HEXAGON
MANUFACTURING INTELLIGENCE

ALPHACAM 2020.1
MACHINE AND CLAMPING CREATION

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Contents

Table of Images

Conventions used in this manual

To enable you to use the information in this guide effectively, you need to understand the conventions used in the guide to represent differing types of information.

- Buttons on the screen are represented as the button text in square brackets.
  For example: Click on **[OK].**
- Keys on the keyboard are represented as bold lettering in between **< >** characters.
  For example: Press **<Enter>.**
- Ribbon Tab options are represented as a path with the Ribbon Tab in **UPPER** case with sub menus Capitalised and separated with an arrow
  For example: Select **FILE > Open.**
- Field names are represented as bold text. And the value to be entered will be represented by Bold Text.
  For example: Enter the value **50** in the **Offset** field**.** Or
  When prompted for the X & Y values type **100,50 <Enter>**

 Denotes a **<LClick>** or Primary Mouse Button Click.
 Denotes a **<RClick>** or Secondary Mouse Button Click.

 This is a note. It contains useful or additional information.

 This is a reference. It directs you to another part of the user guide.

 This is a thought box. It is generally used in exercises and contains a question for you to consider.

 This is a highlighted note to emphasise information

 This is a warning; it contains information that you must not ignore.

 This is a tip. It is generally used in exercises and offers further advice.

1. This is the first line of a number list item
2. This is the second item of the numbered instructions, which you must
3. Follow in sequence.

- This is a list
- of items, in which
- The order is not important.

Recommended Operating Systems and Hardware for ALPHACAM

Supported Operating Systems

- **Operating System**
- **64bit** operating systems of the following list are supported,
  - Windows 7 (Professional, Enterprise or Ultimate) SP1 required,
  - Windows 8.1 Professional and Enterprise,
  - Windows 10 Professional and Enterprise.
- ALPHACAM will install and run on the 'Home' editions of the above operating systems. However, this is not recommended, and we cannot guarantee to fix any ALPHACAM issues specifically related to these operating systems.
- Nvidia or ATI Open GL Graphics Card with 1Gb dedicated memory

We recommend you keep up to date with the with the latest Software Updates for the supported operating systems and drivers for your hardware base.

Any Windows Operating system (OS) prior to and including Vista, is not a supported operating system.

ALPHACAM Minimum Specifications

The latest minimum specification can be found at http://www.alphacam.com/systemrequirements

This minimum specification is to run any **Alphacam Essential** module, you will need to considerably increase the specification if you are working with solid models and producing the NC code for 3D machining and 3, 4, or 5 axis simultaneous machining strategies.

Your minimum specifications should be the fastest processor with the most memory and the highest specification video card that your budget will allow.

If using Autodesk Inventor Files, please check the current Inventor View requirements at autodesk inventor view

Hexagon Customer Portal

At Hexagon, we strive to provide you and your business with first class technical support and services. The Customer Support Portal allows you the tools you need to receive the best from your software. In addition to generating new and updating existing support cases, the portal allows you:

- Unlimited user logins for your company.
- Access to all your licenses for easy reference.
- Get the latest releases and software update at the touch of a button.
- View what is available on your support and maintenance schedule.
- Reference to the Customer Support Charter at any time.
- View the status of your Technical Support cases.
- View all purchased Professional Services like Training and Consultancy.

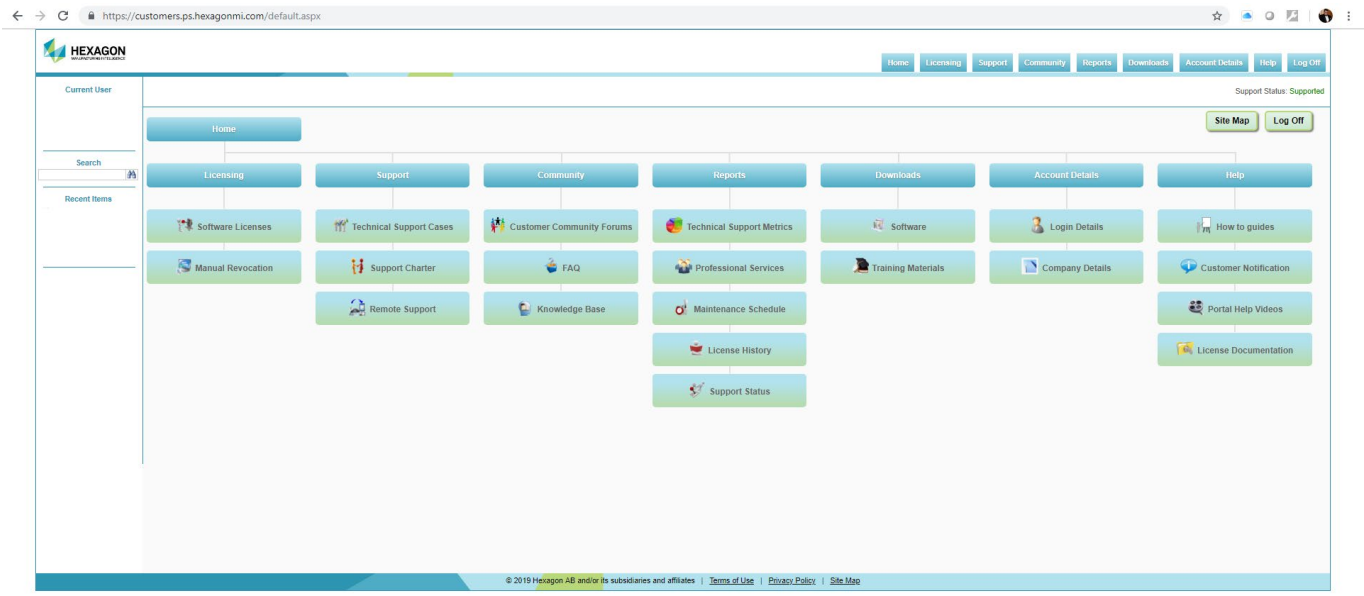


Figure 1 - Customer Support Portal

For the Hexagon Customer Portal visit customers.ps.hexagonmi.com

ALPHACAM esupport

Another location to gain valuable information about using the software or asking other experienced users for assistance are the esupport forums.

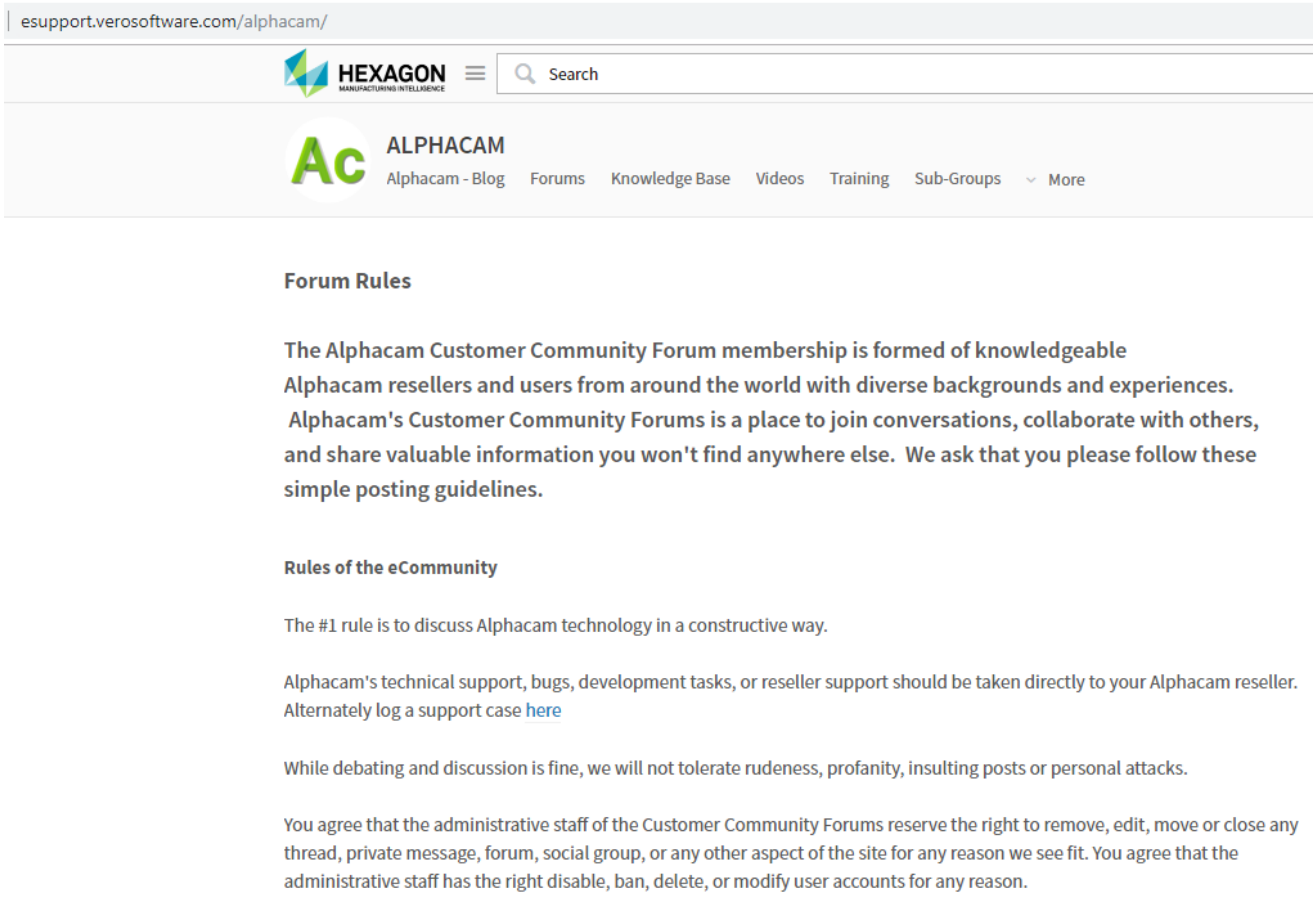


Figure 2 - esupport page

Asking a question of the community, using the knowledge base or other available information links could save you time if you have a problem that someone else may already have supplied a solution for.

Introduction

As a user of ALPHACAM, you will be fully aware of the vast array of geometry creation and machining tools that are available in setting up your processes for creating the actual parts on the machine.
As your requirements for more specialised machining strategies and more advanced equipment evolves you then need to seriously consider the more advance simulation options available.
One of the options in ALPHACAM is the ability to create a machine to run within the simulation so that you can visualise the actual process on screen as if you were stood in front of the machine tool itself.

These machines can be as basic as a simple extruded shape that will look much like a set of building blocks stacked on each other, this may be as much accuracy as you need for a simple 3 axis profiling machine, or you may have a machine build that is accurate down to the last nut, bolt and washer. These states of machine build all depend on what it is you need to see.
As tool paths become ever more complex and machine tools ever more expensive, it makes economic sense to run a true simulation within the software to iron out any errors rather than have an expensive tool drive through a part or worse, the machine head drive down into the machine table.
More importantly if you are using a 5 axis type machine then, more so, you need to see where the head/table are moving so that you can avoid serious and expensive mishaps in real life.

Objective

This supplement is to complement any training course that involves the machining process, from simple profile machining to full 5 axis toolpaths.
By the end of this manual you will have been shown how to create a simple machine using only geometries created in ALPHACAM, through to a fully functional machine created from Solid Models.
Knowledge will be gained to allow the setup of fully functional clamping systems and also the options for linking them into previously created machines.


Please note that the accuracy of the machine being created is down to the parts or geometries used.


Options available may be limited depending on your level of ALPHACAM licence.


Please note that Machine and Clamp definition is NOT available in the Essential level of ALPHACAM.

Machine Creation

Machine building is accessed via the **MACHINE > Machine Configuration**  menu.

Commands

Open Machine		Allows you to select a specific machine that you wish to use in the simulation process.
Save Machine		Saves the current machine in the current drawing.
Clear Machine		Deletes the machine from the active drawing but does not delete the actual machine file.
Set Default Machine		Sets a machine to be the default option that opens with each new drawing file.
Reset Default Machine		Allows you to alter the machine for the above setting.
Machine Configuration		Sets up the various move and rotation options for the machine simulation.
Define Machine Component		Allows the choice and settings for the geometry or solid file to be used as a machine part.
Set Tool Home Position		The location of the tool holder in the spindle. Directly links to the Gauge length when creating tooling.
Set Drill Unit Position		Allows for the accurate location of a multidrill unit to be added to the simulation of the machine, where required.
Set Slave Head Positions		Allows for the simulation of multi-head machines.
Clear Slave Head Positions		Removes any multi-head settings.
Define Axes		Sets up the rotation axes for head, table or tool rotation.
Set Safe Area		Defines and area in in which the tool head cannot travel.
Move Part		Re-positions the machine to suit the datum of the part to be machined.
Rotate Part		Rotates the part to suit an alternate set.

Simple Gantry Machine

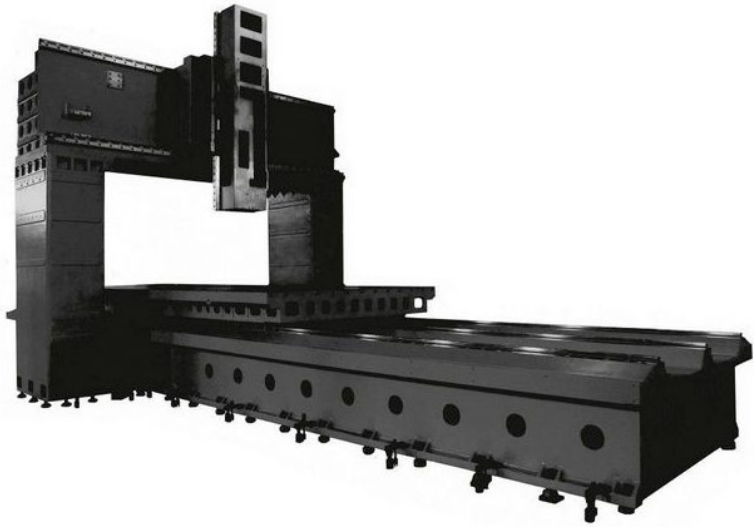


Figure 3 - Simple 3 Axis Gantry style machine

In this example, we will look at the requirements for setting up a very basic 3 axis machine, based on a gantry style. This machine will require four geometries to represent the constituent parts of this type of machine;

- Main Bed
- Gantry
- Ram
- Spindle nose

Geometry Creation

The geometry for any machine build always needs to be created in the actual orientation the machine works in, for example if the longest axis of the table was along the Y axis then we would need to set up and draw the part from the front view of the machine.
In this simple machine, the longest side of the table is along the X axis so we need to draw on the side of the machine.

1. Using the **VIEW** tab, change the drawing area view to the **YZ**  setting.
2. Now create a work plane from this view using **WORK PLANES > Normal to View** 
3. On the work planes tab of the Project Manager, **<RClick>** on this new work plane and select the **Edit** option.
4. Change the name to **Machine Profiles**.

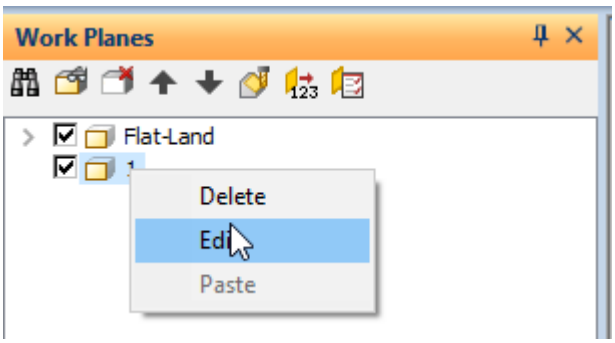


Figure 4 - <RClick> options for Work Planes

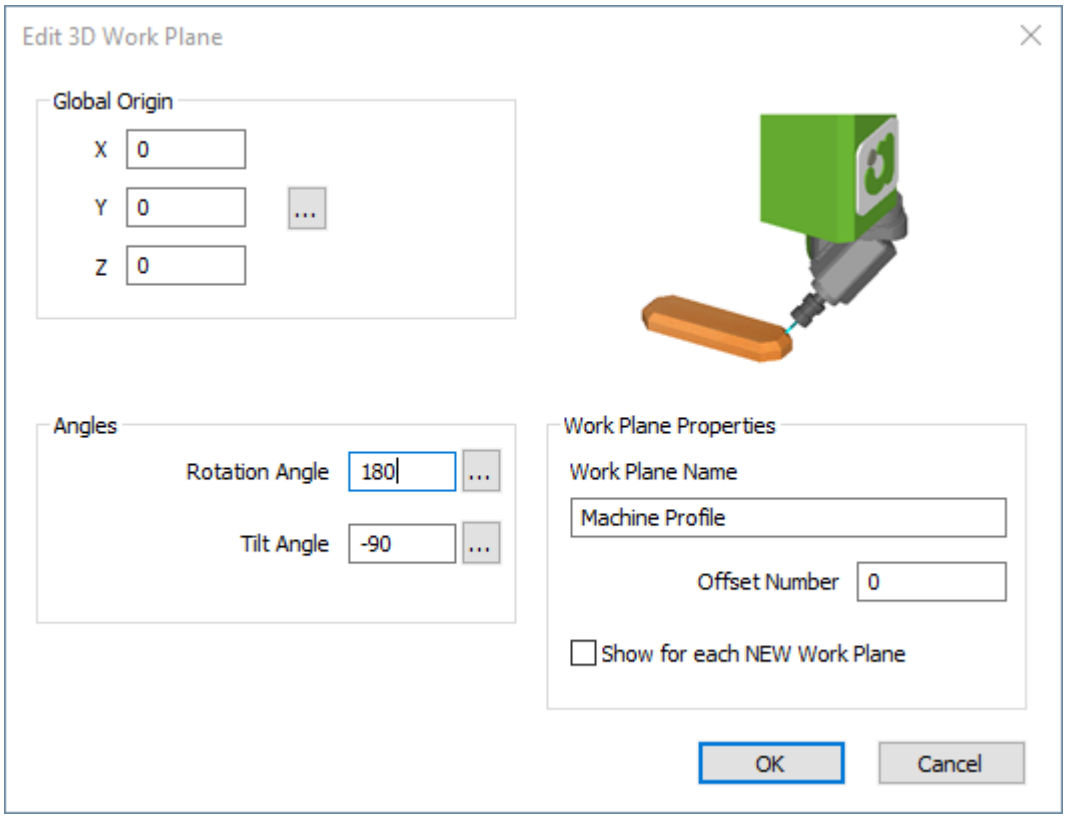


Figure 5 - Work Plane renamed for ease of identification

Once renamed, select **[OK]** to proceed.

<LClick> on the renamed work plane in the **Project Manager** to make it the active drawing plane.

Gantry and Bed Creation

Using **Geometry > Rectangle** 
set the first corner as **X0, Y0** and the second corner as **X2000, Y-300.** This will form the basis of the table.

