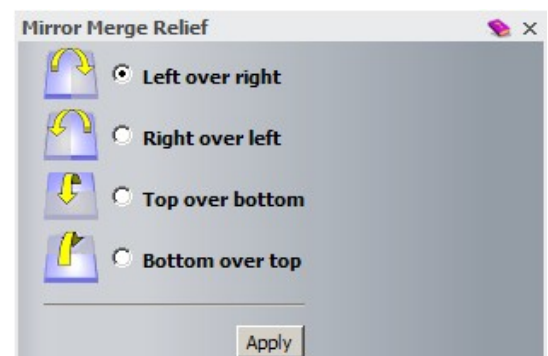


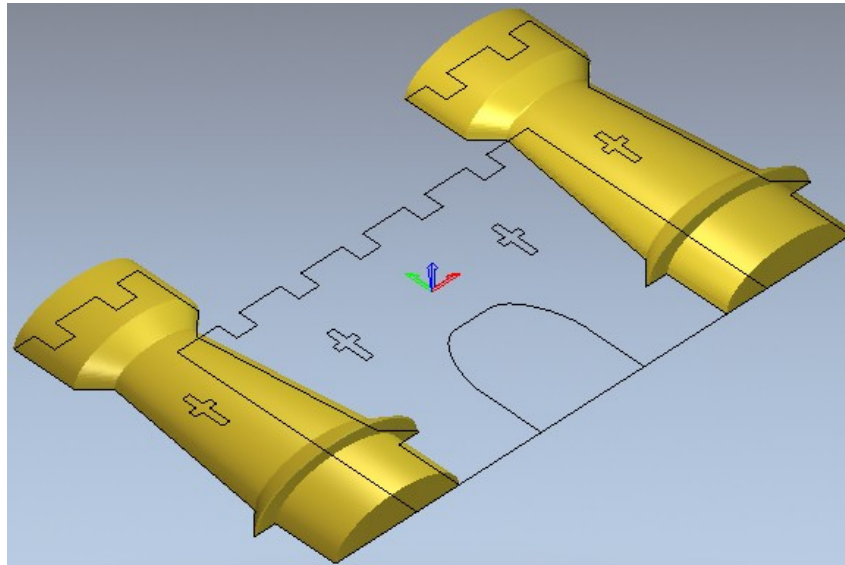
- From the **Relief Tools** area, select **Mirror Merge Relief**.




The Relief will be mirrored across the origin based on the option selected.

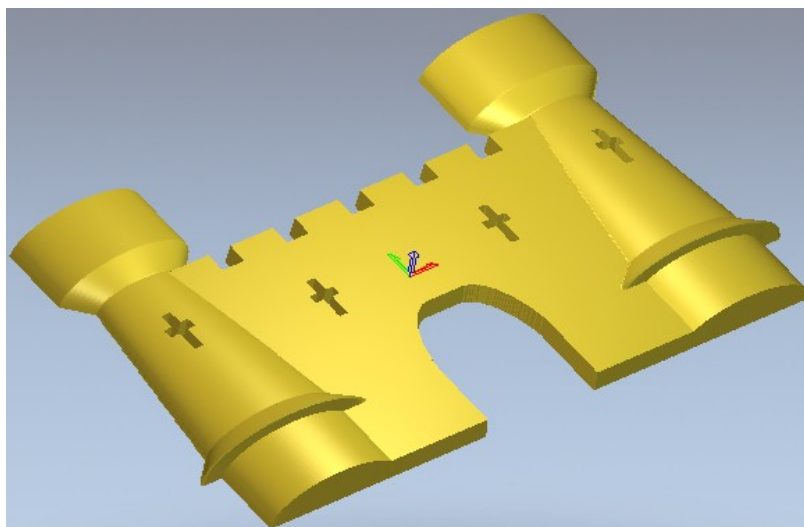
- Select the option **Left over right** and then **Apply**.





The remainder of the castle will be merged.

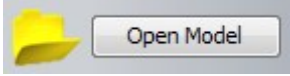
- Select **only** the **outer rectangular vector**.
- Within **Shape Editor**, **Merge High** a flat plane of height **0.8mm**.
- **Shift Select** the **four 'cross' shapes** and the **entrance (door)**
- Within **Shape Editor**, Select **Zero**.
- Select **Toggle Vector Visibility**,  from the **3D view Toolbar** to hide the vectors.

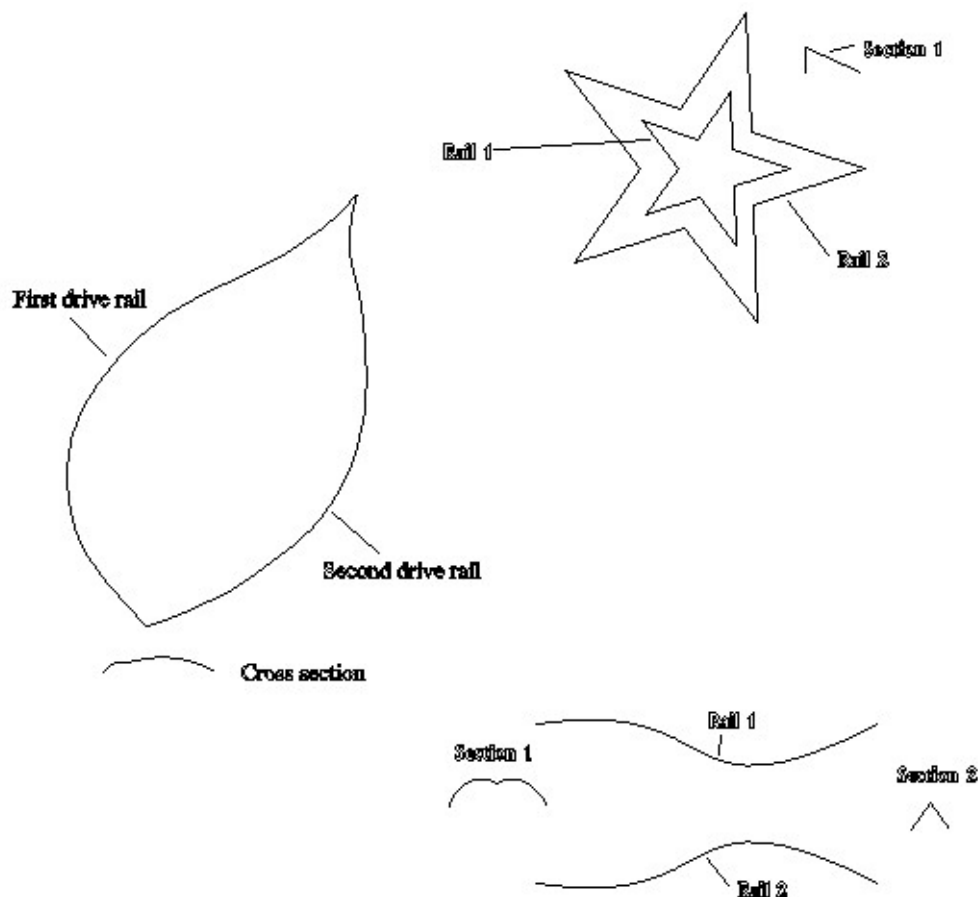


- Select **File - Save As**, enter the **File name** as **training-castleturn** and save it **D:\users\training\COURSEWORK\ArtCAMPro-Jobs**

Two Rail Sweep

The **Two Rail Sweep** provides a powerful **Relief** creation tool with a variety of controlling options. The basic principle is that one or more **scale sectional vector forms (profiles)** are extruded between **two Drive Curve vectors (rails)**.

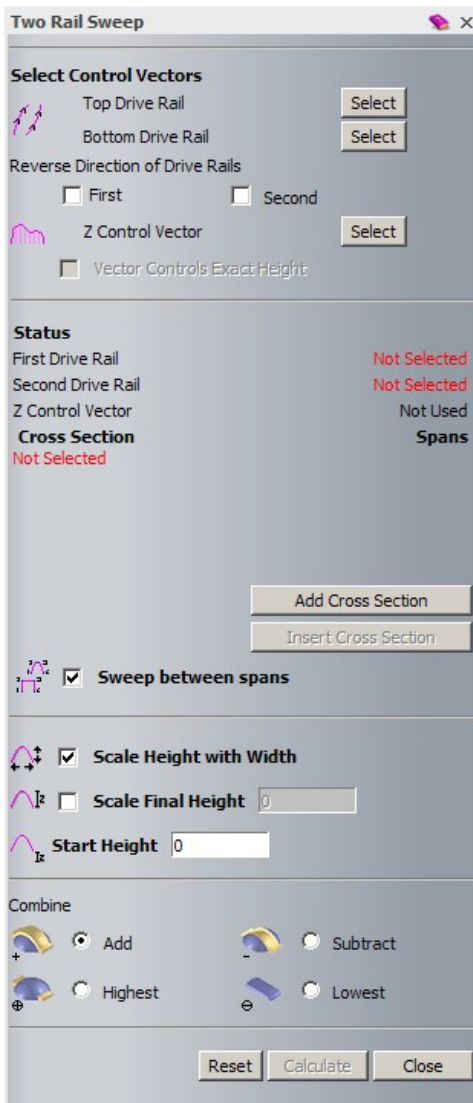
- Select **File > Open** or 
- Load in the model **two rail sweep.art** from: **D:\users\trainingArtCAM Data**.



These three examples will introduce the two rail sweep function capability.

Leaf shape

- Select **Two Rail Sweep**,  from the **Relief Tools** area.



The form enables the required vectors to be selected.

The **two drive rails** must have the **same direction** (as indicated by the arrows once selected)

The **Z modulation vector** (as with extrude and spin) is selected here.

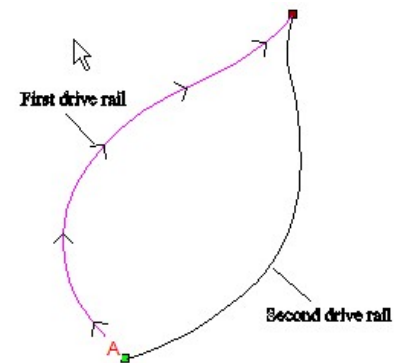
This section allows multiple cross sections to added and individual positions specified. (*Note: Cross sections must be open, ungrouped vectors*)

The final scaling of the relief can be managed in this section of the form.

The usual **Combine options** are selected here before selecting **Calculate**.

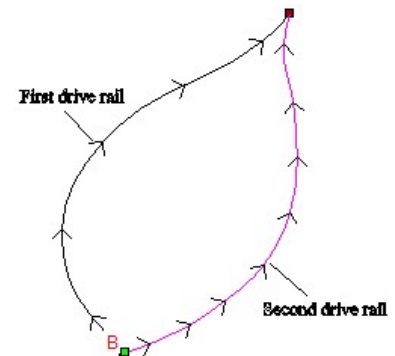
- Select the **left hand leaf vector** identified as the **First drive rail**.
- Click **select** in the form next to **Top Drive Rail**.

Arrows have appeared on the vector indicating its **direction**. The **Green Square** and **red letter A** also signify the start point. In the status area, the **First Drive Rail** status changes from **Not selected** to **valid**.

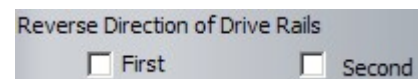


- Select the **right hand leaf vector** identified as the **Second drive rail**.
- Click **select** in the form next to **Bottom Drive Rail**.

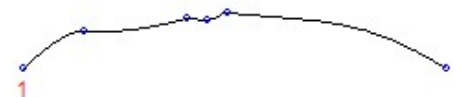
As before, arrows indicate its **direction**. The **Green Square** and **red letter B** signify the start point. In the status area, the **Second Drive Rail** status changes from **Not selected** to **valid**.



If required, the arrow/vector direction can be changed by selecting the relevant check box.



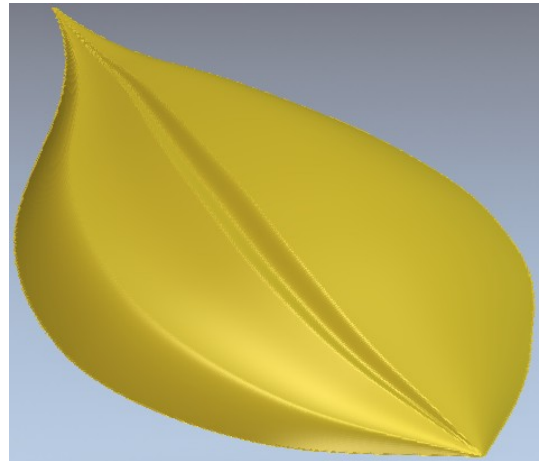
- Select the **profile vector** identified as **Cross section**.
- Click the **Add Cross Section** button in the form.



In the status area, **Cross section 1** is now listed with its status as **valid**. The **number 1** indicates its start point.

- Ensure **Scale Height and Width** and the combine option **Add** are both selected.
- Select **Calculate** and view the resulting relief.

The cross section has swept between the two rails to create the leaf shaped relief.



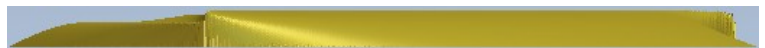
- From the **3D view toolbar**, view the **relief along the Y axis**.



Selecting the option **Scale Height and Width** meant that the Z height of the cross section is scaled relative to the width (across drive rails).



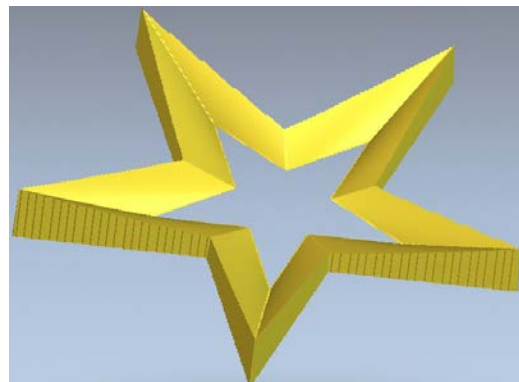
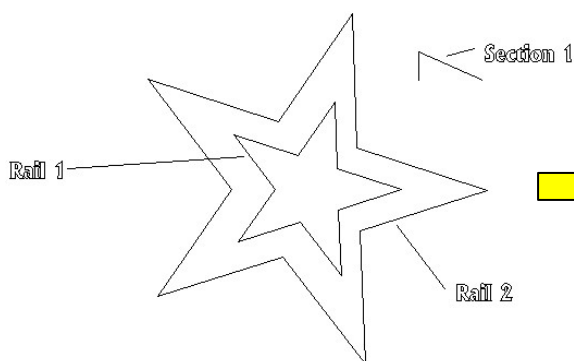
Not selecting the Scale Height and Width option would have given a constant height.



Star shape

Drive curves/rails can also be **closed vectors**.

- **Repeat the above procedure** to create the **star shaped relief**. Use the vectors as labelled.

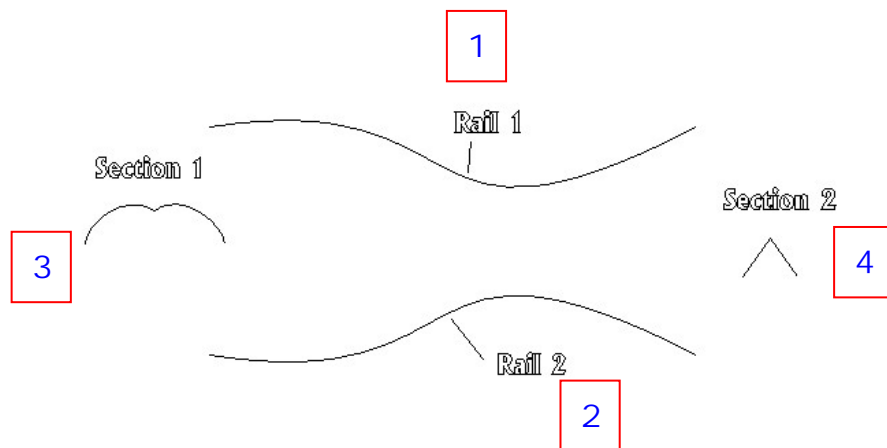


Multiple sections

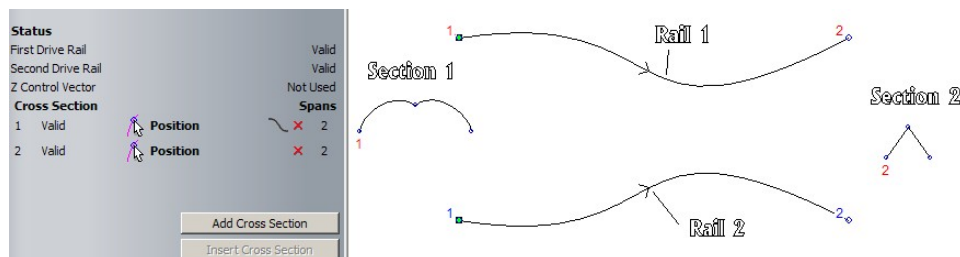
Any number of sections can be added and used in the calculation of the relief. The **position** of the cross sections can also be specified.

Vectors can also be selected prior to opening the two rail sweep form.

- **Shift-select** the two curves and sections in the order shown.

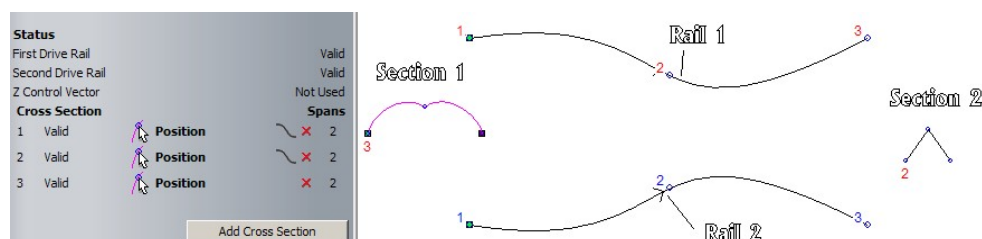


- Select **Two Rail Sweep**,  from the **Relief Tools** area.



The vectors are identified with arrows and numbers to specify their start and end positions.

- Re-select and ensure only the **Section 1 vector**  is selected.
- Select 



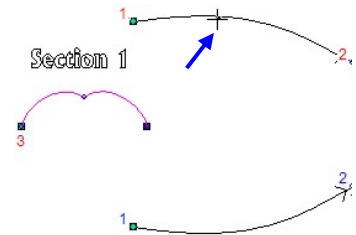
This **additional** section has been inserted midpoint between the previous two.

- In the Cross Section status area, select the word **Position** adjacent to **Cross section 2**.

Cross Section			Spans
1	Valid	Position	2
2	Valid	1st Rail	2
3	Valid	Position	2

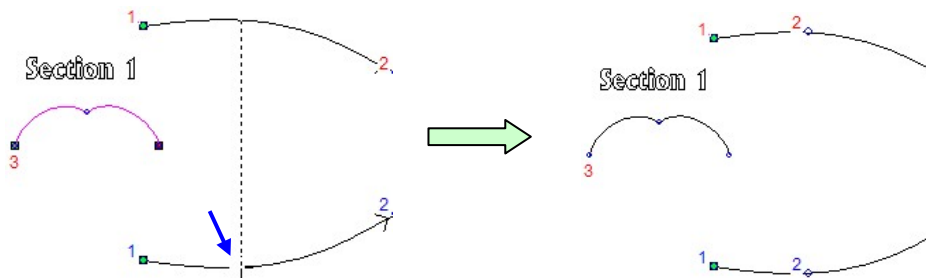
The word **Position** changes to **1st Rail**.

- Select the drive curve vector in the area shown to define the first point.

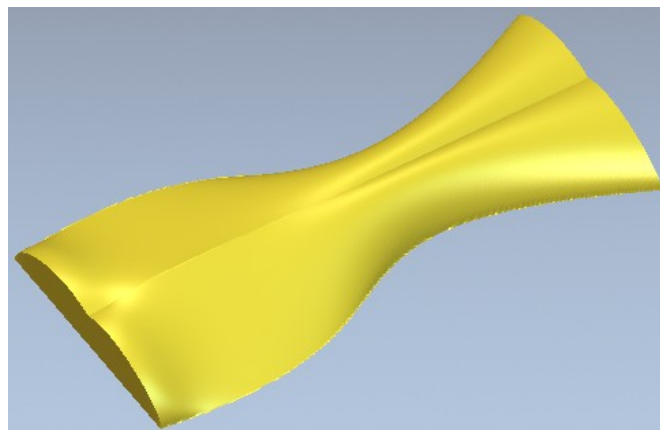


The word **Position** changes to **2nd Rail**.

- Select the second point as shown below to define the new position.



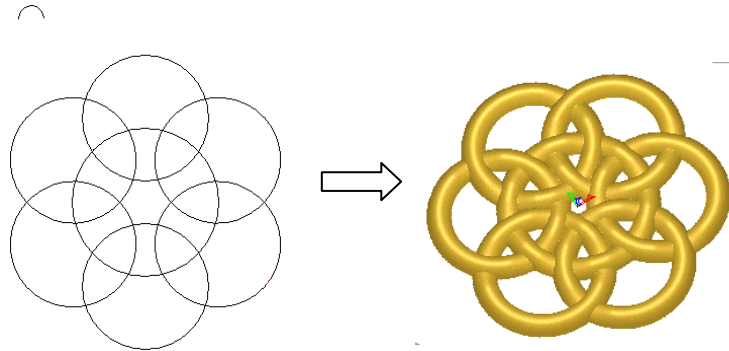
- Untick the option **Scale Height and Width**.
- Select **Calculate** and view the results.



8. Weaves

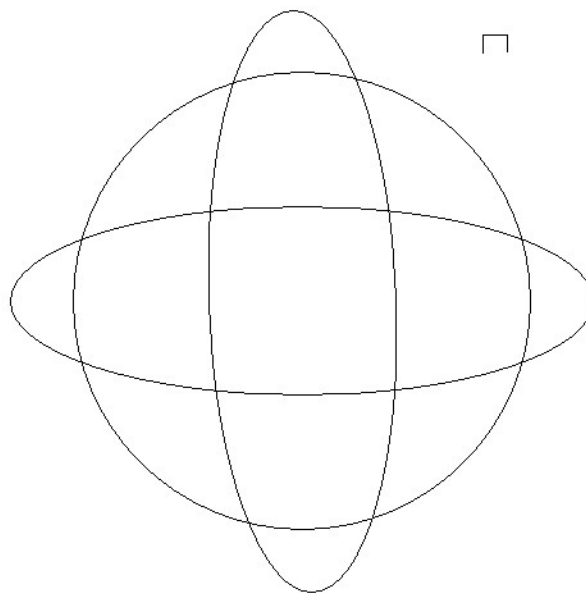
Weave Relief

A **Weave Relief** is generated from a series of overlapping **vectors** and a **Section vector**, using the **Weave Wizard**.



Weave Exercise 1

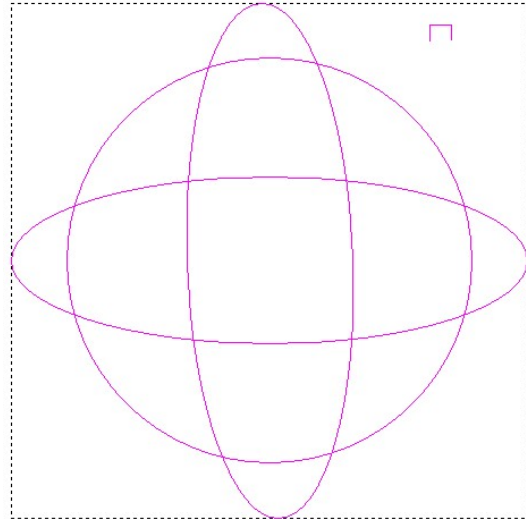
- Create a **New Model** with **Width** and **Height** of **25mm** and **origin** in the centre.
- Create **three vectors** for the **Drive Curves** and a **small open square vector** for the **Cross Section**, as shown in the image below.



The **overlapping vectors** will be used as the **centrelines** for the **Drive Curve**. The **smaller vector** will be the **Cross Section** of the **Weave** pattern and must be an **Open** vector. The small vector section is actual size of the desired relief.

- Shift select the **Drive Curve** vectors and the **Cross Section** vector last.

The vectors turn **pink** as they are selected and a box appears around the extents of the vectors to show that they are selected.



- Select **Weave Wizard**. 



ArtCAM creates the weave pattern at the intersecting regions of the vectors.

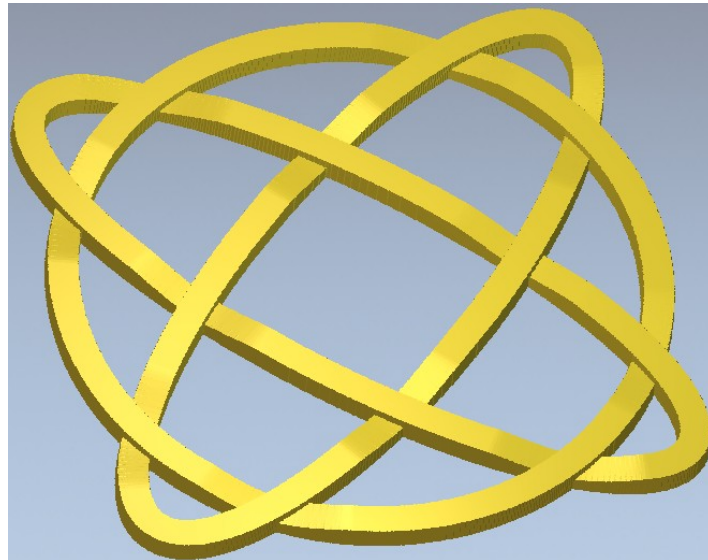
The direction of the vectors determines underpass and overpass which vector goes under or over the others.

Length of Crossover determines the length of the weave that will be lowered or raised at the crossover point. This is usually **Relative to Cross Section**.

% Depth of underpass and **% Height of overpass** allow you to determine the percentage that the height of the weave **Cross Section** is lowered or raised at the crossovers.

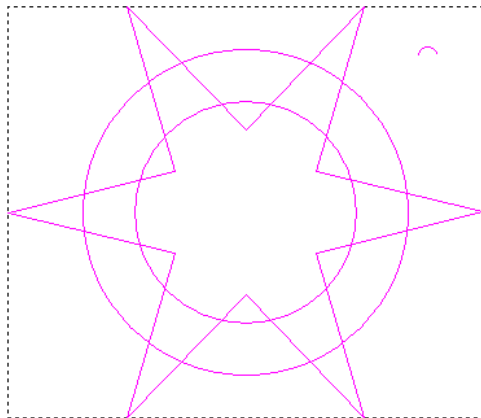
The **Corner Shape** can be **Round** or **Square**, and the relief is combined in the same manner.

- Leave the defaults options and select **OK** to calculate the relief.
- Select the 3D View tab (or F3) to view the result.




Weave Exercise 2

- Create the following **vectors**, including the **small half Ellipse cross section vector**.



If the cross section is too big the weave will cross over itself.

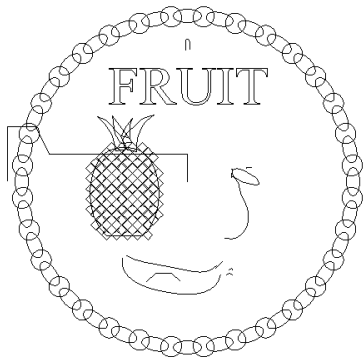
- Shift select the **Drive Curve** vectors and the **Cross Section** vector last.
- Select **Weave Wizard** .
- Select **Relative to cross section** and enter a value of **1.5mm**, select **Square**, followed by **OK**.

With **Square corners** selected, the **Weave** has sharp edges, rather than rounded.



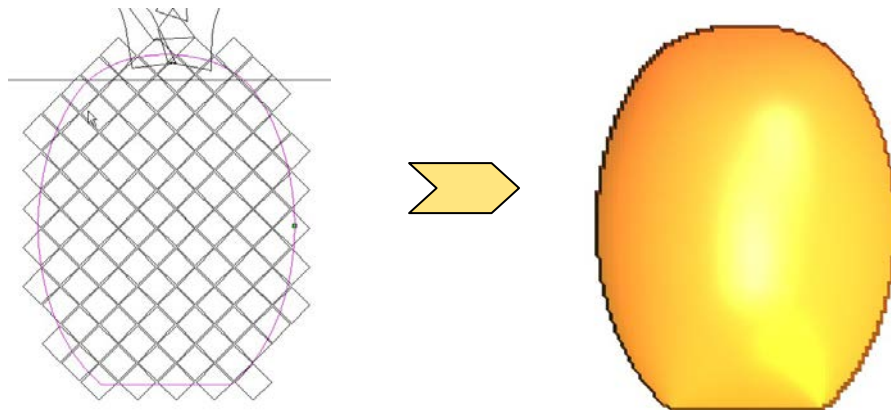
Fruit Plate Exercise

- Open the model **fruits-on-plate.art**, from the **ArtCAM Data** folder.

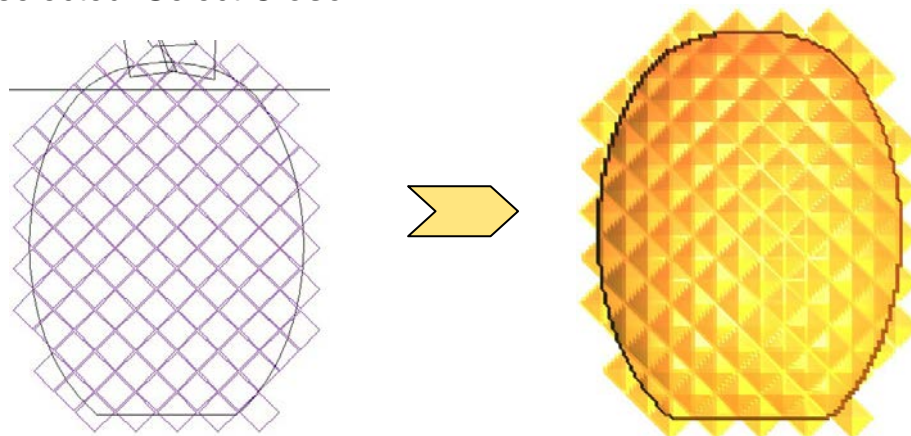


These vectors will be turned into a plate relief, using swept profiles.

- Select just the pineapple **Dome vector** and generate an **Added Dome Relief** with an **Angle** of **45 degrees**, **Start Height** of **0.4mm** and with **No Limit** selected. Select **Close**.

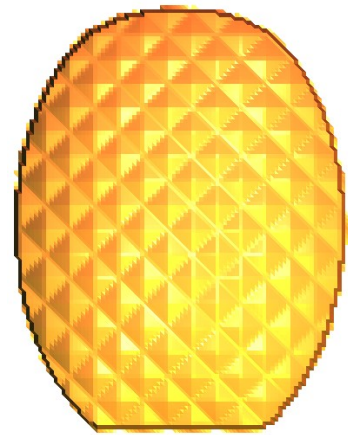


- Use the overlapping **diamond vector group** and generate an **Added Pyramid Relief** with an **Angle** of **25 degrees**, **Start Height** of **0** and with **No Limit** selected. Select **Close**.

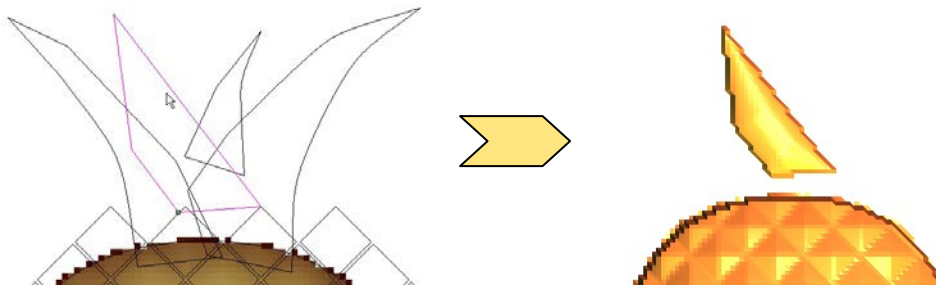


The generated **Relief** goes over the edge of the pineapple. This 'excess' relief can be removed by applying **Zero Rest** in the **Shape Editor**.

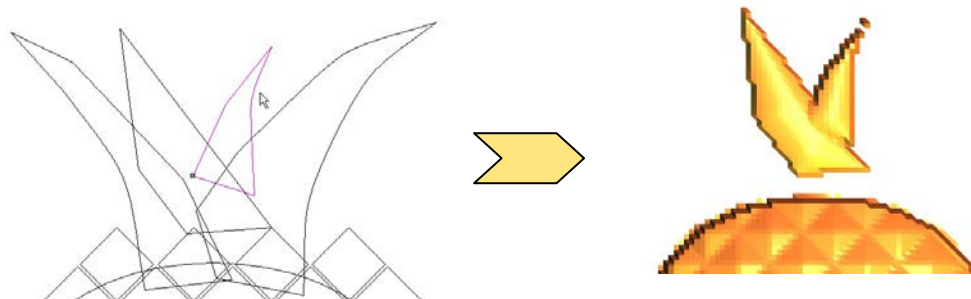
- Double click the **round pineapple vector**. In **Shape Editor**, select **Zero Rest**. **Close** the form.



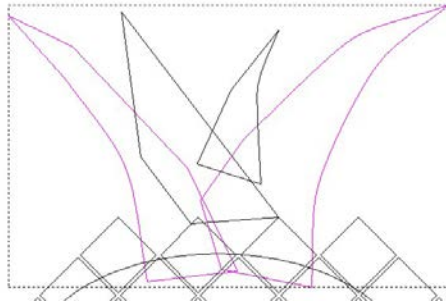
- Use the **left middle leaf vector** and generate an **Added Dome Relief** with an **Angle** of **45 degrees**, **Start Height** of **0.1mm** with **No Limit** selected. Select **Close**.




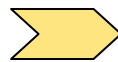
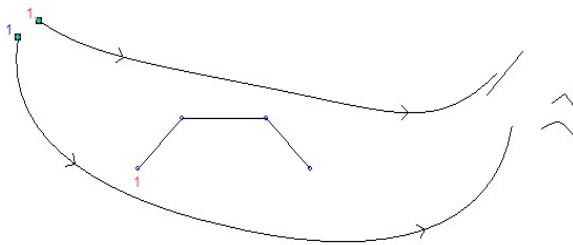
- Use the **right middle leaf vector** and generate a **Merge High Dome Relief** with an **Angle** of **45 degrees**, **Start Height** of **0.2mm** with **No Limit** selected. Select **Close**.




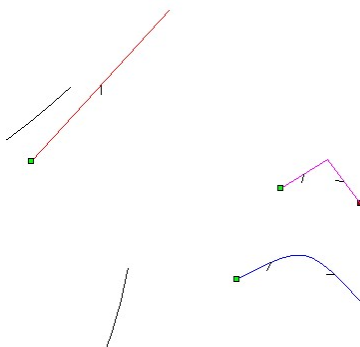
- Use the **outer leaf vectors** and generate a **Merge High Dome Relief** with an **Angle** of **45 degrees**, **Start Height** of **0.4mm** with **Limit to Height** at **1mm**. Select **Close**.



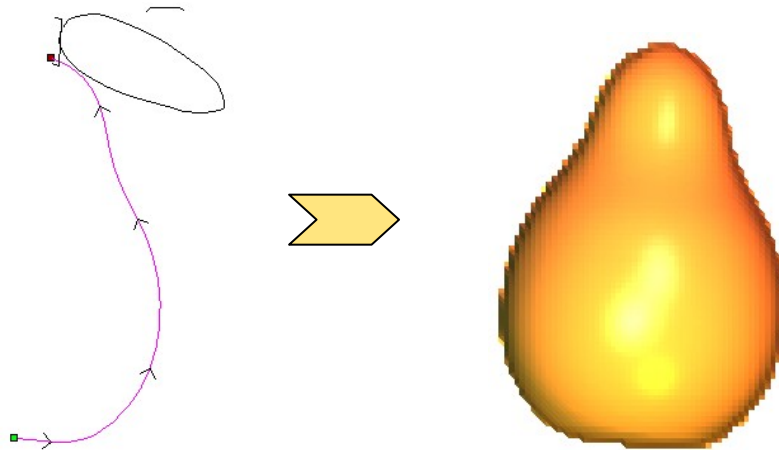
- Select the **three vectors** for the **banana** and generate an **Added Two Rail Sweep Relief**. 