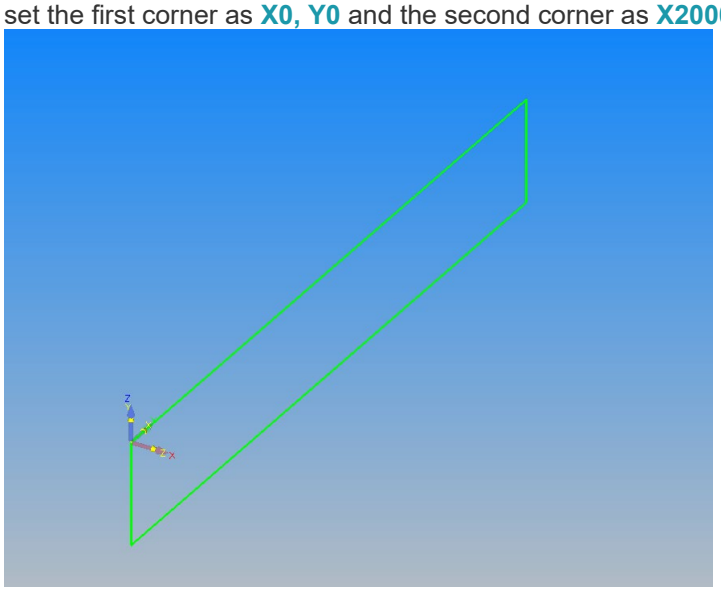


Figure 6 - First Rectangle

Create three more Rectangles as follows;
First corner at **X-50, Y-300** second corner at **X-350, Y2000.**

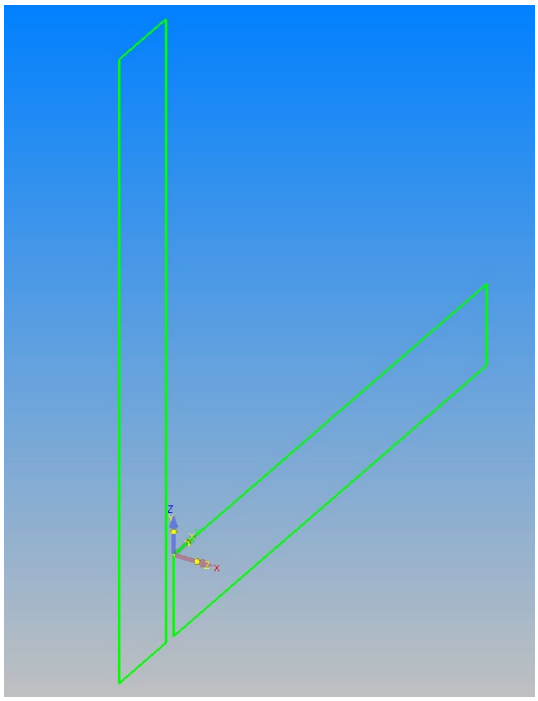


Figure 7 - Second Rectangle

First corner at **X2050, Y-300** second corner at **X2350, Y2000**

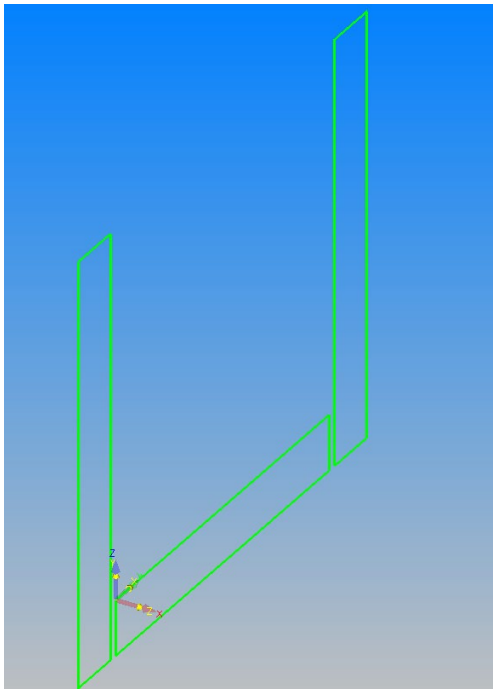


Figure 8 - Third Rectangle

First corner at **X-350, Y2000** second corner at **X2350, Y1500.**

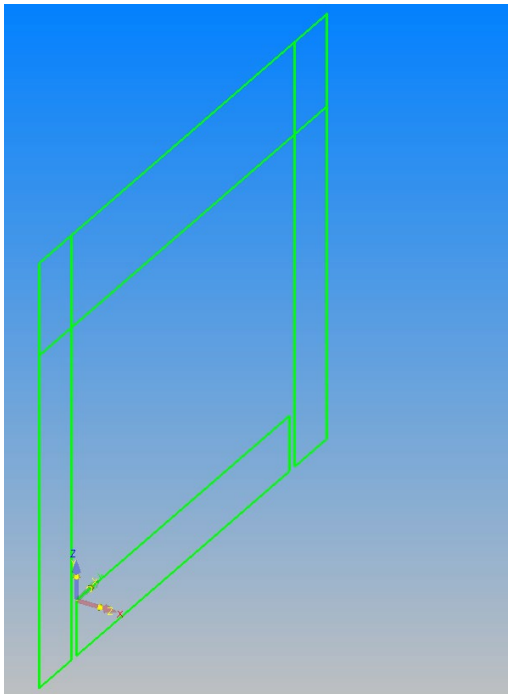


Figure 9 - Fourth Rectangle

Use **EDIT > Fabricate > Unite**  on these last three geometries.

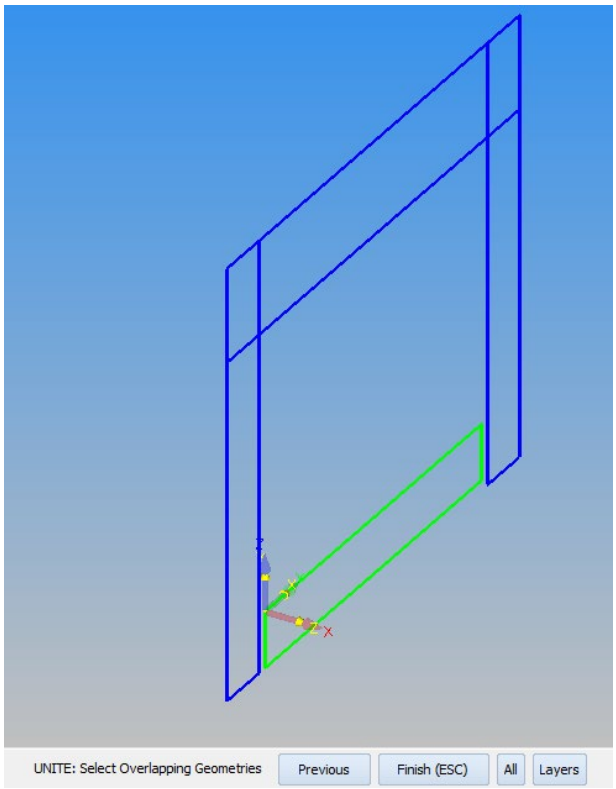


Figure 10 - Rectangles to Unite

This new geometry forms the basis of the machine gantry.

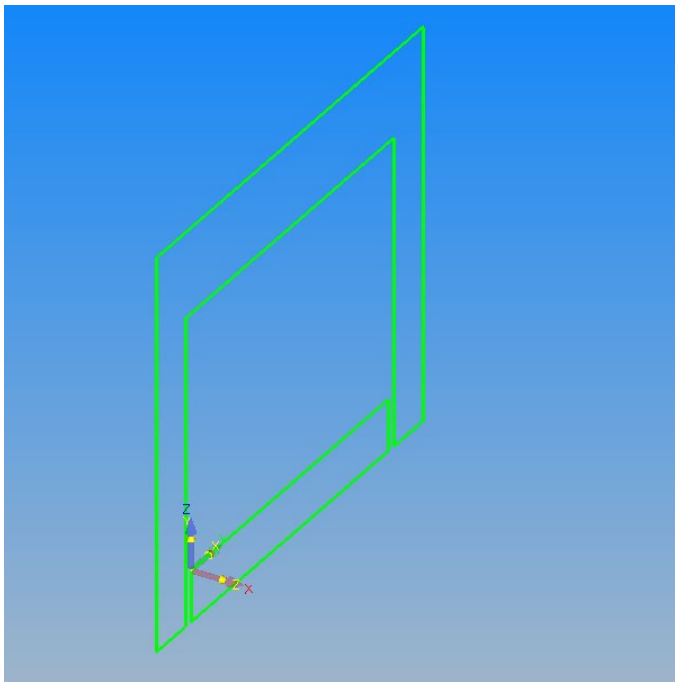


Figure 11 - Created Gantry and Bed

Ram and Spindle Creation

Use **GEOMETRY > Rectangle**  set the first corner as **X1700, Y1200** and the second corner as **X2000, Y3000.** This forms the basis of the machine Z axis ram.

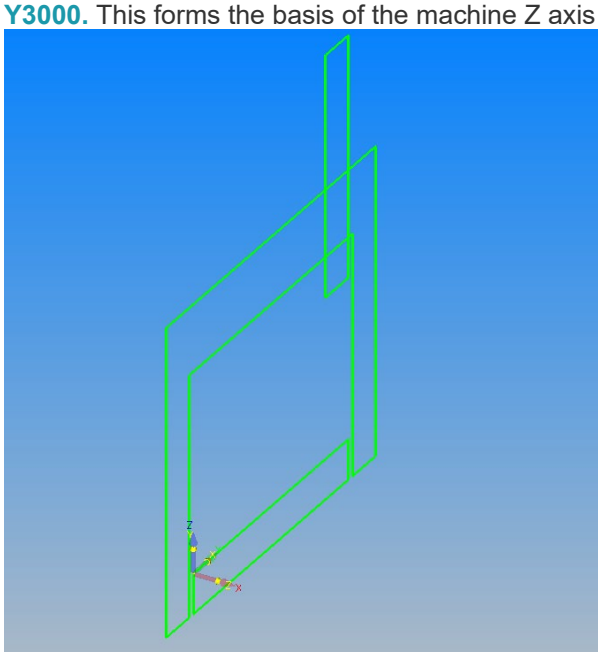


Figure 12 - Ram representation

Use **GEOMETRY > Rectangle**  set the first corner as **X1750, Y1200** and the second corner as **X1950, Y1000.** This forms the machine spindle nose.

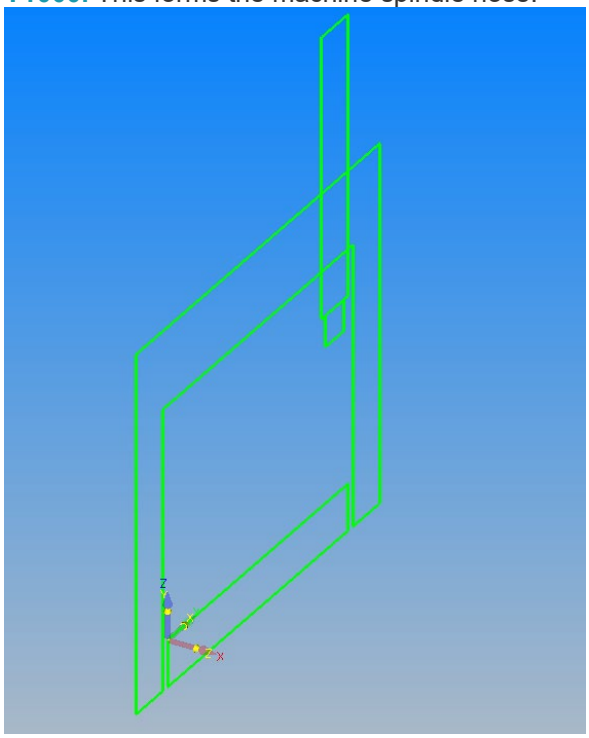


Figure 13 - Spindle Nose Representation

Once all the rectangles have been created, you should have a drawing the looks like this.

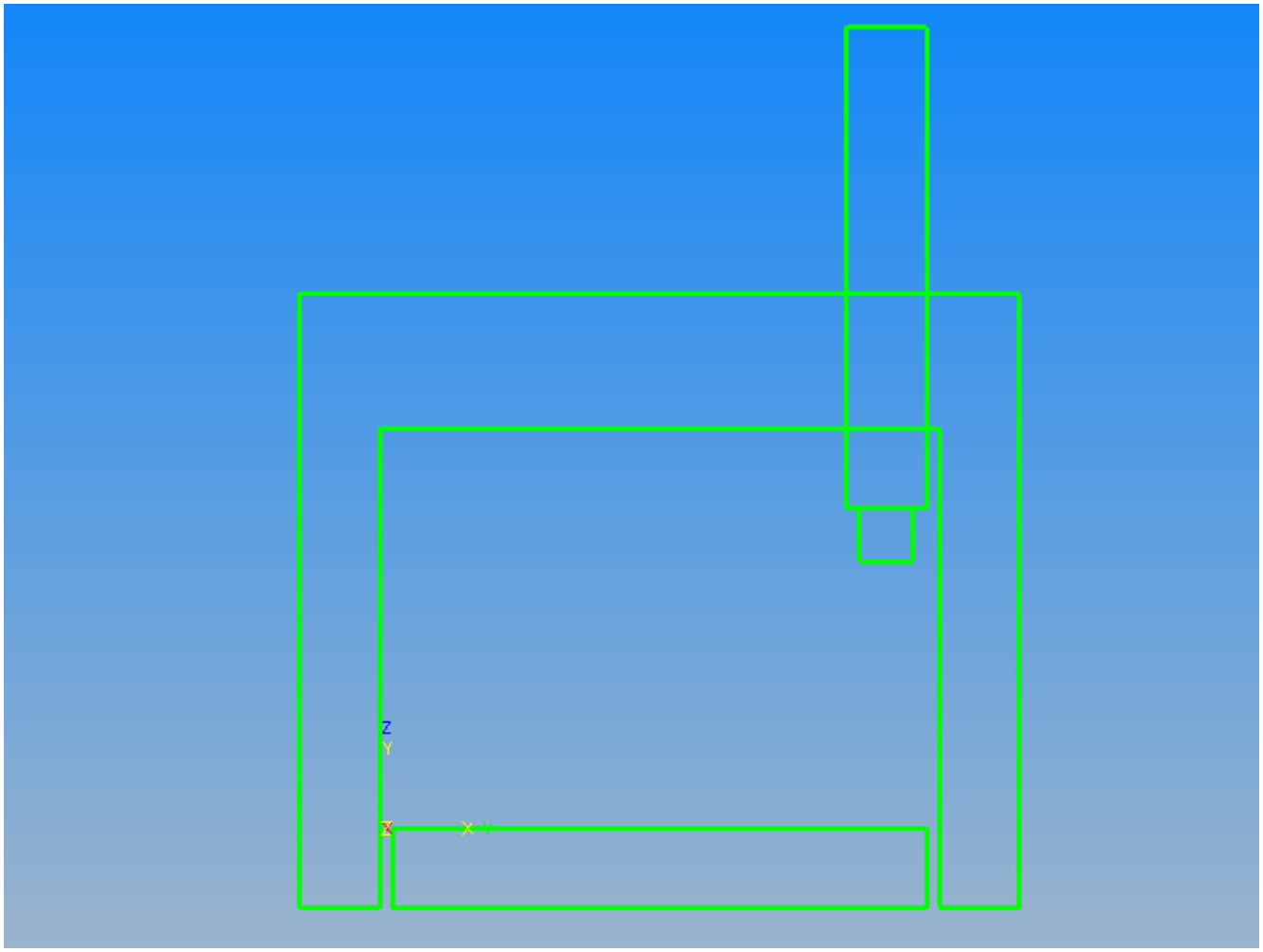


Figure 14 - Basic geometry rectangles for machine creation

The points at which all the elements are created in this geometry represent the position the machine will use for the tool change location. If your tool change takes place at the front side of the table, then you would draw the ram and spindle nose to the left of the drawing instead of the right.

The origin point for all rectangles represents where the datum location for the majority of your machining will take place.

Save the drawing so far in case you make any mistakes.

Machine Configuration

Setting the machine configuration is the process of defining which axes will move on the machine and, if required, the rotational options for 4 or 5 axis types of machines.

Using **MACHINE > Machine Configuration > Machine Configuration**  opens the following dialogue.

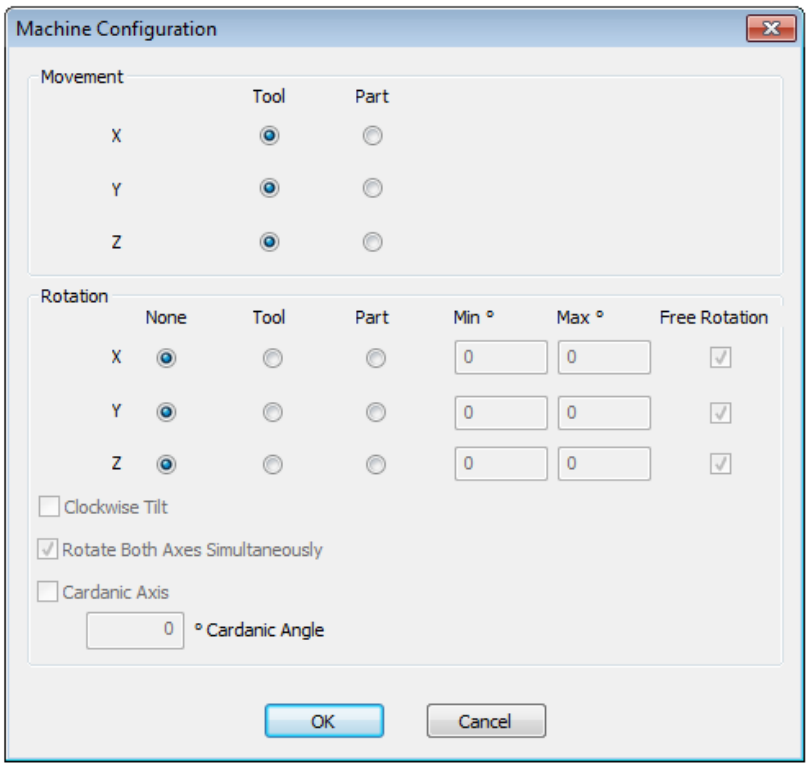


Figure 15 - Machine configuration options dialogue

The upper section deals with the linear motion of the three primary axes, the lower section with the rotational elements of any additional axes.

The third section deals with the style and movement of 5 axis machines only.

In this particular example, we are creating a fixed bed machine so settings for X, Y & Z are all set to ⊙ **Tool.** If your machine was a moving bed, then it would have the X & Y options set to ⊙ **Part** instead.

As we are not creating a 4 or 5 axis machine, all the Rotation options need to be set to ⊙ **None.**

 These lower options are covered in the second machine example in this supplement.

Define Machine Component

To create the actual representation of the machine parts, we use the command

MACHINE > Machine Configuration > Define Machine Component 

The principles behind this command are that you select a shape to represent the machine part, make option choices for the size and type and set how it can move with regards to the final simulation process.

Main Bed

Make sure that the work plane Machine Profiles is active by **<LClick>** on the entry on the work planes tab of the Project Manager.

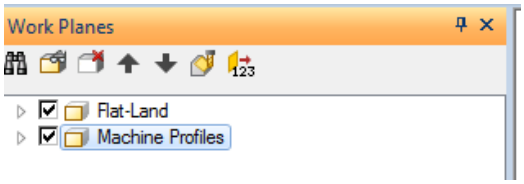


Figure 16 - Select the correct Work Plane

Select MACHINE > Machine Configuration > Define Machine Component 
When prompted at the bottom of the screen to select a part, **<LClick>** on the rectangle that will represent the main bed or table as shown in this image.

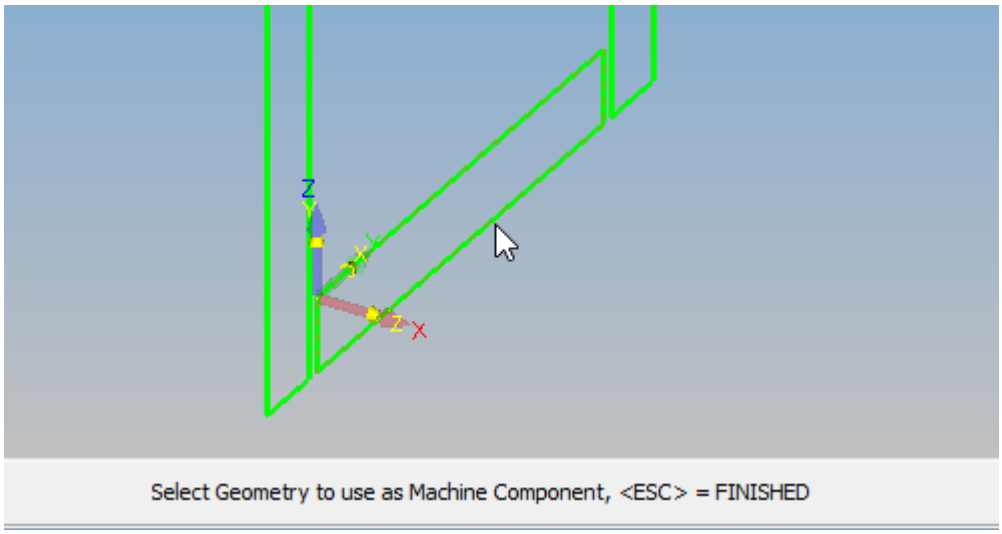


Figure 17 – Selecting the rectangle for the bed

The Define Machine Component dialogue box is now shown allowing you to configure the 2D profile to suit the required needs of the machine.

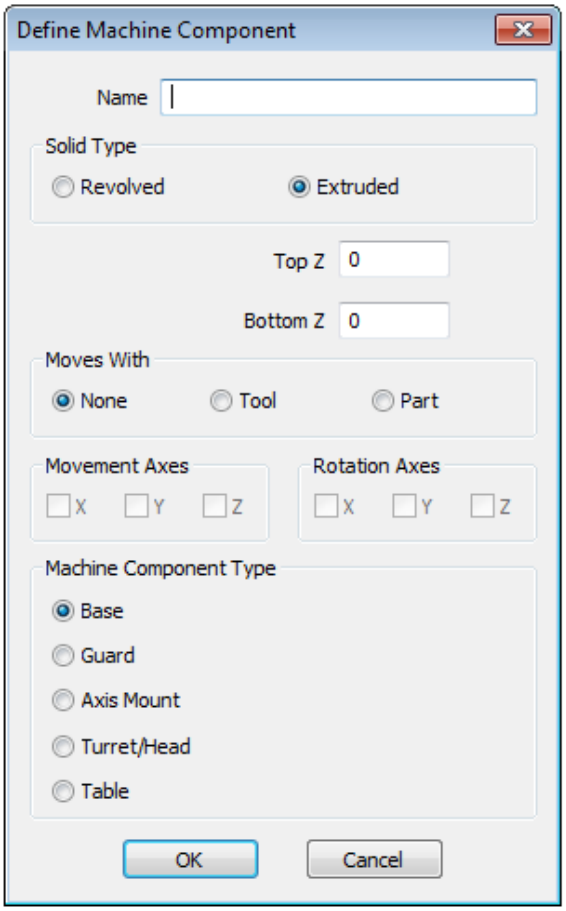


Figure 18 - Define Machine Component dialogue

Name	Enter a suitable name for the part being defined
Solid Type	⊙ **Revolved.** Creates a spun part to represent cylindrical items. ⊙ **Extruded** Creates cuboid style representations.
Z Values	Sets the third direction value for the part, so a 2D shape becomes a 3D representation
Moves With	⊙ **None** The item is static. ⊙ **Tool** The item moves with the tool in the simulation. ⊙ **Part** The item moves with the part in the simulation.
Axes definition	Which axes are involved to create the correct movement of this part.
Component Type	Information only to differentiate the parts.

For this particular part, make the settings as shown below.

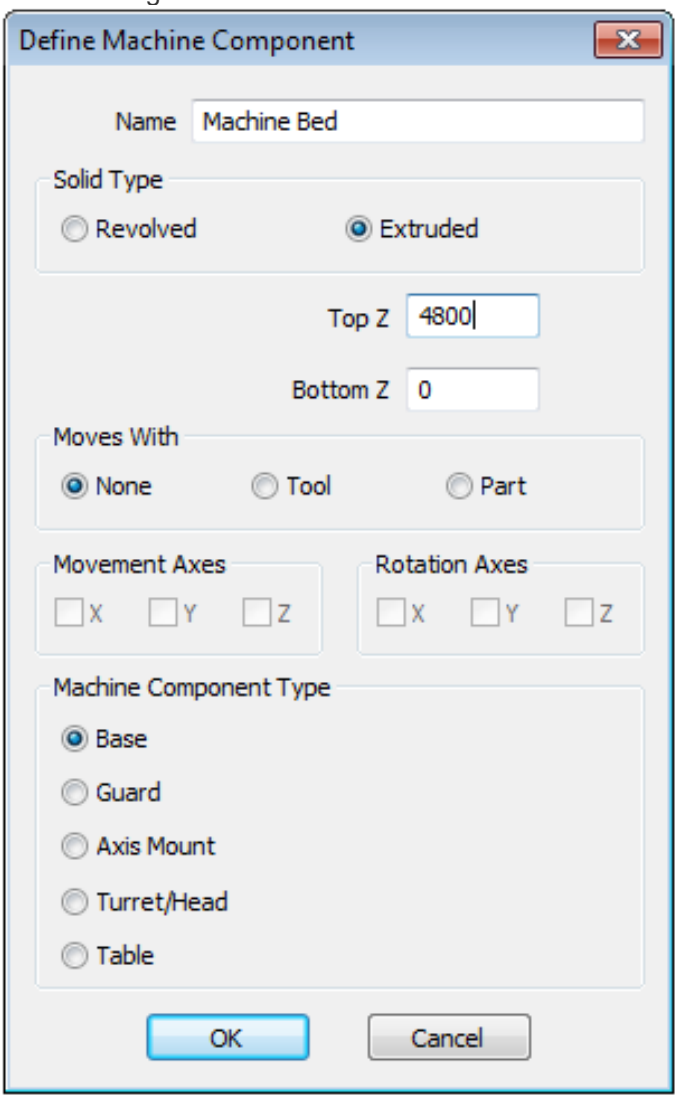


Figure 19 - Correct options entered to the Define Machine Component dialogue

This part is ⊙ **Extruded** to give a representation of the length of the bed at 4.8 metres.

> The Z values are based on the current active work plane, so it is important to take note of the Z direction when you are creating items not on Flatland.

This is the main bed of the machine and in this example, is bolted to the floor, so cannot move
As the option ⊙ **None** has been chosen, the axes options are not available.
The component type is the ⊙ **Base**, this is just to guide you when you look at the build later.

<LClick> [OK] to apply the settings.

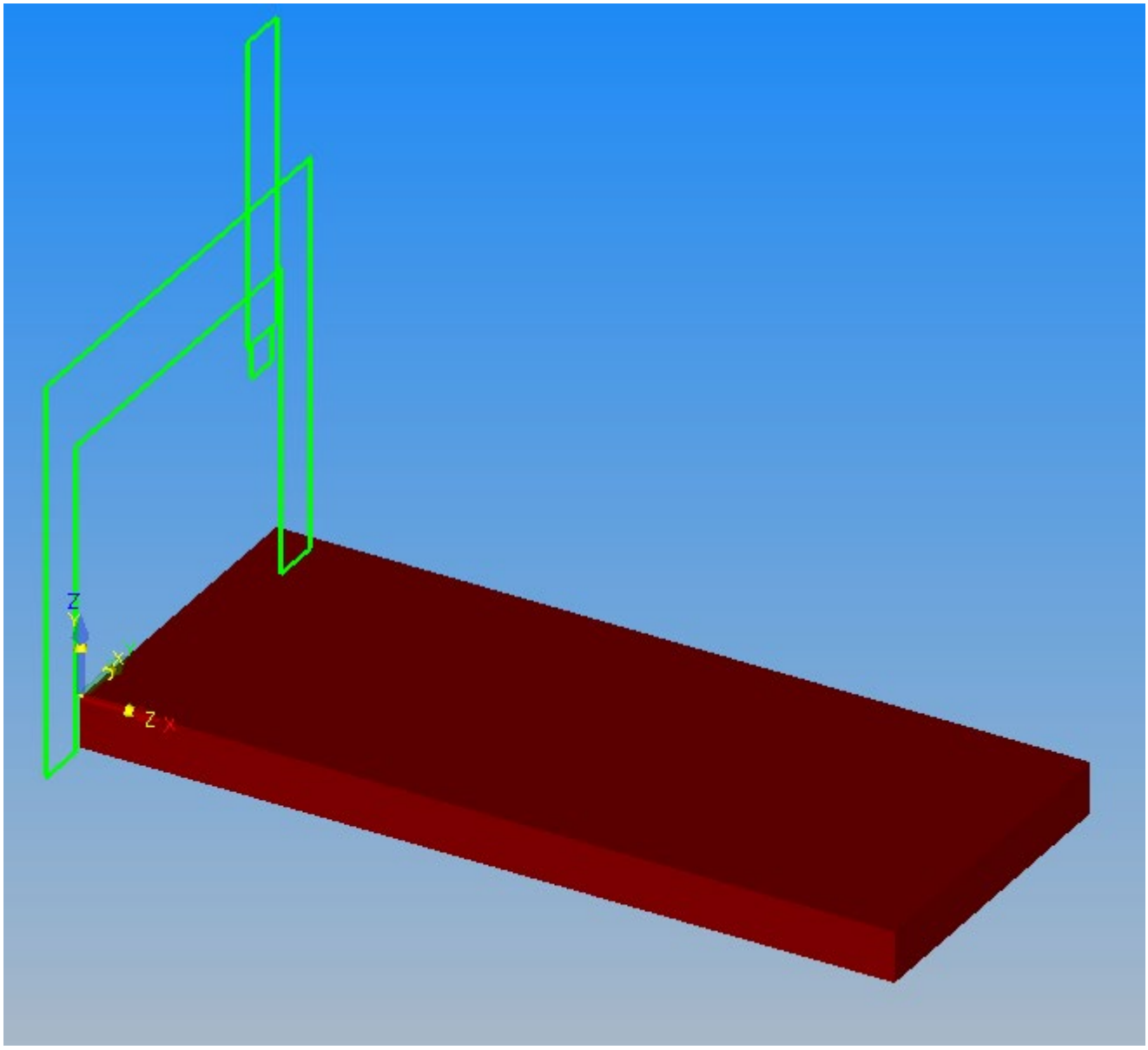


Figure 20 - Base shown after setting the options

The **Define Machine Component** command remains active so you are now prompted to select the other parts of the machine build.

Gantry

<LClick> on the 2D geometry that will represent the Gantry of the machine.

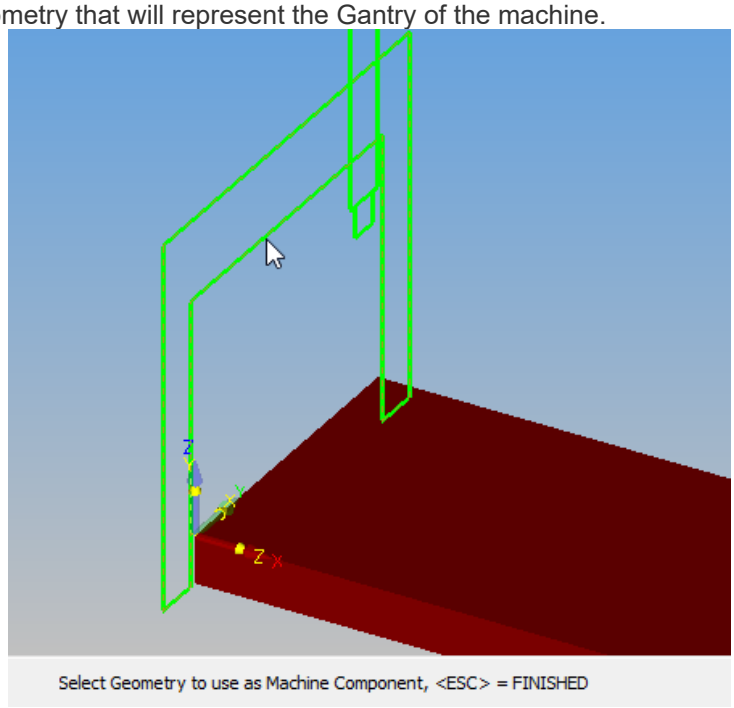


Figure 21 - Select the geometry representing the Gantry

Make the dialogue options as shown below.

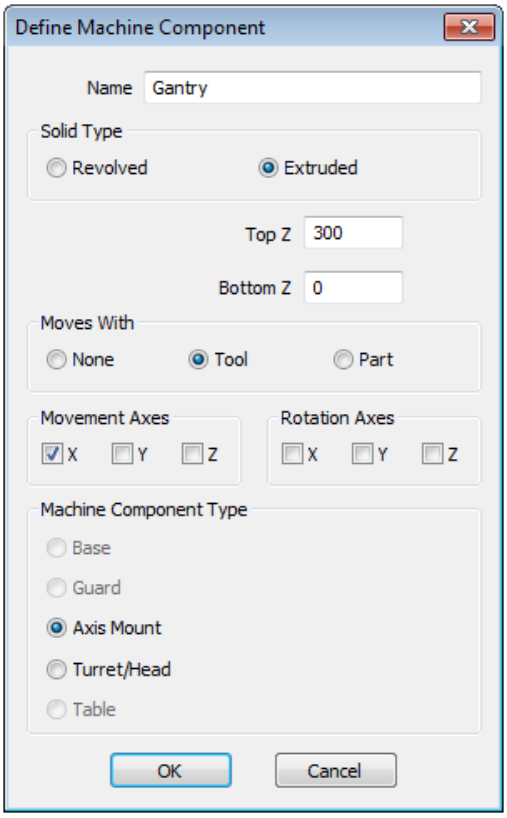


Figure 22 - Set the component options for the Gantry

The Z values are set so the lower value of the Gantry lines up with the lower value of the Machine Bed, and the part is then created 300mm thick.
The Gantry can only move along the machine bed,
so the option is set to ⊙ **Tool** and the Movement Axes to ☑ **X.**

> It is important at this point to stress that the Movement Axes are in relation to the Global directions not any local work plane directions.

> In this example, the extruded values are in Z on the local work plane, but the movement of the Gantry is along the Global X axis.

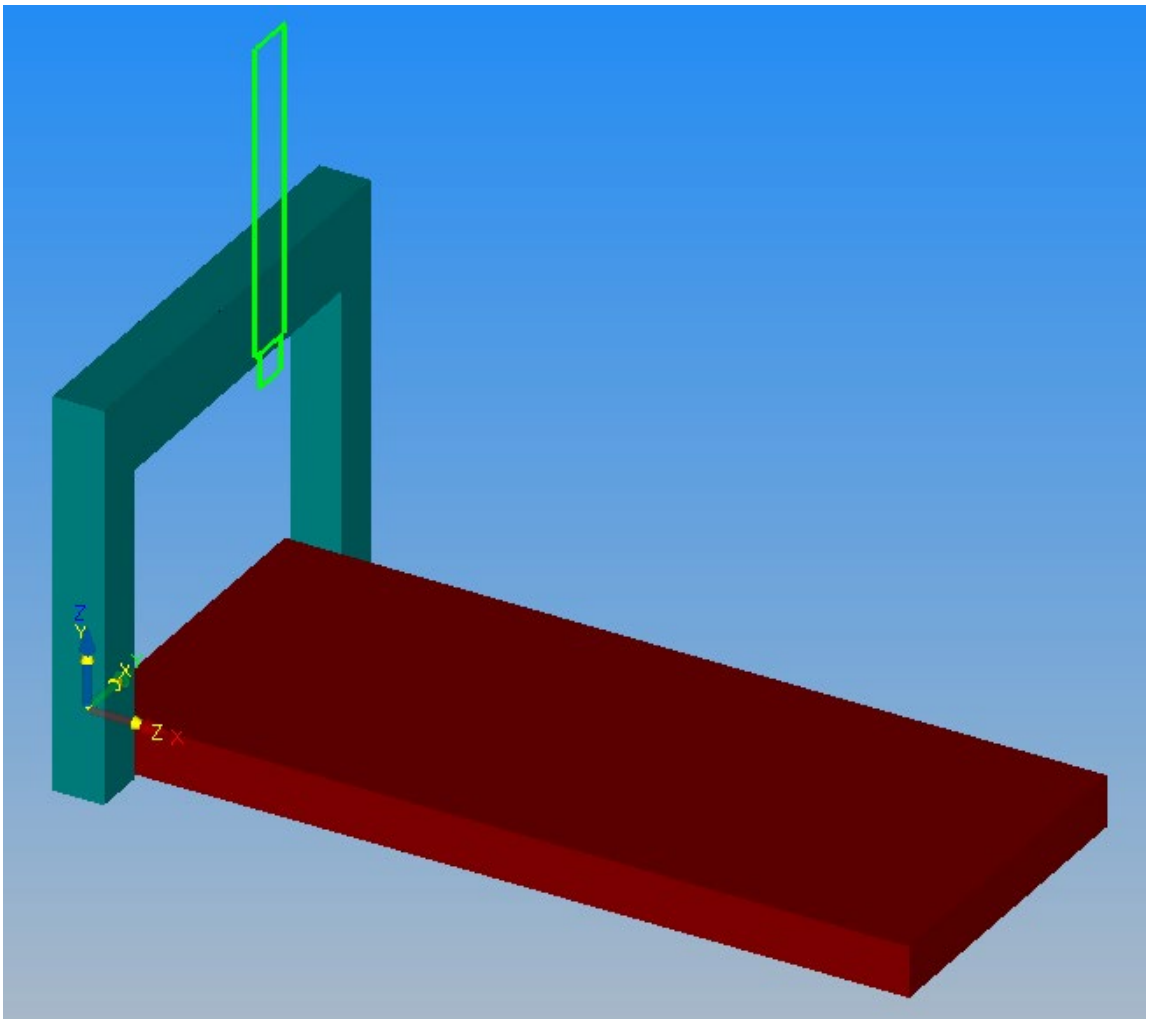


Figure 23 - Gantry creation complete

Note the difference in colour to identify different axis movement elements.

Ram

<LClick> on the 2D geometry that will represent the Z Axis Ram of the machine.

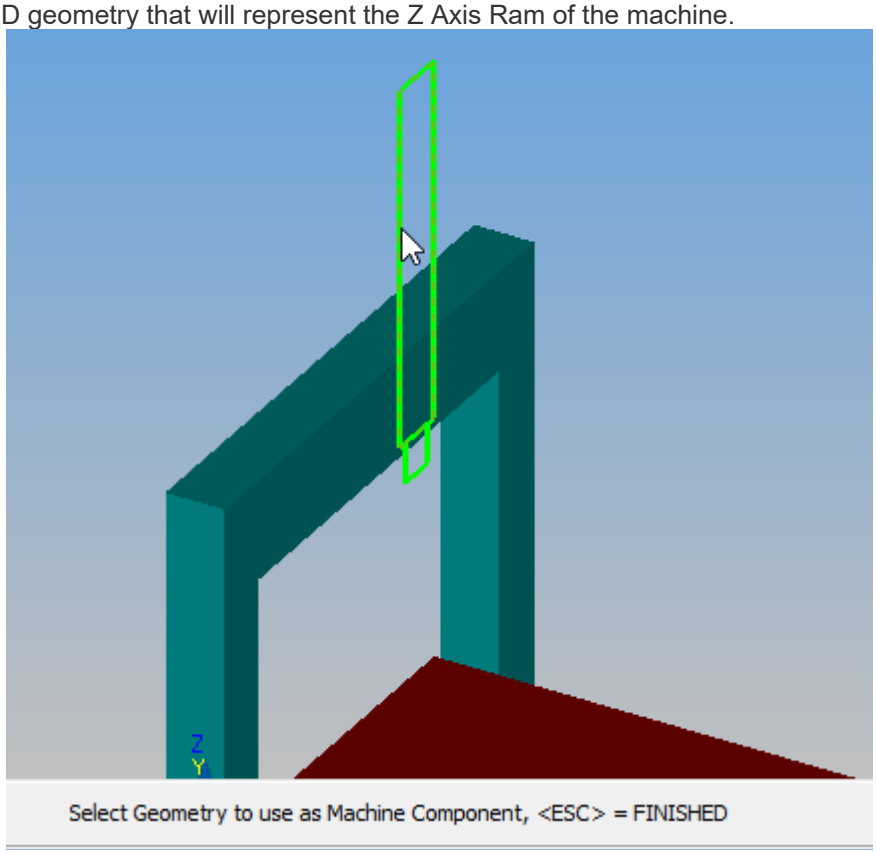


Figure 24 - Z Axis Ram selection

Make the dialogue options as shown below.