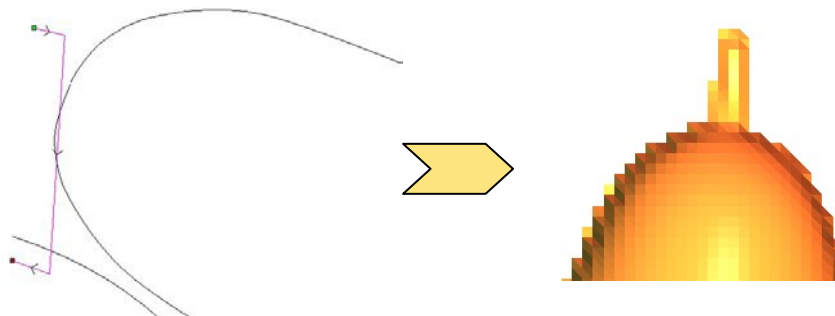
- Generate an **Extruded Relief**  using the **line** as a **Drive Curve**, the **arch** as the **first section** and the **angle** as the **end section**. Select **Merge Highest**.



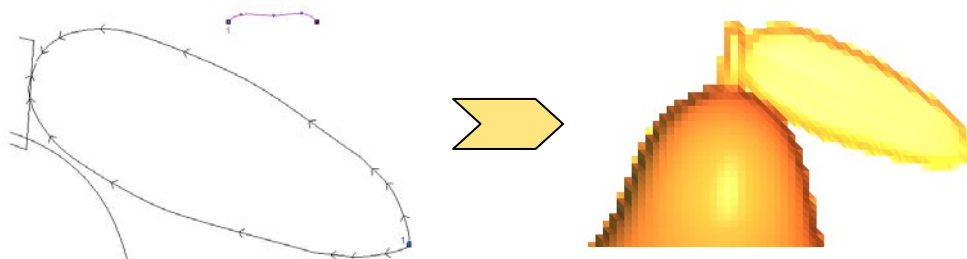
- Select the **pear shape vector** and generate an **Added Turn Relief**.



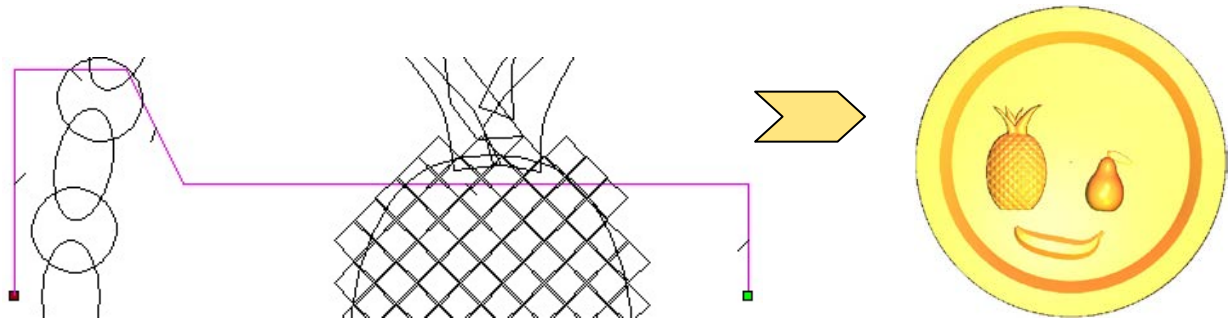
- Select the **stalk vector** of the pear, and generate a **Merge Highest Turn Relief**.



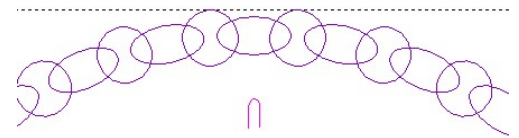
- Use the **leaf vectors** and **section** to generate a **Merge Highest Two Rail Sweep Relief**.



- From the main **Polyline vector**, Add a **Spin Relief**,  with the option **Invert curve in Z** selected.



- Select the **grouped chain** design of **vectors** and then the nearby **small vector**, as shown below.



- Add a **Weave Relief** with the following values and select **OK**.



- Select the **Text fruit** and generate an **Added Pyramid Relief** with **No limit** and a **Start Height** of **0** and an **Angle** of **60 degrees**.

FRUIT

- View the final **Relief**.



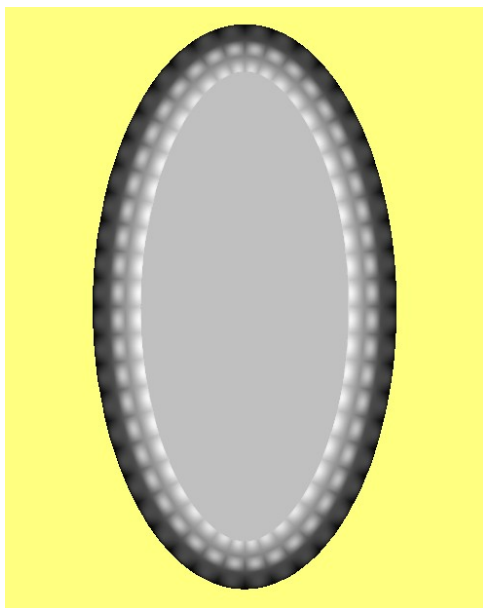
9. 3D Clipart and Texturing

3D Clipart

The **3D Clipart** dialog box opens when the user imports an existing externally stored **Relief** using the **Paste Relief from A File** option. The **3D Clipart** form enables the **Relief** to be **scaled, re-positioned, re-orientated, copied**, etc. Before being combined into the current model.

Lady Exercise

- Select **Open Model**.
- Open **Pend_frm.rlf** from: **D:\users\trainingArtCAM Data**.




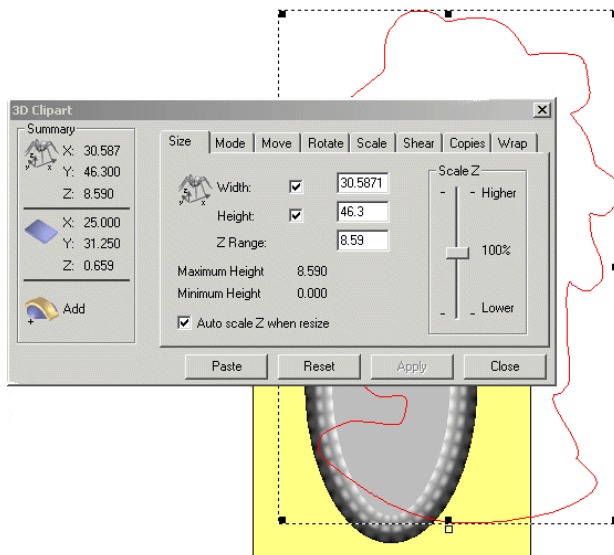
On opening the **Relief**, ArtCAM automatically generates both a **Bitmap** (colour) and **Greyscale** representation in the **2D view**.

The **model size** and **resolution** is the same as the imported **Relief** before it was originally exported from **ArtCAM** as a **.rlf** file.

This summary can be seen at the top of the **Assistant** tab.

Model Information	
Artwork	Relief
X: 25 mm	Max. Z: 0.659 mm
Y: 31.25 mm	Min. Z: 0 mm
1000 x 1250 pixels	

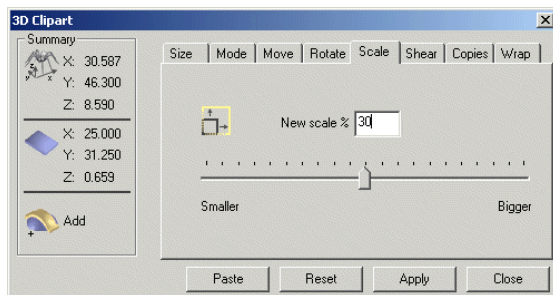
- Select **Paste Relief from a File**,  from the **Relief Tools** area.
- Browse and select the file **Lady.rlf** from the **D:\users\trainingArtCAM Data** directory and select **Open**.



The **3D Clipart** form and a vector outline of the imported relief appear in the **2D View**.

A **Preview** of the **Relief** is displayed as a **vector outline**, and is currently too large. It will be transformed, sized and positioned, using the **3D clipart** form before being **Pasted** onto the existing model.

- Select the **Scale** tab.
- Enter the **New Scale** as **30%**.
- Select **Apply**.

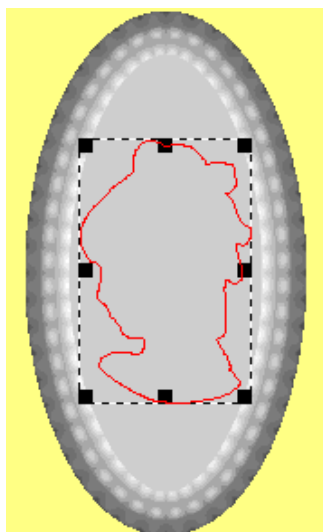


The **Relief** could also be scaled manually by dragging the corner handles of the relief vector, with shift held down to maintain the proportion.

Now the **vector** (and associated relief) can be moved to the centre of the pendant.

- Move the cursor on the vector outline so that **Move Cursor** appears.
- Select the **Left** mouse button and move the mouse to 'drag' the **Relief**.
- Release the button when the **vector** is suitably positioned.

(Note: Keyboard shortcut to *centre in page* is **F9**)

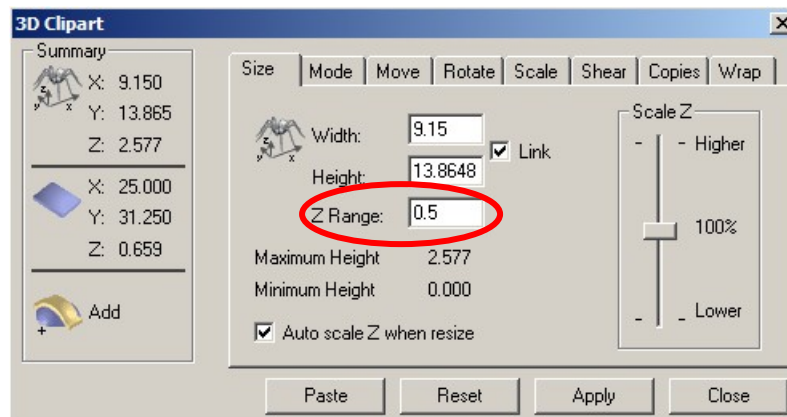


Now that the **Clipart** is suitably positioned, the inherent **Z Range** value can be altered to provide independent control to the final **Z height** of the new **Relief**.

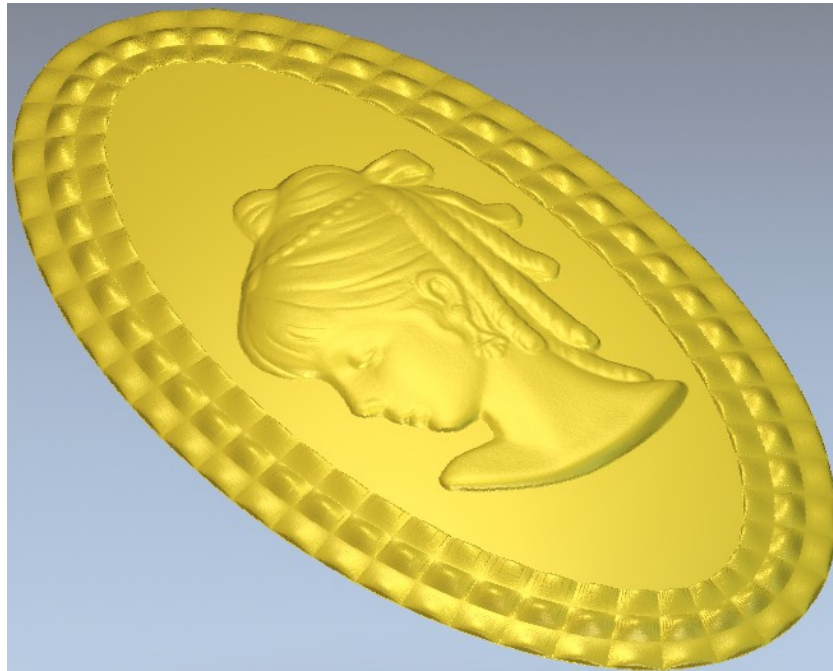
The **Clipart** summary shows the **vector Relief height** as nearly **2.6mm** with the **current Relief** at nearly **0.7mm**.



- Click the **Size** page on the **3D Clipart** dialog box.
- Input a value of **0.5** in the **Z Range** box to control the new **Relief height** and select **Apply**.



- Click the **Mode** tab on the **3D Clipart** dialog box.
- Ensure that the **Add** mode is selected, click the **Paste** button, and then **close** the **3D Clipart** form.



The new **Relief** has been **added** to the original pendant adding an additional height value of **0.5mm** to the model.

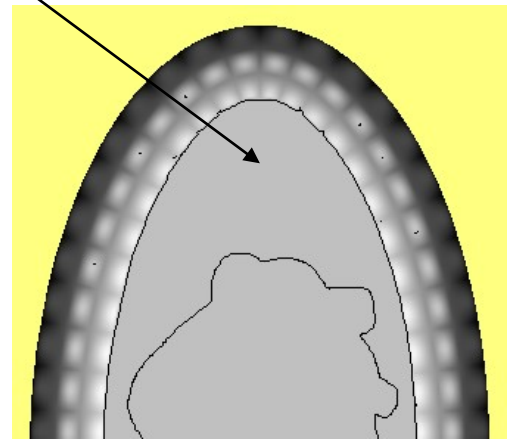
Texture Relief

A **Texture** will be **applied** between the head and the outer frame. To define this area, a **vector** can be created around the central mid-grey coloured area. A **vector** around the profile of the head was created during the last **clipart** operation. The **Texturing** will be created between the **two vectors**.

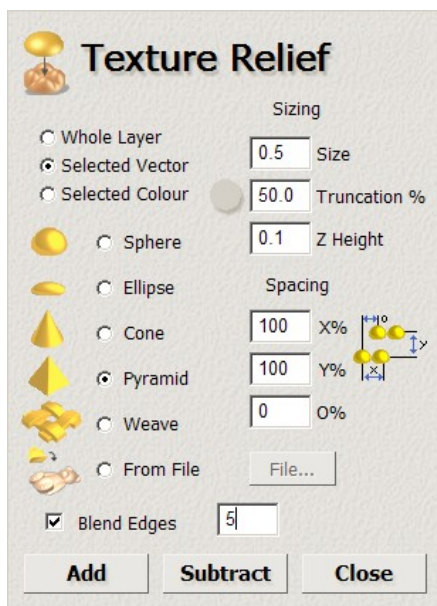
- In the **Bitmap** view, **double click** within the **grey colour** shown.
- **Close** the Shape Editor form. The selected grey colour is now assigned as the Primary colour.



The grey colour also applies to other tiny areas and as a result several additional **vectors** are created, but these can be ignored.



- Select **Bitmap To Vector**.
- Select **Create Vectors**.
- Shift Select the **new oval outer vector** and the **inner head vector**.
- Select the **Texture Relief**.



The **Texture Relief** dialog appears:

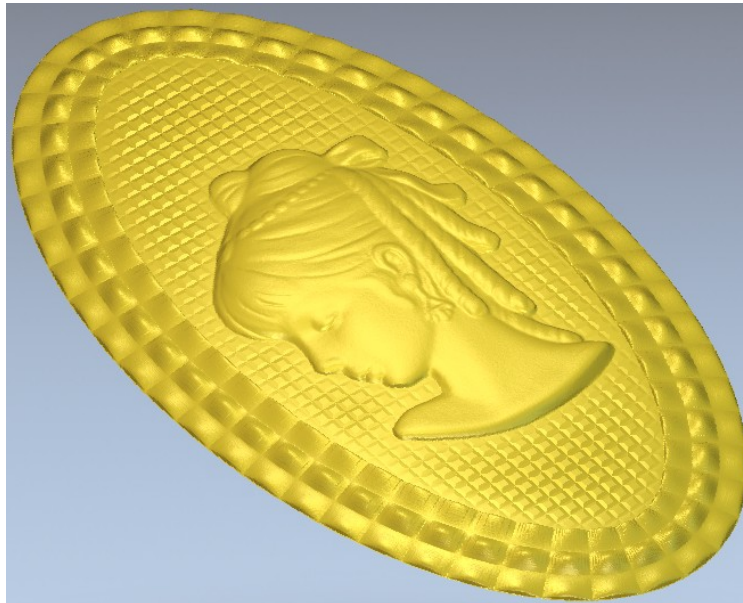
This dialog box allows the selection of several **pre-defined** textures including **Sphere, Ellipse, Cone, Pyramid** and **Weave**.

Other options provide the user with **Sizing** and **Scaling** capabilities to adjust the **Texture** exactly to the desired form.

The **From File** option enables a user defined **Relief** or even **Bitmap** to be imported for use as a **Texture**.

If selected, **Blend Edges** allows the input of a fading distance from the **vector** into the **Relief** area from **zero** to the full **Texture - Z Height**.

- Enter the details into the form as shown above. Select the **Pyramid shape**, enter the **Size** as **0.5mm**, the **Truncation** as **50%** the **Z Height** as **0.1mm** and select the option **Blend Edges**, entering a value of **5mm** and select **Add**.



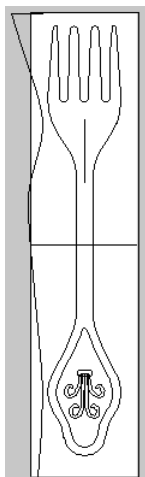
- Select **File - Save As**, enter the **File name** as **lady head pendant** and save it in: **D:\users\training\COURSEWORK\ArtCAM Pro-Jobs**.

Paste Relief Along Vector

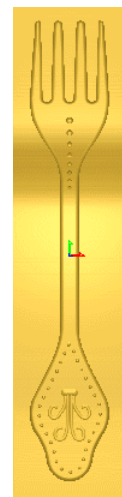
Paste Relief Along Vector on the **Relief Tools** allows several copies of the **3D Clipart** to be pasted along a selected vector.

Fork Exercise

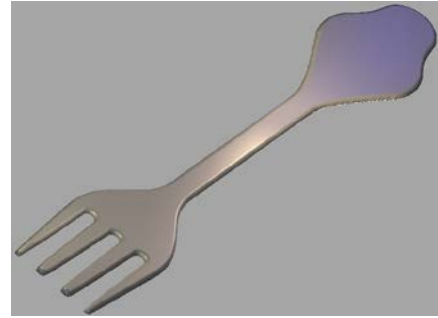
- Open the model **fork.art** from: **D:\users\training\ArtCAM Data**.



This model contains the **vectors** to generate a fork shape. It also contains some additional **vectors** along which a Jewel **Relief** will be pasted.



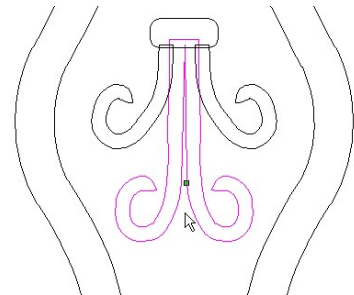
- Select the main **fork vector** and generate an **Added Dome** relief with an **Angle** of **90 degrees** and with a **Limit to Height** of **1.5mm**.



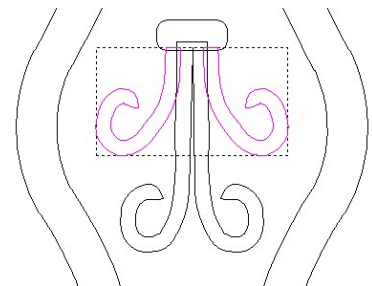
- Select the **bottom curved vector** of the decal.

This decal will be added onto the main flat fork relief.

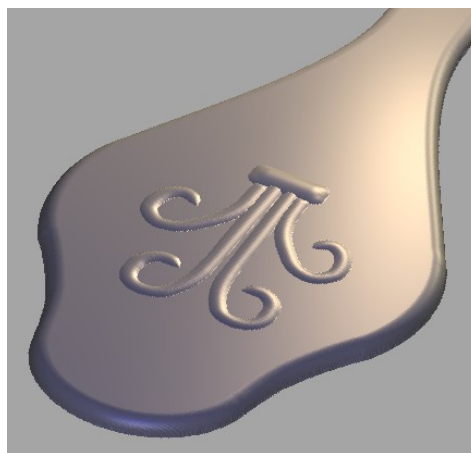
- Generate an **Added Dome** profile with an **Angle** of **30 degrees**.



- Select the **two side curled vectors**.
- Define a **Dome** profile with a **Start Height** of **1.5mm**, an **Angle** of **30 degrees** and select **Merge High**.
- Select the **oval vector** and define a **Dome** profile with a **Start Height** of **1.5mm**, **Angle** of **30 degrees** and **Merge High**.



- View the Relief.



- **Select the inner closed vector** around the decal as shown.

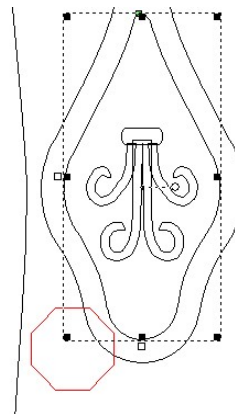
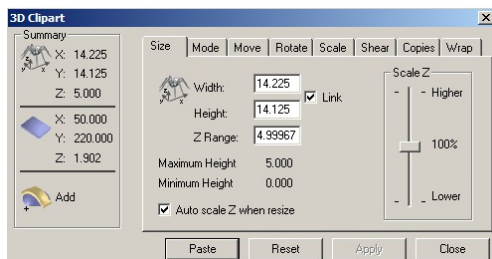
An imported Relief will be pasted along the centre of this selected vector. As with **Paste Relief from a File**, This relief can also be modified prior to pasting.

- From the Relief tools area, select **Paste Relief along**



Vector.

- Select the Relief **Jewel.rlf** from the **ArtCAM Data** folder.

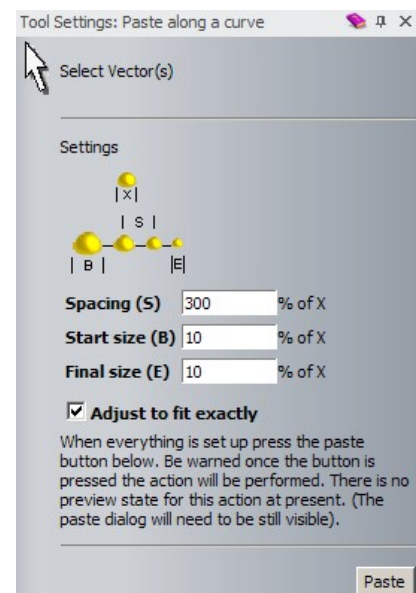


The **vector** outline appears in the **2D View** and the **Paste along a curve** page appears in the **Tool Settings Tab** along with the **3D Clipart** dialog box in the graphics area. The **3D Clipart** box is not used in this case as the **Mode** is already set to **Add**. It must remain open until the **Paste along a curve** process is completed.

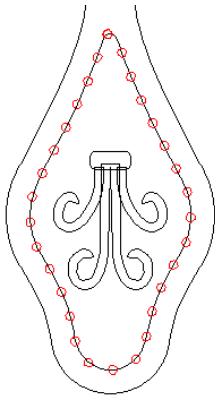
The **Spacing** setting in the **Assistant** page allows you to define the space between adjacent copies of the clipart. 100% means they will be next to each other, less than 100 means they will overlap, and greater than 100 means there will be a gap.

The **Start size** and **Finish size** define the sizes of the **Relief** at the start and end of the curve. By making the sizes different, **ArtCAM** will scale the clipart automatically from one size to the other.

- In the **Paste along a curve** page, set **Spacing** as **300%**, **Start** and **End size** as **10%** and select **Adjust to fit exactly**.

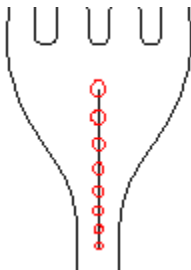


- Select **Paste**.
- Do not close either the **Paste along a curve** or the **3D Clipart** dialog boxes.



The **vectors** indicate where the **new Reliefs** have been **added** to the **original Relief**.

- Select the **vertical vector** in the middle of the fork.
- In the Paste along a curve form, change the **Spacing** to **200%**, a **Start size** of **10 %** and an **End size** of **20%**.
- Select **Paste**.



The gem details have all been added.

- Close the **Paste along a curve** and **3D Clipart** dialog boxes.
- View the results.

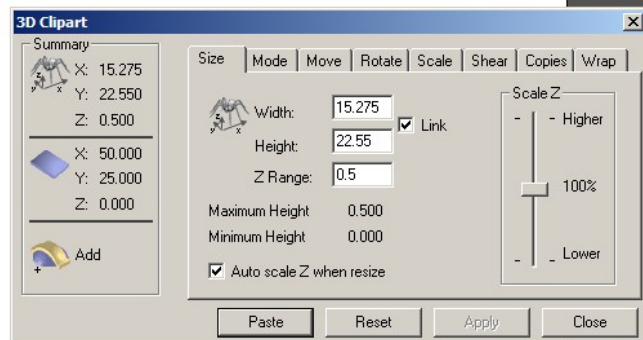
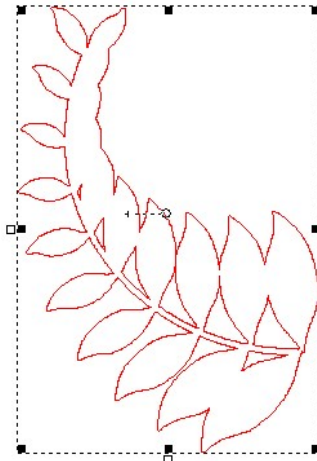


Motif Exercise

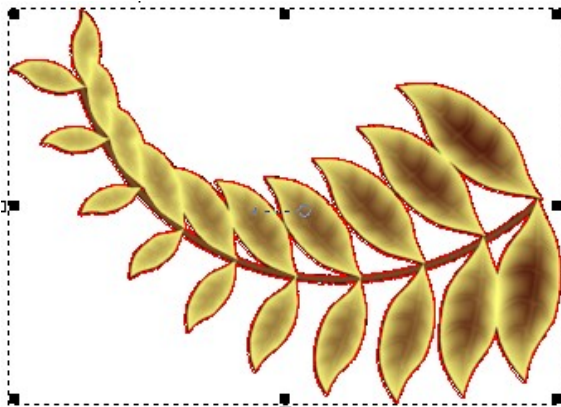
- Create a **New Model** with a **Height** of **25mm**, **Width** of **50mm** and **origin in the centre**.



- Select **Paste Relief from a File** and open the Relief **Leaves.rlf** from **D:\users\training\ArtCAM Data**.

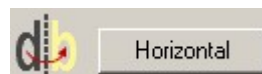


- Select the **Rotate** tab on the **3D Clipart** dialog.
- Enter in the **Rotate by angle** field an **Angle** of **-40 degrees** and select **Apply**.
- Select the **Mode** tab, followed by **Add** and then **Paste**.



The vector rotates to reflect the change in Angle.

When the **Paste** box is selected, the new **Relief** is Added to the model page. The 3D clipart form remains open by default in anticipation of further pasting operations.



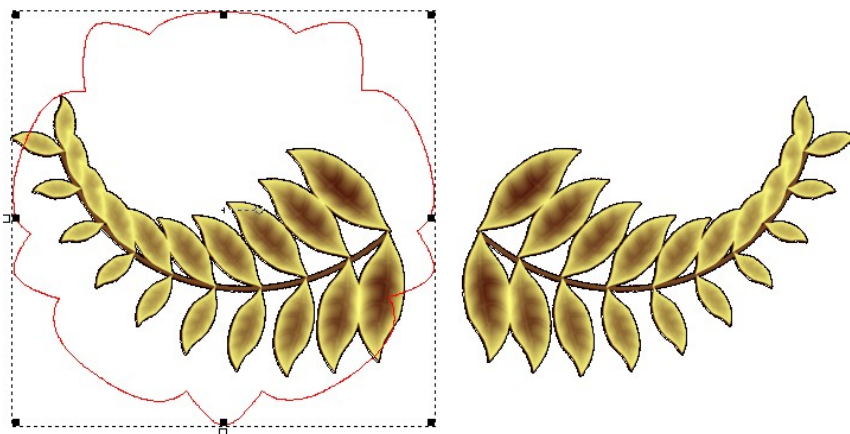
- In the **Rotate** tab, select the **Horizontal** button.
- Switch to the **Move** tab and set the **Move X origin by** field to **25**. Select **Apply** followed by **Paste**.

- **Close** the form and view the results.

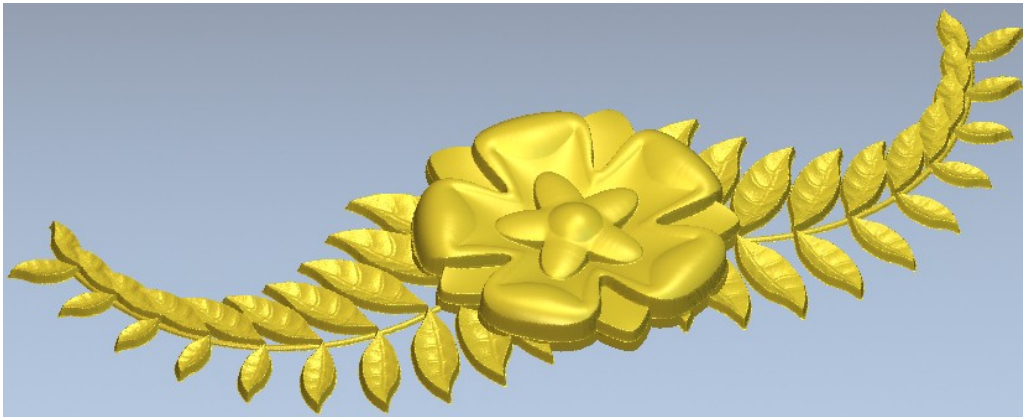


Pasting a relief can also be accessed from the **main drop down**. The Motif will now be completed by adding a central flower relief.

- Select **Reliefs > Import** from the top menu bar and import **Flower.rlf** from the **ArtCAM Data** folder



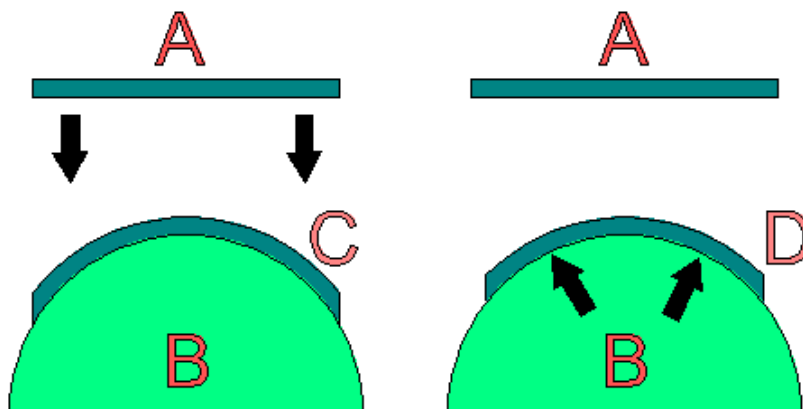
- Select the **Scale** tab on the **3D Clipart** dialog and set the **new scale %** field to **60%**. Select **Apply**.
- In the **2D View**, select and **drag** the **vector outline** of the flower **between** the **leaves**, as shown in the image below. (or press **F9** to centre in page)
- On the **Mode** tab, select a **Start Height** of **0.5mm** and the **Mode** as **Merge Highest**.
- Click **Paste** and then **Close**.



- Select **File - Close Model**. (save if desired)

Relief Wrapping

When a **Relief** is added onto a surface it is normally projected down the **Z-axis**. A **Relief** can also be wrapped onto a surface within the **3D Clipart** or **Vectors** can be wrapped onto the surface. The process of **Wrapping** will 'bend' the **Relief** to wrap around the model without changing its overall size. (Minimise distortion)



In the above diagram the **vector A** is wrapped onto the **relief B**.


On the **left hand side**, the **vector** is **not wrapped** but is simply projected **down Z** and therefore the finished **vector C** is **distorted** as it goes over the curve.

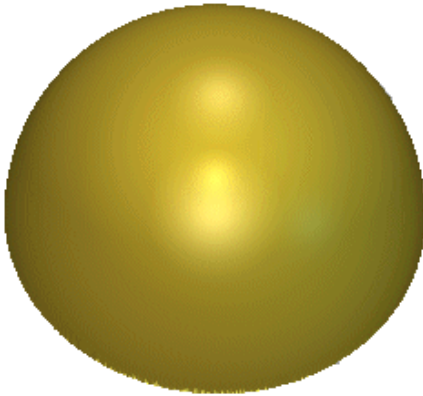
On the **Right hand side** the **vector** is **wrapped** to produce **vector D**, which retains the same dimensions along the 3D surface as the original 2D vector.

In **ArtCAM** in addition to projecting down **Z** it is possible to wrap **radially**, such as around a **sphere**, or **cylindrically**, like a tube in the **X** or **Y** direction.

This will be demonstrated with a simple example.

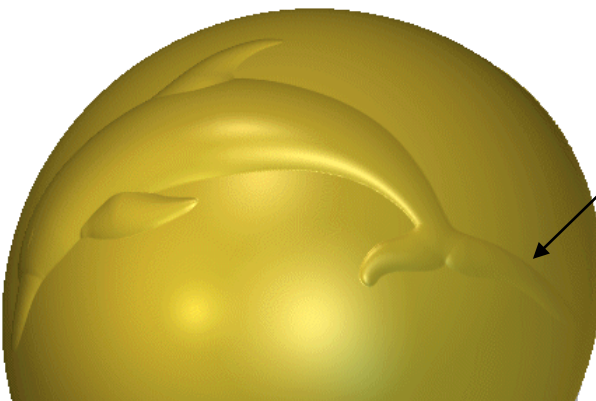
Wrapping Exercise

- Create a **New Model** of size **X 100** and **Y 100** with the **origin** in the **Centre**
- Create a **Circle** of **Diameter 80mm** with the **Centre** at **X0 Y0**.
- Remove the **left half of the circle** using **Node Editing**.
- Create a **Turn Relief**  with a **Z Scale Factor** of **1**.



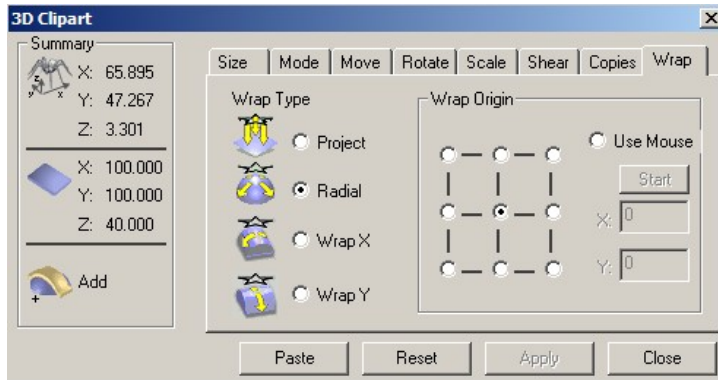
A second **Relief** will be pasted onto this hemisphere.

- Select **Paste Relief from a File**  and select the **Relief dolphin.rlf** from **D:\users\training\ArtCAM Data**.
- Select the **Scale** tab on the **3D Clipart** dialog and set a **New Scale %** of **125%**. Select **Apply**
- Ensure combine mode is set to **add**, followed by **Paste** (do not close the 3D Clipart form).
- Select the **3D View** to view the **Relief**.



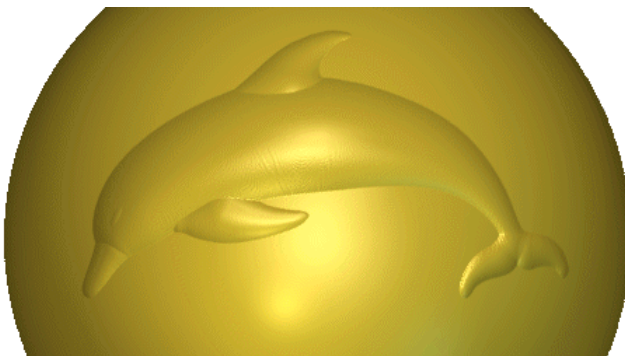
The default option, **project down Z** when applied to a very rounded shape, such as this **Sphere** has caused the resulting relief to be elongated as it is projected onto a steep area. It is especially noticeable on the tail area.

- Select **Undo** (Ctrl+Z).
- On the **3D Clipart** dialog, select the **Wrap** tab.



There are four types of Wrapping - **Project** (default), **Radial** (for **Sphere** shapes), **Wrap X** and **Wrap Y**. The **Wrap Origin** can also be set.

- Select **Radial**, followed by **Paste** and then **Close**.



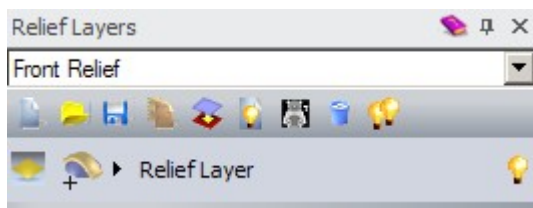
The dolphin is scaled in such a way as to make it look as though it has been wrapped around the spherical surface, as opposed to simply being projected down Z.

- Close the **ArtCAM** model without saving.

10. Relief Layers

Introduction

An individual **Relief** operation can be assigned to a **Relief Layer**. This provides the ability to create a model in which the user can switch the **Relief** components to exhibit different design variants. The Relief Layer Toolbar also allows the Shape (combine option) to be changed between Layers, and create on the Back Layer. A composite Relief showing both front and back layers can be viewed together.



Relief layers are controlled by the **Relief toolbar**. This toolbar can be activated by selecting Relief Layers from the right hand mouse menu (in grey border).



The following can be managed from the **Relief Layers Toolbar**.



Add a new Relief Layer to the model.



Import a new Relief Layer from a file.



Export the selected/highlighted Relief Layer.



Duplicate the selected Relief Layer.



Transfer the selected Relief layer to the opposite side (Back Relief Layer).



Merge (combine) the visible layers to form a new Relief Layer.



Create a new Bitmap Layer from the selected Relief Layer.




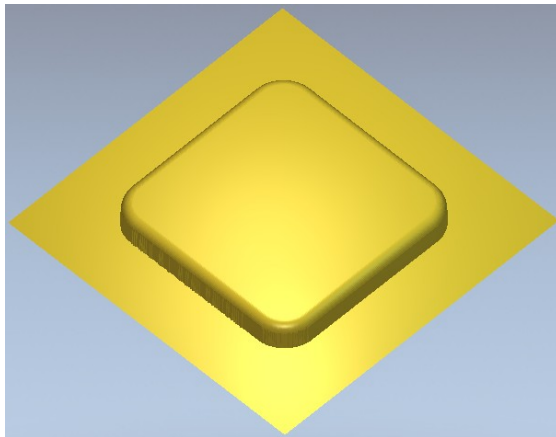
Delete the selected Relief Layer from the model.




Toggle the visibility of all the Relief Layers.

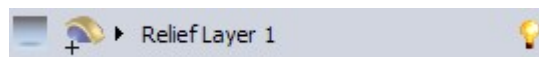
Lid Exercise

- Create a **New Model 100 x 100** with the **Origin in the Centre**.
- View the **Relief Layers Toolbar**. 
- Create a **vector Square** of **Height 65mm** at the **origin** with a **Corner Radius of 10mm**.
- In **Shape Editor**, create a **Dome shape** with an **Angle of 90 degrees**, **Start Height of 5mm**, **Limit to height** with a **Height of 3mm**. Select **Add**, followed by **Close**.



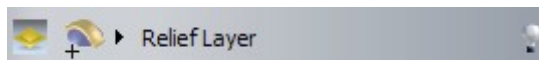
The new **Relief** is automatically assigned to the default **Relief Layer**. A **Relief Layer** can be switched **off** as required by clicking the **light bulb** icon. Any **Relief** operations assigned to a **Relief Layer** that is switched **off** will be temporarily hidden from the model.

- Create a **New Relief Layer** by selecting **New**,  on the **Relief Layers Toolbar**.
- Make the new **Relief Layer 1** active by highlighting the **Layer**.



Any further Relief creation will now be created on this active (highlighted) **Relief Layer 1**.

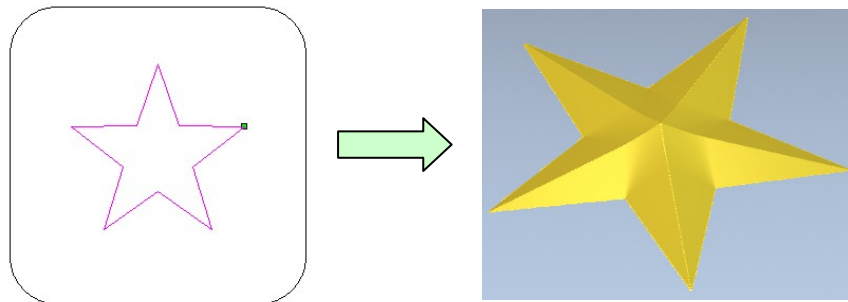
- **Switch off the original default Relief Layer by selecting the corresponding 'light bulb' icon.** 



The previously created Relief has now **disappeared** from the 3D view. Although the Relief is hidden, the **square vector** from which it was calculated is still visible. Vectors are managed independently from the **Vector layers Toolbar**.

- Generate a **Star vector**  with **5 points**, at the **origin**, **First Radius of 20mm** and **Second Radius of 8mm**.


- Press **F12** and select a **Pyramid shape** with an **Angle of 25 degrees**, **Start Height of 0** with **No Limit** selected. Select **Add** and then **Close**.



The **Relief Layers Toolbar** allows the **Combine option** (Add, Subtract, Merge High etc) to be changed between layers. This can be achieved by selecting the required option in the icon

adjacent to the **Relief Layer name**. 

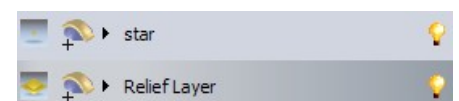
Options available (in order) are **Add**, **Subtract**, **Merge High**, **Merge Low** and **Multiply**.


- Switch on  **Relief Layer**.

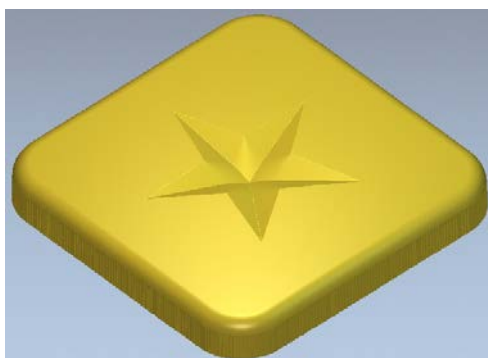
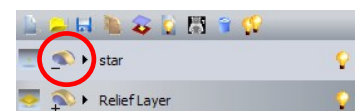


The original relief is now visible with the star Relief 'added' on top.

- Double mouse click** on the name **Relief Layer 1** and change the name to **star**.




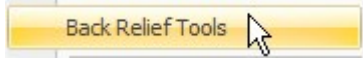
- Change the **combine option** in the **Star Layer** from **Add to Subtract**. 



The star relief is now subtracting from the main Relief layer below it.

Each time the combine icon is selected and changed, the composite relief is automatically updated.

A Relief on the back will now be generated and combined with the front.

- Switch **off**  the **Star Relief Layer** to leave just the default **Relief Layer** visible.
- **Activate** the **Back Relief Tools** Toolbar. 



The Back Relief Toolbar provides options to quickly generate a Back Relief from the composite Front Relief (visible).



Creates an **offset copy** (based on value entered) of the composite Relief and places it on the **Back Layer**.

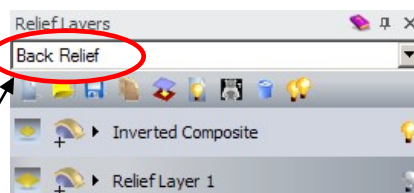
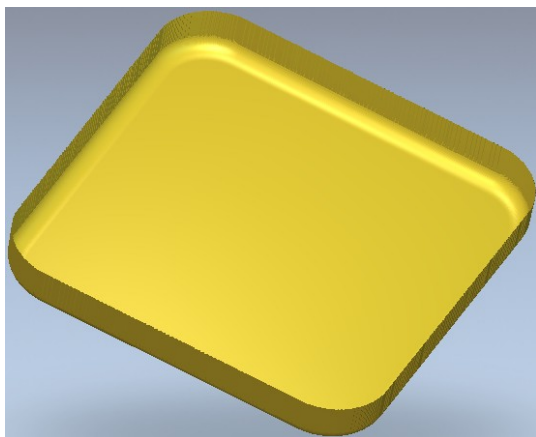


Creates an **inverted copy** of the composite Relief and places it on the **Back Layer**.





Creates a **flip copy** of the **inverted copy** on the Back Layer (for machining purposes).

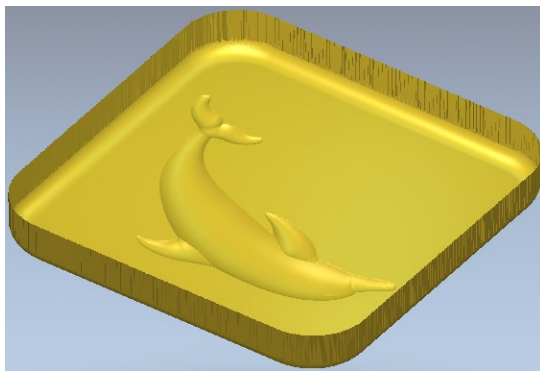
- Select **Invert Composite to Back**. 



An **inverted copy** of the front composite relief has been created and placed on the **Back Relief**. The Toolbar shows the Back Relief as active, and also creates a new layer called **Inverted Composite**.

- **Close or Dock** the **Back Relief Toolbar**.

- Ensure the new **Inverted Composite Layer is active** and switch to the **2D view**.
- Select **Paste Relief from a File**,  from the **Relief Creation Toolbar** or **Assistant Tab**.
- Browse and select the file **Dolphin.rlf** from the **D:\users\trainingArtCAM Data** directory and select **Open**.
- In the **3D Clipart form**, change the **Paste mode** to **Subtract**. 
- **Select Paste, followed by Close.**

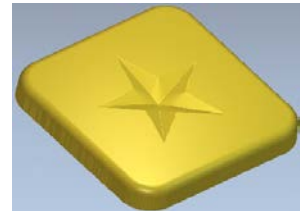


The dolphin has subtracted from the inverted relief, which once assembled to the front (as one half) will result in a positive form.

- Select **Front Relief** from the drop down menu.

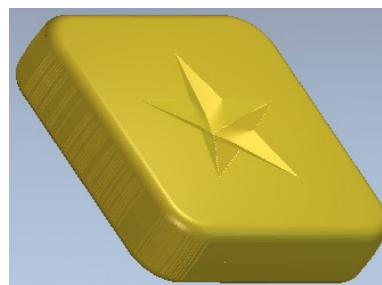
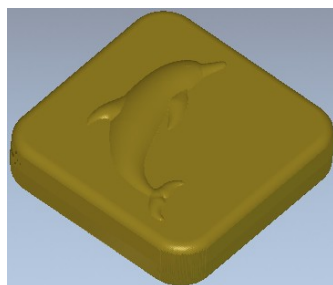


- **Switch on**  the **Star Layer** to show the complete **Front Relief**.



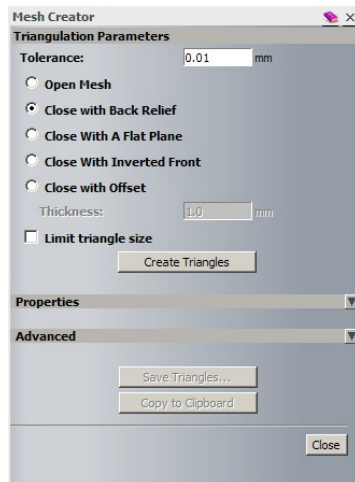
- From the **3D view toolbar**, select **Toggle Back Relief**. 

The Back and Front Reliefs are both shown in combination.



The complete model can be exporting for manufacture. ArtCAM can export a complete assembly as **triangulated mesh data (.stl)** to another CAD/CAM system or directly to a Rapid Prototyping system.

- **Select Create Triangle Mesh.**



The following options are available:

Open Mesh – No Back face or layer is used so the resulting mesh is left open.

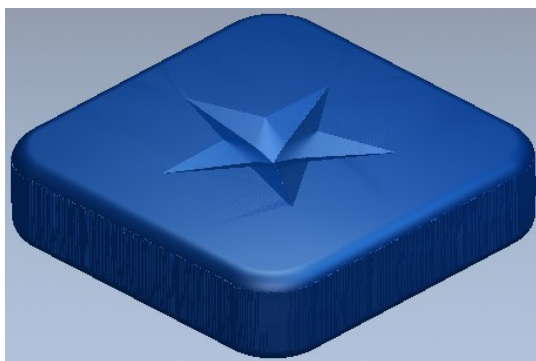
Close with Back Relief – Combines the back with the front relief to produce a single mesh.

Close with a Flat Plane – Model is closed using a plane at zero Z-height.

Close with Offset – Use an offset copy of the current model to form the back face. The resulting triangulated model will effectively be a hollow shell based on the thickness defined.

Limit Triangle size – This can be used to define the maximum X and Y length of each triangle. Limiting the triangle length will ensure a closer match to curved surfaces of the relief when a mesh is generated.


- Select the option **Close with Back Relief**, followed by **Create Triangles**.



A single mesh is created from the combination of the front and back reliefs.

The **volume** and **weight** is also provided in the **Properties Tab** of the form.

This **Triangle Mesh** can be saved outside of ArtCAM using **Save Triangles**.

- If the mesh requires exporting, select. 
- **Close** the form to return to the Relief

When the command is closed the **Triangle Mesh** will disappear.

- **Select** File - Save As, **enter the** File name **as** lid-dolphin **and save it in:**
D:\users\training\COURSEWORK\ArtCAM-Jobs.
- **Select** File – Close Model.

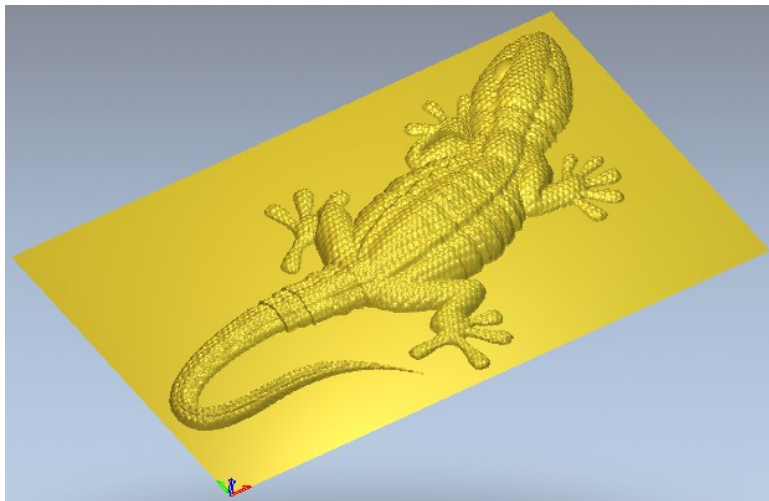
11. Relief Editing

Overview

There are several **ArtCAM** options available to directly edit a **Relief** model.

Lizard Relief Exercise

- Open the model **Lizard.art** from: **D:\users\training\ArtCAM Data**.
- Select **File - Save As** and save the model with the File name **Training-lizard** in: **D:\user\training\COURSEWORK\ArtCAMPro-Jobs**.



The overall height of this lizard can be reduced by using the **Scale Relief Height** function. The option, **Preserve Detail** if selected will take longer to process but will retain features which otherwise may be erased with a general scaling.

At the top of the **Assistant Tab**, view the **Model Information**. The current **Relief.Max.** is displayed as **38.372mm**.

Model Information	
Artwork	Relief
X: 500 mm	Max. Z: 38.372 mm
Y: 300 mm	Min. Z: 0 mm
1150 x 690 pixels	

- In the **Relief Tools** area, select **Scale Relief Height**.

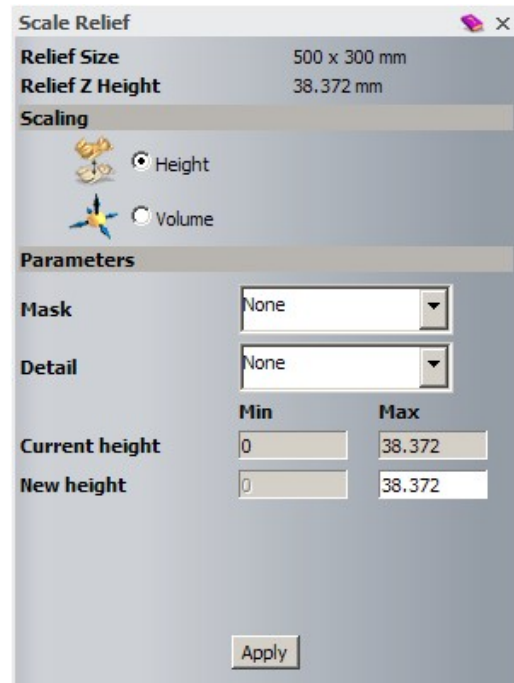


The **Scale Relief Height** button enables **height** or **volume** adjustment over the **entire Relief**.

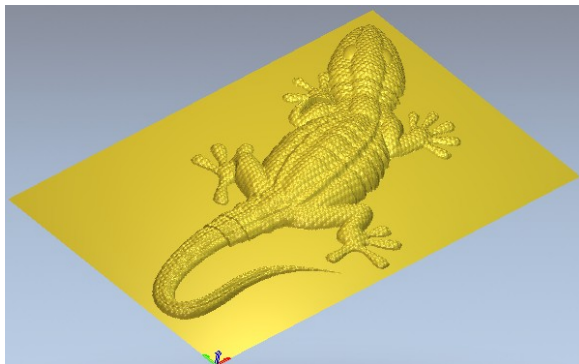
Under Mask, the scale height can be under the **selected Vector**, or **selected Colour**.

The current height of the model is displayed in **New Height** is then amended to the desired height.

Emboss and **Preserve Detail** along with suitable values will identify small features on the relief and scale them locally before merging them with the detail on the top. This is necessary to prevent fine detail being lost during the overall scaling process.

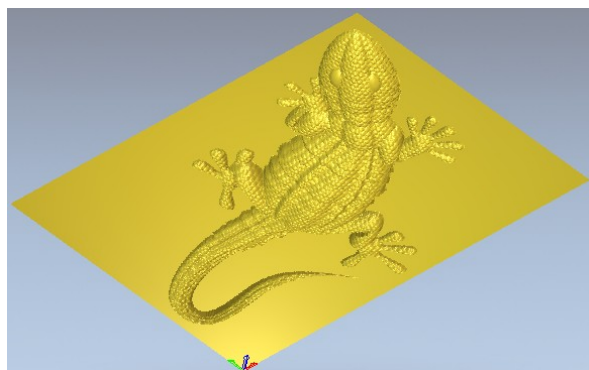


- Enter a **New Height** of **35mm**, leave the other Parameters as None and select **Apply**.



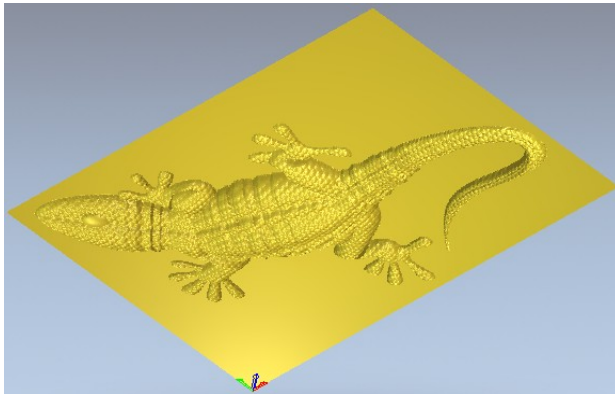
The **lizard Relief** now has a **Maximum Height** of **35mm**. You can invert it negatively for generating a mould as shown below.

- Select **Invert Relief Z Only**  in the **Relief Tools** area.



The **lizard Relief** is inverted, producing a negative image. The **Relief** can be inverted, again returning it to its original state.

- Select **Invert Relief Z Only**,  and then select **Invert Relief - Male/Female**. 



The **lizard** is **inverted** and also **mirrored**. It can be inverted, again returning it to its original state.

- Select **Invert Relief - Male/Female**  to return to the original state.
- From **Relief Tools**, Select **Offset Relief**. 



The **Offset Relief** button allows you to **offset** the **Relief** by a certain distance either **inwards** or **outwards**.

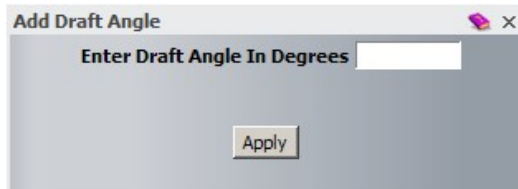
- Select **OK** on an **Offset Distance** of **1mm Outwards**.

The Relief is now 36mm high.

Relief
Max. Z: 36 mm
Min. Z: 1 mm

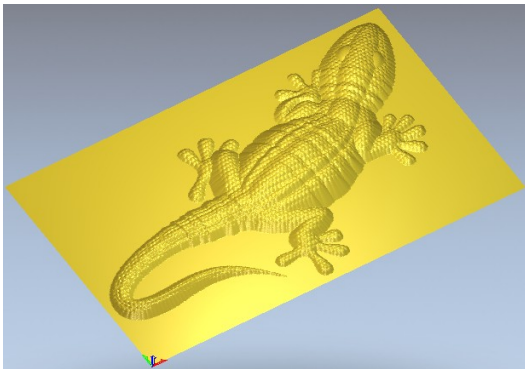
A **Draft Angle** can be added to the **Relief**. This command is found on the pull down **Reliefs** menu.

- From the **Reliefs** pull down menu select **Add Draft**.



The **Add Draft Angle** dialog box appears and a suitable **Draft Angle in Degrees** value is entered.

- Enter a **Draft Angle** of **45 degrees** followed by **Apply**.



The large **Draft Angle** exaggerates the effect of adding draft onto the **Relief**.

- Select **File>Save** and then **Close the model**.

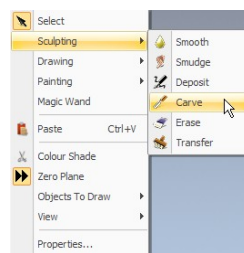
Sculpting


Sculpting is used on **3D Reliefs** to locally add, remove or smooth the model by dynamically using the mouse in the **3D View**.


The **Sculpting Tools** can be accessed directly from the **Design Tools** Toolbar in the left hand side.




..or **right-mouse selecting** in the **2D/3D view area**.




Smooth  allows **selective smoothing** of the **Relief** as opposed to the generalised effect of the **Smooth Relief** feature on the **Relief Tools** area.

Smudge  takes a **copy** of the **Relief** under the brush and allows it to be dragged to another position.

Deposit  adds **material** to the **Relief**.

Carve  removes **material** from the **Relief**.

Eraser  it's a selective undo for any part of the Relief during an active session of **Interactive Sculpting**.

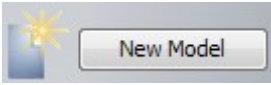

Clone  allows **cloning** certain areas of the **composite Relief**.

Each action has options for **Brush Diameter**, **Strength** and **Smoothness** and different options will be available depending on the action chosen.

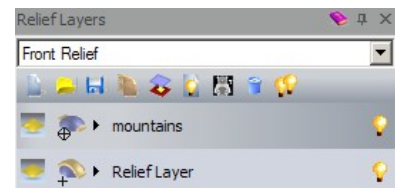
Additional options within the form also allow the relief to be controlled at a defined height and/or linked to the primary colour.



Sculpting exercise

This example will show you how to create an entire scene using the **Sculpting** tools available in **ArtCAM**.



- Select **Create New Model**. 
- Enter a **Height and Width of 300mm** with the origin in the bottom left hand corner.
- Open **mountains.rlf** from: **D:\users\training\ArtCAM Data** using the **Relief layers Toolbar**. 

The Relief has been imported on its own new layer. The Layer name corresponds to the file name.

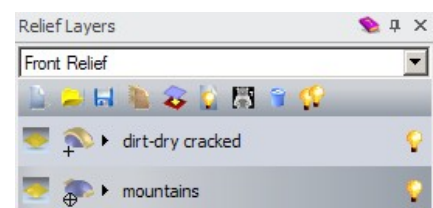


- As no longer required, **Highlight** and **Delete**  the original **Relief Layer**.
- Select **Preview Relief Layer**. 



- Open the bitmap **dirt-dry cracked. jpg** from the **Bitmap layers toolbar**. 
- Select **Create Relief Layer (from Image)**. 
- Enter a **New Height of 2.5mm** and then **OK**.

A new Relief Layer (dirt-dry cracked) has been created from the Bitmap (max height of 2.5mm). This has been added to the **Relief Layers Tab**.



- Open the bitmap **sand. jpg** from the **Bitmap layers toolbar**.

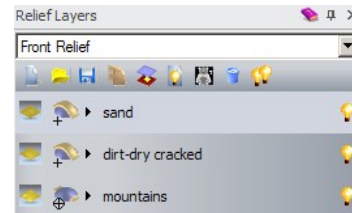


- Select **Create Relief Layer (from Image)**.



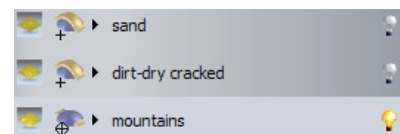
- Enter a **New Height** of **2.5mm** and then **OK**.

The new Relief layer (sand) has been added.



- **Select** (highlight) the **mountains** relief layer to make it **active**.

- Select **Toggle Visibility** for the other two relief layers to hide them from the **3D View**.



- Select **Create Bitmap Layer** of the mountains relief layer (to assign it colours).



- Select **yellow** in the colour palette to assign it as the **primary** colour.



- Select **Colour Shade** from the **3D view toolbar**.



- Select the sculpting tool **Deposit**.



- Select **sand** from the **Tool Settings** pull down menu.

The sculpting brush takes form of the sand relief texture layer, created earlier. Any relief layer created can be selected here.

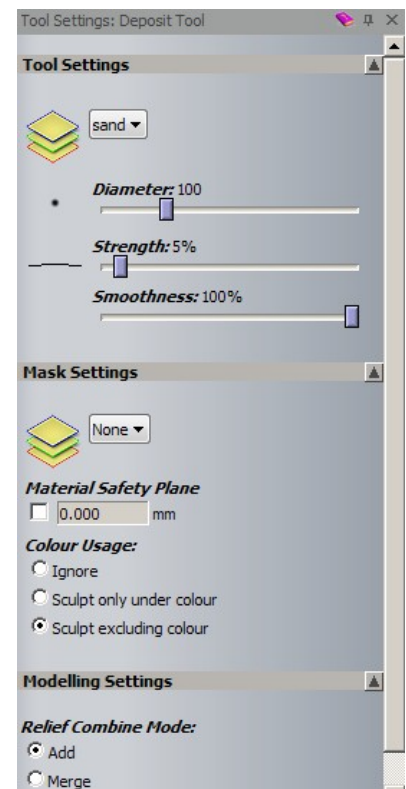
- Select a **Diameter** of **100mm**, **Strength** of **5%** and **Smoothness** of **100%**.

The sand texture and parameters defined above can now be seen reflected on the cursor (brush).



- Under **Colour Usage**, select **Sculpt excluding colour**.


The yellow primary colour assigned earlier will be excluded in the sculpting process. (In this case the background).

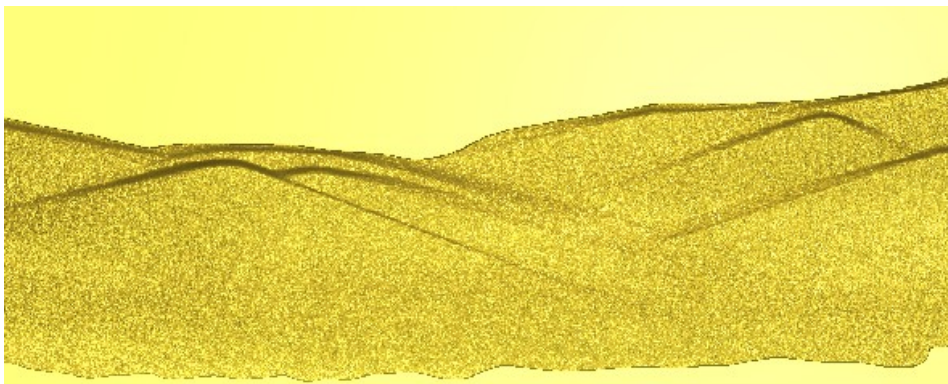



- With the left mouse apply the texture to the mountain region.



The sand texture is applied to the mountain region. The background was not modified as it was excluded as a colour.


- Toggle the **Colour Shade**  to see the results without the bitmap applied.

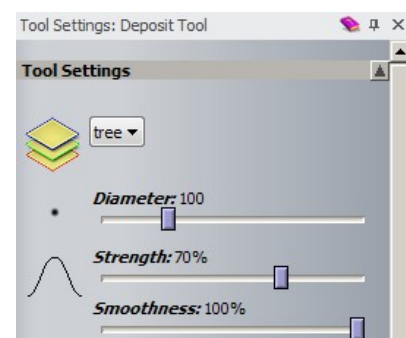


- Open the relief **tree.rlf** using the **Relief layers Toolbar**. 
- Select **Toggle Visibility** for the **tree** relief layer  (switch off from view)

This new tree relief will be used in the next sculpting task as the 'brush'.

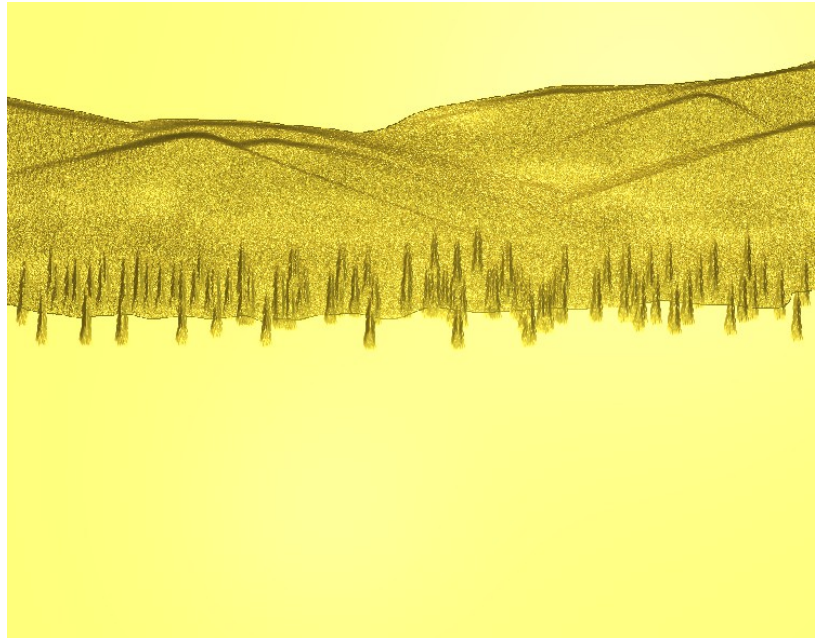
- Re-select the **mountains** relief layer to ensure it is active.






- Select the sculpting tool **Deposit**. 
- Select **tree** from the **Tool Settings** pull down menu.
- Select a **Diameter of 100mm**, **Strength of 70%** and **Smoothness of 100%**.
- Select **Ignore** for the Colour Usage.

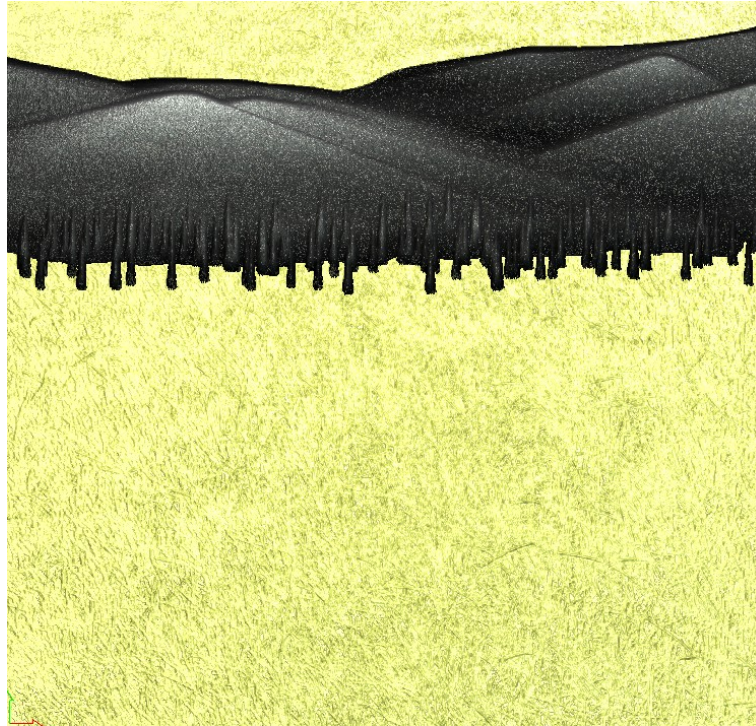


- Select **Merge** for the Relief Combine Mode.
- Single mouse click to **add a tree** in front of the mountains.
- **Repeat this process** to create an entire row of trees along the mountains as shown below.

(Try to use different **Diameters**, **Strengths** and **Smoothness** values to add depth)



- Open the bitmap **grass.jpg** from the **Bitmap layers toolbar**. 
- Ensure the scaling is set to **Fill** before selecting **Open**. 
- Select **Create Relief Layer (from Image)**. 
- Enter a **New Height** of **1mm** and then **OK**
- **Highlight** the **mountains relief layer** (to make active) and then **Create Bitmap Layer**. 
- **Toggle** the Colour Shade **ON**  in the 3D View.



- **Select to highlight the Grass relief layer** (make active)

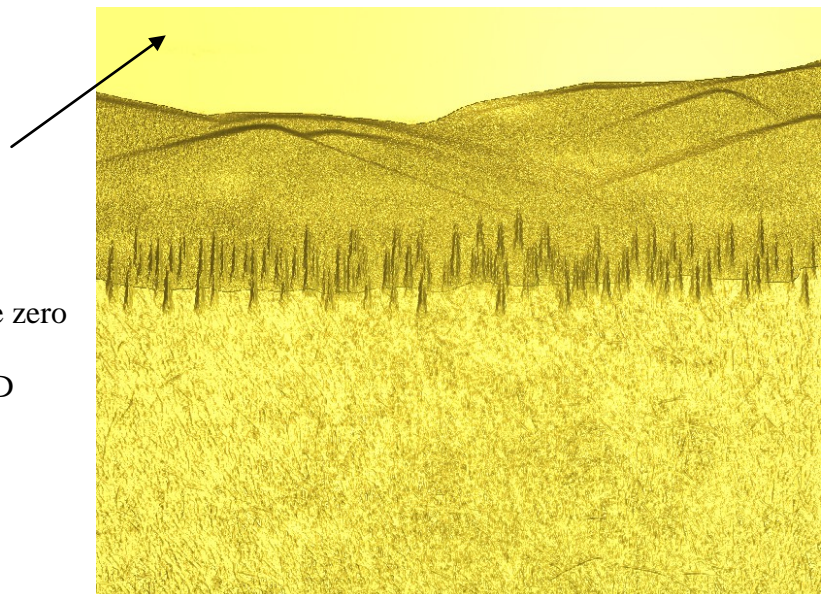
- Select the sculpting tool **Erase**.