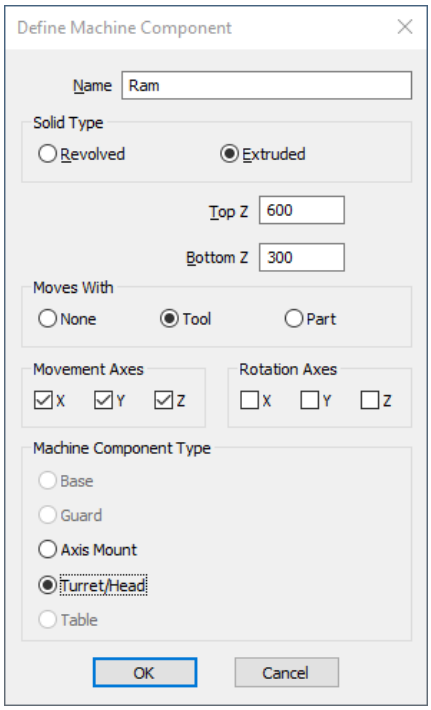


Figure 25 - Set the component options for the Ram

The Z values are set so the lower value of the Ram lines up with the upper value of the Gantry effectively allowing it to sit on the Gantry, and the part is then created 300mm thick.

The Ram moves in all three axes so the option is set to ⊙ **Tool** and the Movement Axes to ☑ **X,** ☑ **Y &** ☑ **Z.**

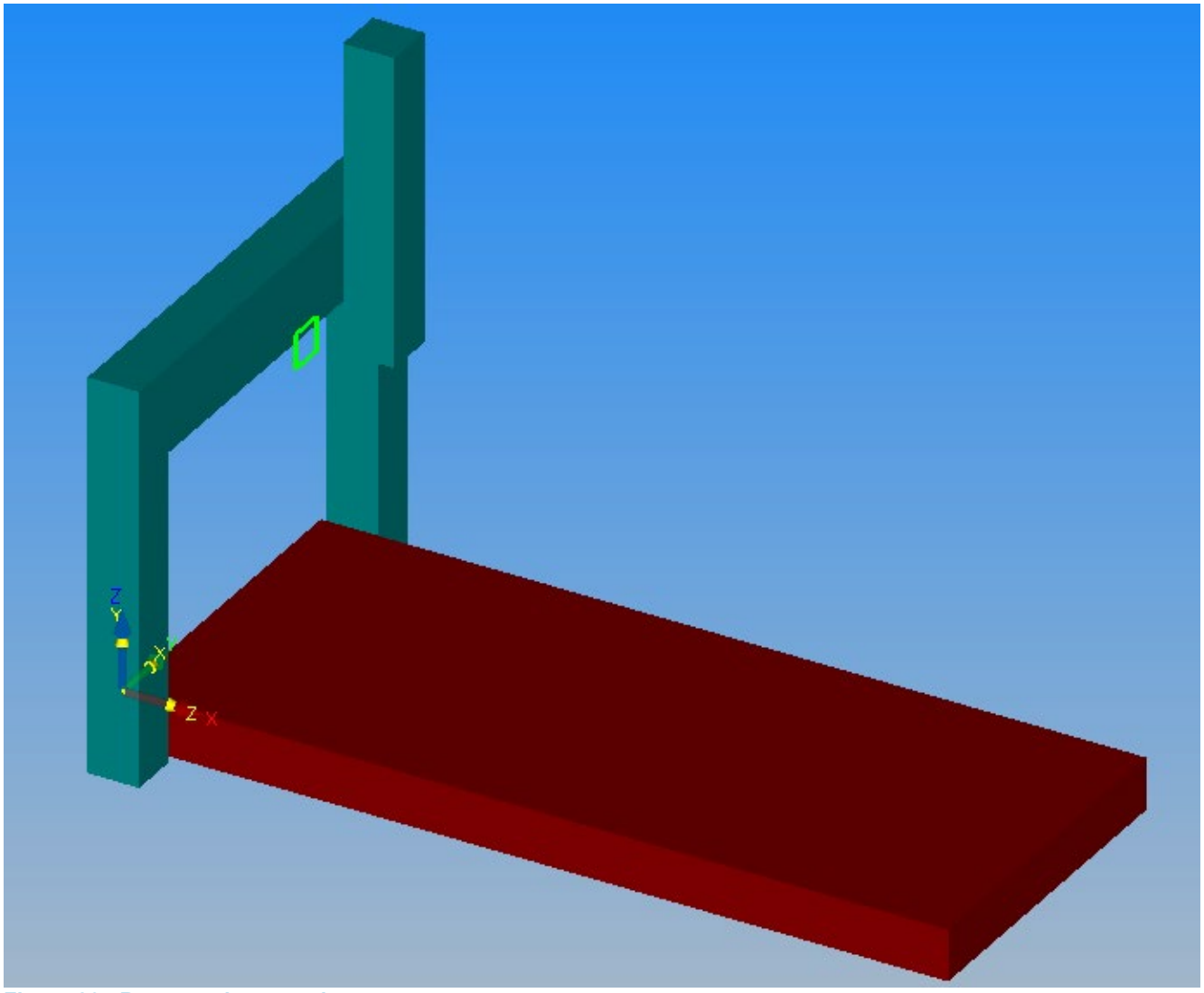


Figure 26 - Ram creation complete

Spindle Nose

<LClick> on the 2D geometry that will represent the Z Axis Ram of the machine.

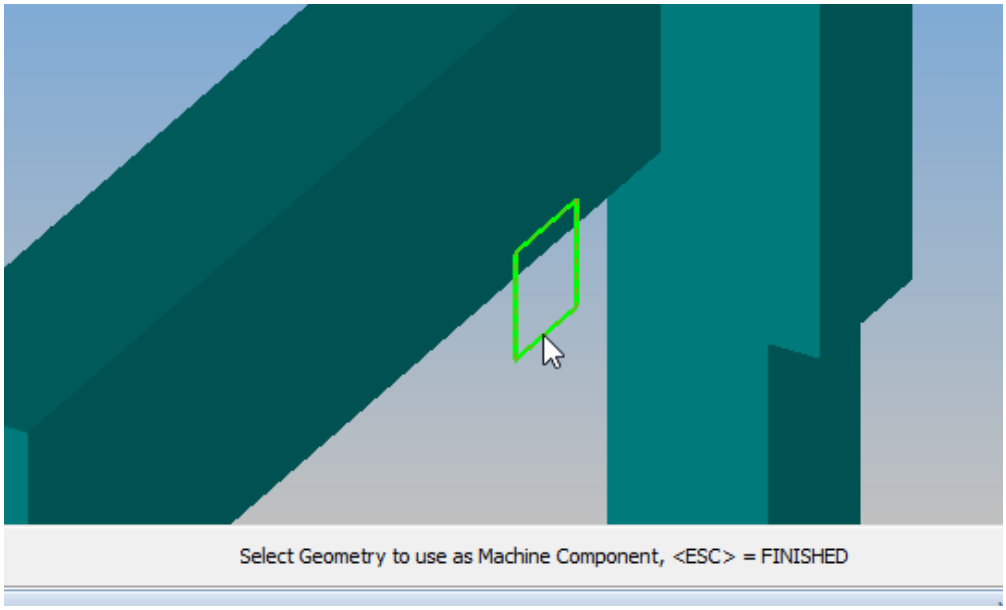


Figure 27 - Spindle nose geometry selection

Make the dialogue options as shown below.

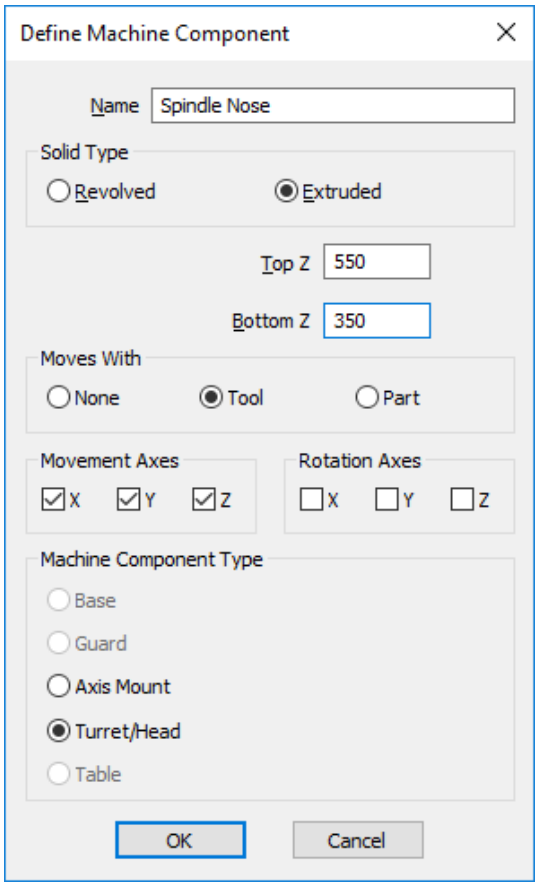


Figure 28 - Set the component options for the Spindle Nose

The Z values are set so the Top Z of the Spindle Nose is 50mm lower than the Ram upper value, and the Bottom Z is 50mm higher than the Ram lower value. This gives the impression of the Spindle Nose located centrally on the bottom of the Ram unit.

The Spindle Nose can move in all three axes, so the option is set to ⊙ **Tool** and the Movement Axes to ☑ **X,** ☑ **Y &** ☑ **Z.**

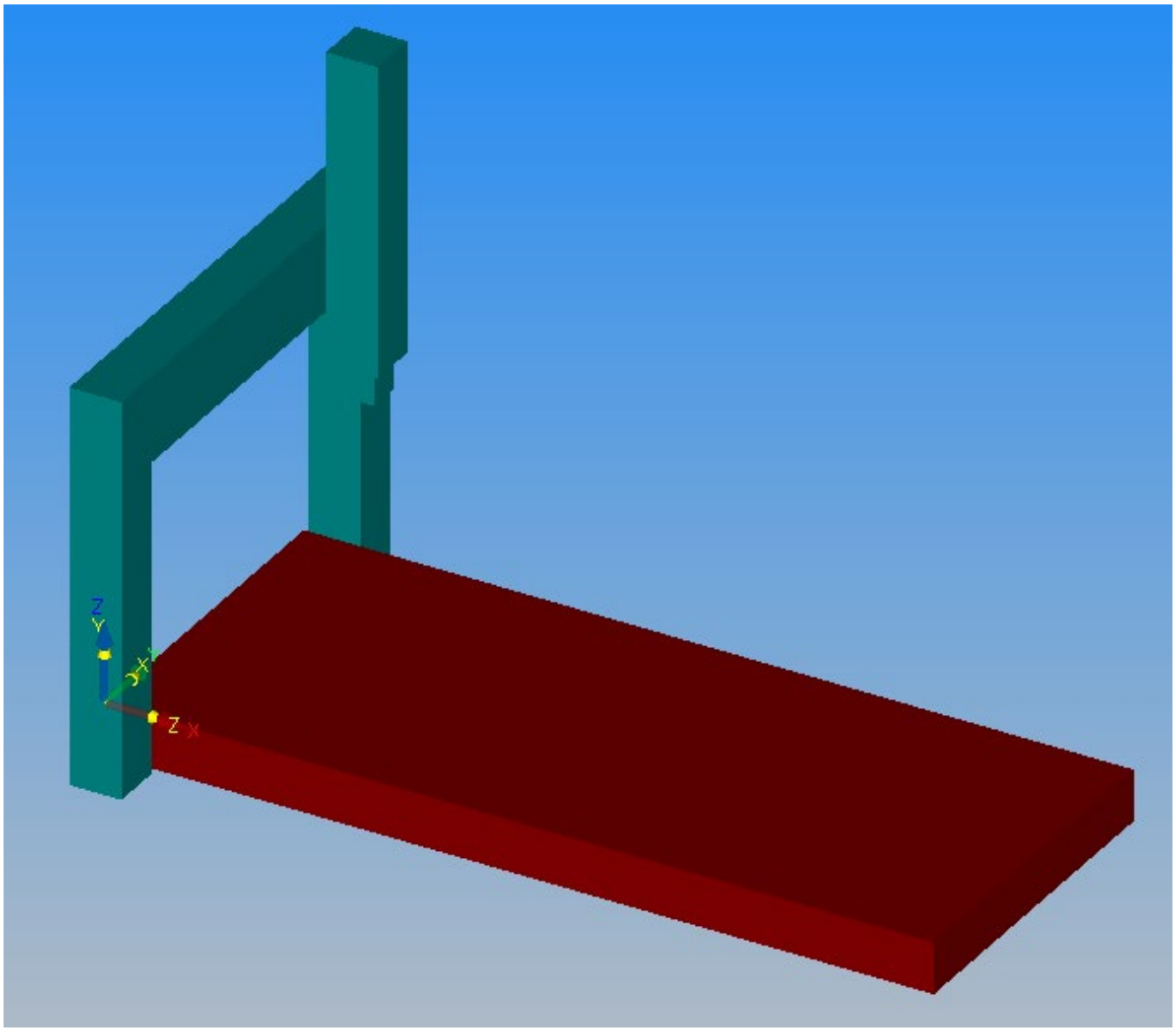


Figure 29 - Spindle Nose creation complete

Tool Location

Now that we have all the parts completed, we need a marker on the machine to locate the tool to give a correct representation of the machining process.
This is done using the command

MACHINE > Machine Configuration > Set Tool Home Position 

This is the position on the machine build that will primarily locate the centre line of the tool so that its Z axis aligns with the Z axis of the plane in which the tool is working.
The tool length is then used to locate the bottom of the tool down the Z axis of the machine away from the **Tool Home position.**
If you are wishing to use tool holders in your simulation then you must also enter a correct value in the **Tool Tip to Gauge Line Length** option on the **Simulation** section of the tool definition dialogue when defining tooling, or use the correct location when prompted, if creating tool holder from solid models. This will then position the tool and holder correctly from the Tool Home Position.

> When creating any form of tool holder, there are differing options available to set this location point. It is recommended that reference is made to the ALP TRG 112 Material and Tooling Creation pdf to understand the options available.

Examples

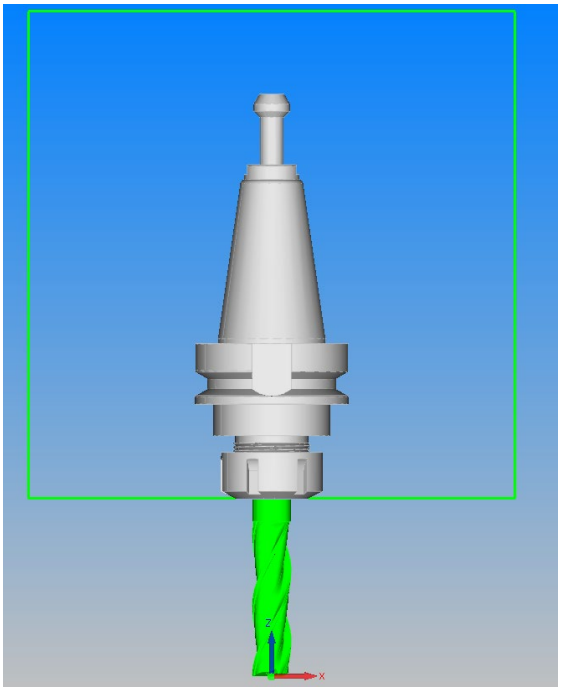


Figure 30 - Tool set without a holder

A standard tool with holder positioned in the rectangle that represents our current spindle nose. With an incorrect or missing **Gauge Line Reference point.**

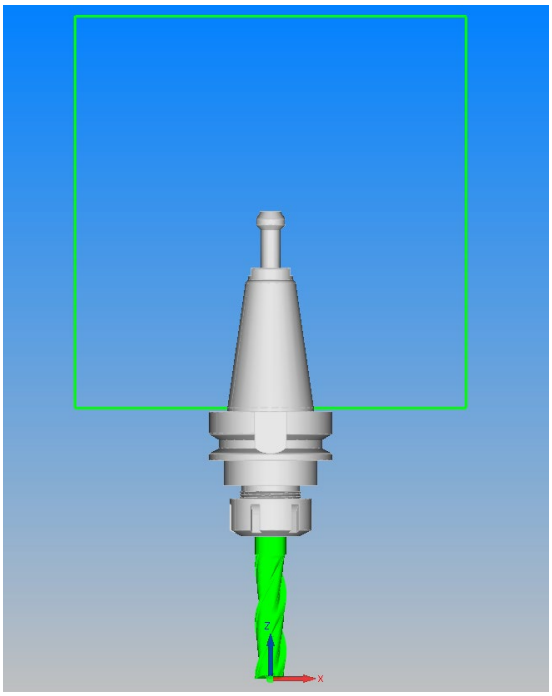


Figure 31 - Tool set with a holder

The same tool using a tool holder with the correct **Gauge Line Reference point.**

Setting the correct position on this build requires the use of a single Polyline to place the **Tool Home position** correctly.

Use **GEOMETRY > 3D Polyline**  , then using the **<F6>** key to snap to the pair of diagonal opposite corners of the extruded Spindle Nose, create a diagonal line as shown below.

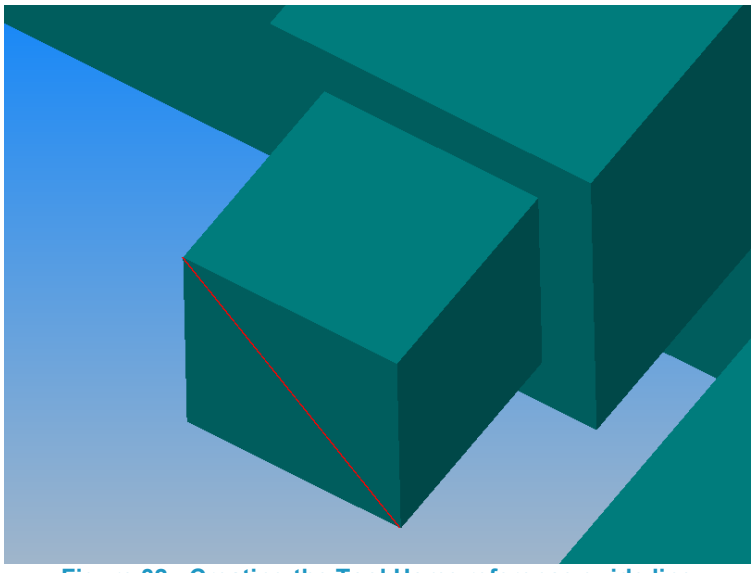


Figure 32 - Creating the Tool Home reference guide line

Using the command

MACHINE > Machine Configuration > Set Tool Home Position 
Place the location using the **<F7>** to the Mid-Point of the 3D Polyline.