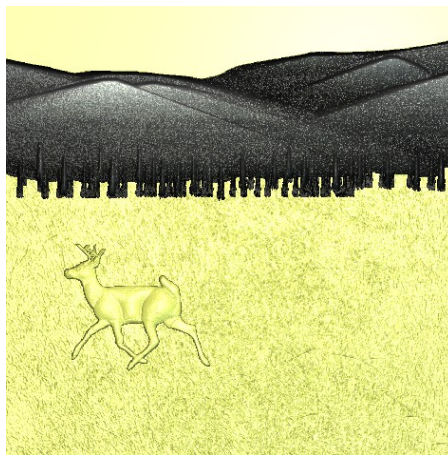
- Select a **Diameter of 100mm, Strength of 70% and Smoothness of 100%**.


- Remove all areas of grass **above the mountain** as shown.

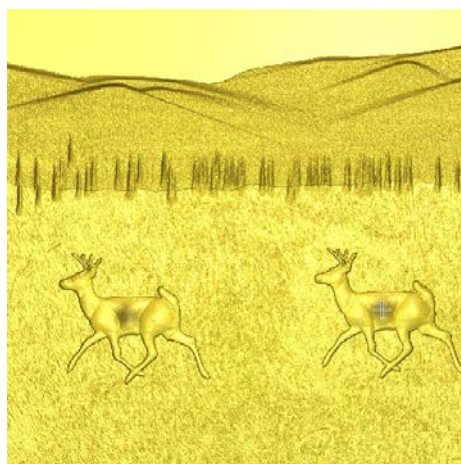
All areas removed are reduced to the zero plane. This can be confirmed by switching off the z plane from the 3D view.



- Ensure only the **mountains** and **trees relief layers** are switched **on**. 
- Change the combine mode for the **grass** layer to **Merge High**. 
- Select Relief clipart library  from the Assistant tab or Reliefs pull down menu.
- Select **Animals** under the **Libraries drop down menu**.
- Select **Deer** and **Scale** it to **50%**, position it at the left side of the grass, set a **Start Height** of **2mm** and select **Merge Highest**.
- Select **Paste** and then **Close**.



- Select the sculpting tool **Transfer**. 
- Select a **Diameter of 70mm**, **Strength of 50%** and **Smoothness of 100%**.
- Hover over the Deer's head and with the shift button pressed, single left mouse click.
- Move to the right side of the grass area
- Hold down and move the left mouse button to create/transfer a new deer.
- **Toggle** the Colour Shade **OFF** in the 3D View to view the results.



Face Wizard

The **Face Wizard** simplifies the side profile of a **face picture file** to be used for generating a **3D Relief**. Ideally, the picture should have a clear background and generally be of good quality. The **Face Wizard** will guide the user through this process, finishing up in **Sculpting mode** to allow fine changes to be made.

Face Wizard Hints

The **Face Wizard** automatically produces a face, but manual **Sculpting Smoothing** and **Smudging** can be used to produce a more defined image. Once the **Relief** is produced you can use sculpting many times to generate the desired image.

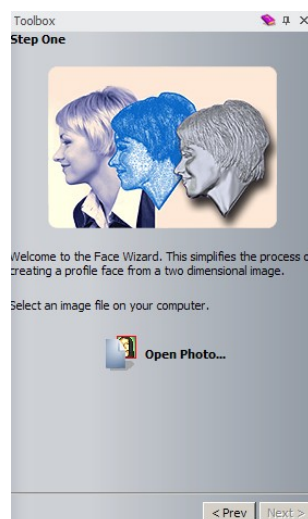
To start the **Face Wizard**, you must be aware of the following details:

1. **Photo** must be well lit to show up the detail.
2. **Resolution** needs to be at least **4MB pixels**.
3. When picking **Nape of neck**, pick under the hair if the hair is long.
4. **Ears** generate an angled plane and merge high. **Smooth** over the join.
5. **Glasses** sketch in vector, use angled plane and get the height merged just below the overall height.

Face Wizard exercise

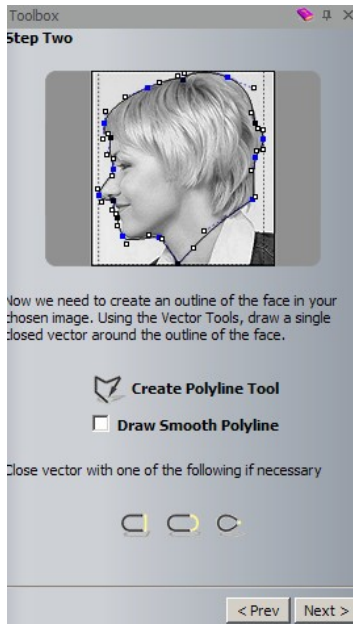
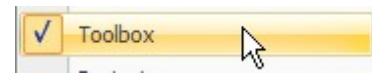
- Select **File – Close Model**.

- From **Other Features** select




- Select **Open Photo**,  then open **woman.jpg** from: **D:\users\training\ArtCAM Data.**

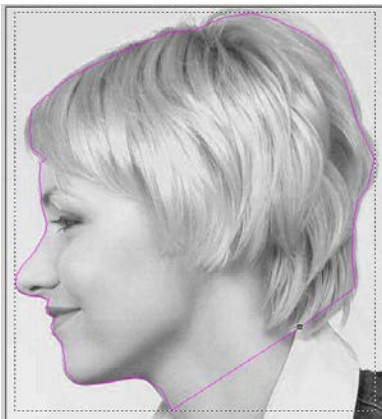
The **Step 2** of the **Face Wizard** appears. Note: If the wizard is not visible, then ensure the **Toolbox Tab** is activated by right-mouse selecting the grey border.





A **Polyline** needs to be created to select the area where the **Relief** is to be generated. A saved polyline can be imported, if required.

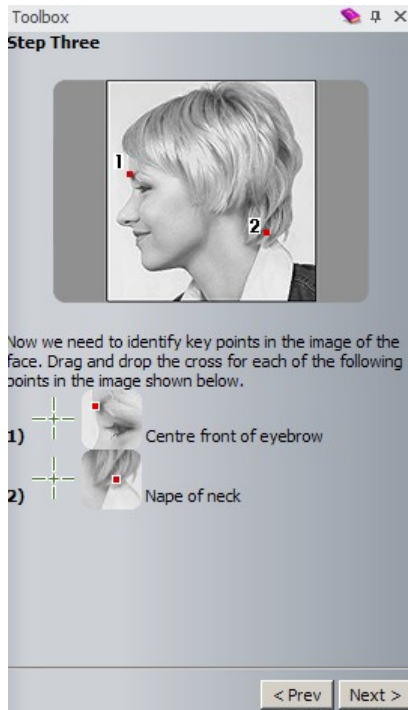
Note: When creating the **Polyline**, make sure you pick just inside the face because any part of the background can produce a spike at the edge of the **Relief**.

- Select  **Create Polyline Tool**.
- Select points **around** the **head** to define the profile as shown.




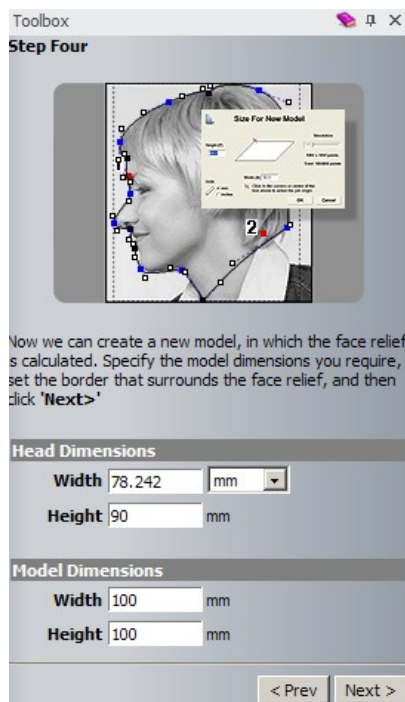
At this stage, it does not matter if you make a mistake when clicking as the **Polyline** can be changed after creation by using **Node** editing.

- Select **Close Vector - Move End Points.** 
- Use Node Editing  to make any final adjustments to your **Polyline**.
- Select **Next**.



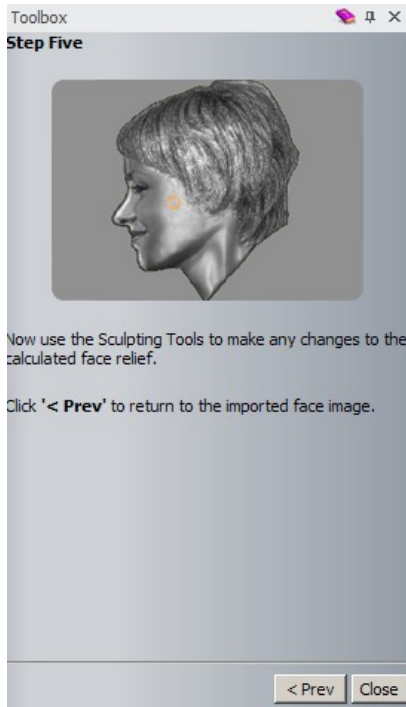
Step Three of the **Face Wizard** appears and indicates where to pick the two locating points for this command. This tells **ArtCAM** which way the relief is facing (to the left or right) and also where the main features are.

- With the left mouse button, **Drag and drop the crosses**  onto the corresponding areas indicated on the image.



Step Four allows you to set the actual **Relief** and **Model Dimensions**, which may be different to the initial picture.

- Under **Head Dimensions**, accept the **Width** and **Height** values.
- Under **Model Dimensions**, change the **Width** and **Height** to be **120**.
- Select **Next**.



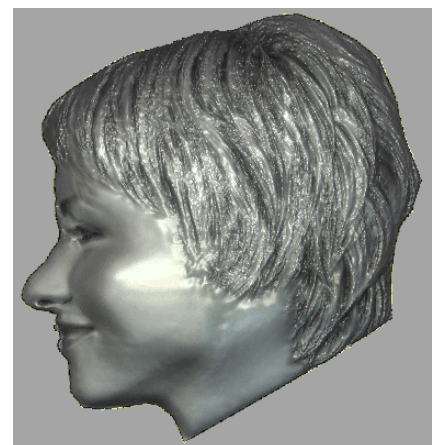
The Relief is generated.

- Close the form to complete the wizard.

- Select **Colour Shade**  from the **3D view toolbar**.



- Apply suitable Sculpting Tools to complete the model.



12. The Toolpath Options

Introduction

ArtCAM can produce a variety of machining strategies on the **Relief**. The machining set up and strategy commands are accessed from the **Toolpaths** tab in the Project tree or by activating the Toolpath's fly out panel. The **toolpaths** that are generated are stored within the **ArtCAM** model and can easily be edited. To drive a specific machine tool one or more **toolpaths** are output as a **post-processed** file translated to the format of the relevant controller.

Toolpaths page

The **Toolpaths** page is segregated into four main categories - **Toolpath Operations**, **2D Toolpaths**, **3D Toolpaths** and **Toolpath Simulation**.



When a **Toolpath** is calculated it will be displayed in this upper area of the **Toolpaths** page. The **Toolpath Names** can be selected for **Toolpath Simulation**, **Toolpath Operations** or to re-opened for editing.

The **Toolpath Operations** area contain operation including Save (to post process), Delete, Tool Database, Material setup and creating machining templates.

The **2D Toolpaths** section contains commands to generate **2D Toolpaths** directly from **Vectors**.

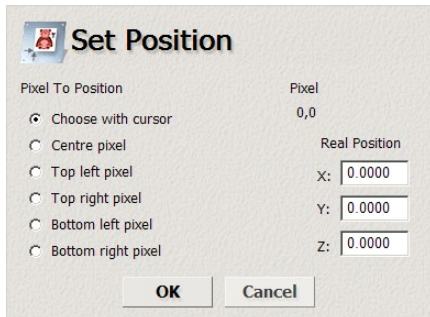
The **3D Toolpath** section contains commands to generate the toolpaths over the **3D Relief**.

The **Toolpath Simulation** section provides controls for viewing **Toolpath** animation and material removal.

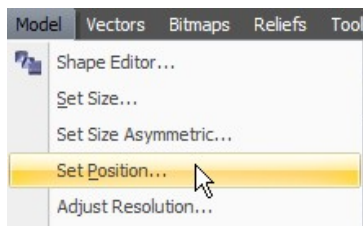
Toolpath Parameters allows changes made to the selected Toolpath Parameters such as Tool number.

It may be required to modify the origin of the model to a position more appropriate as a machining origin. This is achieved by inputting suitable **X Y Z** values in the

Set Model Position dialog box.



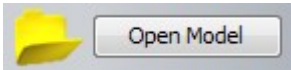
This can be accessed from the top drop down menu **Model > Set position**.

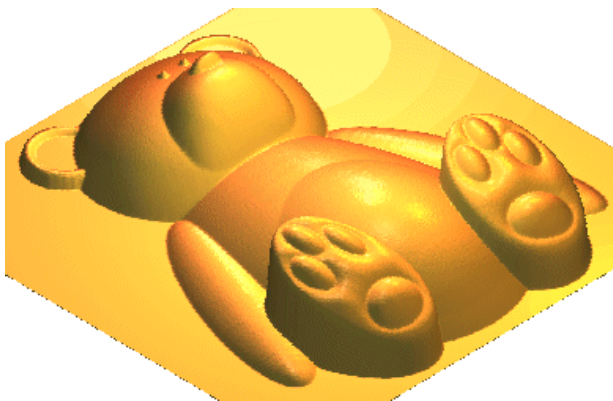


13. Machining a Relief

Teddy Bear Example

The following example takes the user through the complete process of **Machining a Relief**. For the benefit of Training, a number of strategies and functionality will be covered. It is therefore not necessary that these methods will apply to all types of examples. That will depend on user experience, type of machine, materials used and ultimately the type of component being manufactured.

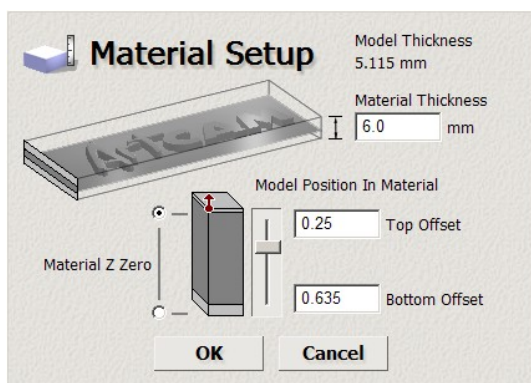
- Select **Open Model**. 
- From: **D:\users\training\ArtCAM Data**, select the model **machine-ted.art**
- Select **File > Save As**
machine-ted.art in: **D:\users\training\COURSEWORK\ArtCAMPro-Jobs**.



The following **Relief** appears in the **3D View** window.

Before generating any Toolpaths, the **Material Setup** is recommended. This can be accessed from the Toolpath Operations area or from within the Toolpath strategy itself.

- Activate the **Toolpaths Panel**,  and then select **Setup Material**  from the **Toolpath Operations** tab.



The **Material Thickness** allows you to input the **thickness of the material to be machined**. The **current relief height** is also displayed (**5.115**). If the **Material Thickness** is greater than the **Relief Thickness**, a value for top or bottom offset can be entered.

A suitable **Z** position for the **Relief** within the material is set here, allowing the user to position the Relief within the material as required. The **X Y** dimensions of the material are the same as the initial model setup. This can be changed as described in the previous chapter from the top menu **Model > Set Position**.

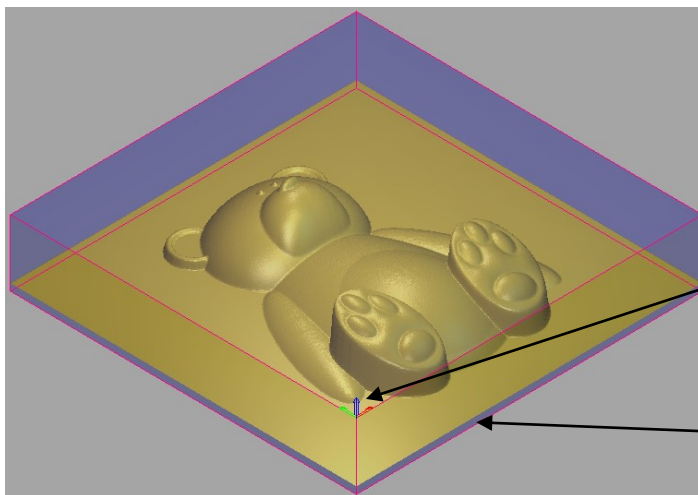
- Enter a **Material Thickness** of **6mm**.

With a **Relief height** of **5.115mm**, this provides a **total of 0.885mm** offset.


- Set a **Top Offset** of **0.25mm**.

As shown, this will now result in a **0.635mm** offset (platform) at the bottom of the teddy bear after machining.

- Ensure that the **Material Z Zero** is set to the **top**.
- Select **OK**.



The material is displayed in blue around the **Relief** in the **3D View**.

The machining origin is displayed by switching on the **Origin** icon  located at the **top** of the **3D Window**.

The **0.635mm** offset at the bottom of the block is also displayed.

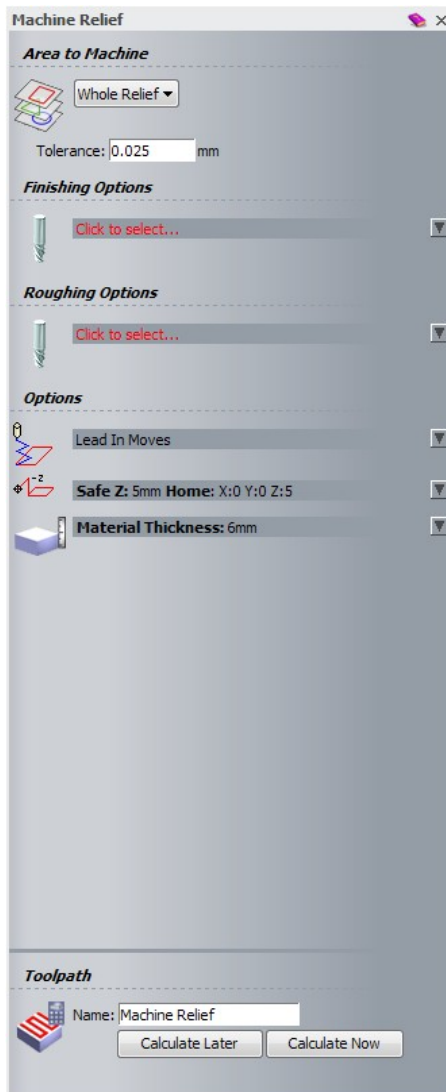
- From the **3D Toolpaths** area, select **Machine Relief**.



The **Machine Relief** page appears.

The Machine Relief form allows both the Roughing and Finishing operations to be defined here.

The basic areas are summarised below but will be discussed in greater detail at each stage.



Area To Machine – this either applies to the **Composite Relief**, the area within the **Selected Vector** or an **Automatic Boundary**.

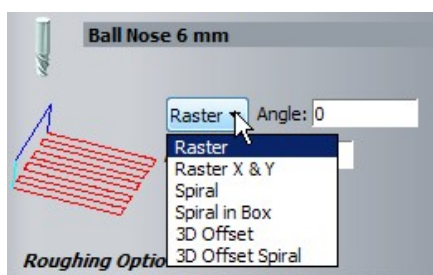
Finishing Options – allows the **Finishing tool**, **cutting strategy** and **angle** to be defined here.

Roughing Options – allows the **Roughing tool**, **cutting strategy** and **angle** to be defined here. The Z slices (thickness of each cut) is also defined here.

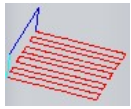
Lead In Moves – For harder materials, this option is used to apply a ramping move of the tool into the material instead of the default vertical plunge.

Safe Z, Home – Sets the **safe Z height** (rapid move) and **Start/End** position of the tool.

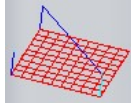
Material Thickness – This can be defined here or as shown previously.



When a **Tool** is selected for the **Finishing operations**, a number of **machining strategies** (for cutting) are available. These will be summarised below.



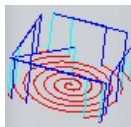
Raster - Creates the strategy along one direction. The default angle of **0 degrees** specifies the **X direction** (therefore angle of **90 degrees** would change to a **Y direction** cutting direction)



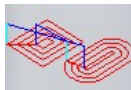
Raster in X and Y - Repeats the above strategy in both X and Y direction.



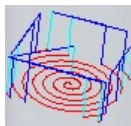
Spiral - Creates a spiral strategy limited by the model.



Spiral in a box - Creates a spiral strategy trimmed to the model.

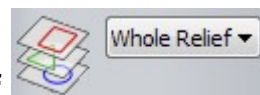


3D Offset - Follows the outer contour offsetting the Toolpath with a **Stepover** relative to the 3D form.



3D Offset Spiral - Same as **3D Offset** but creates a **spiral** instead of a **stepped offset**.

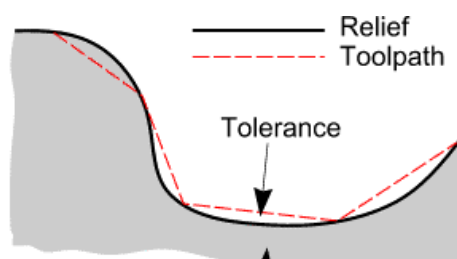
The form will now be completed to Machine the Teddy Bear example.




- Select the **Area to Machine as Whole Relief**.

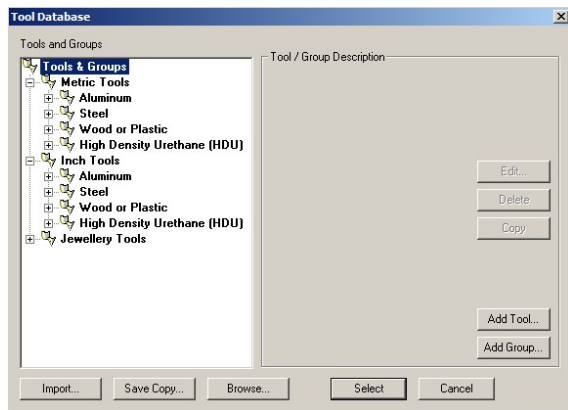
Note: Whole Relief defines the complete model page and not just the Relief itself. Machining can be restricted by using the alternative options of **Automatic Boundary** or **Selected Vector**.

- Change the **Tolerance to 0.01**



Tolerance determines how accurately a cutter path follows the true shape of the **relief**, the actual value being the maximum permissible deviation from the **relief** form.

- In **Finishing Options**, select  to launch the **Tool Database**.

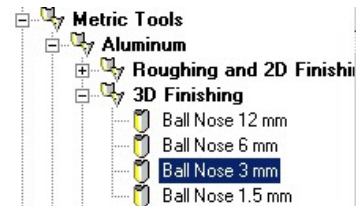


The default **Tool Database** contains a large selection of tools and associated parameters for a variety of materials. The selection can be modified, deleted, or added to by the user as required.

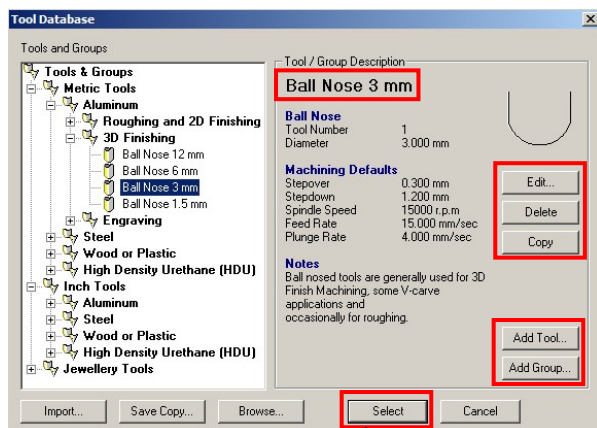
You can also have access to the **Tool Database**

by selecting the icon  in the **Toolpath Operations Tab**.

- By selecting the  sign next to the names, **Browse to Metric Tools > Aluminium > 3D Finishing >**



- Select the **Ball nose 3mm**.



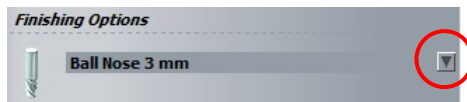
When a tool is **selected** (highlighted) in the left hand window, the tool data and description is displayed on the right-hand side of the form.


Individual tools can be **Edited, Deleted or Copied**.

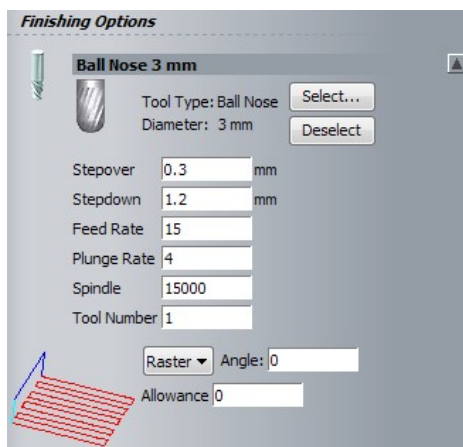
New **Groups and Tools** can also be created for **customisation**.

- Press **Select** on the form to **accept** the **3mm Ball Nose** as the **finishing operation tool**.

The **3mm Ball nose tool** and its parameters are now **loaded** into the **Machine Relief** form.



- Select the **down arrow**  to reveal the default settings for the selected tool.



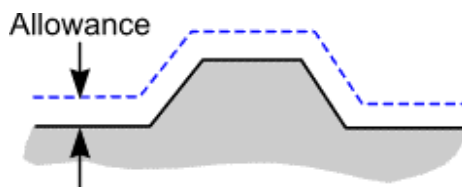
The **default tool parameters** (for Aluminium 3mm Ball Nose) are shown. Changing values in this form do no affect the original tool stored in the database.

The **Stepover** is the distance between passes.

The **Stepdown** is the incremental depth of cut (slices).

A **Tool number** is essential if outputting to a machine tool fitted with an automatic tool changer.

- Change the **Stepover** to **0.5mm**.
- Leave the **Stepdown** as the **default 1.2mm**.
- Ensure the **Raster** strategy is selected and change the **Angle** to **45 degrees**.
- Enter an **Allowance** of **0.25mm**.



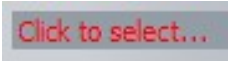
The **Material Allowance** is the specified thickness of material that is left on over the actual **relief** when the toolpath is created.

So based on the above figure, **0.25mm** of material will remain on the relief after machining has completed. This can be therefore regarded as a semi-finish, where a final tool (to be calculated later) will complete the finishing with an allowance of zero.

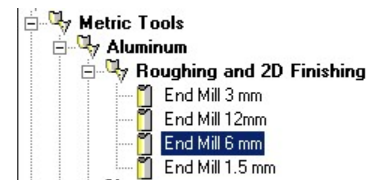
The advantage of running a **Semi Finishing toolpath** is that it removes the steps left by the previous **Roughing Pass**, leaving a more consistent material removal rate for the final finishing operation.

The **Roughing Tool** (first operation) will now be defined.

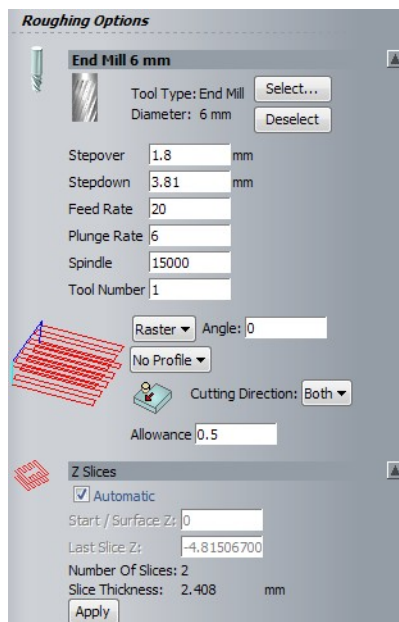
Roughing will remove the excess material from around the **Relief** up to the specified **Material Allowance** and **Tolerance** values. For efficiency, a relatively large tool is generally used for this operation. **Roughing** splits the **Material** into **Z Slices** and performs the selected **Area Clearance** strategy (**Raster** or **Offset**) on each one.

- In **Roughing Options**, select  to launch the **Tool Database**.

- Browse **Metric tools**, **Aluminium**, **Roughing** and **2D Finishing** and then select **End Mill 6mm**.



- Select the tool.
- Select the down arrow  on the **End Mill 6mm** bar.



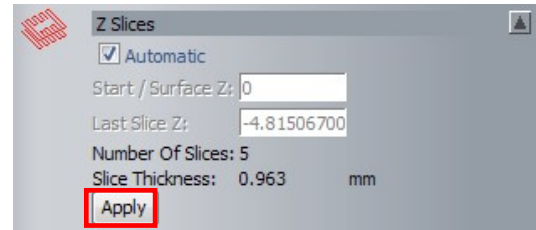
As before, the **Feed Rate**, **Plunge Rate** and **Spindle Speed** are based on the tool manufacturer recommendations but can be adjusted to suit the machine tool, and material used and how rigidly it is clamped down.

A unique **Tool Number** value must be input if the **toolpath** is for a machine tool with an automatic tool changer. If not, the value can be left as **1**.

- Change the **Stepover** to **4mm**.
- Change the **Stepdown** to **1mm** (this will be used for calculating the **Z Slices**).
- As before, leave the default **Feed Rate** at **20mm/sec**, **Plunge Rate** at **6mm/sec**, **Spindle** at **15000 r.p.m**, and **Tool Number** as **1**.

- Select **Apply** in the Z slices area

On clicking the **Apply** the number of **Z slices** (depth of each cut) is automatically calculated. The automatic figure of **5 slices** each at **0.963mm**, was calculated from the tool **Stepdown** (set as 1mm), Distance to bottom offset and Allowance.



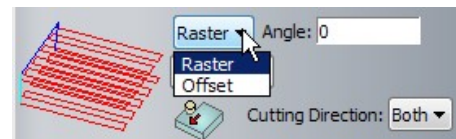
Start/Surface Z at **0** (this is the initial height from where the first **Step Down** value will be subtracted).

The **Last Slice Z** at **-4.815** defaults to the height of the **Material Allowance** above **Relief** base level. This value can be modified upwards to leave more material on the base level if required.

These values can be customised to suit (e.g if a thicker base is required) by altering the **Tool Stepdown** value, **Material thickness**, or by **unticking** the ☐ **Automatic** box and entering suitable settings.

- **Leave the values** as calculated automatically.

The next stage is to select a suitable **Strategy** from either **Raster** or **Offset**.



Raster Roughing

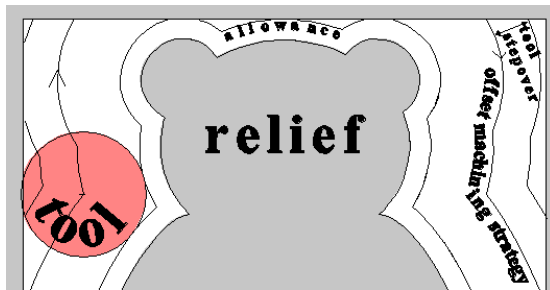


With the **Raster** strategy, the tool moves across the **Z Slices** in parallel, straight line moves separated by the **Stepover** distance. The toolpath is automatically limited away from the relief by the **tool radius** plus the **Material Allowance**, as shown.



The **Raster** process on its own tends to leave steps around the **Relief**. If required these can be removed by applying a **Profile Pass** either before (**First**) or after (**Last**) the **Raster** moves.

Offset Roughing



With the **Offset** strategy, the tool moves are offset inwards from the shape of the **Complete Relief** or limiting **Vector**, and outwards from the shape of the **Relief** contour. Individual tracks are separated by the **Step over** distance.

- Ensure the **Raster strategy** is selected with an **angle of 0 degrees**.

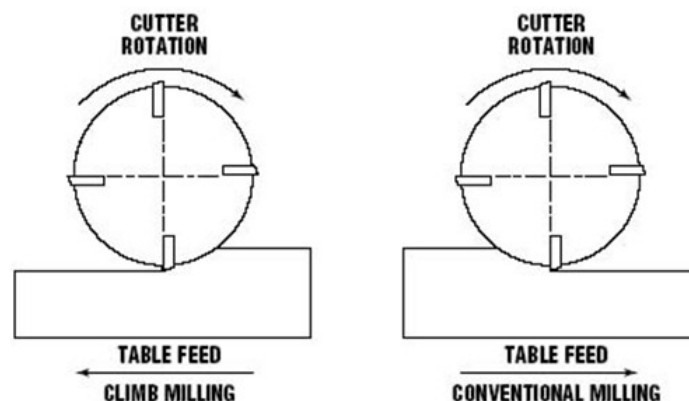
Selecting a profile will Add a profile 'clean up' pass either before, during or after each Z slice is machined. In this example the **Z Slices** will be machined using a **Raster** strategy without the addition of a **Profile Pass**.



- **Do not** select a **Profile Pass**.

The default **Angle: 0** (along **X**) for the **Raster** strategy can be changed if required.

The cut direction of the tool can be selected here from either **Conventional** or **Climb Milling**.



In **Conventional Milling**, the teeth of the tool meet the block of material at the bottom of the block. With this action, the teeth of the tool slide along until sufficient pressure builds up to break through the material surface.

In **Climb Milling**, the teeth of the tool meet the block of material of material at the top of the cut, at the thickest part of the cut.

Climb milling often provides a better finish, permits greater tool feed rates and prolongs the life of the tool.

- Leave the **cutting direction** as **both**.
- Ensure the **Allowance** is **0.5mm**.

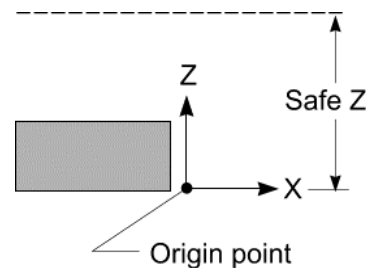
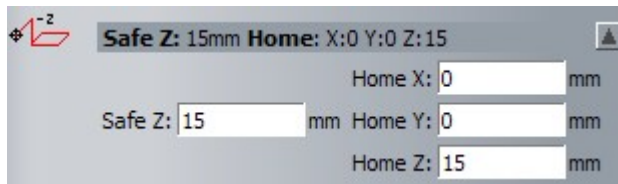
As discussed earlier, this will leave 0.5mm of material after machining. The semi-finishing toolpath will then reduce the material from 0.5 to 0.25mm. Then finally zero on the final finishing strategy.

- Leave **Add Ramping Moves** unticked.



Ramping Moves are applied to avoid plunging, especially where harder materials are being machined. If **Add Ramping Moves** the user has access to a selection of ramping options to control the **Angle**, **Length**, and incremental **Height** of ramp moves.

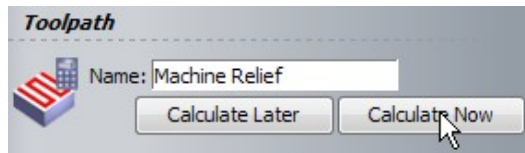
- Select the down arrow  on the **Machine Safe Z** and Home bar.
- Set **Safe Z** at **15** and the **Home Position** as **X0 Y0 Z15**.



Safe Z is the user defined height in Z above the material where the tool can safely perform rapid moves to and from plunge positions.

Note: do not forget to consider the heights of clamping and fixture components, if applicable. The tool **Home Position** defines the **Start** (1st move) and **End** (last move) of the **toolpath**. It is not permitted for the selected **Z** value that is less than the **Safe Z** value.