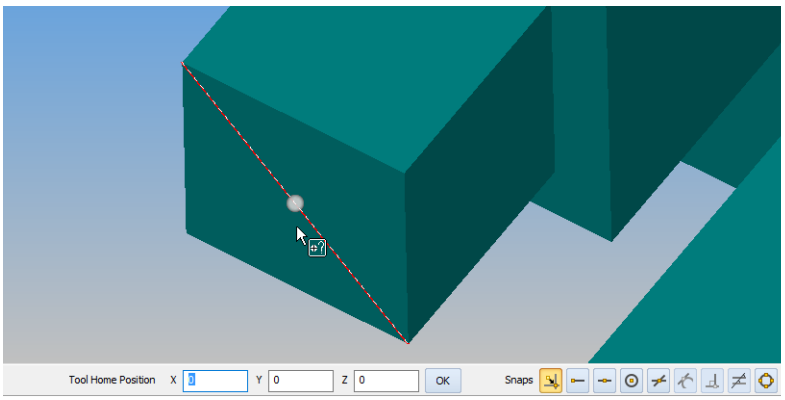


Figure 33 - Tool Home position chosen

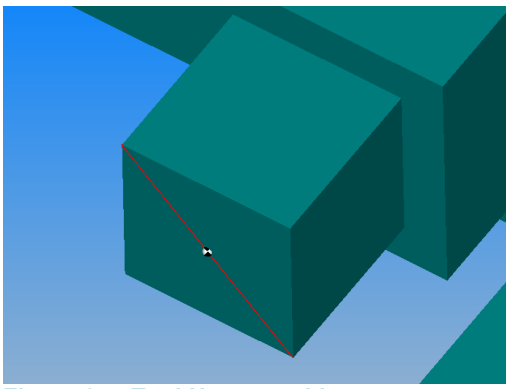


Figure 34 - Tool Home position set

A black and white datum marker will be added to the Machine Build to denote the home position of the tooling.

Use **MACHINE > Machine Configuration > Save Machine**  and call it "**Simple Gantry Machine".**

This has only saved the machine configuration so if you wish to use this drawing again, you need to save the actual ALPHACAM drawing file using **FILE > Save.**

Testing

To start the testing process, open the test file **Simple Door** in the following location on the memory stick **"……TRG112 2D Machining 2020\Examples\Machine Configuration Examples\"**

Using the command **MACHINE > Machine Configuration > Open Machine**  and load the **Simple Gantry** machine that you have just created.

The first and most important thing to notice is that the global datum of the machine is lined up with the global datum of the actual part.

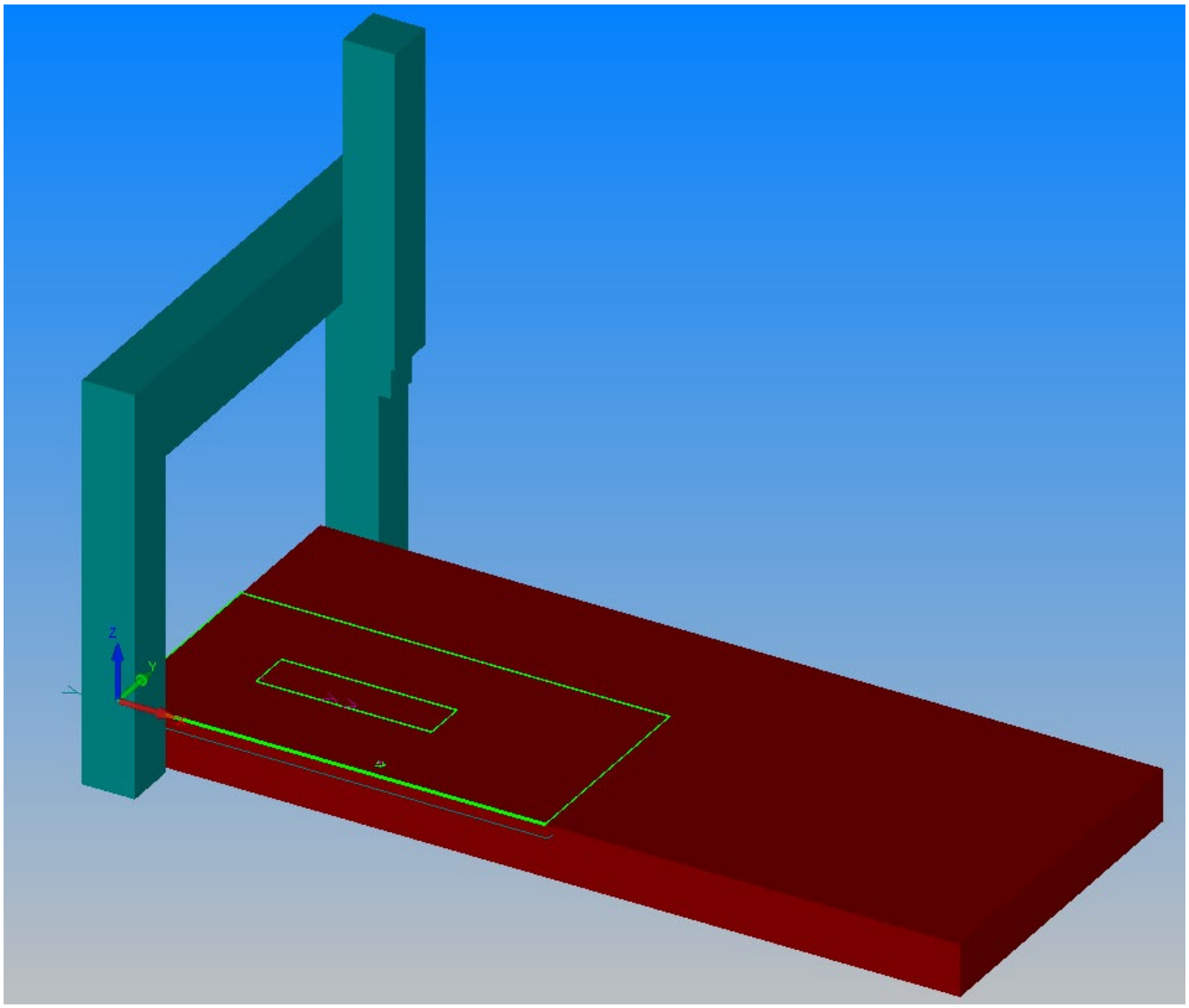


Figure 35 - Simple Gantry Machine with loaded part

To correct this, use the command **MACHINE > Machine Configuration > Move Part**  .
This command does not physically move the part, but re-positions the machine around the part to suit the correct location of the part on the machine.
Enter the values **X500, Y250** and **Z100** to place the part correctly on the machine.

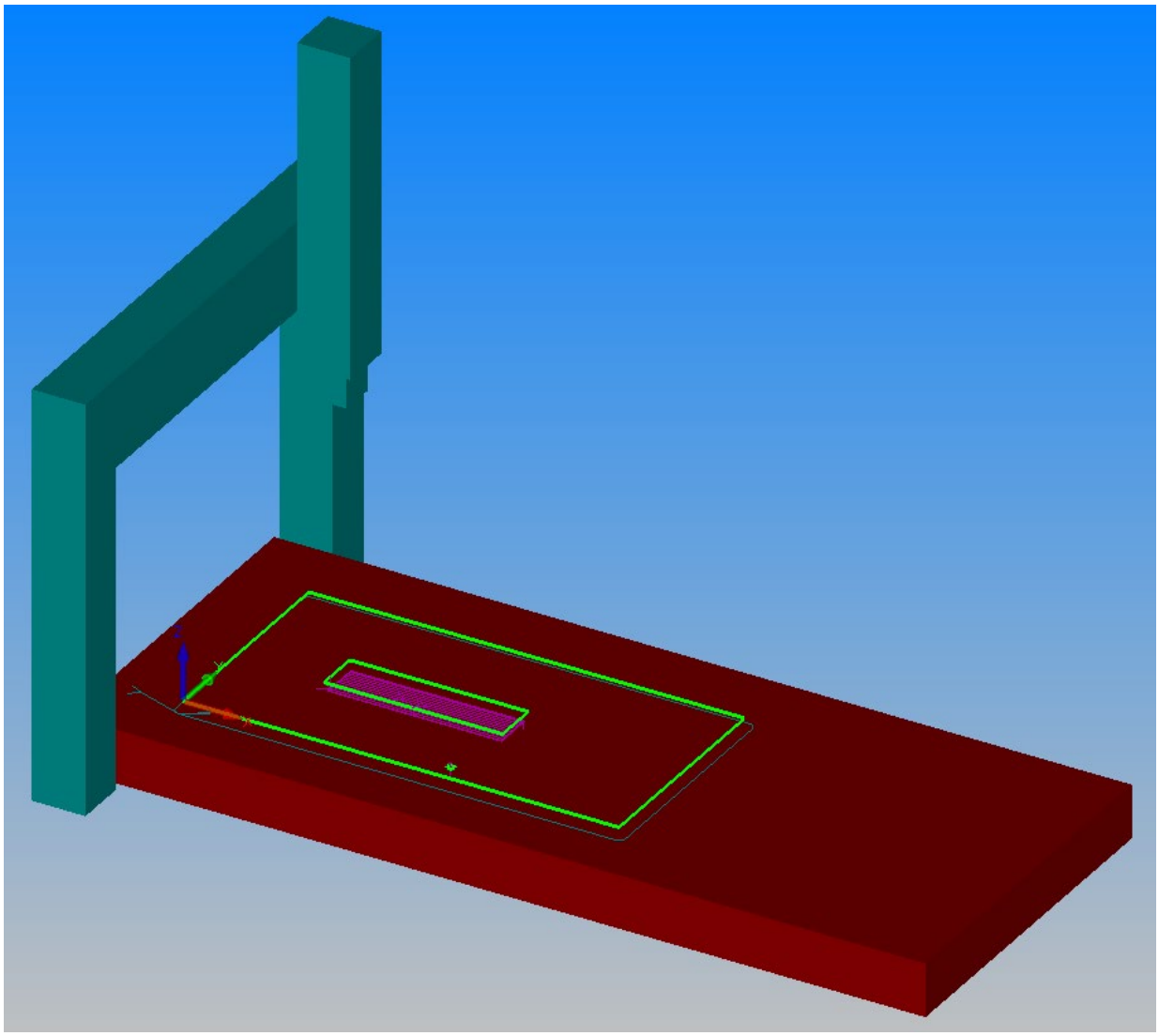


Figure 36 - Part repositioned correctly

Using the Simulation page of the Project Manager, run the wire frame simulation to test your settings for this machine.

If you notice any errors, use the correct options from the **MACHINE > Machine Configuration** to alter the inaccuracies.

> It can prove prudent to alter the global origin of the machine to suit the normal location for part machining so that you do not have to use the Move Part option every time you add the machine build to your part to be machined.

Complex Table Machine.

Figure 37 - A complex 5 axis machine

In this example, we will look at the necessary requirements for creating a more complex moving machine using Solid Models instead of 2D geometry.
It is possible to mix and match 2D and 3D items within the same build, this example is a pure Solid Model based creation.

We will be creating several different parts;

- Main Casting
- Machine Doors
- Saddle
- Rotating Table
- Head Unit
- Company Logo

Also, there will be the need to create a pair of 3D Polylines to dictate the rotation capabilities of the machine head unit and the rotary table section.

Machine Configuration

Setting the machine configuration is the process of defining which axes will move on the machine and, if required, the rotational options for 4 or 5 axis types of machines.

Open the file **Complex Table Machine** in the following location
"……TRG112 2D Machining 2020\Examples\Machine Configuration Examples\"

Using **MACHINE > Machine Configuration > Machine Configuration**  opens the following dialogue.

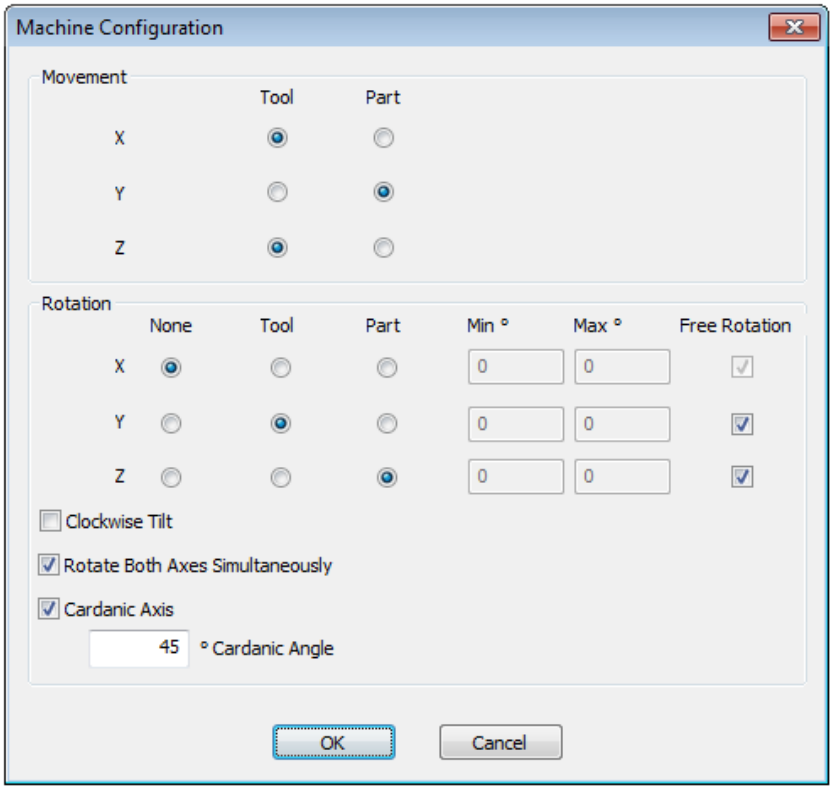


Figure 38 - Correct options for Machine Configuration of the complex machine

Set the options as shown above for this machine.

This style of machine has a table that will only move in the Y axis and the Head unit that only moves in X and Z.

The **Rotation** section deals with rotating around the axis in question.

On this machine, there is a rotary table unit that spins around the Z axis and the head unit that can rotate around the Y axis.
There is nothing on the machine that can spin around the X axis.

For this example, we will use the **☑ Free Rotation option** which allows the axis to rotate through any angle, if your machine has definite positive and negative limits of rotation, you would not tick the option and enter the required values in the relevant box(es).

The bottom three tick boxes are machine specific; this machine does have a **☑ Cardanic Axis head**, this is a head unit mounted at an angle rather than connected at 90°. This type of head uses compound angles to rotate the head to the correct programmed angle value. You are also requested to enter the actual Cardanic angle of the head mating faces.
On more complex machines, the manufacturers' machine tool manual may need to be referenced to find the exact angle.

The **☑ Clockwise Tilt and ☑ Rotate Both Axis Simultaneously** options are machine specific, if you require these options ticking, tick them. If not, leave them un-ticked.

It should also be noted at this point that it is always advisable to set up the moving and rotational axis options prior to building the machine as this will directly affect the questions asked in the dialogue box when setting the rotational axis for any section.

Define Machine Component

To create the actual representation of the machine parts, we use the command

MACHINE > Machine Configuration > Define Machine Component 

Main Bed

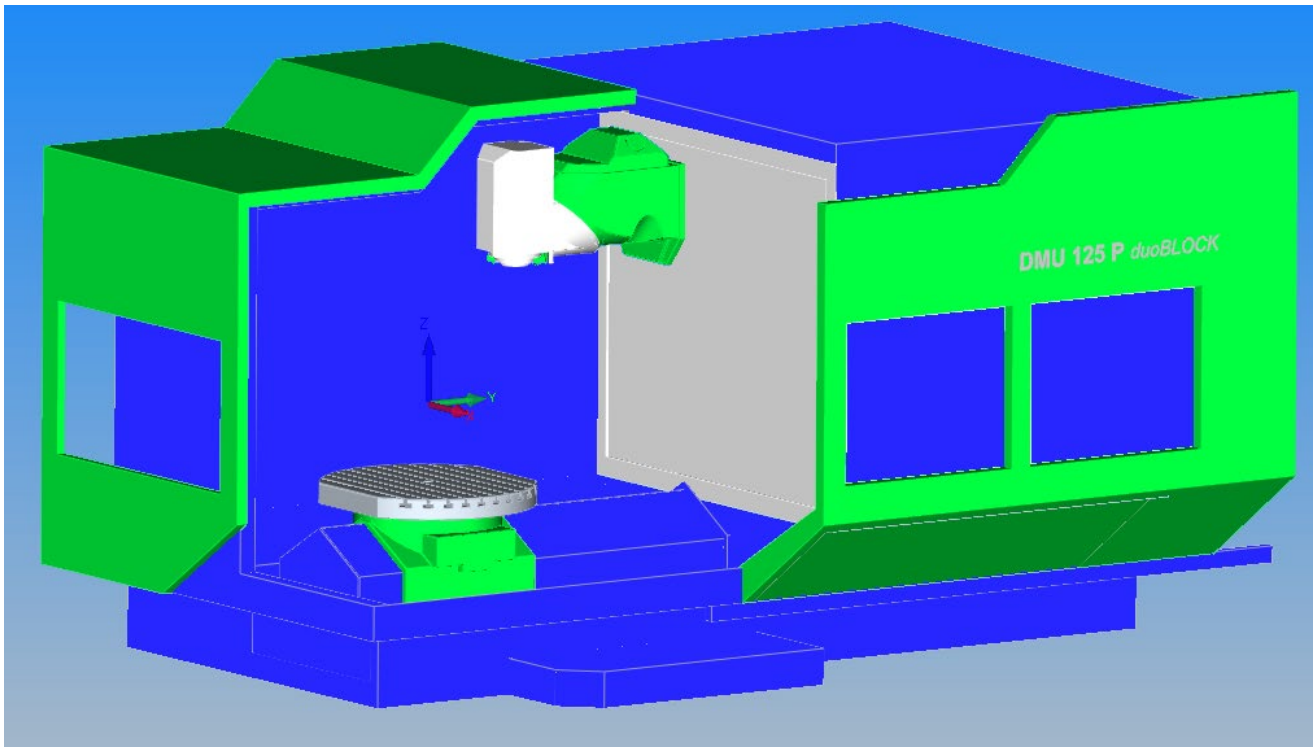


Figure 39 - Selecting the Main Bed solid component

When prompted **<LClick>** on the main area shown on blue.

Make the options as shown below.
Note that you cannot enter any values in the Top Z and Bottom Z boxes as the shape is defined by the solid model you have selected.

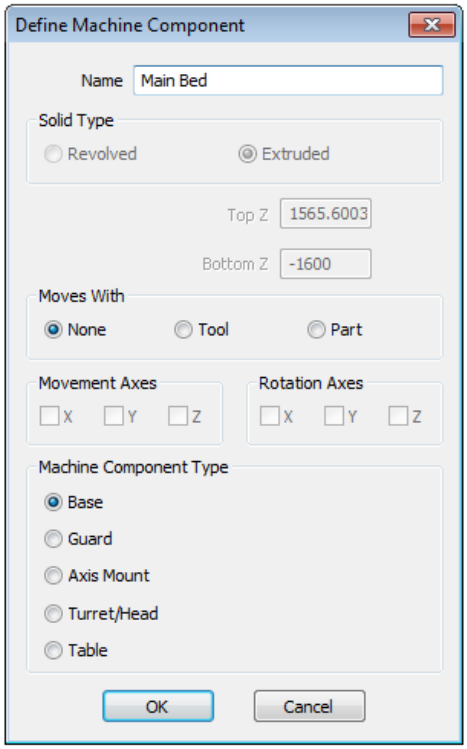


Figure 40 - Set the component options for the Main Bed

On the following pages are images of the parts to select using the **<LClick>** option, and the dialogue settings for those parts.