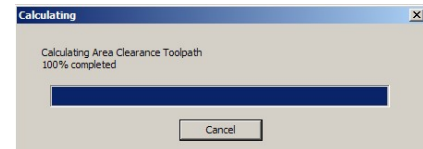
- The **Material** has already been defined hence there is no need to open **Setup**.
- Leave the **default name** for the Toolpath (Machine Relief) or enter a suitable one.
- Select **Calculate Now** to commence the toolpath calculation.



The **Toolpath** can be calculated **Now** or **Later**. When the option **Later** is chosen it will save the uncalculated toolpath until the **Batch Calculate** option is selected from the toolpaths menu.

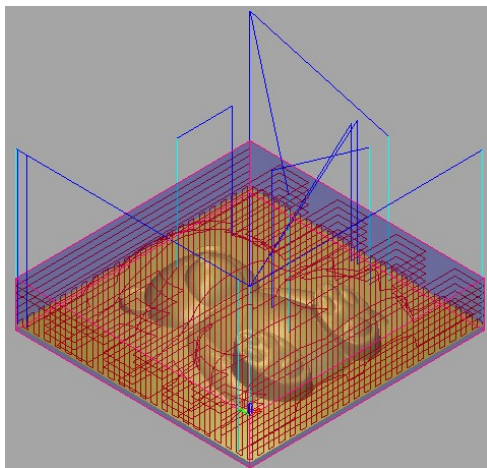
Several unprocessed **Toolpaths** could be **Batched** ready to be calculated at a later time.

During calculation, a progress bar will show the current percentage completed.



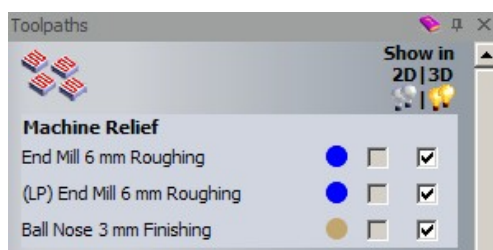
- Upon completion, **close** the machine Relief form

The 3D view, illustrates the calculated cutter paths.




The generated **Toolpath** components are colour coded to assist with both visualisation and identification for **post-processing**.

Cutting **Feed Rate** moves are **Red**, **Safe Z** rapid moves are **Dark Blue**, and **Plunge/Ramp** moves are **Pale Blue**.

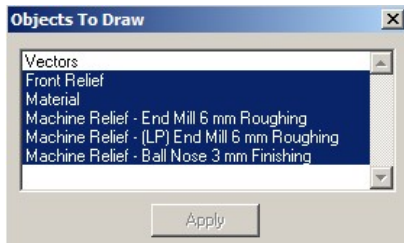


The **Toolpath** appears at the top of the **Toolpaths** page. The **Toolpath** can be shown or hidden by ticking or unticking the relevant **Show in - 3D** column boxes.

The Roughing process has created **two** toolpaths. The second toolpath (**labelled LP – Last Pass**) is a small incremental slice (left over by the main roughing process) that is remove in a single and final stage. This is used to improve the finish of the toolpath.

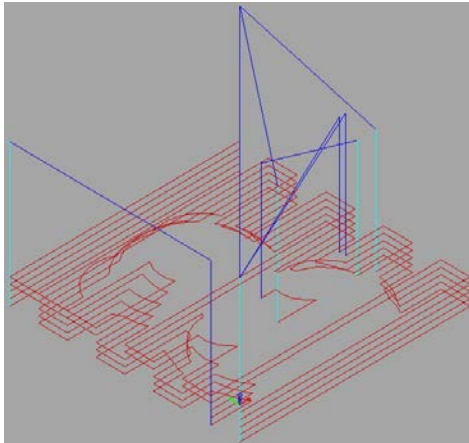
The **Objects To Draw** icon  at the top of the **3D View**, allows the user to toggle the visibility of all entity types (not just machining toolpaths).

- Click **Objects To Draw**  on the **3D View** Toolbar.



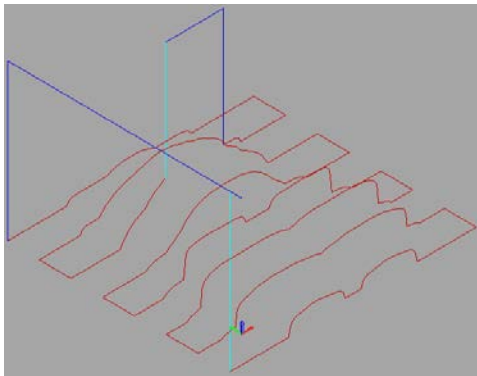
You can toggle between different objects by clicking on them and by selecting **Apply** to display the selected items in the **3D View**. Currently, only the Vectors are undrawn.

- Highlight **only** the **End Mill 6mm Roughing** toolpath and select **Apply**.



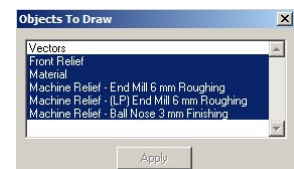
The Initial **Roughing Toolpath** is now the only displayed item.

- Highlight **only** the **(LP) End Mill 6mm Roughing** toolpath and select **Apply**.



The Final Last Pass (LP) **Roughing Toolpath** is now displayed.

- Highlight all objects as before, followed by **Apply**.
- Select **File** and then **Save**.



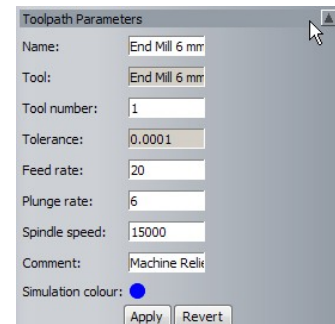
The **Toolpaths** have been saved into the current **ArtCAM** model.



If the Toolpaths require **Editing**, double left mouse clicking on the toolpath in the Toolpaths window will reopen the **Machine Relief** form.

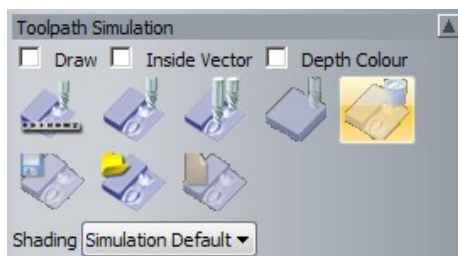
Any parameter can be **changed** and **recalculated** to update. **Note:** if a new, separate **Toolpath** is required, edit the **Name** to be different from the original.

Certain parameters can also be quickly changed by highlighting the individual toolpath and then selecting **Toolpath Parameters** at the bottom of the **Toolpaths fly out menu**. Select **Apply** to update.



Simulating the Toolpaths

Toolpath movement and material removal can be **simulated** in the **ArtCAM 3D View**. Options are available in the **Toolpath Simulation Tab** at the bottom of the **Toolpaths fly out menu**.



Options available in this menu are **simulate**, **reset**, **delete**, **export** and **import the simulation**.

The shading can also be changed to reflect the final material.

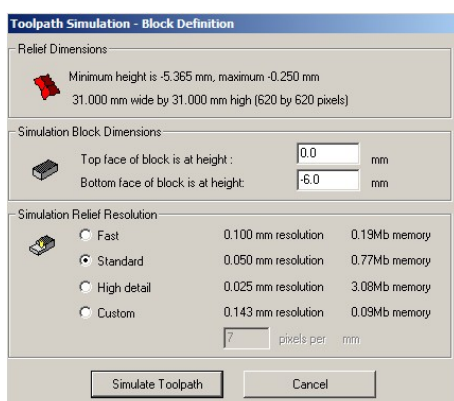
- Select and **Highlight** the **Machine Relief** Toolpath.



If **Simulate Toolpath** is selected, all individual Toolpaths (within the Toolpath) will be simulated in sequence.



- Select **Simulate Toolpath**.



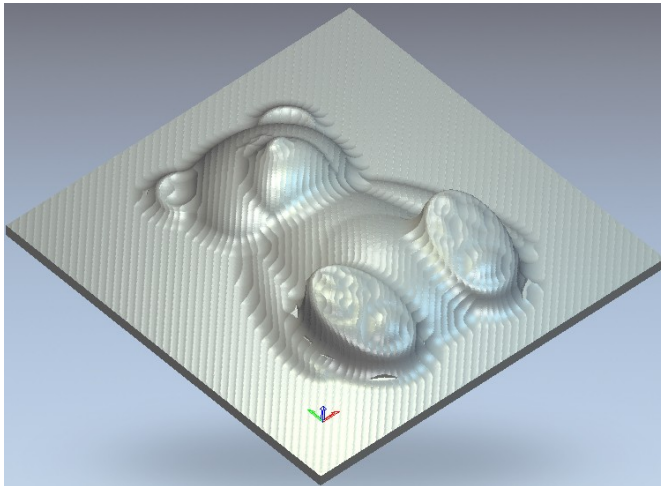
The following form will be displayed:

Relief Dimensions: shows the overall dimensions of the relief.

Simulation Block Dimensions: gives the size of the block. This should be at least as big as the minimum and maximum height of the relief plus any height (or depth) of the engraving features.

Simulation Relief Resolution: specifies the quality of the image that you require. The lower the resolution, the greater the speed of calculation.

- Select **Standard** from the **Simulation Relief Resolution** area.
- Use the other default settings and select **Simulate Toolpath**.



The three toolpaths in the sequence listed are simulated on screen and the final result shown (after finishing operation)

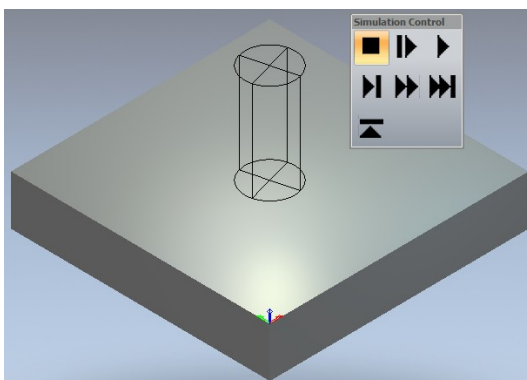
- Select **Reset Simulation** to reset the block.



The toolpaths will be simulated individually to verify the results after each stage.

- Select and **Highlight** the **Machine Relief Toolpath**.

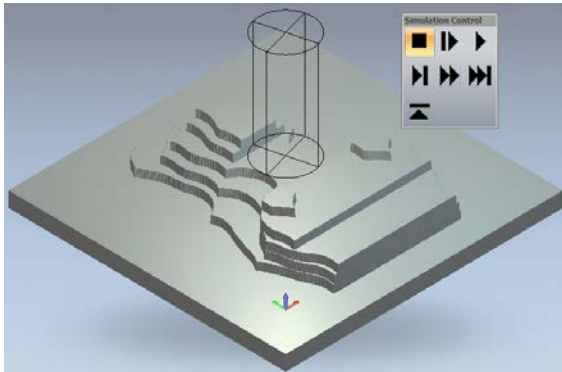
- Select **Simulation Control bar**.



With this option the highlighted tool is drawn (End Mill 6mm first), along with a control panel to control the speed of the simulation.

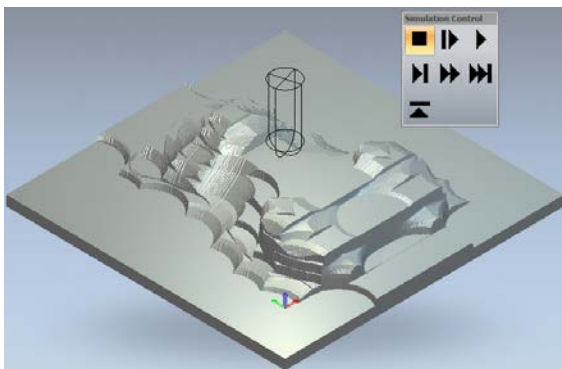
For example, Selecting  will simulate at normal cutting speed.

- In this case, select **Run at Max speed to next retract**.



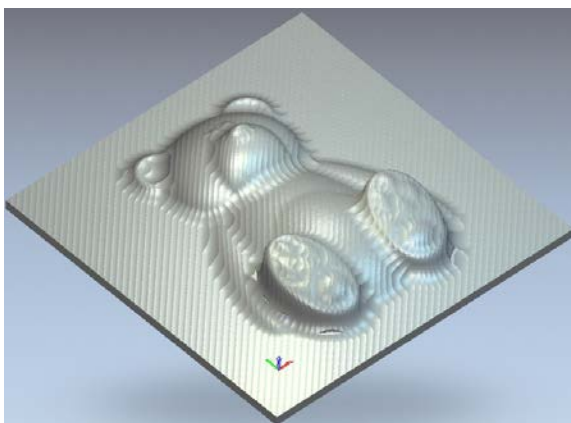
The simulation stops (and retracts) at the end of the first Toolpath **End Mill 6mm Roughing**.

- Select **Run at Max speed to next retract**



The simulation stops (and retracts) at the end of the second Toolpath (**LP**) **End Mill 6mm Roughing**.

- Select **Run at Max speed to next retract**



The simulation ends at the final toolpath **Ball Nose 3mm Finishing**.

The result is a 3D model of the part machined component which also within graphics limitations will indicate the standard of surface finish.

It can be seen that an additional toolpath is required to obtain the final result. Also note the above result/simulation includes the **0.25mm allowance** of material that was defined in the **finishing options** of the **Machine Relief** form.

The final toolpath will be calculated and will therefore have an allowance of zero.

- Select **Delete Simulation**.

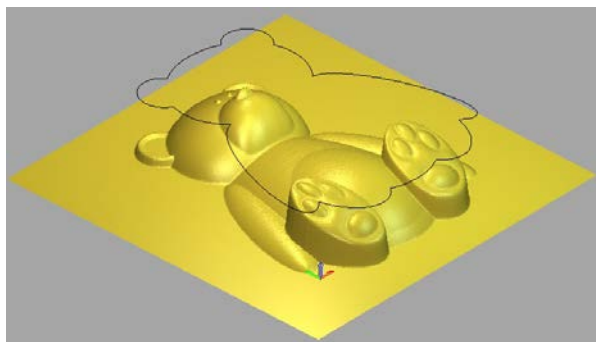


Finishing (3D Offset) Toolpath

For the initial finishing, the same **3mm Ball Nose** tool will be used, but this time using the **3D Offset Spiral Strategy**. An **improved finish** will be achieved by specifying a smaller **Stepover** and as discussed, an **Allowance** of **0**.

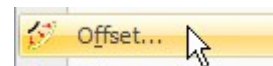
To speed up machining times, A **vector** will be used to limit the extent of the **toolpath** to be over the **3D Relief** form and not the complete flat base area (as before). The 3mm ball nose will still leave excess material on internal corners but these will be picked out locally using the **Rest machining strategy**. (To be discussed later)

- Switch on **Toggle Vector Visibility**



A pre-defined vector outlining the Teddy bear is now visible. This vector will be **offset** to define a boundary to restrict the next toolpath calculation.

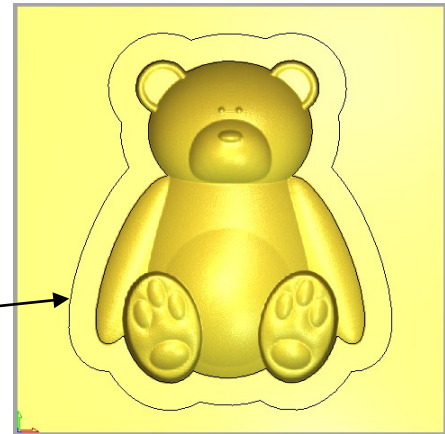
- **Select this vector** and from the main **Vectors pull down menu**, select **Offset**.




- **Offset** the vector **Outwards** by a **Distance of 2mm**. (Ensure the **Radiused** option is selected)

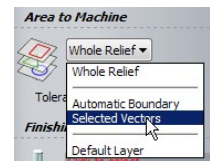
- Select **View along the Z axis**  from the **3D view menu**.




- Select this **new offset vector**.



- From the Toolpaths fly out panel, select **Machine a Relief**  to create a **new toolpath**.

- From the **Area to machine** drop down menu, select **Selected vectors**.

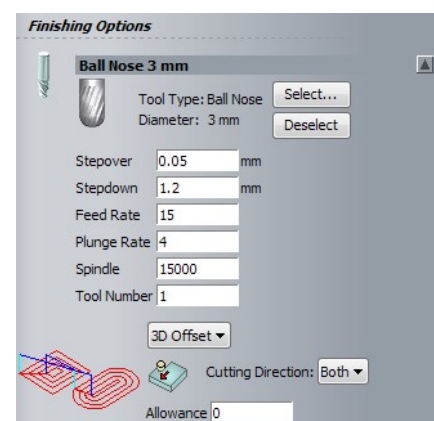


- Ensure **Inside Vector** is selected.
- Leave the **Tolerance as 0.01**.
- In **Finishing Options**, select  to launch the **Tool Database**.
- By selecting the  sign next to the names, **Browse to Metric Tools > Aluminium > 3D Finishing >**
- **Select the same Ball nose 3mm as before.**
- Select the **down arrow**  to reveal the default settings for the selected tool.

- Change the **Stepover to 0.05mm**.

This will ensure a closer and improved finish.

- Leave the **Stepdown** as the **default 1.2mm**.
- Select the **3D Offset** strategy is selected.
- Ensure the **Allowance is 0**.




ArtCAM retains the previous **material** and **Safe Z** and **Home** settings.

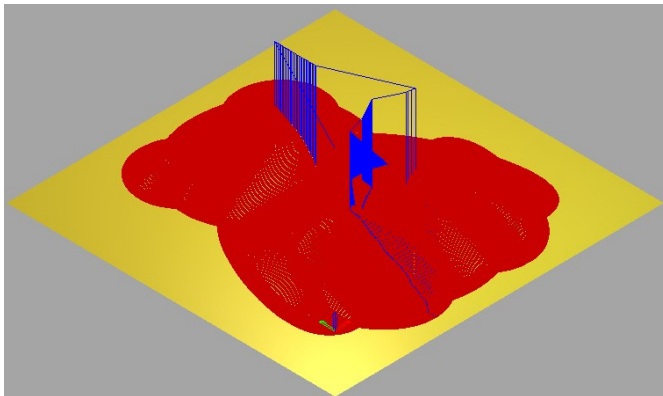
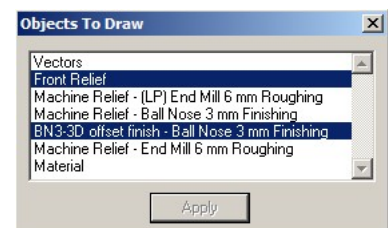
- Change the **Safe Z** height to **5mm**.

This will reduce overall machining times by reducing the time spent at rapid speed between toolpath segments.

Safe Z: mm

- Leave the other options as before.
- Change the file name to **BN3-3D Offset Finish**.
- **Select Calculate Now** and **close** the **machine Relief** form.

- From **Objects to Draw**,  **Hide** all entities apart from the **Front Relief** and the **new 3D Offset toolpath**.

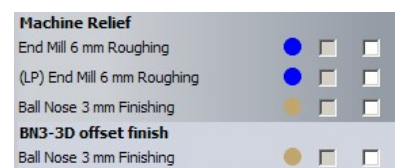


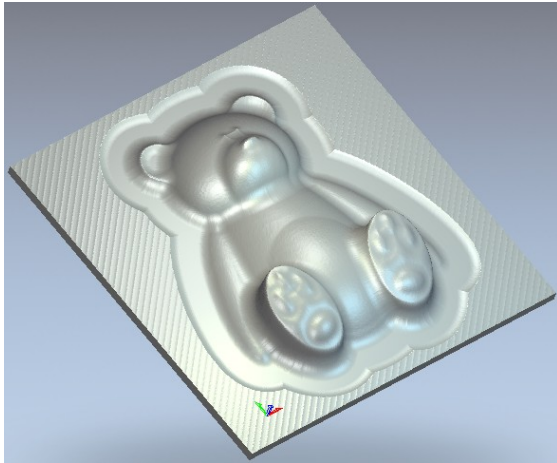
The **3D Offset** with small stepover is displayed. The Selected vector has **limited** the **machining boundary**.

- Select **Simulate All Toolpaths**.



This option simulates **ALL** the toolpaths calculated and displayed in the Toolpaths form.





The final result (following the 3D offset toolpath) shows a significant improvement.

Upon close inspection, there are areas of material not yet removed. (E.g. around neck and feet)

These regions will be removed using a new strategy called 3D Rest Machining.


- Select **File – Save**.

3D Rest Machining.

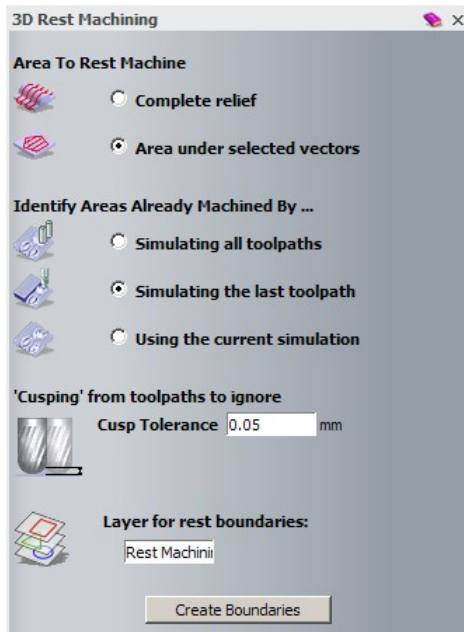
3D Rest Machining creates closed **vectors** around areas of the **Relief** that are out of reach to the **tooling geometry** of previously created **toolpaths**. A further **Machine Relief toolpath** using a smaller tool can then be applied within the **vector** area to locally pick out the remaining detail. The calculation of the **Rest Machining vectors** uses the **simulation** model of the previous **toolpaths**.

- Reselect the previous offset vector that was used to limit the previous toolpath.



- In the **3D Toolpaths** area select **3D Rest Machining**  strategy.

This form will identify areas by **comparing** the simulation from the previous toolpaths to the current relief. ArtCAM will then automatically create vectors to mark out the areas which require further machining.



- Select the option **Area under selected vectors**. (The offset vector is used)
- Select the option **Simulating the last toolpath**.

This will use the 3D offset vector for reference

- Enter a **Cusp Tolerance** value of **0.05mm**.

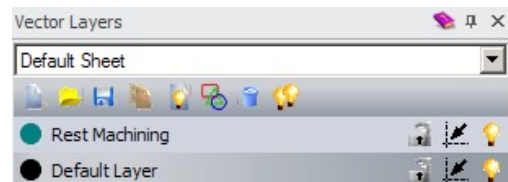
This height will ignore all ‘cusps’ (created from toolpath geometry during passes) below this level when identifying the areas to be rest machined.


- Keep the default Layer name, **Rest Machining**.
- Select **Create Boundaries**.

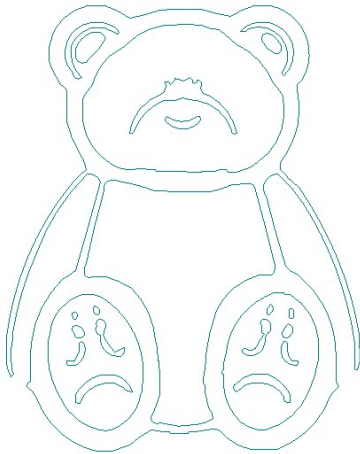
- Activate the Vector Layers Flyout tab.



New **vectors** have been and assigned to a new **Layer** with the name **Rest Machining**



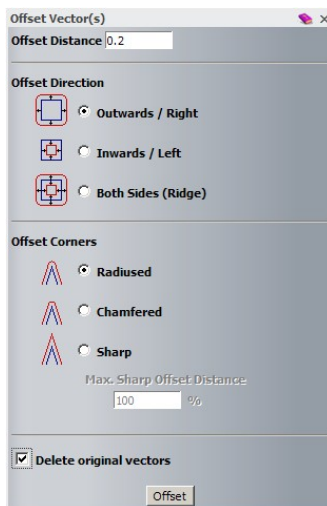
- Switch **off the Default Vector Layer** (by selecting the adjacent **light bulb** icon )
- In addition, Ensure the **Bitmap Layer** is also switched **off**.



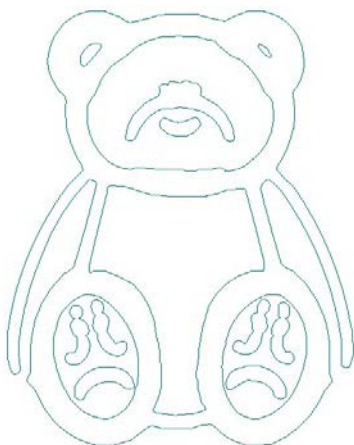
The Rest machining vectors are displayed

However these vectors will be offset outwards to provide the next tool a region to blend more smoothly.

- With the **Rest Machining vectors** selected, select **Offset Vector(s)**.



- Enter an **Offset Distance** value of **0.2mm**, select the **Outwards/Right**, **Radiused** and **Delete original vectors** options.
- Select **Offset** then **close** the form.



The **Offset - Rest boundary** will allow the new **finishing toolpath** to blend more smoothly over the form previously finished with the **3mm Ball Nose tool**.

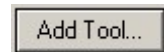
It will be easier to use a copy of the previous finishing **toolpath** as the basis for the new **Rest** finishing strategy.

- Select and double click on the stored **BN3-3D Offset Finish toolpath** to open the **Machine Relief** form to enable editing of the settings and parameters.
- Ensure the **new Offset vectors** are selected.

All of the previous parameters and settings will remain the same for the new **toolpath** apart from the **Tool** selection and the **toolpath Name**.

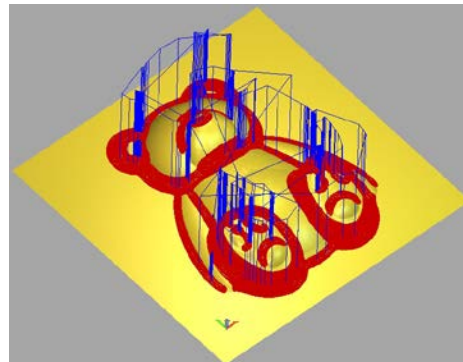
- In the **Finishing Options**, Change the 3mm Ball nose to a **0.5mm Ball Nose tool**.

If a 0.5 mm is not listed, then create a new Tool by selecting **Add Tool** on the **Tool database** form.

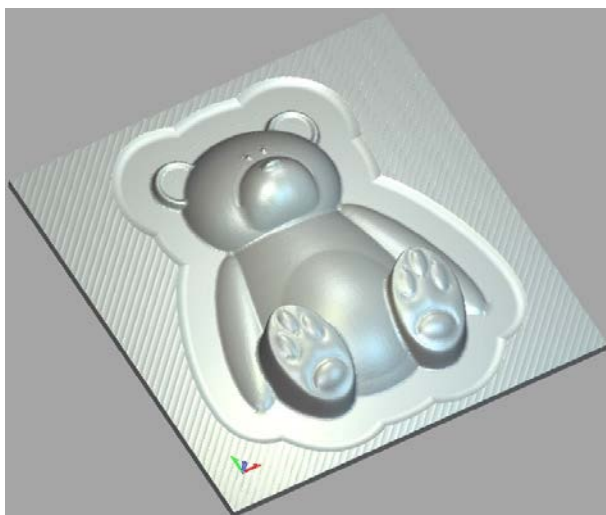


- Change the **Stepover** to **0.05mm**.
- Change the name the **Toolpath BN0.5-Finish**.
- **Select Calculate Now** and **close** the **machine Relief** form

The Toolpaths are calculated **within** the **Rest machining vectors**.



- Select **Simulate All Toolpaths**.



Sharper detail in the corners has been produced by removing previously inaccessible regions to the **3mm Ball Nose tool**.

The machining if the model is now complete.

- Select **File- Save** (to update the model **train-machine-ted**).
- Select File – Close Model.

14. 3D Cut Out Machining

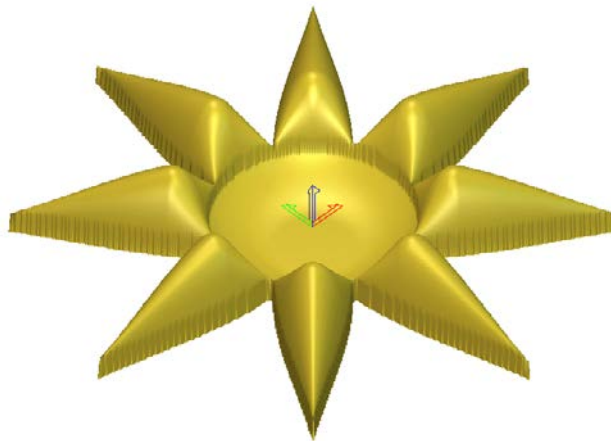
Overview

The outside form of a model will be profile machined in stages with the **3D Cut Out profile** strategy.

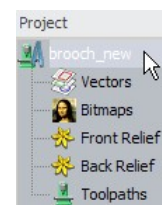
This strategy follows the shape of the selected **vectors** and automatically compensates for **tool radius** and material **Allowance**.

This Chapter will also introduce the application of **Lead In/Out**, **Ramping** and **Bridges to Relief Machining**

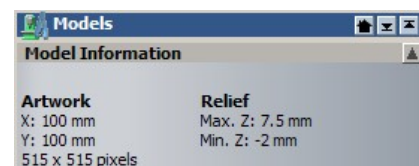
- Select **Open Model**.
- From D:\users\training\ArtCAM Data, select the model **brooch_new.art**.



- Highlight Brooch_new in the Project Tree.



The Model Information summary shows that the **Relief** exists both above and below **Z0**.

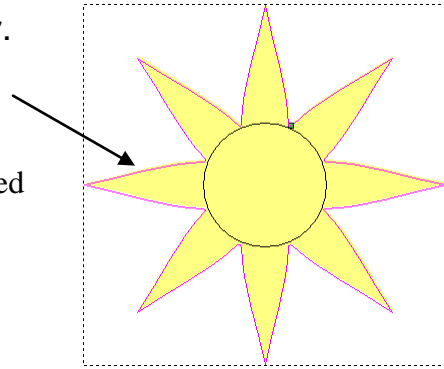


- If not visible, Activate the **Toolpaths** fly out panel.

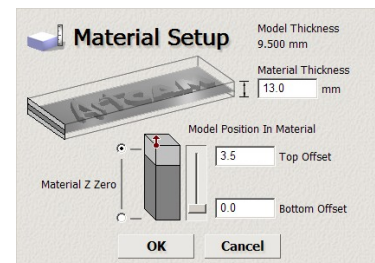
- In the **2D View**, select the **Outer star vector**.

3D Cut Out uses **vectors** as the basis for creating a stacked **toolpath** offsetting either **Outside** or **Inside** for the tool geometry and machining **Allowance**.

Note: the **Relief** is not directly involved.

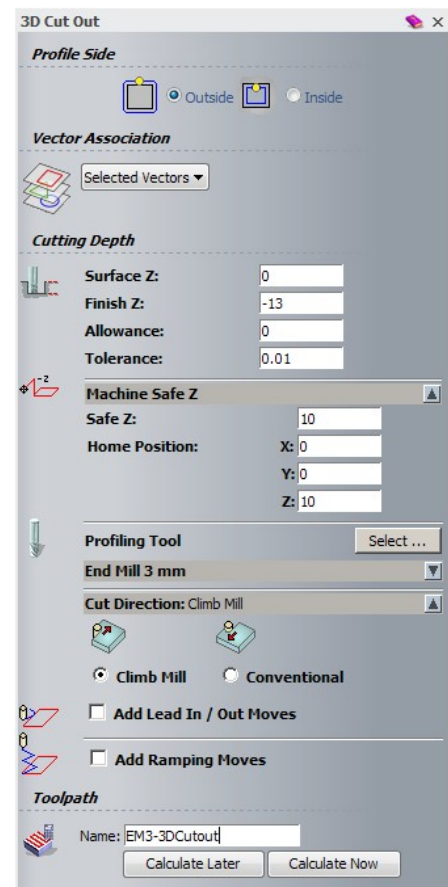


- Define a material  of **13mm depth** with **Z zero at the top** and **zero bottom offset**.

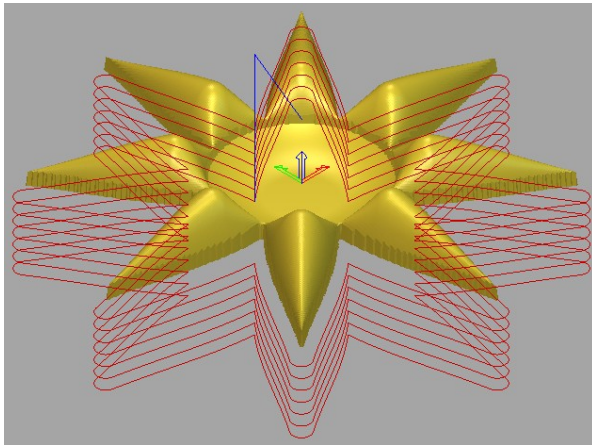


- In the **3D Toolpaths** area select **3D Cut Out**. 

- Select the **Profile Side** as **Outside**.
- Ensure **Selected Vectors** is selected.
- Enter a **Surface Z** distance of **0** and a **Finish Z** distance of **-13mm** (depth of material)
- Enter a **Safe Z** distance of **10** and a **Home Position** of **X0 Y0 Z10**.
- Select a **3mm End Mill Tool** and override the **Stepdown** value to **2mm**.
- Select **Climb Mill** as Cut Direction.
- Enter the **toolpath Name** as **EM3-3DCutout** and select **Calculate Now**.



- **Do not close** the 3D Cut out form.



The **toolpath** has been generated at **2mm Z height slices** calculated using the tool **stepdown**.

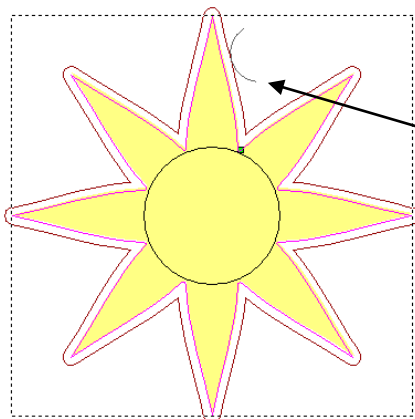
Lead in/Out Moves

To provide a smoother **tool move** onto the component profile it is possible to apply a **circular lead move** on and off the **toolpath**.

- **Tick** the option for **Add Lead In/Out Moves** to reveal the options.

The **Add Lead In/Out Moves** form provides two main options, **Linear** or **Circular Arc**.

- Enter a **Distance of 5mm**, select **Circular Arc** with a **Radius of 5mm**.
- Select **Calculate Now** to update.

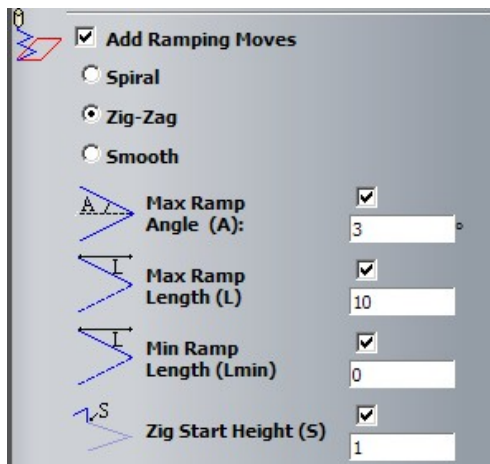


A smooth **Lead In** and **Lead Out** Arc had been added to the toolpath

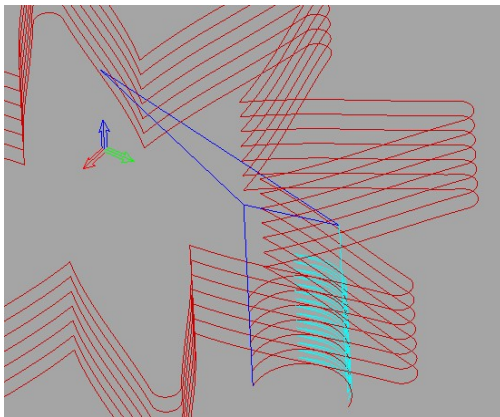
A **Ramping Move** will now be added. This will instruct the tool to ramp down in a **zig-zag** or **spiral** motion during the **Lead In** move.

Ramping is used for tools that do not cut at the base but only around the edges.

- **Tick** the option for **Add Ramping Moves** to reveal the options.



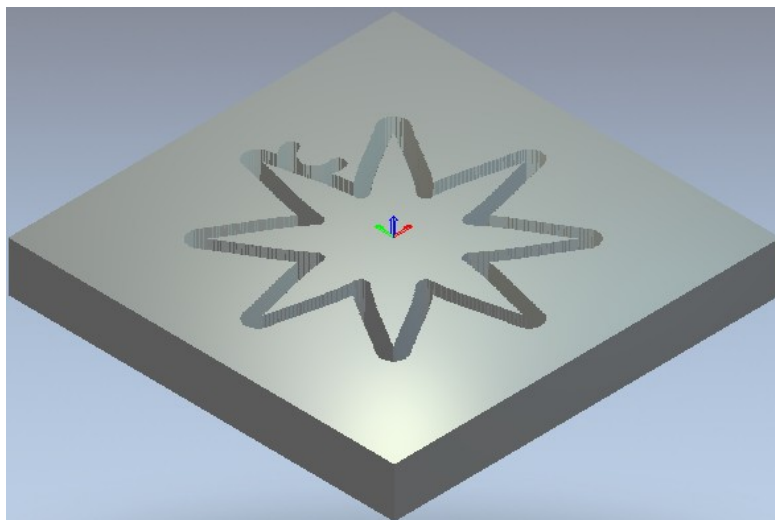
- Set the values as shown
- Select **Calculate Now** to update.



The **light blue moves** on the **toolpath** are **ramping moves** onto the **profile passes**. These only apply to the **Lead In** moves. At the end of the **Lead out** the tool finishes with a **rapid retract** to **Safe Z** followed by a **rapid move** to the **Home Position**.

Ramping is essential in cases where a non-plunging tool is being used.

- Select **Simulate Toolpath**  to view the results graphically.




- **Close** the **3D cut out** form.
- Select **File- Save As**.
- Enter the File name as **BroochMachineTraining** in **D:\users\training\COURSEWORK\ArtCAMPro-Jobs**.

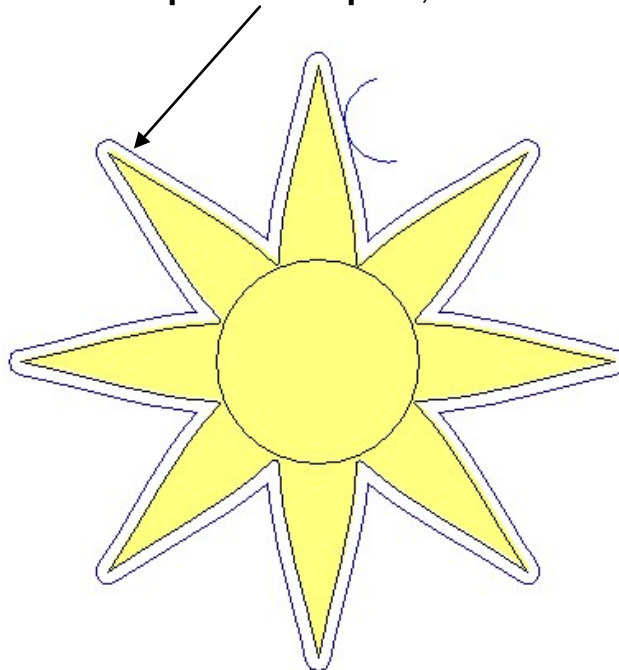
Creating Bridges


In some applications it is required to profile around a component within a block of material leaving **location lugs** to keep it in position until such time as it is required to break it free.

To create suitable **location lugs**, the **Profile Options** from the **2D Toolpaths** area are

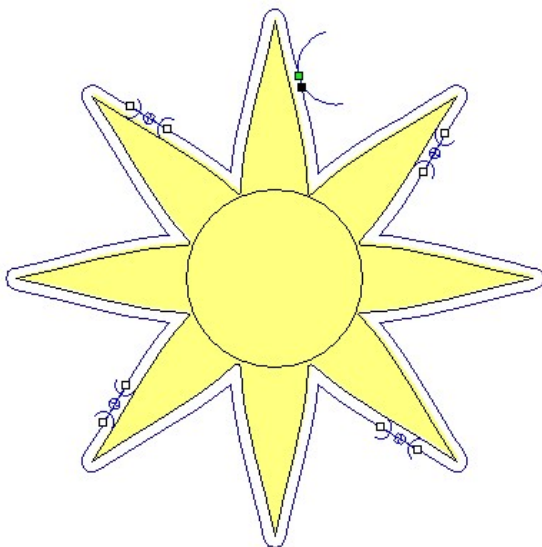
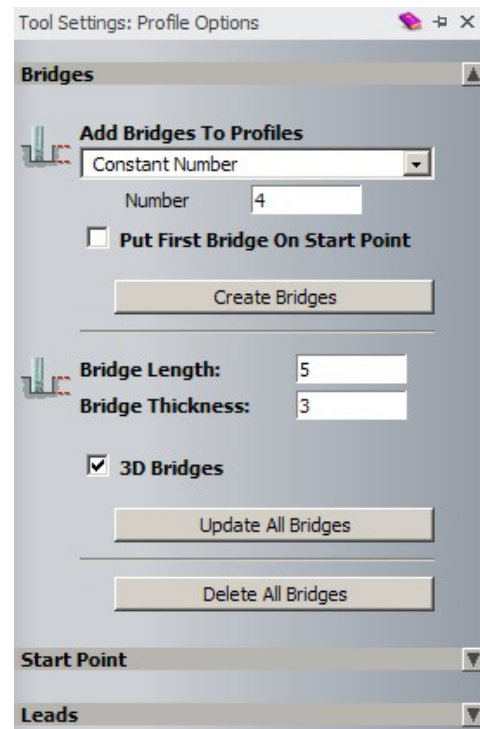
utilised. 

- In the **2D View** select the **profile toolpath**, as shown in the image below.



- In the **2D Toolpaths** area select **Profile Options**. 
- If not visible, **Select F6** to activate the **Tool Settings fly out Panel**.

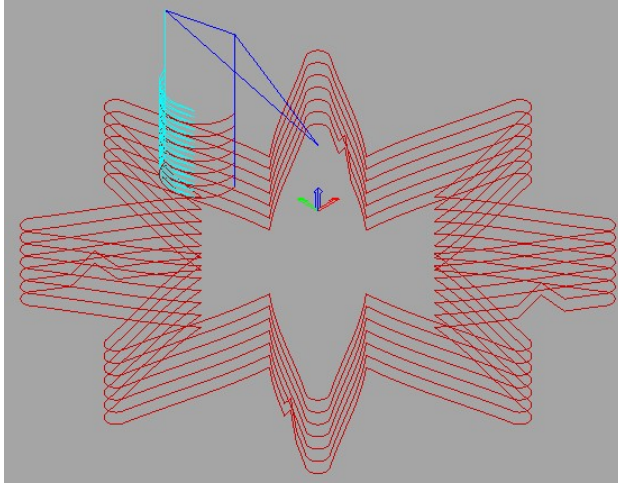
- Select **Constant Number** from **Add Bridges to Profiles**.
- Enter Number **4**.
- Input a **Bridge Length** of **5** and a **Bridge Thickness** of **3** with **3D Bridges** selected
- Select the **Create Bridges** tab at the top.



The **four Bridges** are added to the **3D Cut Out toolpath**.

Note: Individual Bridge lengths can be edited by dynamically dragging on a square marker at the end of a **Bridge** preview. Dragging the 'centre cross' moves its position.

- **Close** the **Profile Options** form to exit.



The **4 Bridges** are formed with a triangular movement in the **Z Plane**.

If **3D Bridges** was **unticked**, then the **Bridges** are formed with a rectangular movement in the Z Plane.

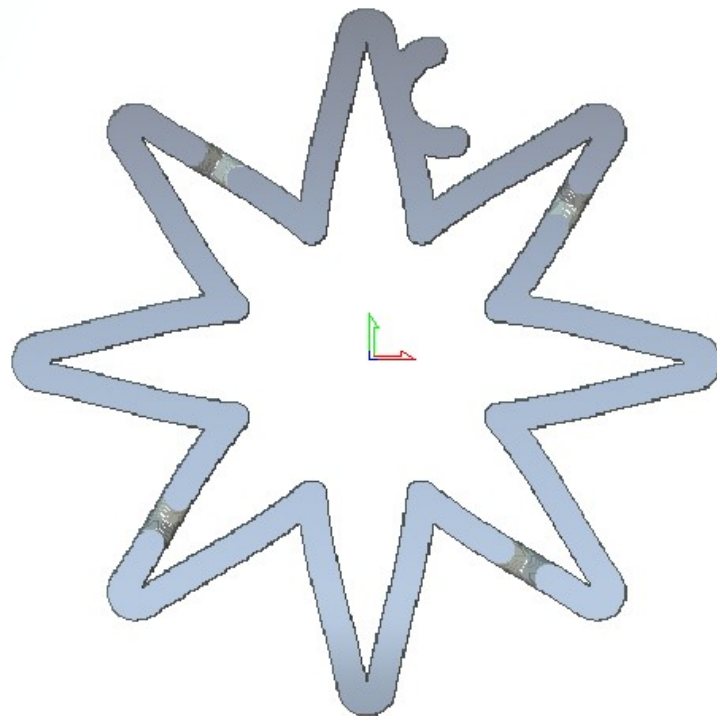
- If required, Select **Reset Simulation**.



- Select **Simulate Toolpath**



to view the included bridges.



- **Save** and **Close** the ArtCAM model.

15. Post Processing Toolpaths

Introduction

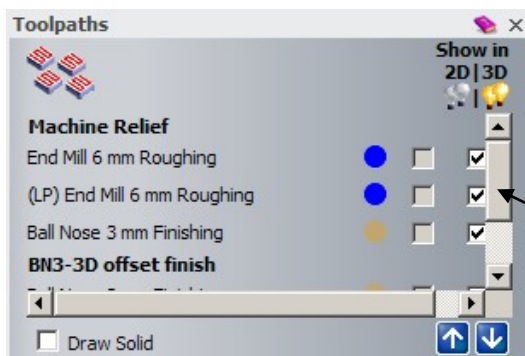
The **Toolpaths** produced in **ArtCAM** have to be translated into a different format as an exported file for a specific **machine tool controller**. The collective name for one of these files is **NC data** and the operation is called **Post-Processing** which is accessed via the **Save**

Toolpaths option in the Toolpaths Tab.



Post Processing of Toolpaths for a Manual Tool Changer

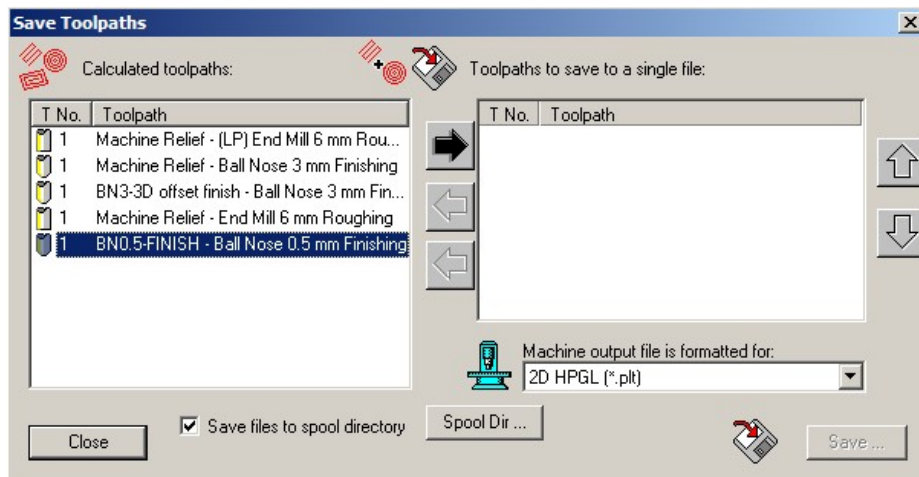
- Open the previously machined model. **machine-ted.art**
D:\users\training\COURSEWORK\ArtCAMPro-Jobs.
- **Activate the Toolpaths fly out panel** if not already visible.



All toolpaths previously calculated (in chapter 13 are listed)

Use the scroll bar to view all.


- **Select Save Toolpaths**  from the **Toolpath Operations** area.

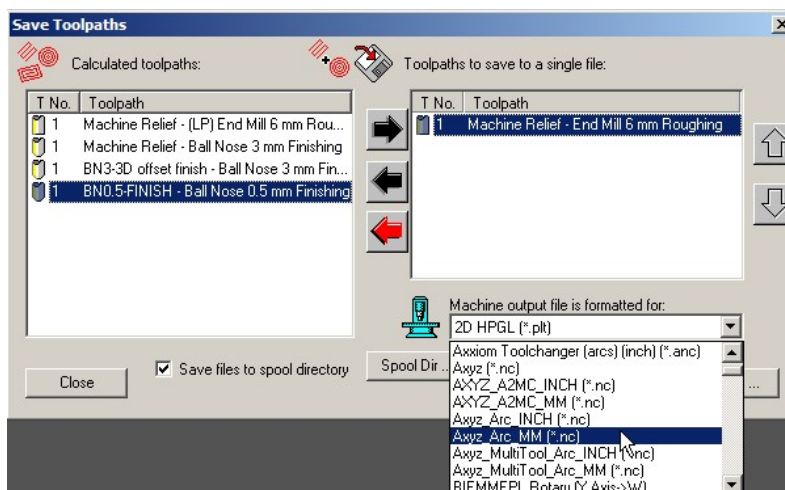


When the **Save Toolpaths** form is opened all existing toolpaths are listed in the **left hand window**. **Toolpaths** are selected and transferred from one side to the other using the central **Arrow** buttons.





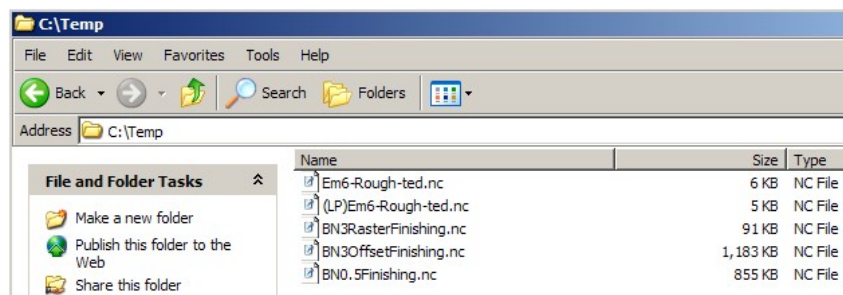
All the files in the **right hand window** will be included for output into a single **NC data** file. If the machine tool uses a **manual tool changer** then it will only be possible to include **Toolpaths** in the **NCdata** file that share the same cutting tool. If the machine tool has an **automatic tool changer** then any combination of the available **toolpaths** can be include in the **NCdata** file. (as long as the selected machine supports it)

- Select the toolpath **Machine Relief-End Mill 6mm Roughing** and then the **right Black arrow**.  (to transfer it across)
- Deselect **Save files to spool Directory** (You will be prompted for the location directory for outputting the current **NCdata** file).
- From Machine Output, **select Axyz_Arc_MM(*.nc)**



Note: this machine does not support an **automatic tool changer** hence only **Toolpaths** that use the same **tool** can be included in the **ncdata** output file.

- Select **Save** and browse to select **C:\temp**, enter a **File name** as **Em6-Rough-ted** and select **Save**.
- Select the **left black arrow**  (to move the toolpath back to the left window).
- Select the toolpath **Machine Relief-(LP) End Mill 6mm roughing** and then the right **Black arrow**. 
- Select **Save** and browse to select **C:\temp**, enter a **File name** as **(LP) Em6-Rough-ted** and select **save**.
- **Repeat the above procedure** for the **remaining Toolpaths** providing suitable file names.
- **Browse to the C:\Temp directory to see the saves toolpaths.**



All the **post-processed Toolpaths** have been saved outside **ArtCAM** and translated in the format required for an Axyz machine controller. These files can now transferred to the machine controller itself, ready for manufacture.

Note: If the Toolpath is modified within ArtCAM, the above process must be repeated for that specific file.

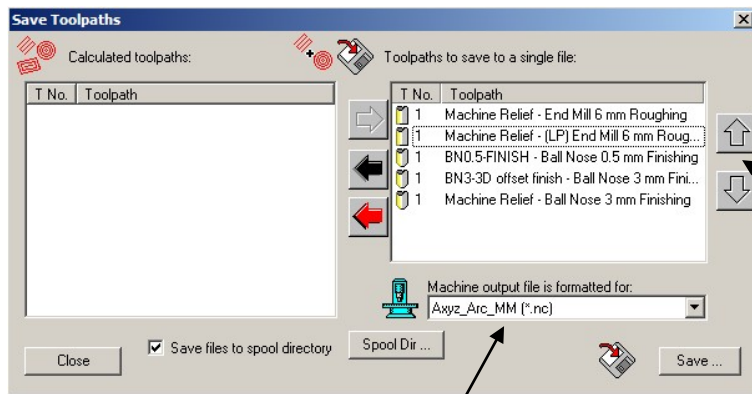
- Do not **close** the model as it is required again in the next chapter.

Post Processing of Toolpaths for an Automatic Tool Changer

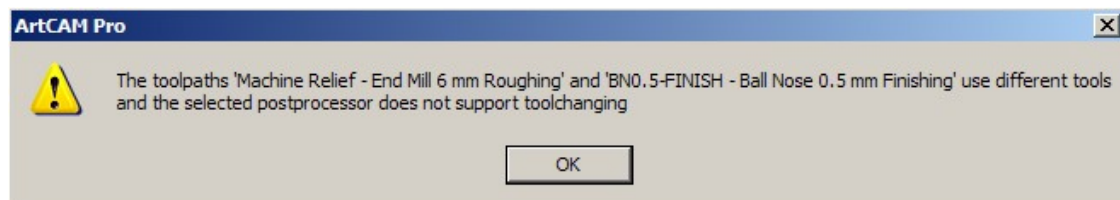
If a **Machine Tool** is fitted with an **Automatic Tool Changer** then the control of this feature will be available in the **Post Processor** translation.

If toolpaths containing different tools are passed over to the right hand window of the **Save Toolpaths** form and the selected **Post Processor** does not support an **Automatic Tool Changer** then a box with an error message will appear.

- Using the **black arrow**,  **Transfer** all the toolpaths into the right hand window as shown.



- Ensure the **same machine output file** is selected as before.
- Select **Save** to output the combined files.



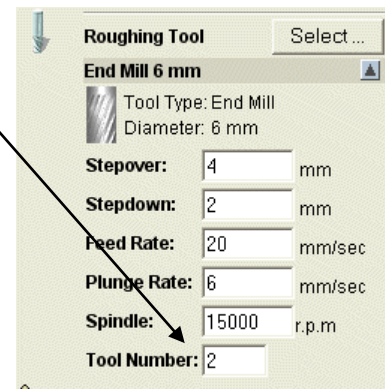
The operation has failed and the above error message appears. The files were unable to be processed for two reasons.

- The selected Machine (post processor) does not support tool changing itself.
- All tools are currently identified as Tool number 1. The **Tool Number** is essential to identify the location of an individual **Tool** in the **tool changer** or **carousel**

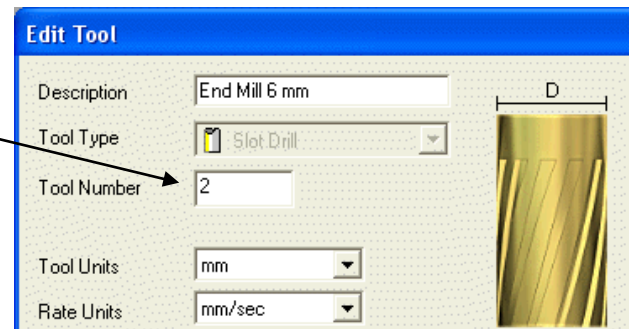
T No.
1
1
1
1
1

The Tool Number can be defined in a number of ways.

1. **Entering the tool number** within the defined tool of the toolpath. The Toolpath must be **recalculated**.



2. **Entering/Editing the default tool number** defined in the Tool database.

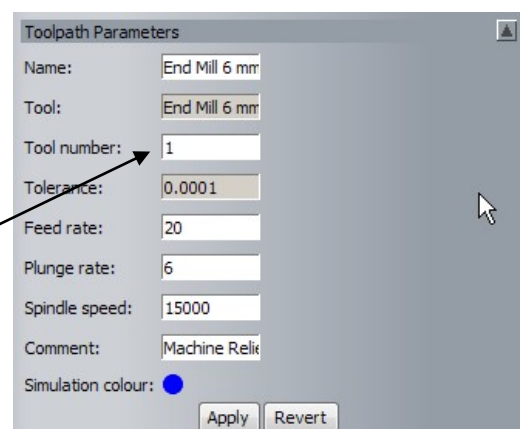


3. The simplest way is to change the tool number by first highlighting the tool in the Toolpaths Tab.



Expand  the **Toolpath parameters Tab** at the bottom of the **Toolpaths Panel**.

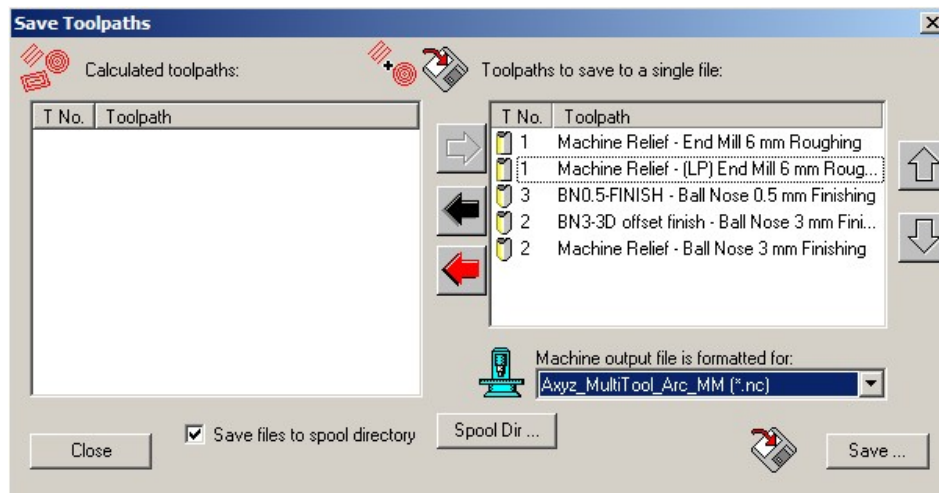
The **Tool number** can be changed here and updated by just selecting **Apply**.



- Use **any** of the methods described above to assign **Tool numbers** as shown in the image below.



- Select **Save Toolpaths** from the **Toolpath Operations** area.
- **Move** all the Toolpaths to the **right hand window**.
- **Reorder** the Toolpaths as required.



- **Change** the Machine output file to **Axyz_MultiTool_Arc_MM**.
- Select **Save**.

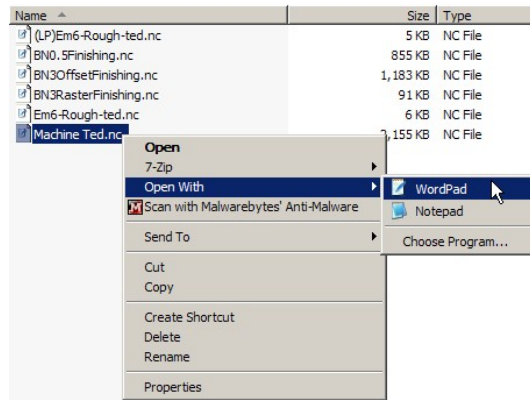
Note: No Error message is displayed and now allows the files to be saved as one.

- Locate **C:\temp** and enter the **File name** as **MachineTed** and select **save**.

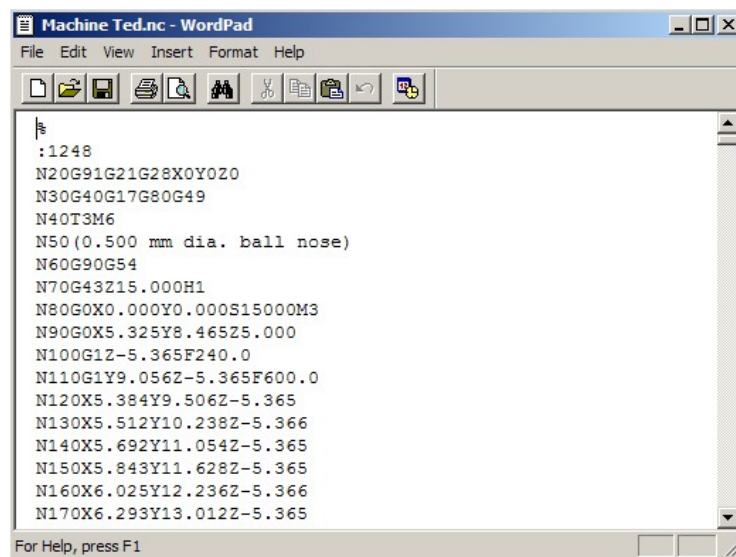
NC code can be viewed in WordPad for analysis or editing if required.

- **Browse** to the **C:\Temp** directory to see the saved toolpaths.

- **Right mouse click** on the Toolpath an **open with WordPad**.



The outputted NC code can be viewed.



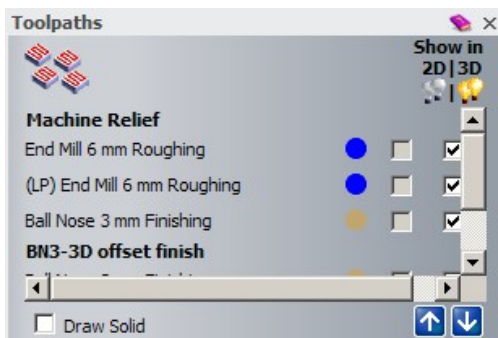
16. Toolpath Templates

Toolpath Templates

A **Toolpath Template** is a file containing one or more unprocessed machining strategies stored outside **ArtCAM** as a **.tpl** file. A previously stored **Toolpath Template** is imported into **ArtCAM** and the associated **machining strategies** can be then edited (if required) before the **toolpaths** are regenerated for the current **model**.

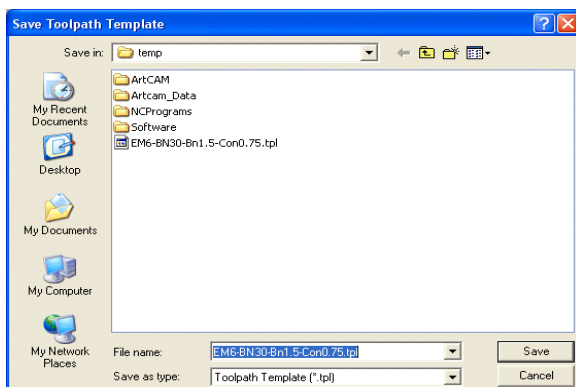
The benefit of **Toolpath Templates** is that a whole set of unprocessed machining strategies can later be loaded into **ArtCAM** with all the **tooling** and **settings** already set for the user specific application or for a series of similar **ArtCAM** models.

- Open the previously machined model. **machine-ted.art**
D:\users\training\COURSEWORK\ArtCAMPro-Jobs.
- **Activate the Toolpaths fly out panel** if not already visible.



This **ArtCAM** model contains **five Toolpaths**, two of which require closed **vectors** to control the area to be machined. When a **Template** is **Saved/Created**, all **toolpaths** that exist in the model are included in the output file.

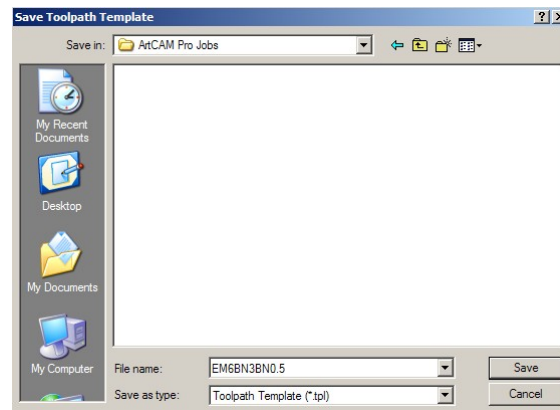
- Select **Save Toolpath as Template**  from the **Toolpath Operations** area.



The toolpath template is a special file type (*.tpl) and is stored outside of the **ArtCAM** model.


It is a good idea to be as descriptive as possible with the template name.

- Select the area **D:\users\training\COURSEWORK\ArtCAMPro-Jobs** and enter the **File name EM6-BN3-BN0.5.tpl**.




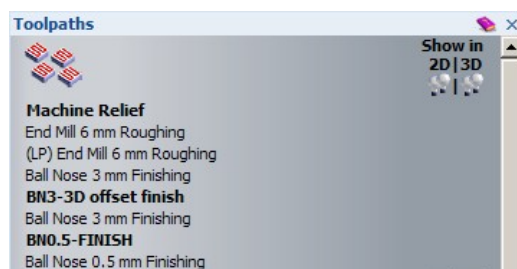
- Select **Save**.

The template can now be loaded into a different model or, if these toolpaths have been deleted, they can be loaded back into the current model.

- In the current model, Select each **toolpath** and delete it using **Delete Toolpath**  in **Toolpath Operations**.

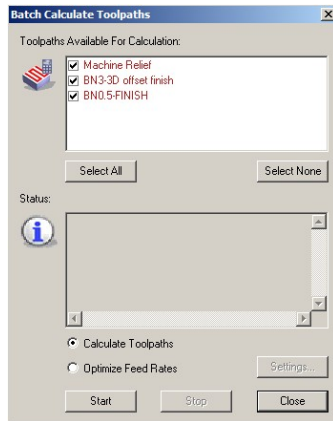
(It therefore assumes at this point, the Relief has just been created.....)

- From **Toolpath Operations**, Select **Load Toolpath Template**. 
- **Browse and Select** the previously created file **EM6-BN3-BN0.5.tpl**.
- Select **Open**.



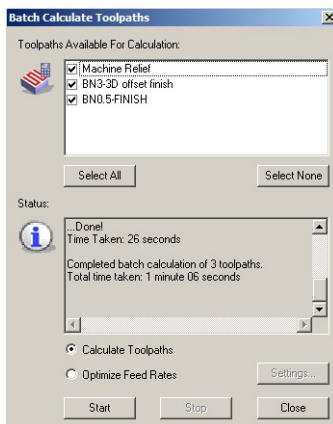
The Unprocessed **toolpaths** are displayed in the Toolpaths Tab. In addition, there are no '**display toolpath**' tick boxes below '**Show in 2D/3D**' indicating that they have not yet been calculated.

- From **Toolpath Operations**, Select **Batch Calculate Toolpaths**. 




The form appears with all of the **toolpaths** listed. By default all of the toolpaths are ticked, ready to be included in the **Batch Calculate** process.

Note: If use a **selected vector** is specified in the **toolpath** page, a suitable **vector** must first be created and selected if **Batch Calculating** the **template** on a different model.



- Select the **Start tab** to commence calculation of the toolpaths.
- **Close** the dialog box when finished.

All of the **toolpaths** have been calculated including the last two, which require the selection of a suitable limiting **vector**. As the **Toolpath Template** is being applied to the same model then the **vectors** will be remembered and selected automatically. If the **Toolpath Template** is applied to a different **model** then these **toolpaths** will have to be opened on an individual basis and suitable limiting **vectors** created and selected before applying **Calculate Now**.

- **Simulate All Toolpaths**  if required.
- Select **File Save** and then **Close**.

17. 2D Vector Machining


Introduction

For certain type of **2D** components it is of no benefit to create a **3D Relief Model**. For these applications **ArtCAM Pro** has a series of options to create **2D Toolpaths** that are **directly calculated from vectors**.

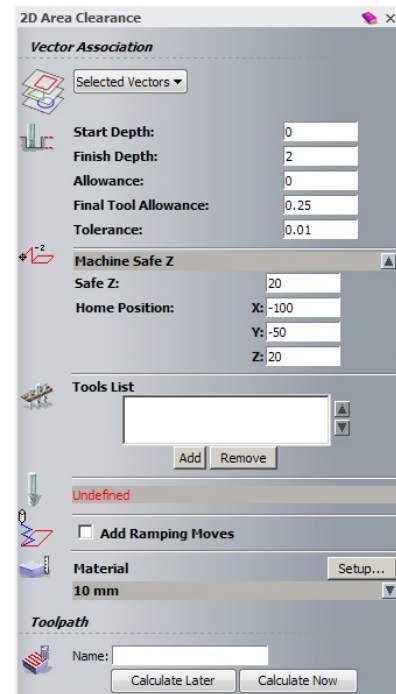
Forest Sign – 2D Area Clearance

- **Open** the model **Forest_Sign.art** from: D:\users\training\ArtCAM Data.



- **Hold down the shift key** and **multi-select** the **Inner Ellipse**, **Squirrel**, **Tree**, and **Text** vectors.
- **Activate** the **Toolpaths fly out panel** if not already visible.
- **Select Area Clearance Toolpath**  from the **2D Toolpaths Tab**.

- Set the **Start Depth** as 0, **Finish Depth** as 2mm and **Allowance** as 0.
- Set the Final **Tool Allowance** as 0.25mm and **Tolerance** as 0.01mm.
- Select the downward arrow under **Machine Safe Z** and enter a value of 20mm for **Safe Z** and **X-100, Y-50** and **Z20** for the **Home Position**.



Although the terminology is similar to Relief machining, the following information was entered.

Start Depth – is the height from where the **Stepdown** is calculated.

Finish Depth – is the maximum depth for machining to occur.

Allowance – is the amount of **2D stock** remaining on the **vectors** for the final tool.

Final Tool Allowance – is the amount of **2D stock** remaining for all except the final tool (normally used to produce a better surface finish)

Tolerance – the **toolpath** will create a finish to within **0.01** the original **vector**.

Safe Z – is the height at which **rapid moves** across the component are permitted.

Home Position: specifies the coordinates of the **Start and End** point of the **toolpath**.

- Select **Add** from the **Tools List**.
- From the **tool database Wood or Plastic > Roughing and 2D Finishing** area and load in both the **End Mill 6mm** and the **End Mill 1.5mm** tools.

The **2D Area Clearance** strategy allows multiple **tools** to be selected.



The selected **tools** are displayed. The adjacent arrows can be used to change the sequence if required.

The **Tools List** contains two different **End Mills**. When the **toolpath** is calculated, the larger **6mm End Mill** is used first to perform the main **2D Area Clearance** machining. Any subsequent, smaller tools in the **Tools List** will only operate locally in areas that are out of reach to the previous tool (i.e. **Rest Milling**).

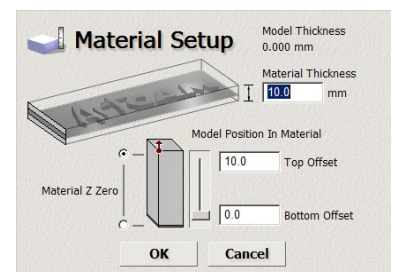
- Select a **Raster** strategy and leave the **angle at zero** ($X=0$).

Note: There are two options available for **2D Area Clearance** machining strategies, **Raster** which steps a linear cutterpath backwards and forwards across the component or **Offset** which steps the cutterpath parallel to the selected **vector(s)**.

- Leave the **Independent Finish Depth** option unticked.

This allows the option to specify an **Independent depth** for a **particular tool**.

- Set up the **Material** to have a **Thickness** of **10mm**, the **Z Zero** should be at the **top**.
- Enter the Name **EM6EM1_5-AreaClear**.
- Select **Calculate Now**.