Follow through the images and set the options as shown in the dialogues.

Remaining Component Definitions

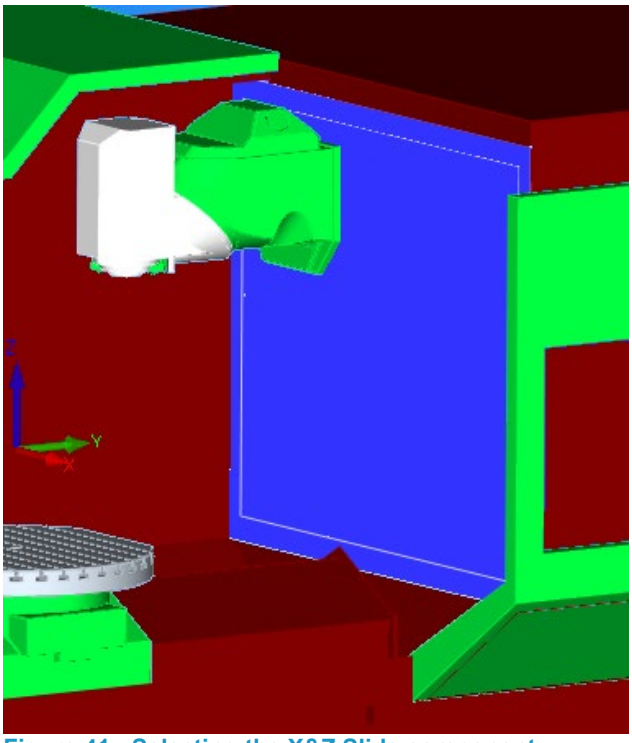


Figure 41 - Selecting the X&Z Slide component

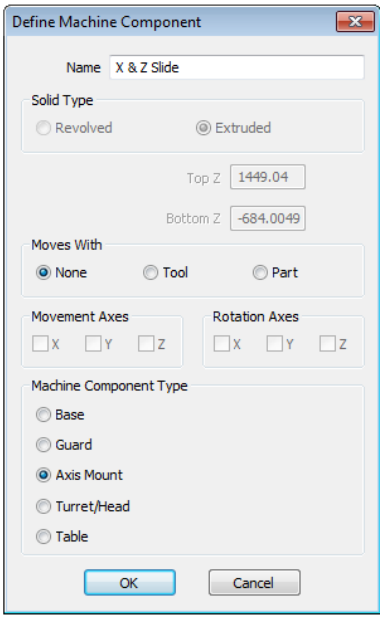


Figure 42 - Set the component options for the X & Z Slide

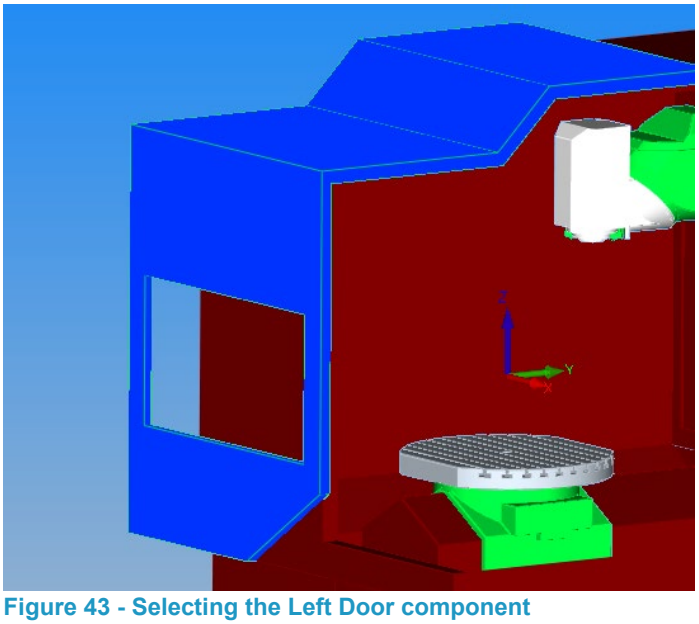


Figure 43 - Selecting the Left Door component

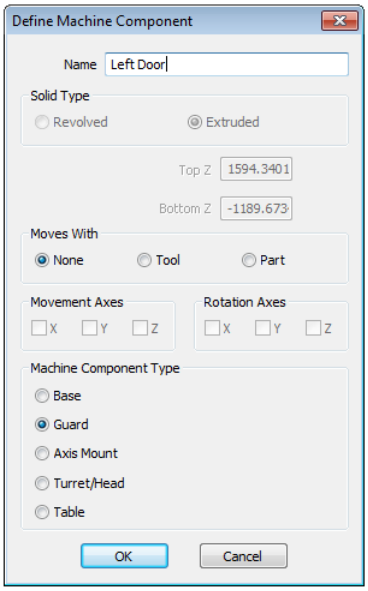


Figure 44 - Set the component options for the Left Door

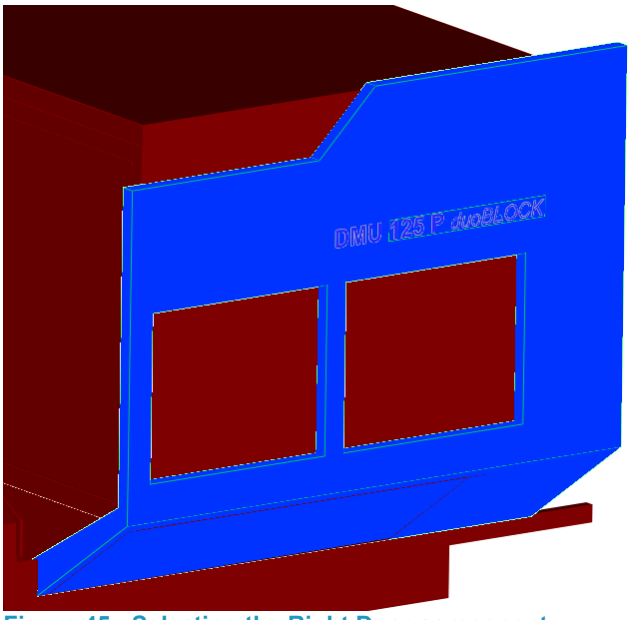


Figure 45 - Selecting the Right Door component

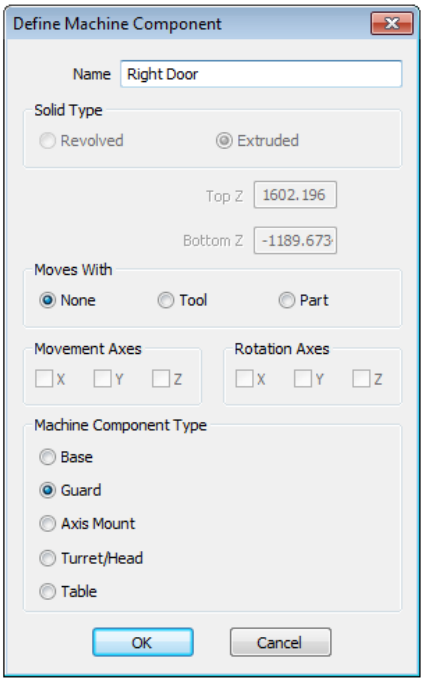


Figure 46 - Set the component options for the Right Door

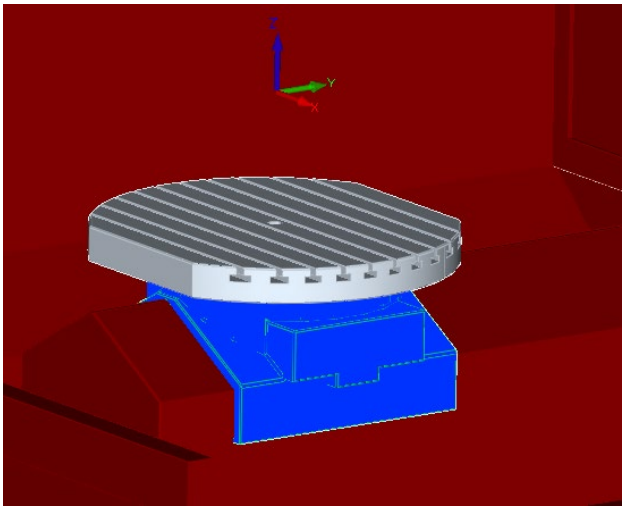


Figure 47 - Selecting the Y Axis Saddle component

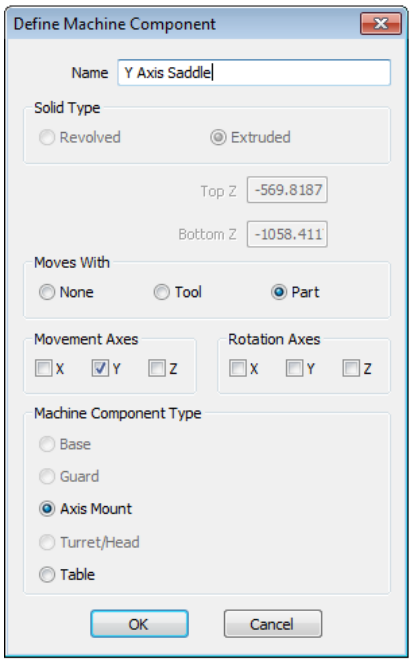


Figure 48 - Set the component options for the Y Axis Saddle

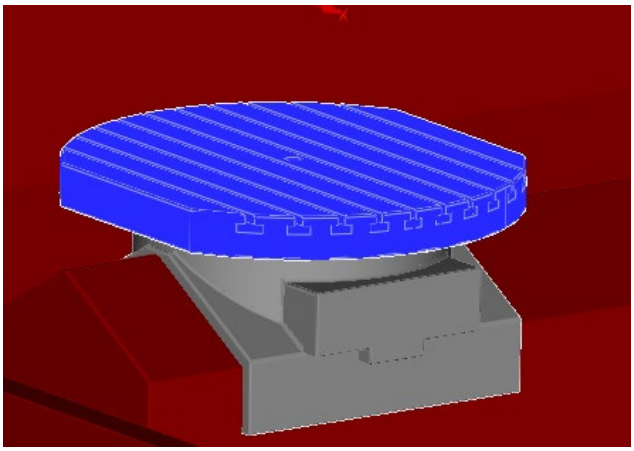


Figure 49 - Selecting the Rotary Table component

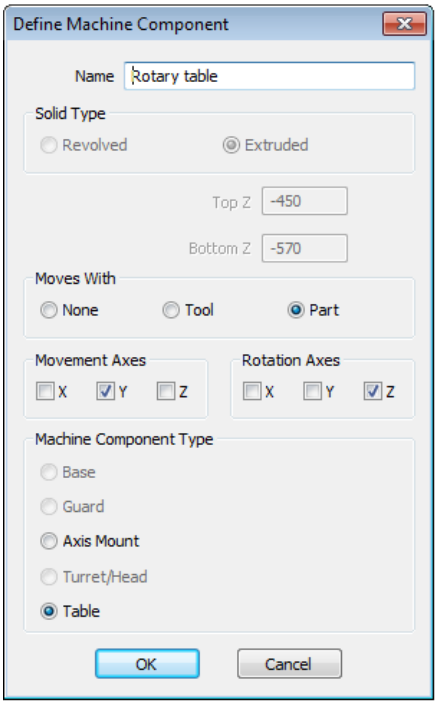


Figure 50 - Set the component options for the Rotary Table

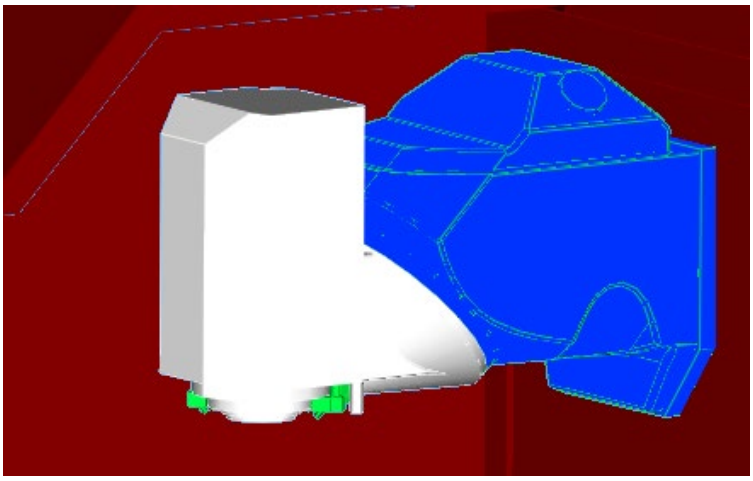


Figure 51 - Selecting the Head Unit component

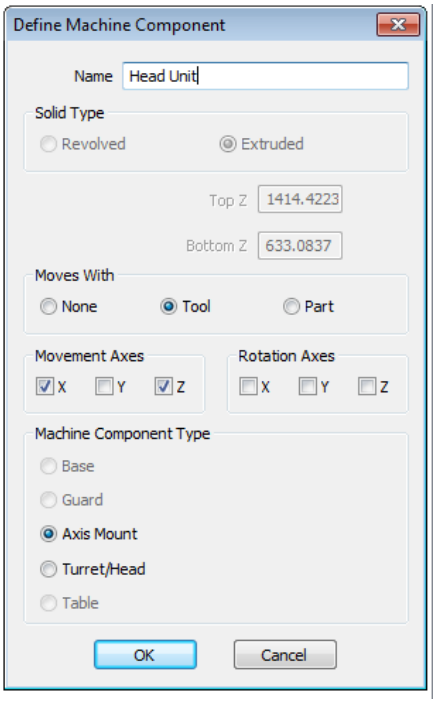


Figure 52 - Set the component options for the Head Unit

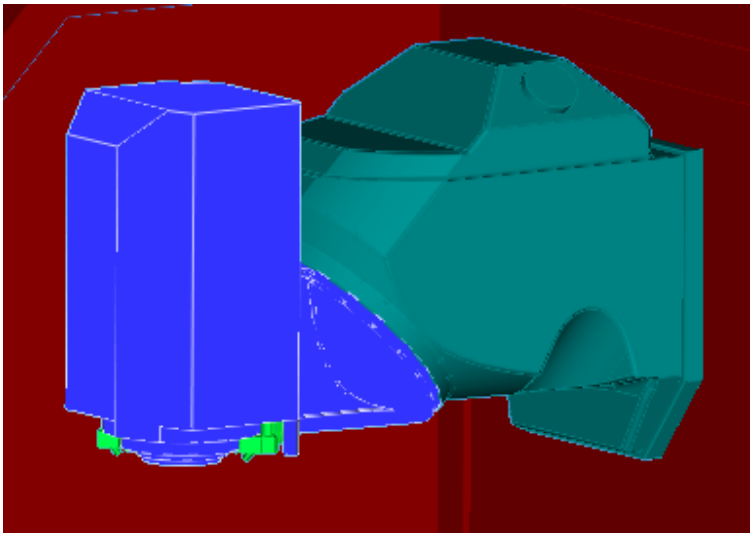


Figure 53 - Selecting the Rotating Head Unit component

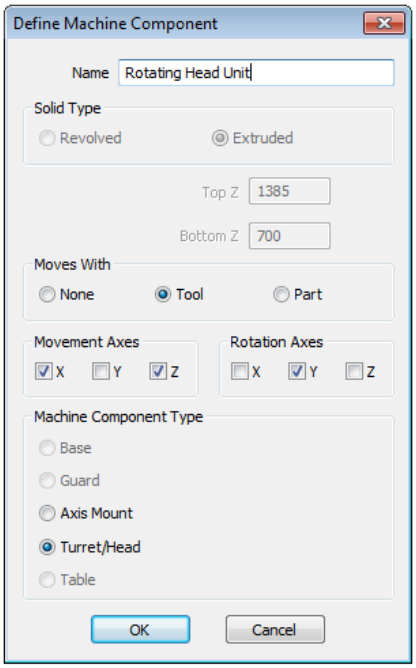


Figure 54 - Set the component options for the Rotating Head Unit

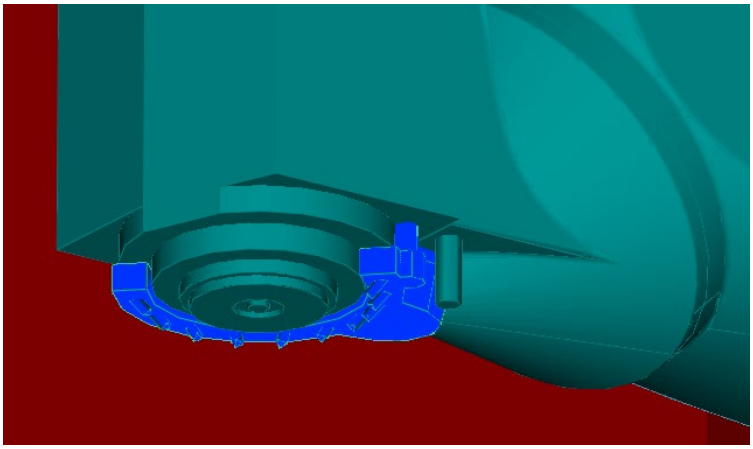


Figure 55 - Selecting the Coolant Unit component

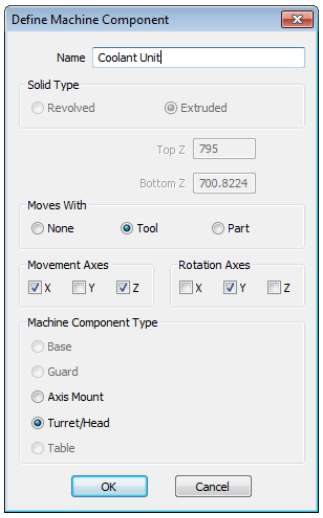


Figure 56 - Set the component options for the Coolant Unit

Rotational Axis

With this build of machine, there is the requirement for a pair of 3D polylines that will define the axis of revolution for the **Rotary Table and the Rotating Head Unit.**

Use **GEOMETRY > 3D Polyline**  , then using the **<F8>** key to snap to the **Centre Of an arc**, carefully create the two lines as shown below.

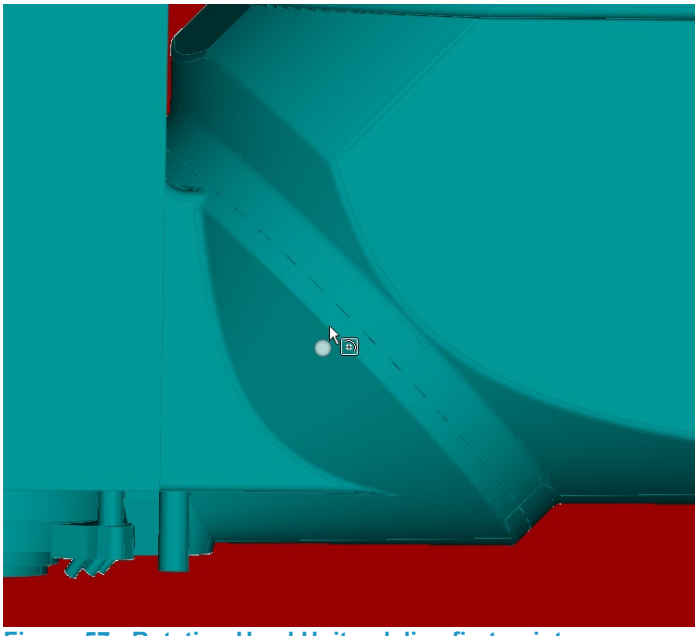


Figure 57 - Rotating Head Unit polyline first point

Select an arc on the Rotating Head Unit as the first point.