The **2D Area Clearance** toolpaths will appear as shown above. As the primary tool (**End Mill 6mm**) had a default **Stepdown** value of **2.4mm**, all of the machining has been performed at the single depth of **-2mm**. If the above **Stepdown** value were **1mm** then the machining would have been performed at depths of both **-1mm** and **-2mm**.

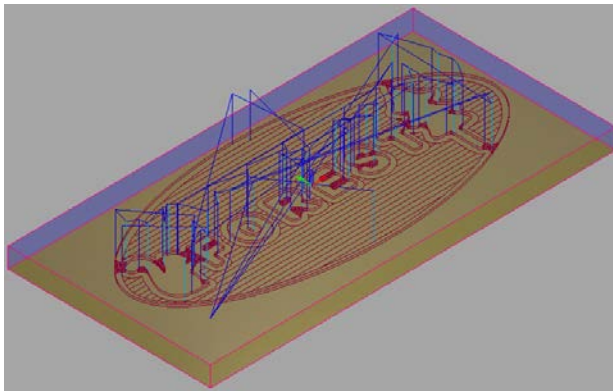
- **Close the 2D Area clearance form.**

The Toolpaths are listed in Toolpaths fly out panel.

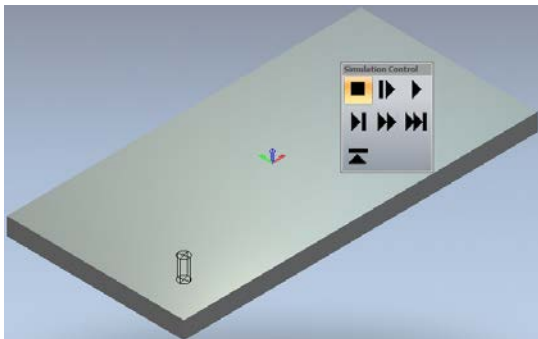


The **Toolpaths** window now contains two named **toolpaths**, which by default are also displayed in both the **2D** and **3D** views – by using the check boxes.


- In the **3D view**, select the **Isometric View**.



- Select **Simulation Control bar**  from **Toolpath Simulation**.

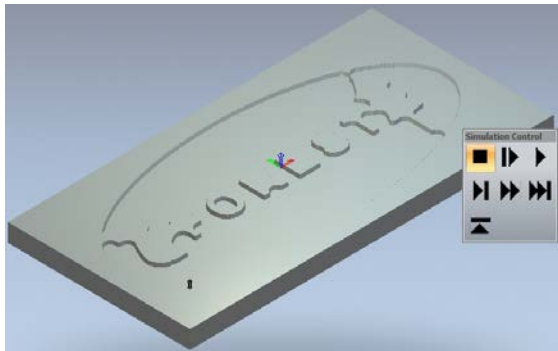


With this option the highlighted tool is drawn (End Mill 6mm first), along with a control panel to control the speed of the simulation.

For example, Selecting  will simulate at normal cutting speed.

- In this case, select **Play Simulation at Fast speed**.

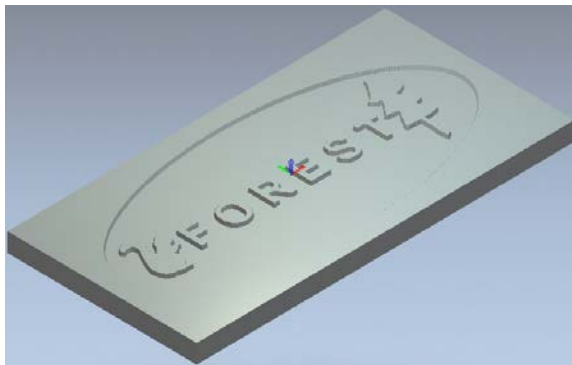




The **End Mill 6 mm** is simulated.

This toolpath has machined the inner form leaving a **2D stock** of **0.25mm** to be finished by the **End Mill 1.5mm** toolpath.

- Select **Play Simulation at Fast speed**.



The **End Mill 1.5 mm toolpath** has successfully rest machined the remaining areas inaccessible to the previous cutter and removed the final **0.25mm stock allowance**.

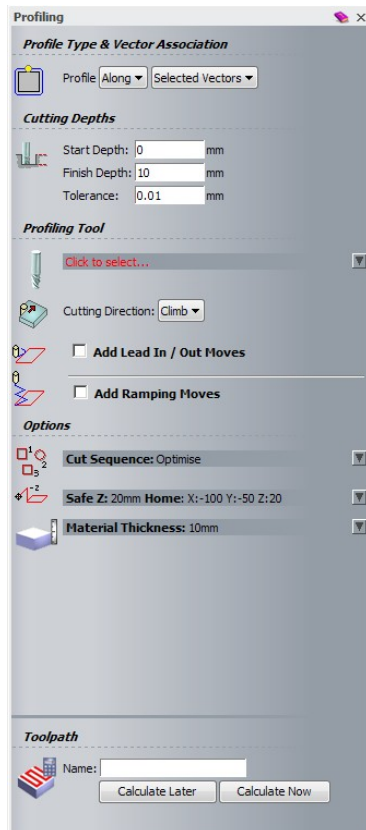
Forest Sign – 2D Profiling

- Select the **2D View** and select the **Outer Ellipse vector**.



A **2D Profiling** strategy will be used to drive the tool around the outside of the sign.

- Select **Create Profile Toolpath**  from the **2D Toolpaths Tab**.



A **Profiling** toolpath can be generated to the defined depth, on the **Inside**, **Outside** or **Along** a closed vector. There is also the option to apply a **Climb Mill** or **Conventional** direction of cut. For an **open vector**, **Inside** will offset the **toolpath** to the **right** of the **vector direction** whereas **Outside** will offset the **toolpath** to the **left** of the **vector** direction.

The depth of cut for each **profiling pass** is defined by the tool's stored parameters, for example if the tool has a step down of 2mm maximum, it would take 5 profiling passes to get down to a total depth of 10mm.

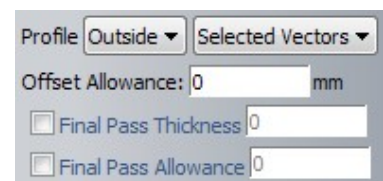
With a **2D Profiling toolpath** the option is available to approach required profile with a horizontal, arc **Lead In** and **Lead Out**. This would result in a **tool plunge** move occurring away from the profile followed by a smooth, tangential transition onto the actual tool track.

- Select **Profile side as Outside**.

Offset Allowance specifies an offset distance to the vector.

Final Pass Thickness allows a 'skin' of material removed only on the last pass.

Final Pass Allowance as above leaves a skin of material but in the Z Height only. Also is removed on the last pass.



- Leave the above settings as zero.
- Select a **Start Depth of 0**, **Finish Depth of 10**, **Allowance of 0** and a **Tolerance of 0.01mm**.
- In **Profiling Tool**, select the **Select** button and load in the same **6mm End Mill** that was used earlier in the **2D Area Clearance** operation.

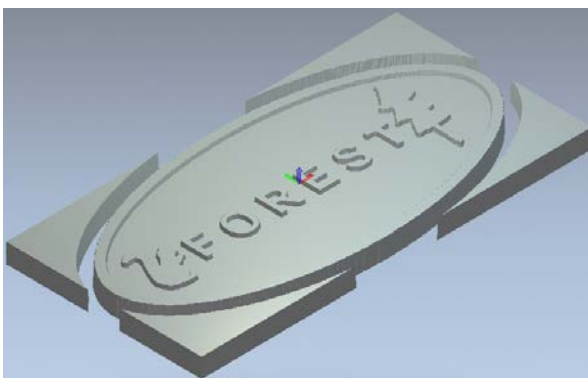
When **2D Profiling** around a component, a superior finish is achieved for most materials if the direction of travel is the **left** of the **vector (Climb Milling)**. There are however a few materials (certain plastics) where a superior finish is achieved if the direction of travel is the **right** of the **vector (Conventional)**.

- Select **Climb** at the Cutting direction.
- Leave the same (as before) **Material Thickness, Safe Z, and Home position.**
- Enter the Name **EM6Profile**.
- Select **Calculate Now**.

The **2D Profiling toolpath** has been generated **outside** the **Outer Ellipse**.



- Close the **Profiling form**.
- Select **Simulate Toolpath**.



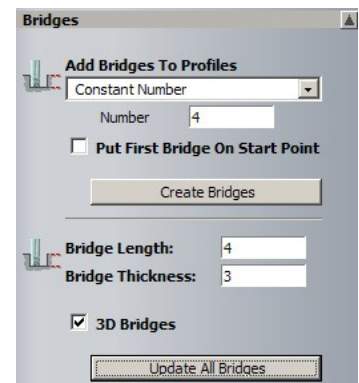
The simulation steps the **2D Profiling** pass down to a total depth of 10mm. If it is required to keep the sign attached to the outer material then **location lugs (Bridges)** can be applied retrospectively along the **toolpath**.



This will be shown next.

- Select File - Save As **TrainForestSign.art** in:
D:\users\training\COURSEWORK\ArtCAMPro-Jobs.
- **Do not** close the model.

- Select **Profile Options**  from **2D Toolpaths**.

- As described in chapter 13, Create four suitably positioned **3D Bridges** of **Thickness 3mm** and **Length 4mm**.



- **Reset**  and **Rerun**  the simulation to view the **added bridges**.



Further 2D machining strategies will be applied to this example.

- **Do not** close the model.

Bevel Carving

The **2mm** high text '**FOREST**' on the sign will have a **1mm** chamfer added by using the **2D Toolpaths** option called **Bevel Carving**.

The process requires the user to input a **Bevel Carving Tool**. The **tool** dimensions and/or stored values of **Stepdown** and **Stepover** will determine if the chamfer is machined as a series of 'stepped passes' or in a single 'pass'

- In the **2D View** select the **Text** item '**FOREST**'.

(Note: View shown is with toolpaths switched off)



- Select **Bevel Carving**  from the **2D Toolpaths Tab**.

- Enter a **Start Depth 0**, **Bevel Max Depth 1**, **Finish Depth 2mm**.

Bevel Depth is the max depth the carving tool will reach.

Wall height is the height of the profiled part of the carving which is zero, if no profiling tool is selected.

Finish depth is entire depth of the whole cutting operation

- Enter **Allowance of 0** and a **Tolerance of 0.01mm**.
- Enter a **Safe Z of 20** and a **Home Position of X-100 Y-50 Z20**.
- Select **Centreline**.

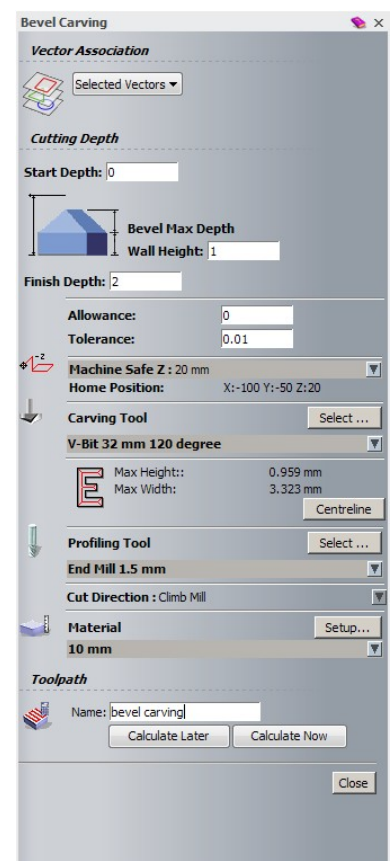
This determines the max width of path to engrave.

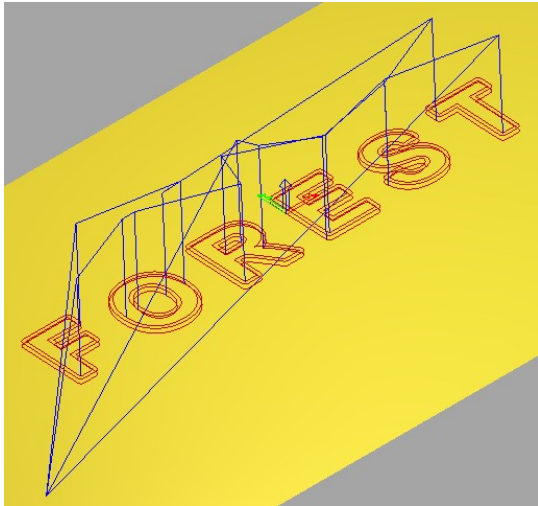
- Select a **V-Bit 32mm 120 degrees Carving Tool** and a **1.5mm End Mill Profiling Tool**.
- Set a **Climb Mill Cut Direction**.

- Set up the **Material** to have a **Thickness of 10**, the **Z Zero** should be at the **top**.

- Enter a Name as **Bevel_Carving**.

- Select **Calculate Now**.





The toolpaths can be seen in the 3D view.

Note: view is shown with other toolpaths switched off.

- Close the **Bevel Carving** form.

- Select **Simulate All Toolpaths**.



The **1mm chamfer** can clearly be seen on the embossed 2mm high text.

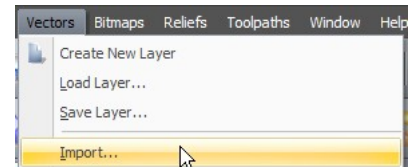
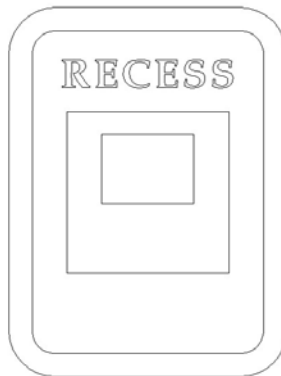
- Select **File - Save** to update the model saved earlier.
- Select **File - Close Model**



V Bit Carving

The following example illustrates the **V-Bit Carving** strategy.

- Select **Create New Model** and Enter a **Width and Height of 100mm**.
- Set the resolution to **2004 x 2004 points** and **origin in the centre**.
- From the top pull down menu, Select **Vectors - Import** and **Open** the file:

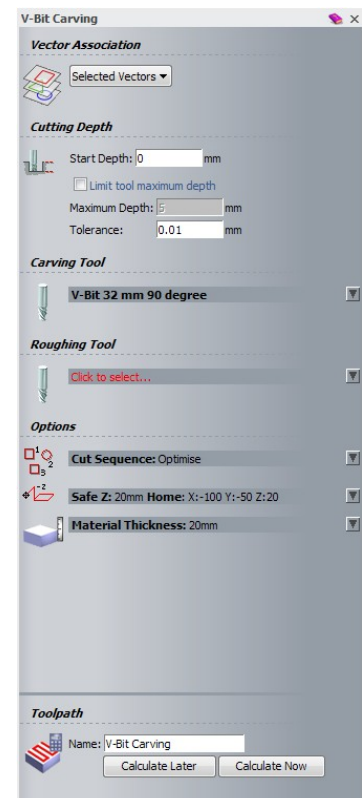
D:\users\training\ArtCAM Data\V-BitCarvingVectors.eps




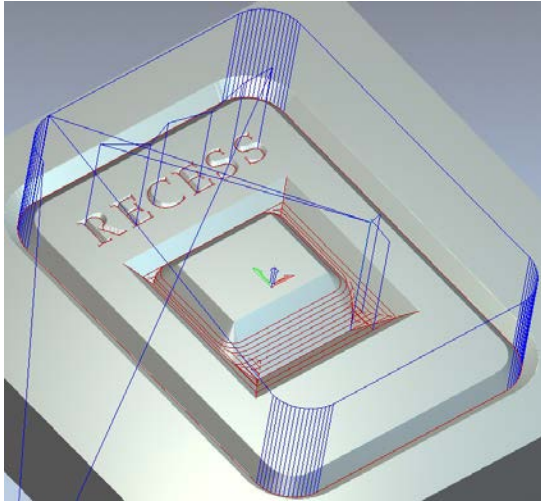
- Ungroup  (or **Ctrl+U**) and then **select the Vectors**.
- Select **V-Bit Carving**  from the **2D Toolpaths Tab**.
- Leave the **Start Depth as 0**.
- Ensure **Tolerance is set as 0.01**.

The maximum permissible depth for machining to occur can be set by selecting **Limit tool maximum depth** and specify a **Maximum Depth** value.

- Select a **V-Bit 32mm 90degrees Carving Tool** from Wood or Plastic – V-Carving, and change the **Stepover to 1mm** and **Stepdown to 3mm**.
- Set the **Safe Z as 20mm** and the **Home Position as X-100 Y-50 Z20**.
- Enter a **Material Thickness of 20mm** and set the **Material Z Zero is at the top of the block**.
- Enter a **Name of VBitCarving** and select **Calculate Now**.
- **Do not Close** the form.

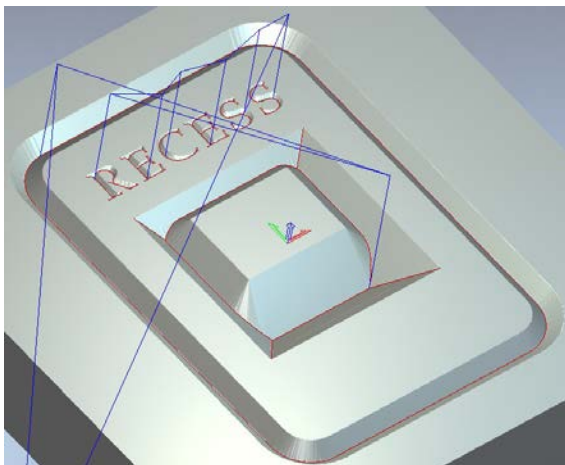
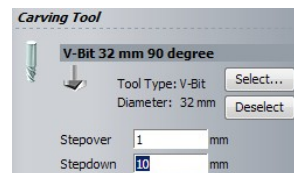


- **Simulate**  the calculated Toolpath.



The toolpath is calculated creating '**V**' shaped **recesses** inside or between pairs of selected **vectors** and **text**. The maximum depth of the recesses is currently unlimited but the tool **does** perform an **area clearance** at incremental depths equal to the specified **Tool Stepdown** value. The **Area Clearance** can be removed by inputting a suitably high value for **Stepdown**.

- Edit the **Tool Stepdown** to **10mm**.
- Calculate the Toolpath again.
- **Do not Close** the page.



The toolpath has created the same end result, but without performing **area clearance** at **3mm incremental depths** (the tool **Stepdown** is now 10mm).

- Select **File - Save As** and save the model with the File name **VbitCarving** in:

D:\users\training\COURSEWORK\ArtCAMPro-Jobs.

- Select **File – Close Model**.

18. Engraving & Scribe Lines

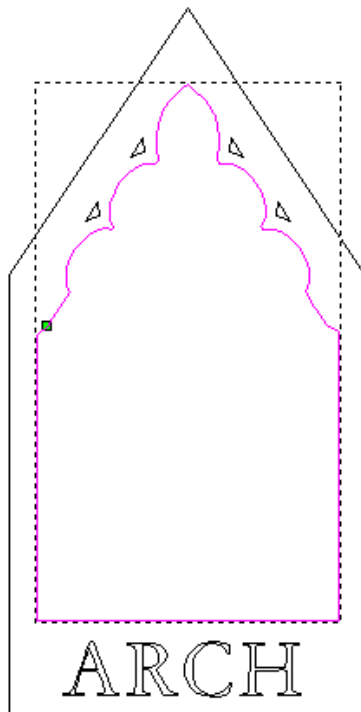
Introduction

Smart Engraving allows you to input a selection of **Roughing (End Mill)** and **Engraving (V Shaped)** tools, which create a series of **efficient toolpaths within the defined vector selection** ultimately producing the required **engraved** form. Different machining parameters and tool settings can be applied to each **toolpath** from within the **Smart Engraving** options. For small detail it is possible to run **Smart Engraving** with one 'V' shaped tool.

If more than one tool is selected, Smart Machining is performed. This is the strategy where smaller tools will only machine the areas previous tools were unable to reach. If conical tools are used, options to enable 3D corner sharpening moves are available.

Smart Engraving Exercise

- Open the model **arch.art** from: **D:\users\training\ArtCAM Data**.

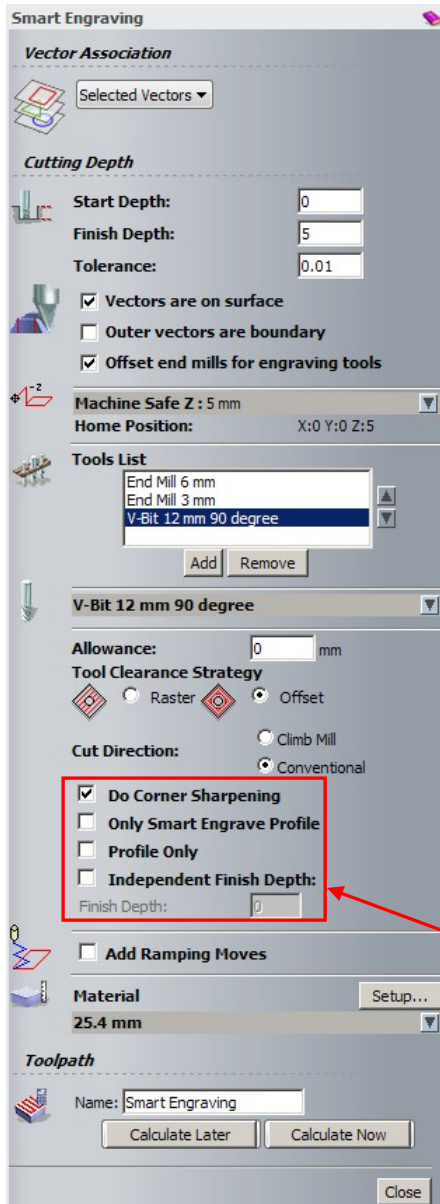


The **Smart Engraving** options provide for finishing of sharp internal corners for the finishing toolpaths using the 'V' Bit Cutters.

The **selected vector** is the top edge of the detail. The option to offset the **End Mill** for the **Engraving Tool** (it leaves additional material on) is used to give the **V-Bit finish tool** some material on each side to cut out, to balance the loading on the **V-Bit tool**.

- Select only the **Inner feature vector** as shown above.

- Select **Smart Engraving**  from the **2D Toolpaths Tab**.



- Enter a **Start Depth of 0** and a **Finish Depth of 5mm** and **Tolerance as 0.01**.

- Select the option **Vectors are on surface**. This assumes the vectors lie at the **top of the surface**. **Unticking** the box assumes the vectors **lie at the bottom**.

- Select **Offset End mills for Engraving tools**.

The End Mill tool will be offset to ensure the engraving tool will be able to machine an angled wall.

- Set **Safe Z as 5** and **Home Position X0 Y0 Z5**.
- **Add a 6mm and 3mm End Mill tools**, along with a **Small V-Bit 12mm 90 Degree tool**.

Note: the V-Bit tool will have to be copied and edited within the Tool Database from an existing stored tool.

- Enter an **Allowance of 0.1mm** only on the **End Mill 6mm** tool.

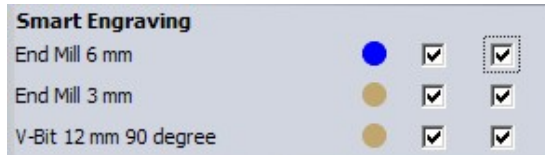
Note: Several parameters can be defined independently for the specific **tool** selected (highlighted) in the form.

- Select **Do corner Sharpening** only for the **V-Bit 12mm 90 degree tool**.
- Set the **Material Thickness to 25.4mm** with the **Z0 origin at the top**.

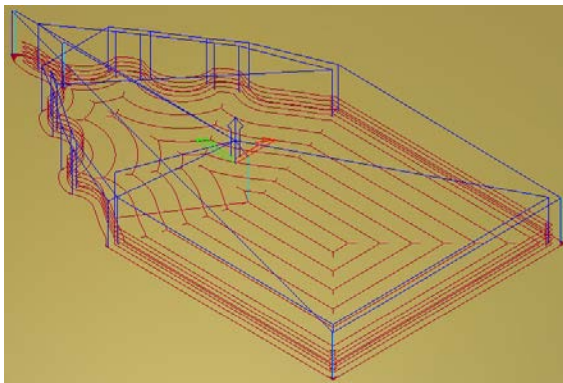
The machining calculations will take the **vector** to be the top edge of the chamfered detail.

- For the **End Mill 6mm** tool set the tool **Stepover to 4mm** and the **Stepdown to 5mm**.
- For the **End Mill 3mm** tool set the tool **Stepover to 0.5mm** and the **Stepdown to 1mm**.
- For the **Small V-Bit 12mm 90degrees tool** set the tool **Stepover to 0.1mm** and the **Stepdown to 5mm**.

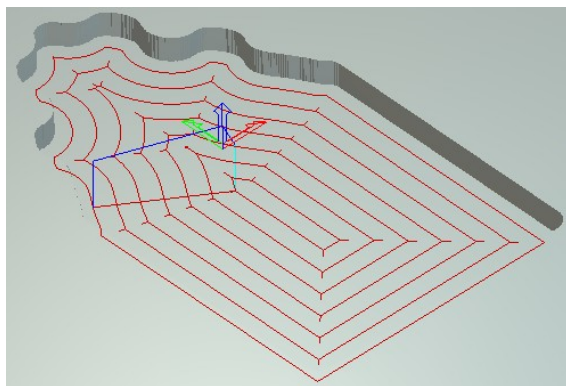
- Enter the Name **Smart Engraving**.
- Select **Calculate Now**.
- Close the form



As always, The Toolpaths are listed in Toolpaths fly out panel.

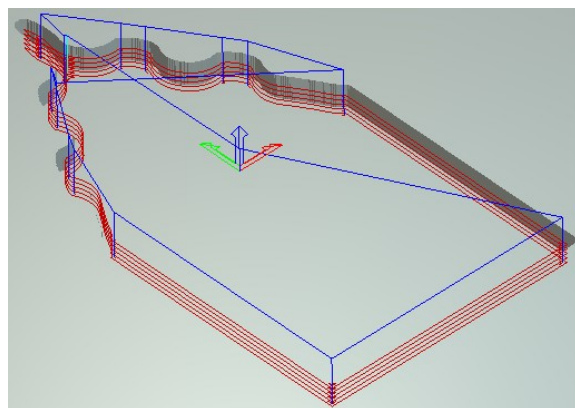


All of the 3 toolpaths created by the Smart Engraving options are displayed and could all be simulated at the same time. It would however be better to simulate them one at a time to see more clearly what each one is actually machining.



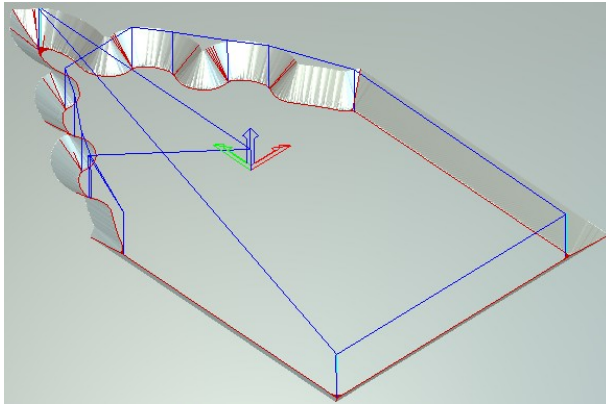
End Mill 6mm tool

This operation performs **Area Clearance** on the whole aperture to full depth (less than the **Stepdown** value).



End Mill 3mm tool

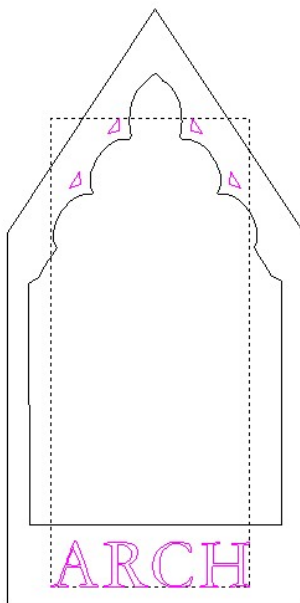
This operation performs **Area Clearance** on areas inaccessible to the larger End Mill. In the small enclosure at the tip the **1mm stepdown** causes machining to occur at several **Z** descending **Levels**.



Small V-Bit 12mm 90degree tool

With **corner sharpening on**, the tool will ramp along internal corner intersections to produce the sharpened and completed shape.

- Select the 2D View and **select the four triangular vectors and the text arc.**



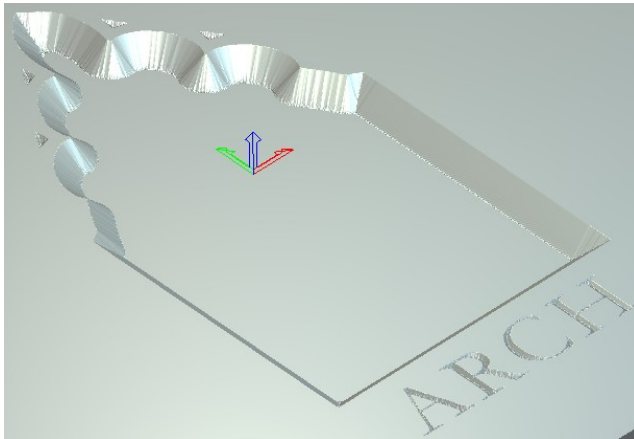
As these are only small indentations only one **V-Bit** tool will be required.



- Select **Smart Engraving** from the **2D Toolpaths Tab**.
- Enter a **Start Depth of 0**, a **Finish Depth of 3mm** and a **Tolerance of 0.01mm**.
- Select the **Small V-Bit 6mm 90 degrees tool**.
- Change the **Stepdown to 3mm**.
- Select **Tool Clearance Strategy as Offset**.
- Select the option **Do Corner Sharpening**.
- Select **Calculate Now**, followed by **Close**.

Note: The name Smart Engraving 1 was automatically provided.

- Select **Simulate Toolpath**.



The small features and text have been machined using a single operation with the V-Bit tool.

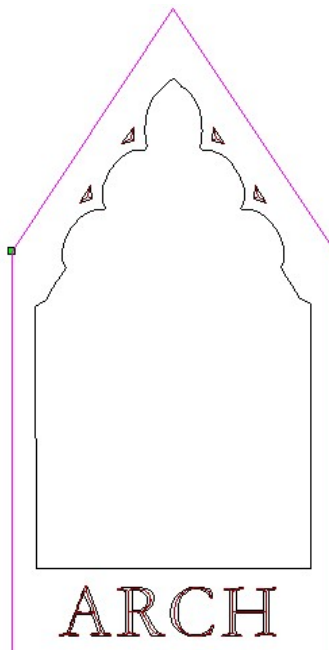
Machine Along Vector

The **Profile Toolpath** option

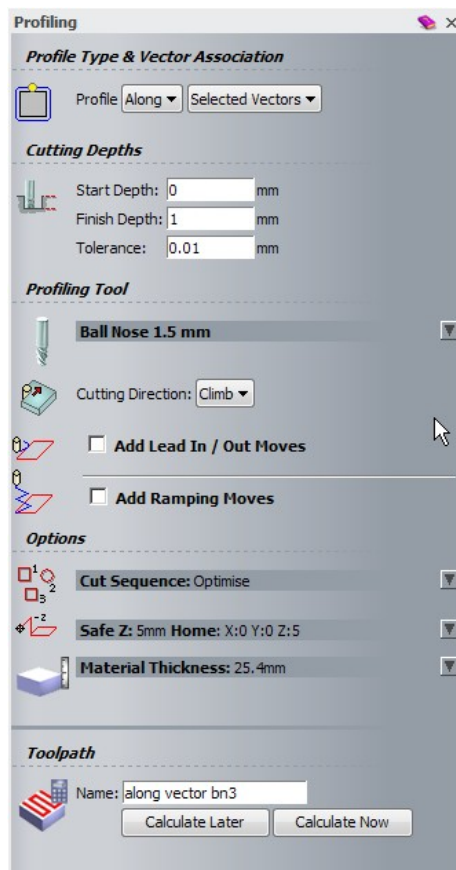


also provides the option to directly trace along a **selected vector**, to a user defined depth. A typical application would to mark a **scribe line** around the outside of a component form.

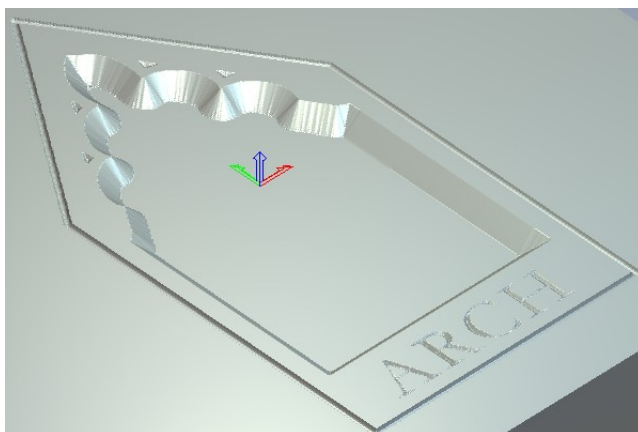
- Select the **Outer vector** as shown below.



- Select **Create Profile Toolpath**  from the **2D Toolpaths** Tab.



- Enter a **Finish Depth of 1mm**.
- Select a **Ball Nose 1.5 mm tool**.
- Enter a name **Along vector BN3**
- Select **Calculate Now**.
- **Close** the form.
- **Simulate** the toolpath



The **outer** limit of the component has been 'scribed' with the **1.5mm Ball Nosed tool**.

- Select **File - Save As** and enter as File Name **SmartEngraving.art** in: D:\users\training\COURSEWORK\ArtCAMPro-Jobs.
- Select **File – Close Model**.

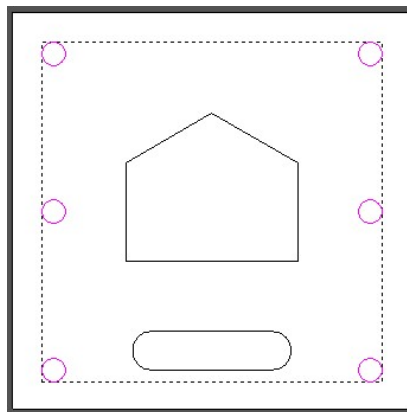
19. Drilling

Introduction

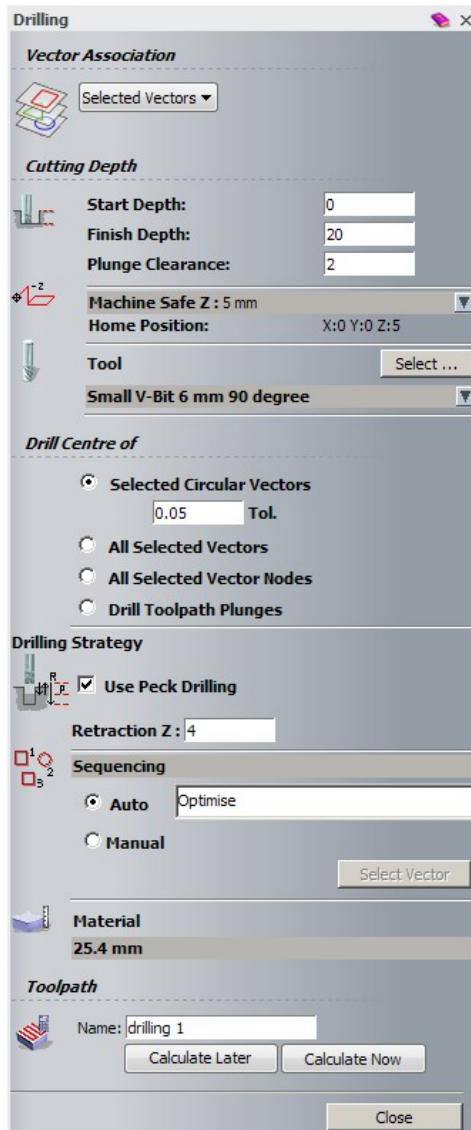
In the **2D Toolpaths** section there is a **Drilling** option, which uses selected **vectors** for defining the **hole** positions. The hole positions are defined either **Central** to **circle vectors**, at **vector Node points**, at a **vector dimensional Centre**, or on the **Plunge Move** positions of a selected **2D Toolpath**.