For the second point, select an arc on the Head Unit.

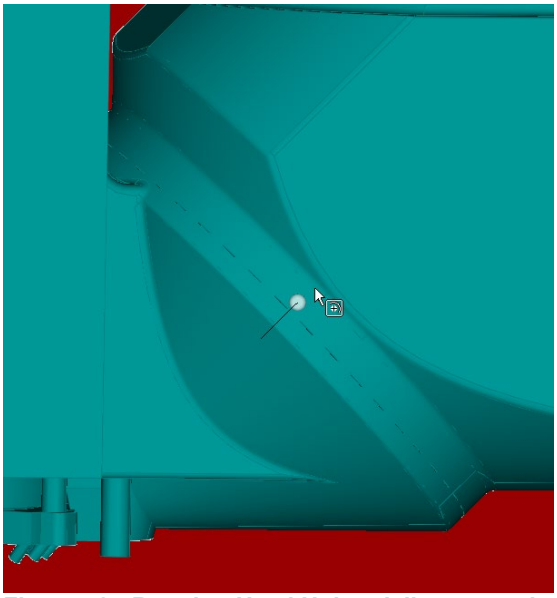


Figure 58 - Rotating Head Unit polyline second point

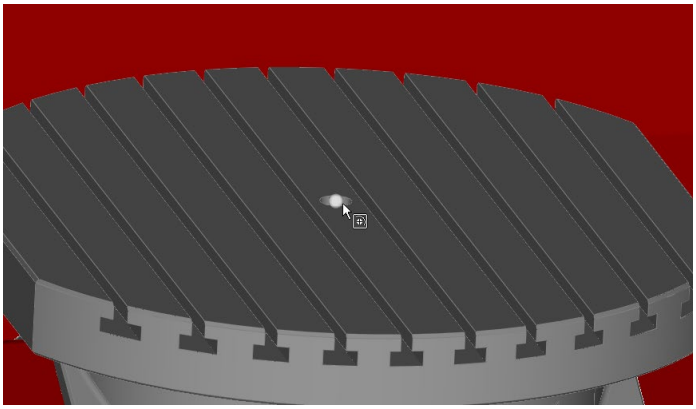


Figure 59 - Rotary Table polyline first point

For the second 3D Polyline, select the centre point of the Rotary Table

For the second point, enter the values in the dialogue boxes manually, X0, Y0, Z0.

(Hint, the X & Y values are already populated)

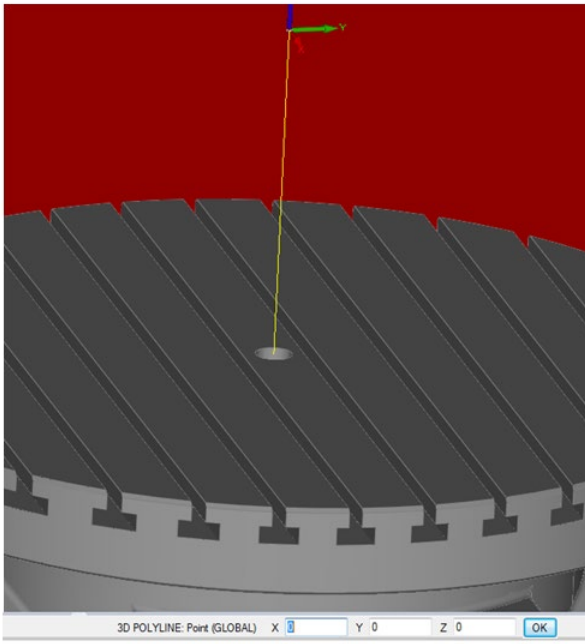


Figure 60 - Rotary Table polyline second point

Using **MACHINE > Machine Configuration > Define Axes** 

You will be prompted to select the line that represents the Y axis rotation direction.
Y axis is the only selection option as this was set in the Machine Configuration section earlier.
Select the first 3D Polyline that you created which runs between the two head sections.

You may find it useful to turn off Shading using the **VIEW > Shading**  option.

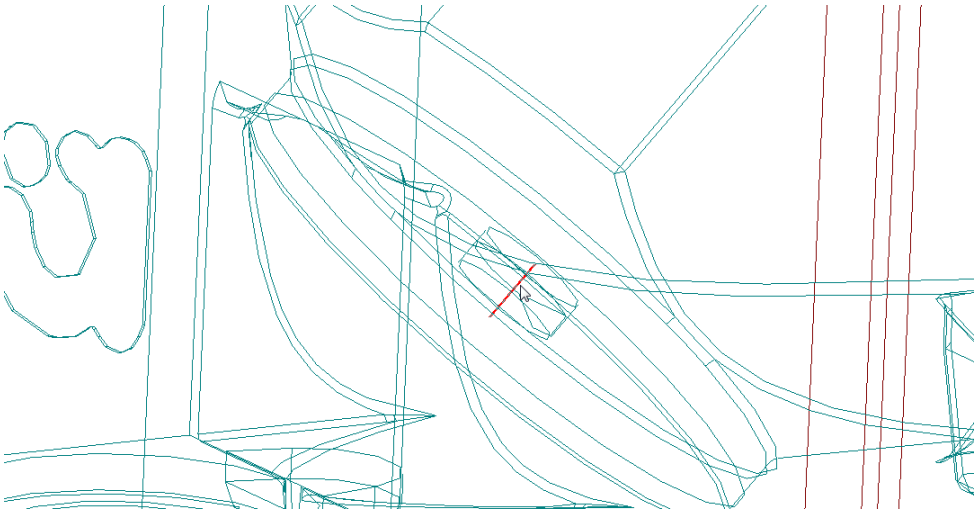


Figure 61 - Polyline selection for Head unit rotation axis

<LClick> the first polyline, you will then be asked for the Z Axis for Part Rotation, **<LClick>** the second polyline running up from the Rotary Table.

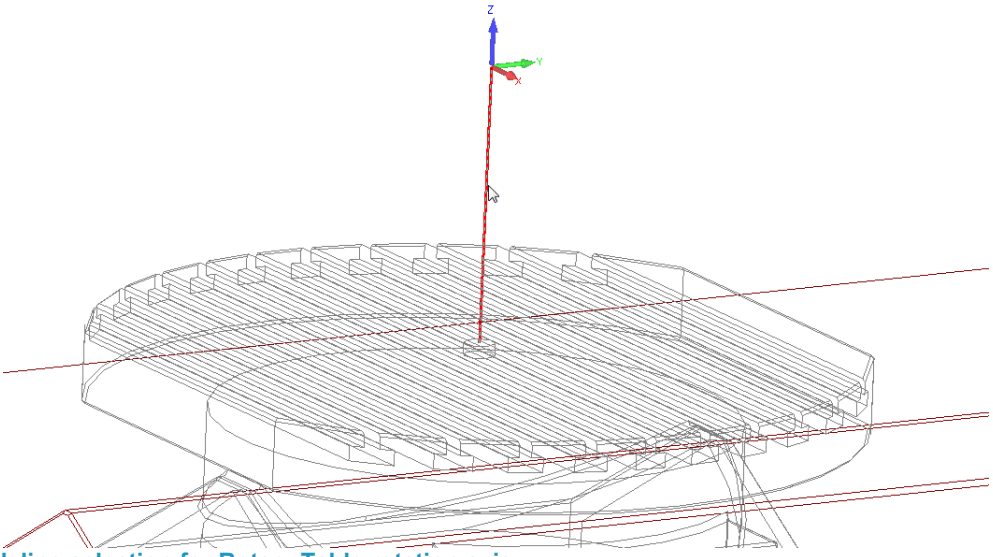


Figure 62 - Polyline selection for Rotary Table rotation axis

Tool Location

Now that we have all the parts completed, we need a marker on the machine to locate the tool to give a correct representation of the machining process.
This is done using the command

MACHINE > Machine Configuration > Set Tool Home Position 

This is the position on the machine build that will primarily locate the centre line of the tool so that its Z axis aligns with the Z axis of the plane in which the tool is working.
The tool length is then used to locate the bottom of the tool down the Z axis of the machine away from the Tool Home position.

If you are wishing to use tool holders in your simulation, then you must also enter a correct value in the **Tool Tip to Gauge Line Length** option on the **Simulation** section of the tool definition dialogue when defining tooling. This will then position the tool and holder correctly from the Tool Home Position.

Examples

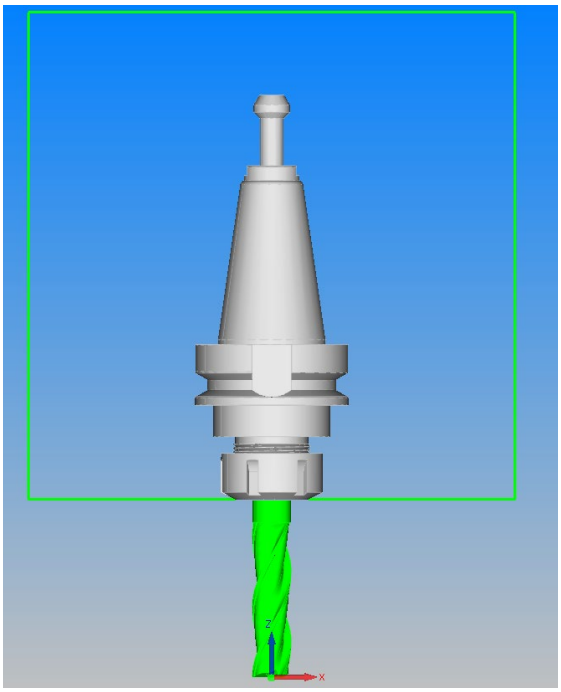


Figure 63 - Tool set without a holder

A standard tool with holder positioned in the rectangle that represents our current spindle nose. With an incorrect or missing **Gauge Line Reference point.**

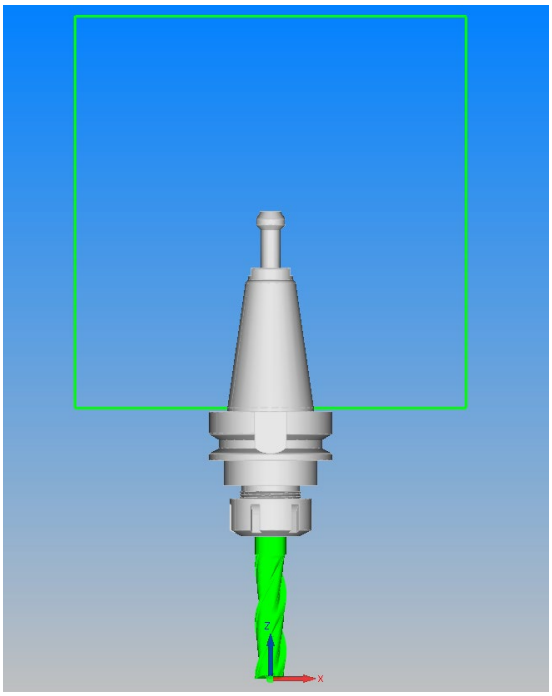


Figure 64 - Tool set with a holder

The same tool using a tool holder with the correct **Gauge Line Reference point.**

Using the command

MACHINE > Machine Configuration > Set Tool Home Position 
Place the location using the **<F8>** to the Centre of the arc shown below.

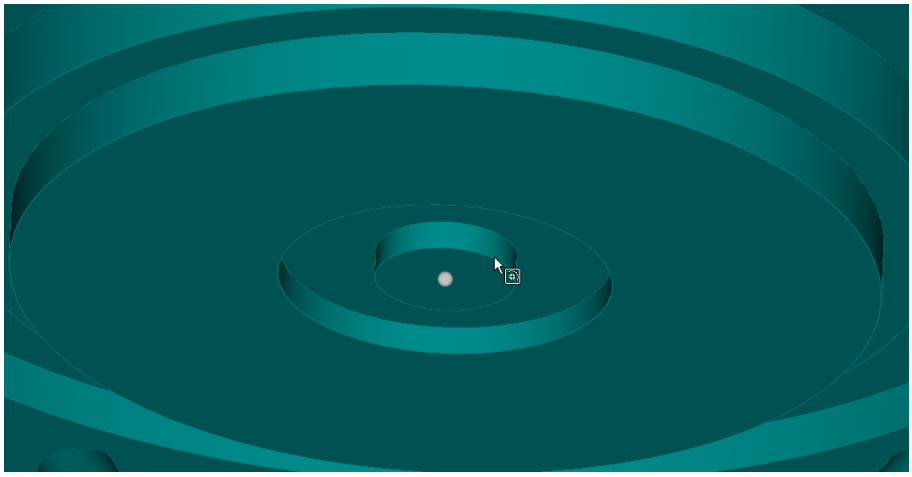


Figure 65 - Tool Home position chosen

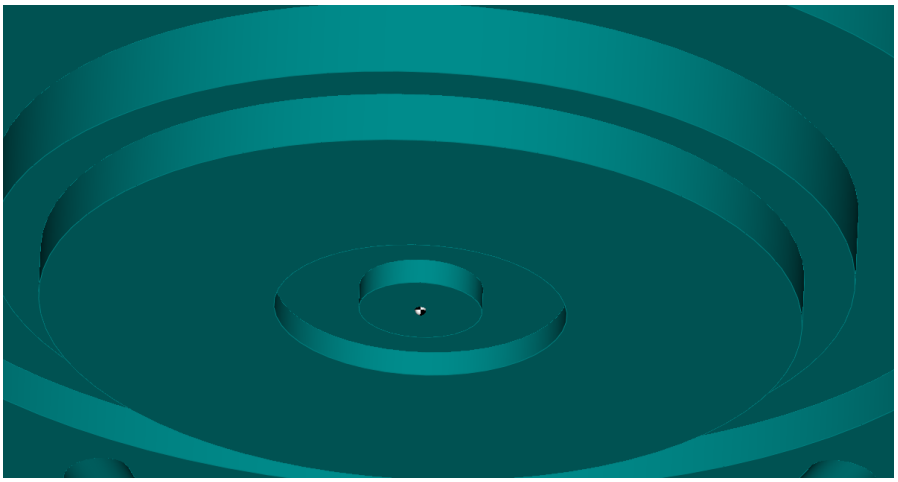


Figure 66 - Tool Home position set

A black and white datum marker will be added to the Machine Build to denote the home position of the tooling.

Use **MACHINE > Machine Configuration > Save Machine** 
and call it **Complex Table Machine.**

This has only saved the machine configuration so if you wish to use this drawing again, you need to save the actual ALPHACAM drawing file using **FILE > Save.**

Testing

To start the testing process, open the test file **Side Machining** in the following location "**……TRG112 2D Machining 2020\Examples\Machine Configuration Examples\"**

Using the command **MACHINE > Machine Configuration > Open Machine** and load the **Complex Table Machine** that you have just created.

Different to the first example, this machine has been created with the Global datum point in the most used location, so on this machine there is no requirement to use the

MACHINE > Machine Configuration > Move Part command.

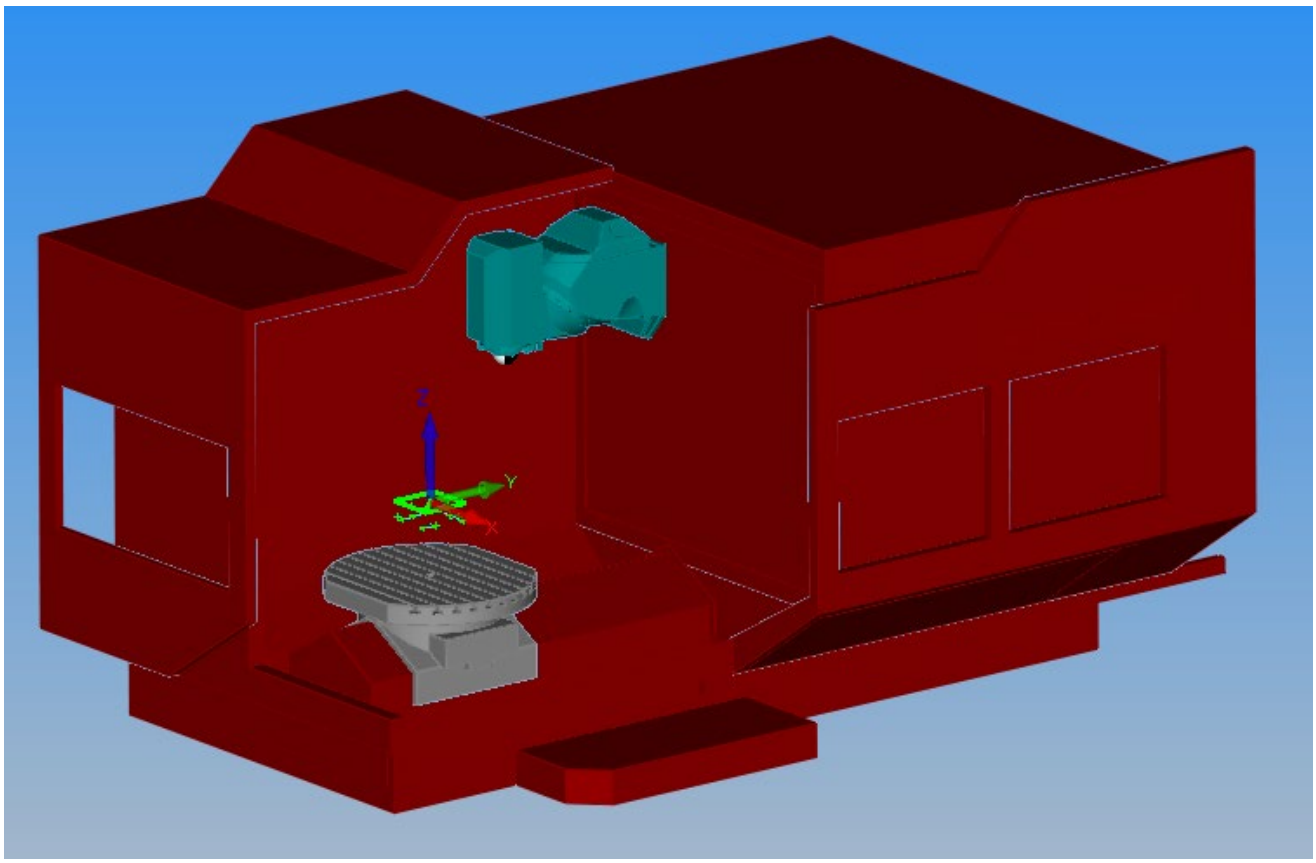


Figure 67 - Complex 5 Axis machine with loaded part

Using the Simulation page of the Project Manager, run the wire frame simulation to test your settings for this machine.

Tips and Tricks

Project Manager, Show Machine Configuration

Unless you work with machines in the simulation all the time then this particular option may be turned off.