For creating a **Drill tool** the **V-Bit tool page** is used as this has the same geometrical shape.

- Open the model **Drilling.art** from: **D:\users\training\ArtCAM Data**.



- Select the **6 Circle vectors**.
- Select **Create Drilling Toolpath**  from the **2D Toolpaths Tab**.



- Enter a **Start Depth of 0**, a **Finish Depth of 20mm** and a **Plunge Clearance of 2mm**.

Plunge Clearance is a separate **Safe Z** for **Drilling**.

- Set a **Safe Z of 5mm** and a **Home Position of X0 Y0 Z5**.
- Select a **Small V-Bit 6mm 90 degree tool**.
- Change the **Tool Stepdown** to **6mm**.

- Select the option **Selected Circular Vectors**.

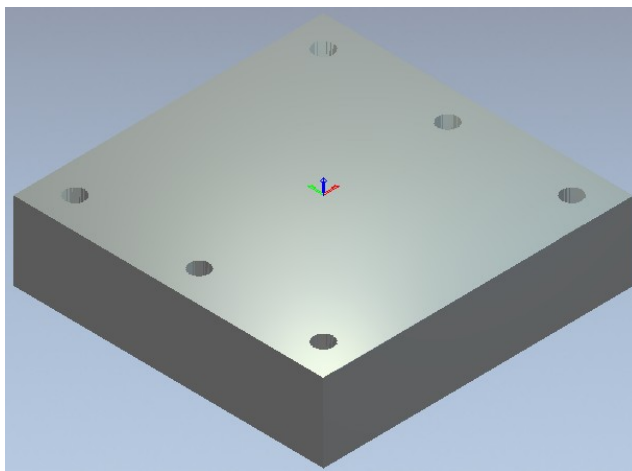
- Select **Use Peck Drilling** and enter a **Retraction value of 4mm**.

The **Drill** will lift **4mm** at each **incremental Stepdown** depth of **6mm**.

Optimise is one of several options controlling the order in which a **hole pattern** is **Drilled**.

- Define a **Material Thickness of 25.4mm** and set **Z Zero at the top**.
- Enter Name as **Name Drilling-1**.
- Select **Calculate Now**.
- Select **Close**.

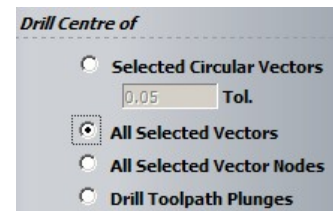
- Select **Simulate Toolpath**.



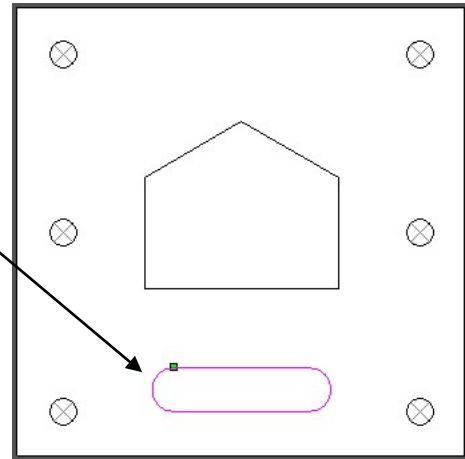
Note: To observe the **4mm** upward **Pecking** movements at **6mm incremental depths**, simulate at normal speed.




The **Drill Centre of... All Selected Vectors** will now be demonstrated. The **drilled hole** will be positioned dimensionally central to the **selected vector**.

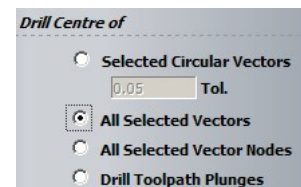


- In the **2D View** select the oval **vector**.

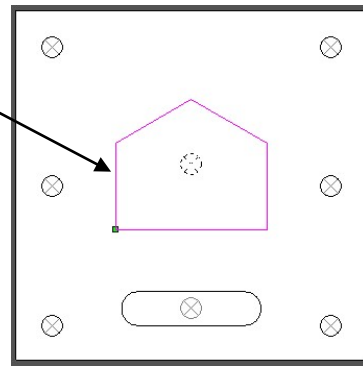



- Select **Create Drilling Toolpath**  from the **2D Toolpaths Tab**.
- Enter a **Start Depth of 0**, **Finish Depth of 6mm** and a **Plunge Clearance of 2mm**.
- Use the same **Small V-Bit 6mm 90 degree tool**.
- Change the **Tool Stepdown to 6mm**.
This means the drilling will be performed in a single peck.

- Define **Drill Centre of ... as All Selected Vectors**.
- Enter as Name - **Drilling-2**.
- Select **Calculate Now**.
- **Close the form**.

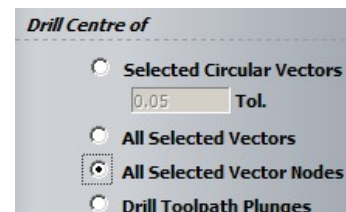


- In the **2D View** select the **5 Sided vector**.



- Select **Create Drilling Toolpath**  from the **2D Toolpaths Tab**.
- Enter a **Start Depth of 0**, a **Finish Depth of 10** and a **Plunge Clearance of 2mm**.
- Use the same **Small V-Bit 6mm 90 degree tool**.

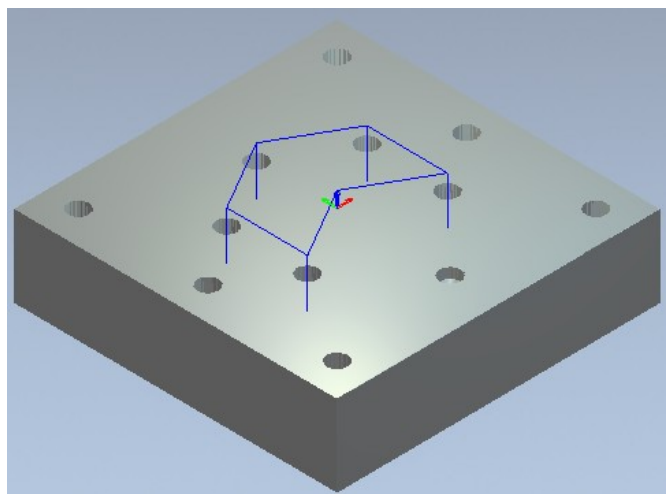
- Define **Drill Centre of...** as **All Selected Vector Nodes**.



- Enter as Name - **Drilling-3**.
- Select **Calculate Now**.
- **Close** the form.

- Simulate the **Toolpath**.

Observe the drill plunge directly to the full depth of 10mm, at the Node points of the 5 sided vector.



- Select **File - Save As** and enter a File name as **Drilling Example** in: D:\users\training\COURSEWORK\ArtCAMPro-Jobs.
- Select **File – Close Model**.

20. Projects

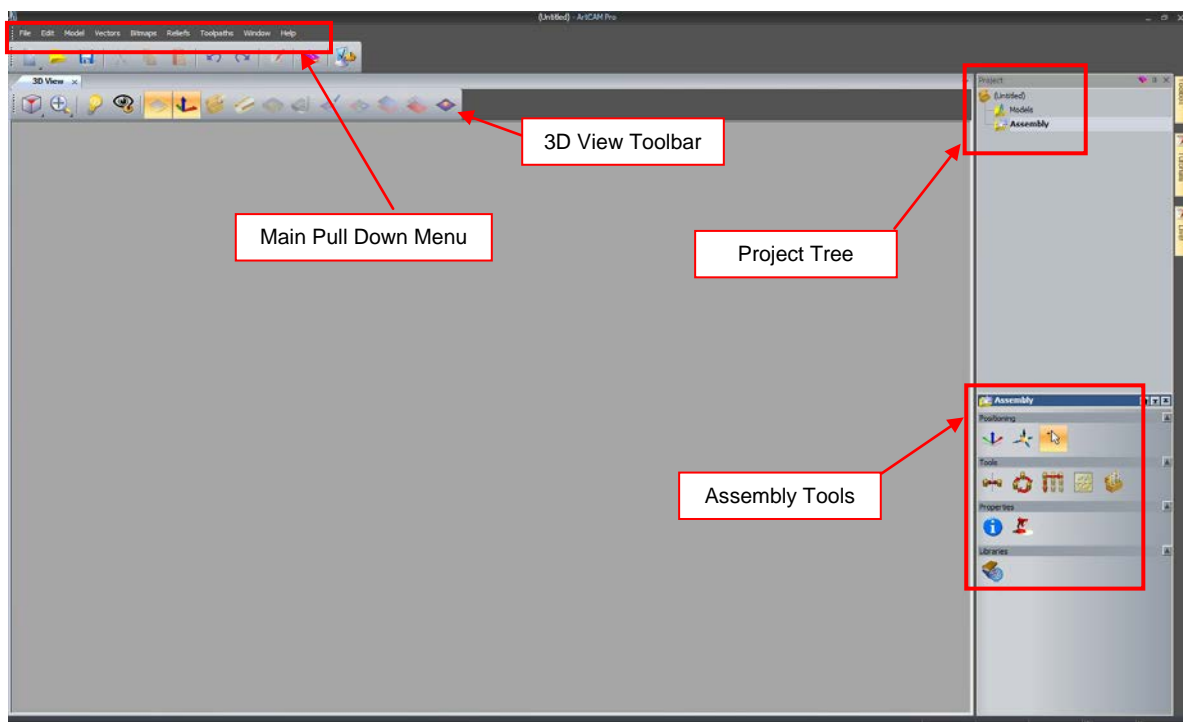
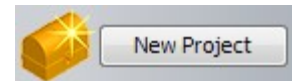
Overview

An **ArtCAM project** hosts any number of ArtCAM models, assemblies, and triangle mesh replicas. Each **ArtCAM model** within a project contains vector and bitmap artwork, reliefs and toolpaths. Each **Assembly** hosts triangle mesh replicas of ArtCAM models, material information, or further assemblies.

A **Project** enables the user to perform such tasks as to **re-orientate** and **reposition** separate **model** items to put together a complete **3D Assembled Component**. It is also possible to directly **import Surface** data (converted as a **Triangle Mesh**) into a **Project** as a separate **Assembly** item.

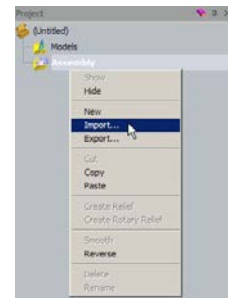
Assembled Table Example

- From the **ArtCAM** start up screen, select **New Project**.

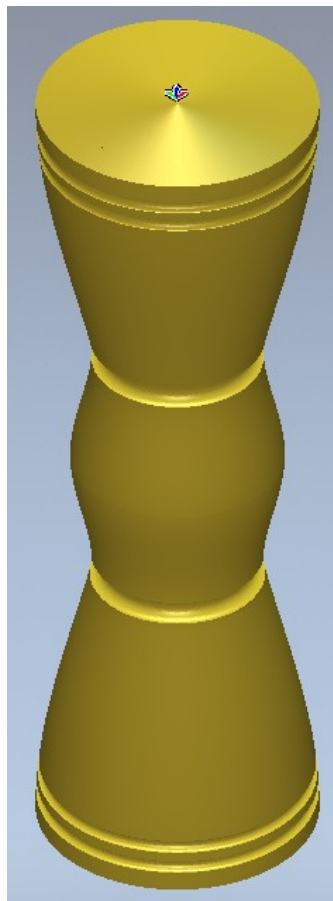


Import of a Surface Model (Table Leg)

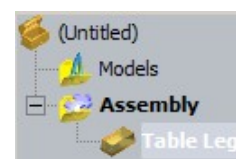
- Right mouse click on the **Assembly** and select **Import...**



- In the **Import 3D Model** dialog box, change the **File of type** to **Surface Models** and **Open** the File **Table Leg.3dm** from: D:\users\training\ArtCAM Data.



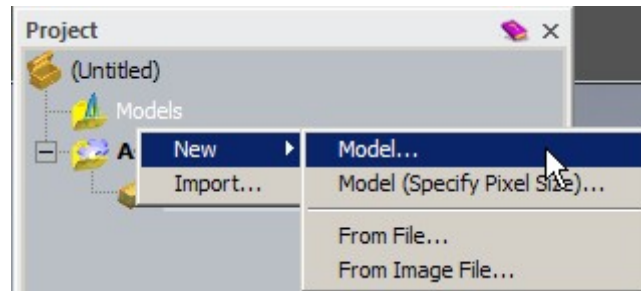
ArtCAM has converted the .3dm surface model and placed it into the Assembly tree.



The remaining Assembly components will be created within ArtCAM.

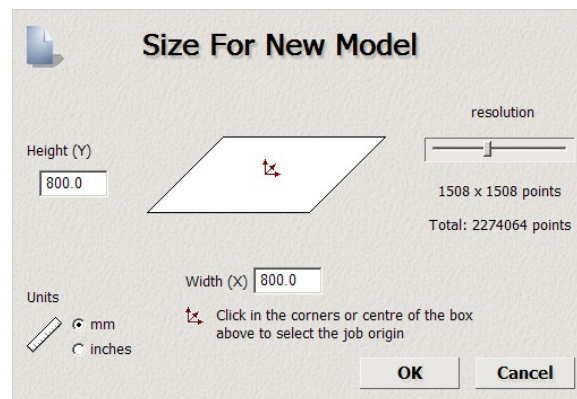
Creating the table top

- In the **Project Tree Right** mouse click on **Models**, select **New** then **Model**.

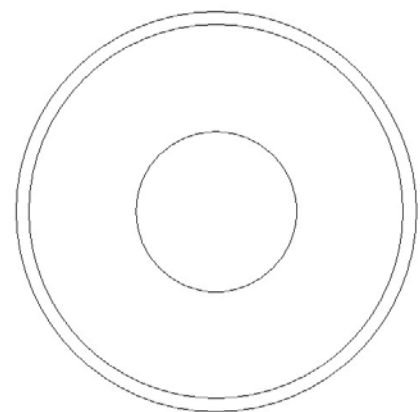


A new ArtCAM model will be created but also associated to this Project.

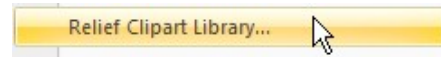
- In the **Size for New Model** form enter the values as shown in the image below.
- Select **OK** to proceed.



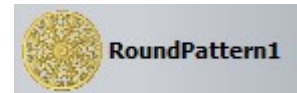
- Create **three Circles** centred about **X0 Y0** with respective **Diameters** of **750mm**, **700mm** and **300mm**.



- From the **Reliefs top pull down menu**, select **Relief Clipart library**.



- From the **Architectural Library**, select **Round Pattern 1**.



- Once the **3D Clipart** dialog box and **preview relief vectors** are visible, close the **Relief Clipart Library form**.

- Centre (in page) the preview **Relief** on the model using the **F9** shortcut.

- In the **3D Clipart** form, set the following:

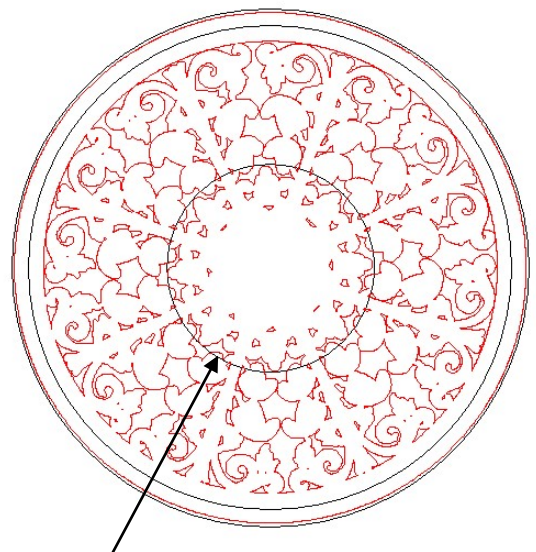
- **Apply** a suitable **Scale dynamically** to the **preview relief** so that it is just within the **outer circle vector** (this will be a 2 stage process!).

- **Enter** a new **Z Range** of **10** in the **Size** options.

- Set the **Mode** to **Add**.

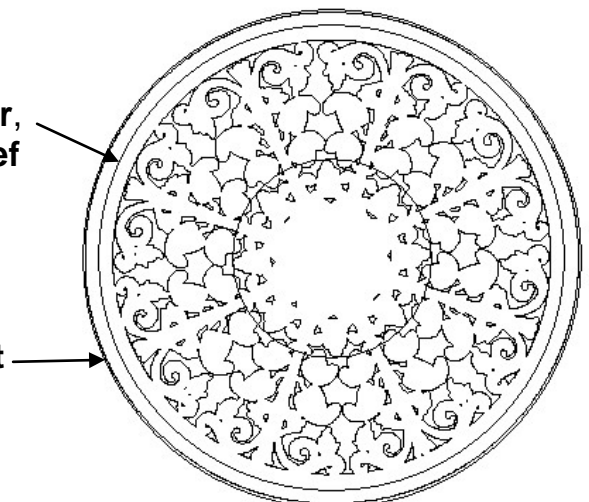
- Select **Paste** and then **Close**.

- From the **2D View**, select the **inner most circle vector**, open the **Shape Editor** and select **Zero** to remove the **inner part** of the **Relief** form.

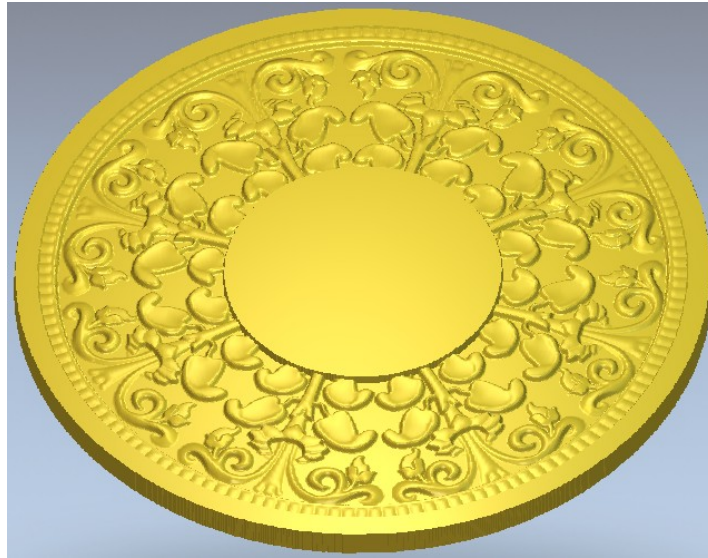


- Select the **Circle vector** defining the inner edge of the table rim, and in the **Shape Editor**, select **Zero Rest** to remove the **outside Relief** form.


- Select the **outer circle vector** and in the **Shape Editor - Add** a **Plane Relief** of **Height 20** over the whole of the existing table top.



- Select both the **outer and inner rim circle vectors**, and in the **Shape Editor - Merge High** with a **Plane Relief** of **height 30** to produce the rim form.
- Finally select the **inner most circle vector** and in the **Shape Editor - Merge High** with a **Plane Relief** of **Height 30** to form the centre area.



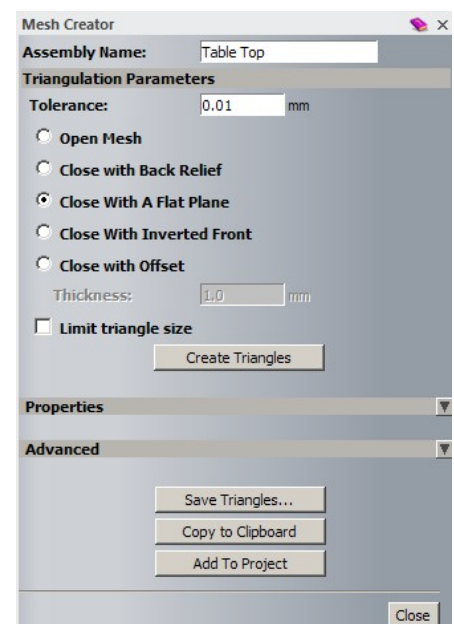
The next stage is to include this table top in the **Assembly**.

- From the Model Toolbar, select **Create Triangle Mesh**. 
- Enter an Assembly name **Table Top**.
- Select the option **Close With a Flat Plane**.
- Select **Create Triangles**.

The mesh is generated and shown in blue. It can be rotated to view the flat bottom.

- Select **Add to Project**.
- **Select OK** and then **Close** the form.

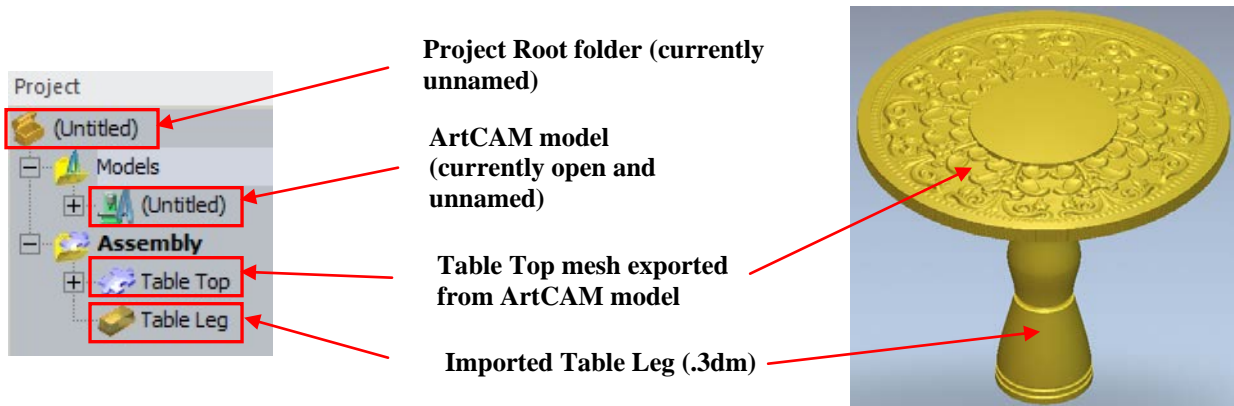
A mesh copy of the relief has been exported to the Assembly.



If not already visible, **activate** the **Project** fly out panel.



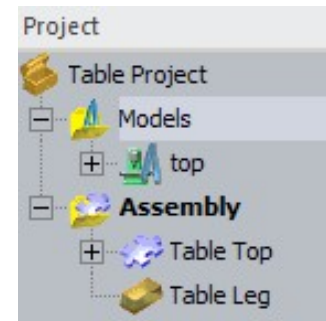
The current **Project status** is summarised.



- Under Models, **Right mouse click** on the **(Untitled)** model and **Rename** it to **Top**.

To specify a Project name, it must be saved.

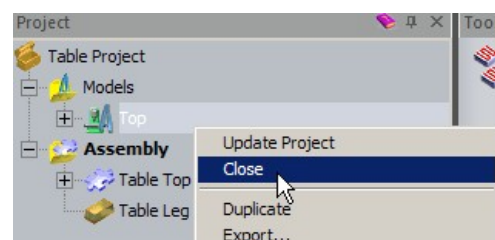
- Select **File - Save As** and enter a File name as **Table Project** in:
D:\users\training\COURSEWORK\ArtCAMPro-Jobs



Note: A project is associated with a (*.3dp) file extension. When a project is opened, all associated ArtCAM models and Assemblies are opened with it.

A new ArtCAM model will be created so the current model (named Top) will be closed.

- Right mouse select** on the model named **Top** and then **Close**.



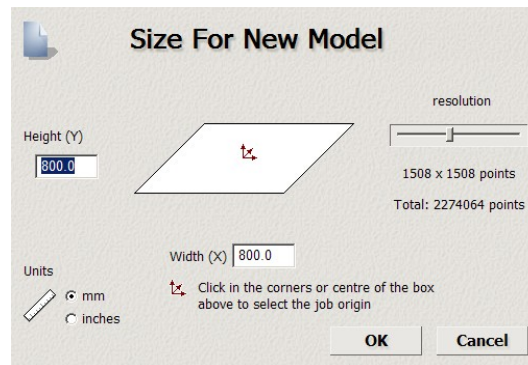
The current ArtCAM model is **closed** and so returns to the original **Project window**.

Creating the base

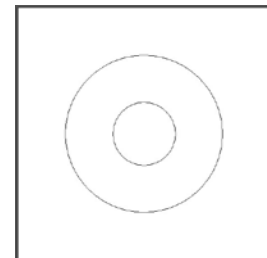
- In the **Project Tree Right** mouse click on **Models**, select **New** then **Model**.


A second new ArtCAM model will be created but again associated to this Project.

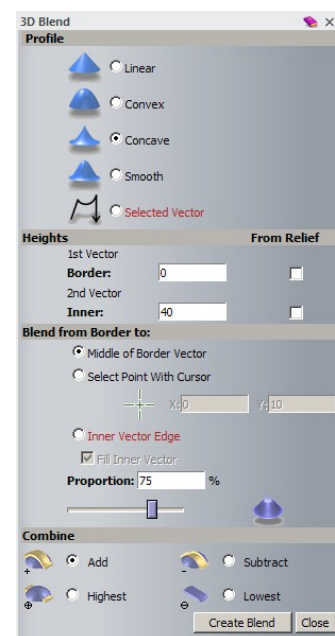
- In the **Size for New Model** form enter the values as shown in the image below.



- Select **OK** to proceed.
- Create two **Circle vectors** about **X0 Y0** with **Diameters** of **500mm** and **200mm**.



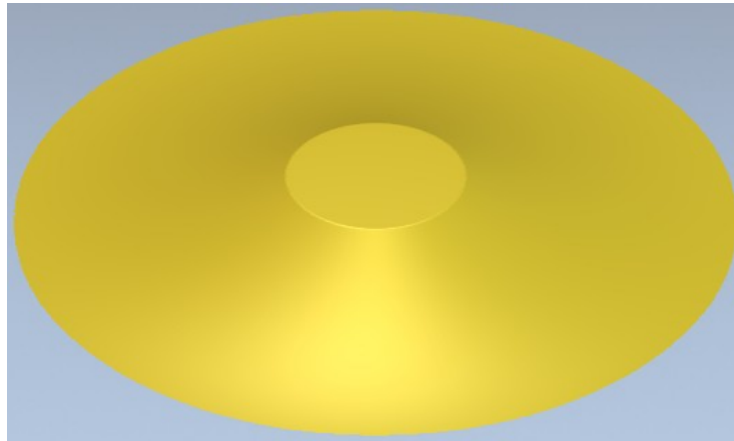
- Select the **outer circle vector** and then **Create 3D Blend**  from the **Relief creation Toolbar**.
- In the **Profile** options select **Concave**.
- In **2nd Vector** type in a value of **40**.
- Select **Middle of Border Vector**
- Change the **Proportion** to **75%**.
- Select **Add**.
- Select **Create Blend** followed by **Close**.

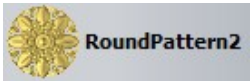


- View the results in the 3D view.

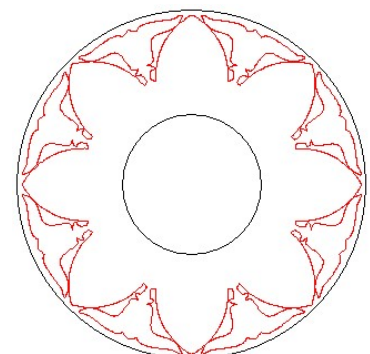
Note: If the Project assembly is **visible (table)**, then it can be switched off by selecting

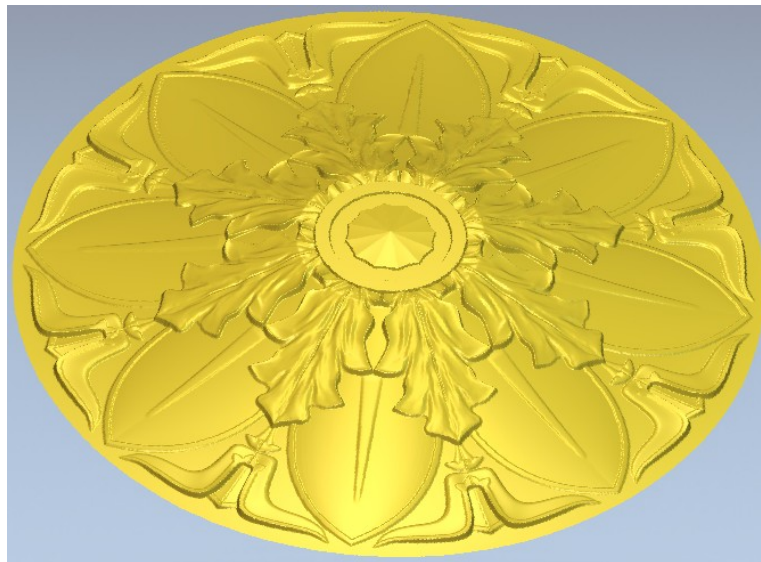
Toggle Assembly Visibility  or using **Objects to Draw**  from the **3D view tab**.




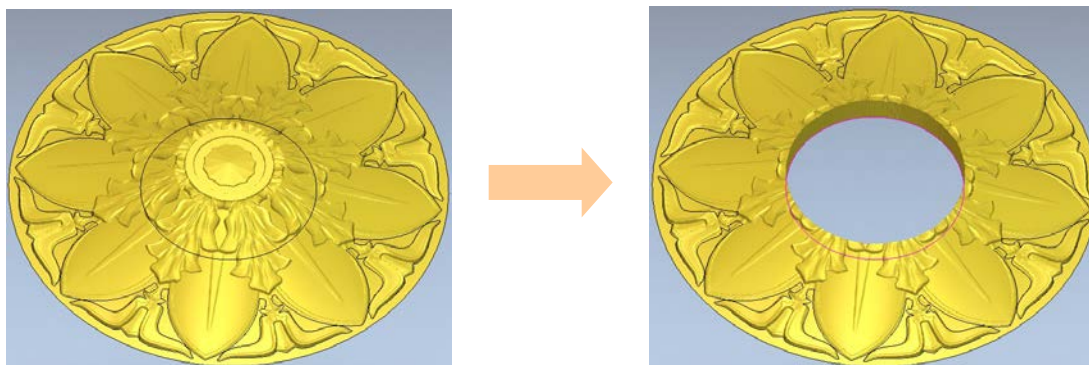
- **Switch** to the **2D view**.
- From the **Reliefs top pull down menu**, select **Relief Clipart library**.
- From the **Architectural Library**, select **Round Pattern 2**. 
- Once the **3D Clipart** dialog box and **preview relief vectors** are visible, close the **Relief Clipart Library form**.
- **Centre (in page)** the preview **Relief** on the model using the **F9** shortcut
- In the **3D Clipart** form, set the following:

- Enter a suitable **Scale dynamically** to the **preview Relief** so that it is just within the **outer circle vector** (this will be a 2 stage process!). Select **Apply**.
- Enter a new **Z Range** of **10** in the **Size** tab options, followed by **Apply**.
- Set the **Mode** to **Add**.
- Paste the preview **Relief** to the model.

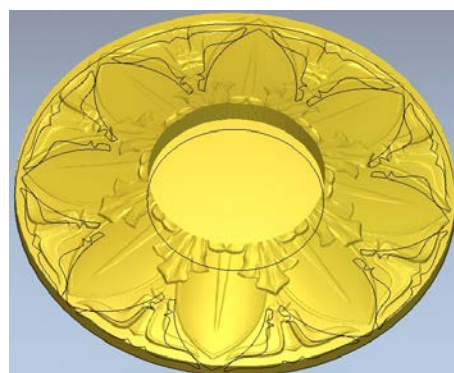




- From the 3D view Toolbar, select **Toggle vector visibility**. 
- Select the **inner most Circle vector**, open the **Shape Editor** and select **Zero** to remove the **inner part** of the **Relief** form.



- Select the **outer most Circle vector**, open the **Shape Editor** and **Add a Plane of Height 20mm** to the **Relief** form.



The next stage is to export this table base as a mesh to the **Assembly**.

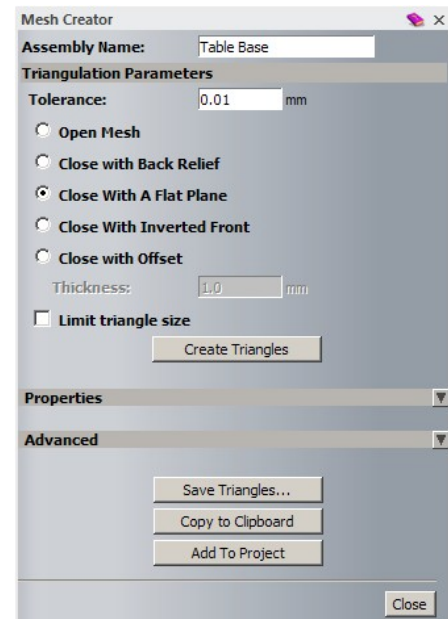
- From the Model Toolbar, select **Create Triangle Mesh**.



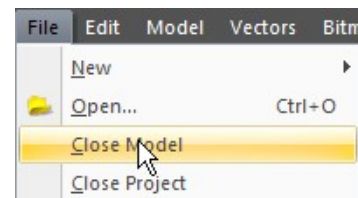
- Enter an Assembly name **Table base**.
- Select the option **Close With a Flat Plane**.
- Select **Create Triangles**.

The mesh is generated and shown in blue. It can be rotated to view the flat bottom.

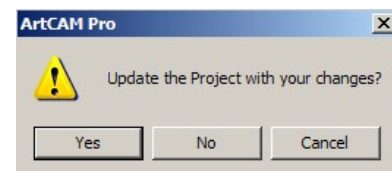
- Select **Add to Project**.
- Select **OK** and then **close** the form.



- From the top menu, select **File > Close Model**.



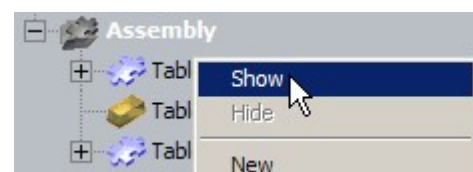
- Select **Yes** to **Update the Project with your changes**.



The ArtCAM model is closed and reverts to the Project window.

If nothing is visible, then the Assembly needs to be '**shown**'.

- Right mouse select** on the **Assembly** and select **Show**.

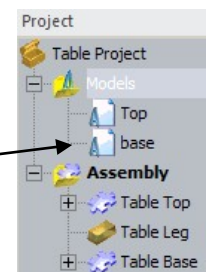




The full assembly is now shown. In the same way, individual meshes can be hidden or shown (using right mouse select).

Note: The Table base is currently not shown as it is covered by the Table base.

- **Rename** the second ArtCAM model to **base** as shown.



- **Select and highlight** the **Table Base** mesh in the **Assembly tree**.



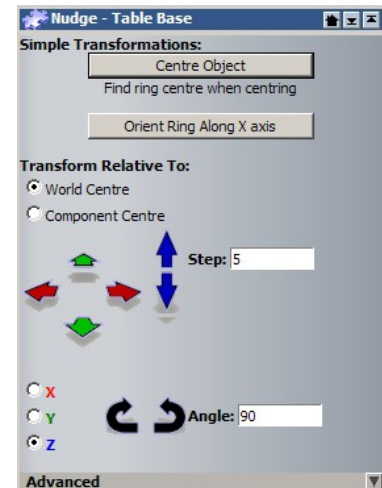
This reveals **further options** that will apply **only to the selected item (base)**.




- In the **Positioning Tab**, select **Nudge**.



This form allows a **selected assembly** to be transformed and rotated in X, Y and Z directions. In this case, the base will be nudged in the Z direction to position it correctly at the bottom of the Leg.



- In the **Step** field, enter a value of **630** and select the **down arrow**  to move the **Base** component into place.



The assembly is now complete

- **Save (to update)** and **close** the Project.