At the top of the **Layers Project** Manager page there is the **Show Machine Configuration icon** 

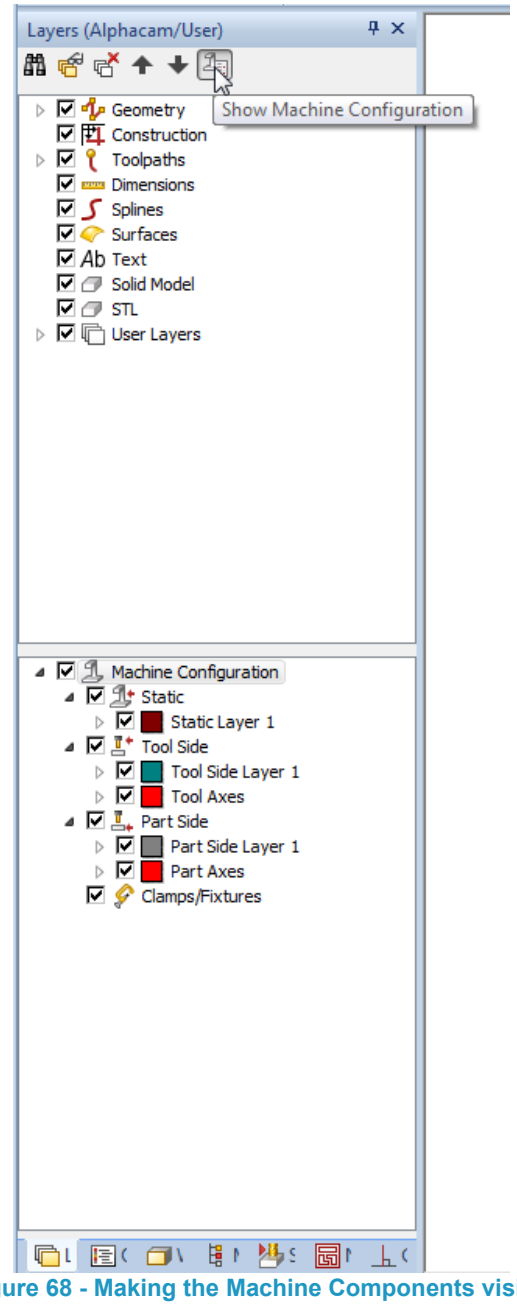


Figure 68 - Making the Machine Components visible

With this turned on, the Layers assigned to the current machine in the ALPHACAM drawing are displayed.

Additional Layers

As with any drawing in ALPHACAM, the **Machine Side** can also be re-organised into differing layers and alternate colour schemes to suit your own needs.
Try experimenting with additional layers, **<RClick>** on the layer **Static** and select the **Add Layer** option.

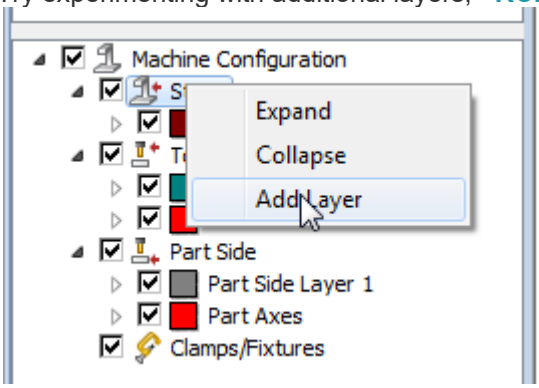


Figure 69 - Adding an extra layer to the Machine Configuration

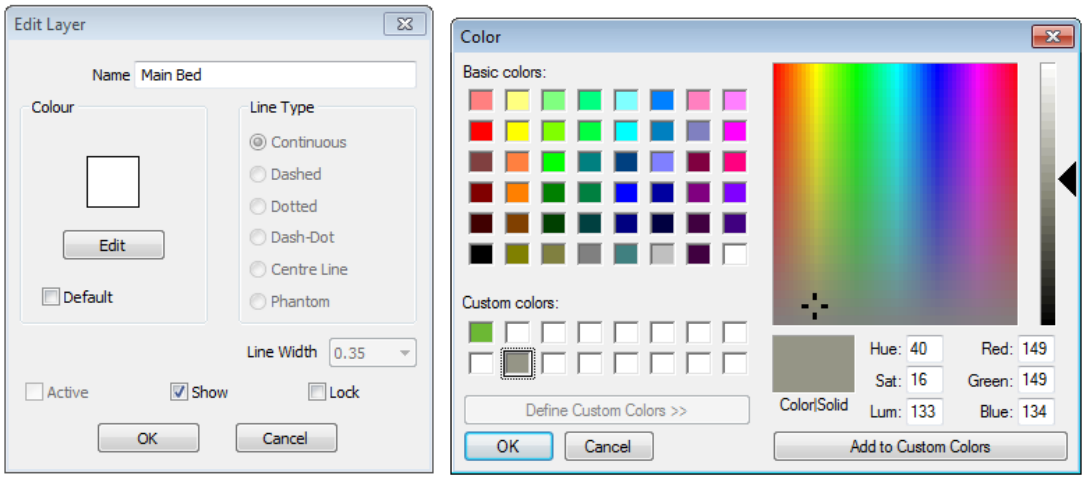


Figure 70 - Resetting the layer colours to your own choice

Give the new layer a suitable name and **<LClick>** on the **[Edit]** button to access the colour palette.
Select a suitable colour, then **<LClick> [OK]** twice to complete the creation.

Once the new layer is available, expand the **Static Layer 1** to see all the components we created earlier. All the same colour.

<LClick> and hold down the button on the entry **Main Bed,** then drag it down until the Main Bed layer highlights, now release the mouse button to drop the Main Bed from its original layer to the new layer.

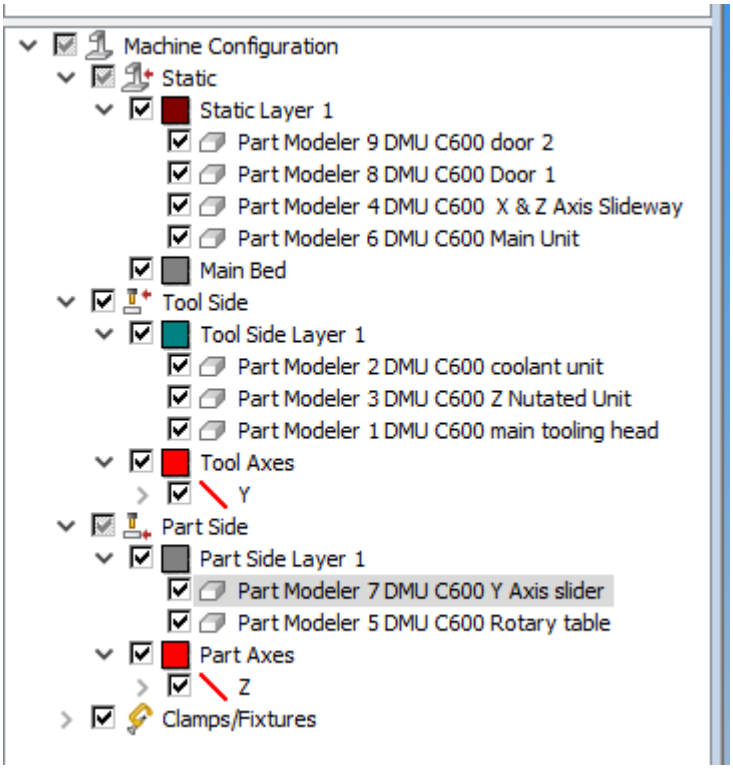


Figure 71 - Moving the Main Bed component to the newly created Main Bed layer

This can be worked on to a fine degree as shown in the following example of the same machine. This has had all the parts re-assigned to different layers with different colour schemes applied.

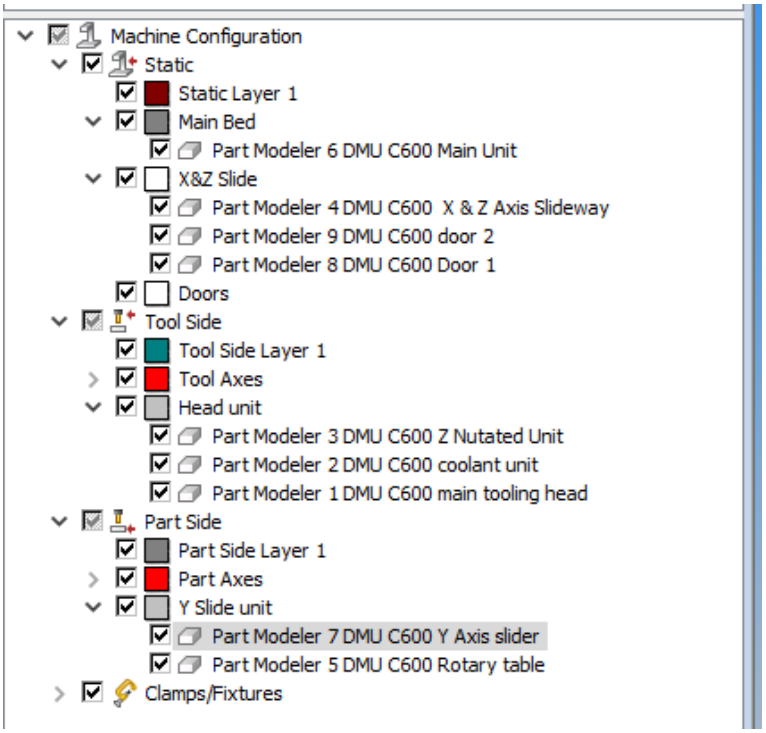


Figure 72 - Default layer assignments altered to a User specific set up

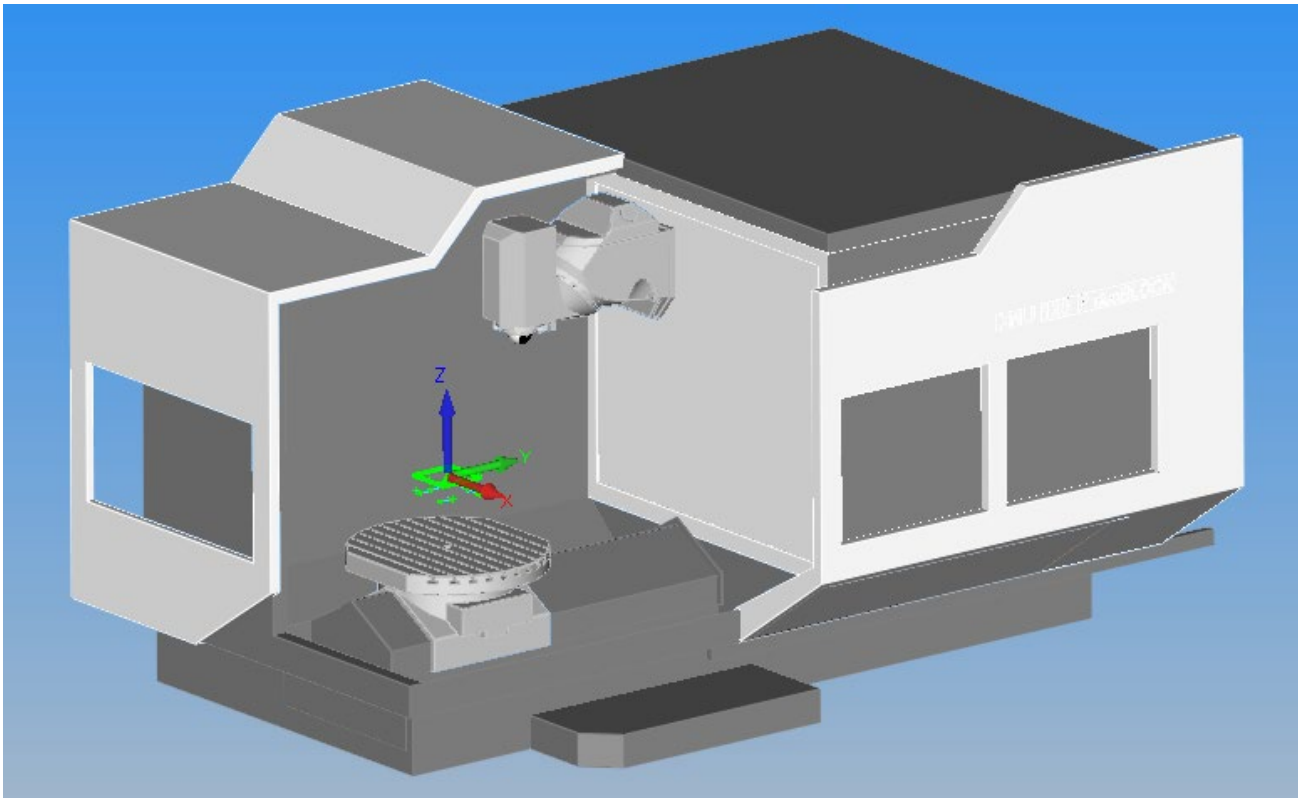


Figure 73 - Layer adjusted machine

Machine with Every Drawing

If you want to have the machines available for every drawing or part that you create in ALPHACAM, there are two methods you could use.

Set Default Machine

Using the **MACHINE > Machine Configuration > Set Default Machine** command will allow every new drawing that you create to have your machine of choice preloaded to the drawing.
If you only have one machine this can be very useful if you wish to simulate all parts prior to running on the machine. When using multi-axis machines, this almost becomes a rule rather than an option.

Saving with the drawing

On the other hand, if you do not want to load the machine every time, then do not set a Default machine, instead use the **☑ Include Machine with File Save option** from **HOME > Configure > General** for those times that you think it would be beneficial to have the machine saved along with the drawing.

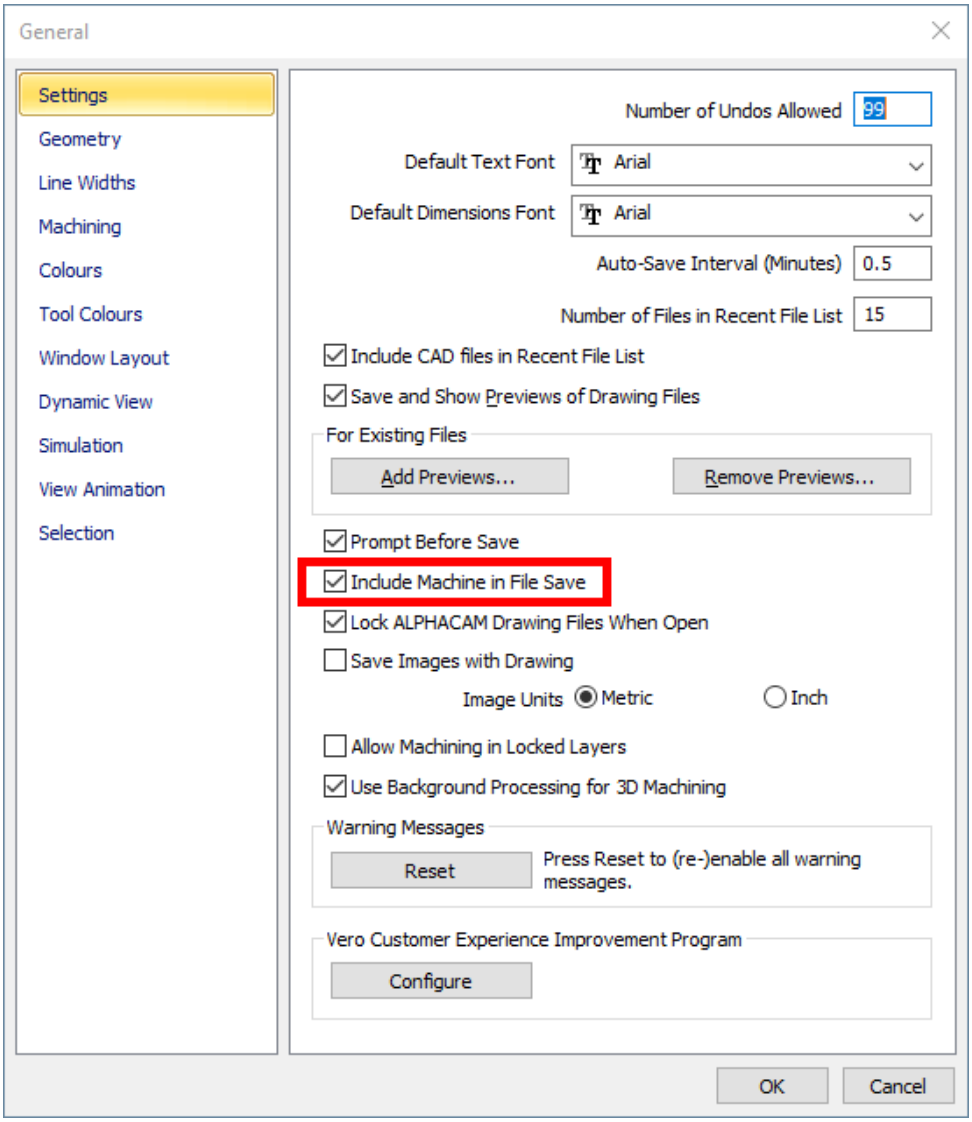


Figure 74 - Include Machine in File Save option

Clamping and Fixtures

In ALPHACAM there exist the processes to set up and automate the manipulation of clamping systems that can be set up on many modern machines. This can range from the simulation of a simple on or off type clamp to the multi-positioning set up of a pod and rail type woodworking machine.

In this next section, we will look at the methods of setting up a simple set of clamps that will permit the machining of one side of a part, and then reverse the clamping to machine the second side.
Whilst this may not represent your machine exactly, the methods of setting up clamps are the same in all ALPHACAM modules.

The initial processes for setting up a clamping system are;

- Create the clamp Solids or Geometries, both can be used and in any combination.
- Use Define Clamp and make the options to suit the needs of the clamping system, based on how many different elements there are.
- Add additional reference geometry to aid in positioning, if required.
- Add additional clamp geometry for alternate set ups, if required.

The process for using the clamping system once created is;

- Position the various clamps to suit the initial start point.
- Move the clamps to the secondary set up position.
- If required move the clamps to the third or subsequent positions.
- In the Operations page of the Project Manager, move the clamp entries to the correct position in the Operations tree.

Clamp Creation

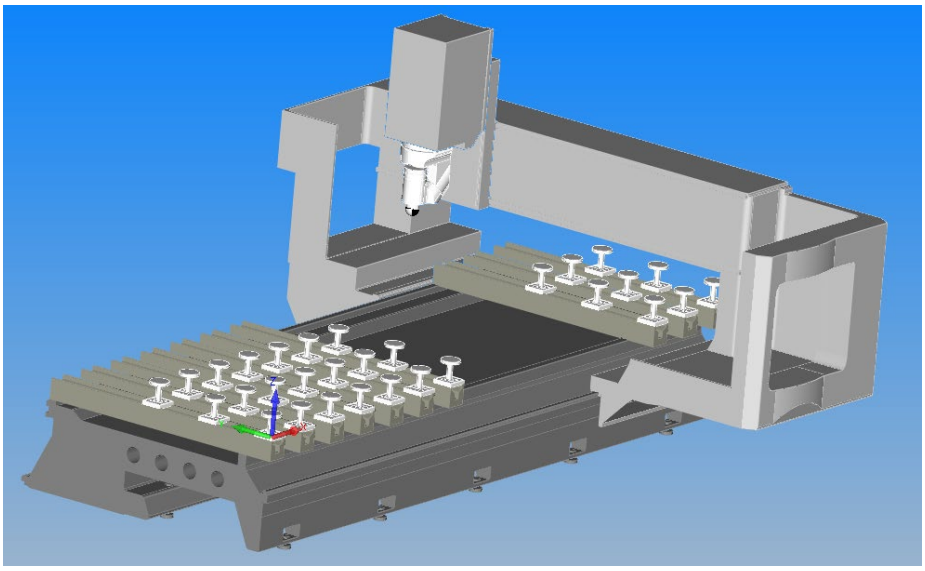


Figure 75 - 5 Axis Pod & Rail machine

The machine shown above is one which we will be setting up the clamps for, though not in as much depth as the one shown. We will be creating only one section to demonstrate the methods which can be applied to full machine and clamping simulations.

Open the file **"…\ALP TRG112 2D Machining 2020\Examples\Clamps and Fixtures\Drawings\Automation 3 Rail"**

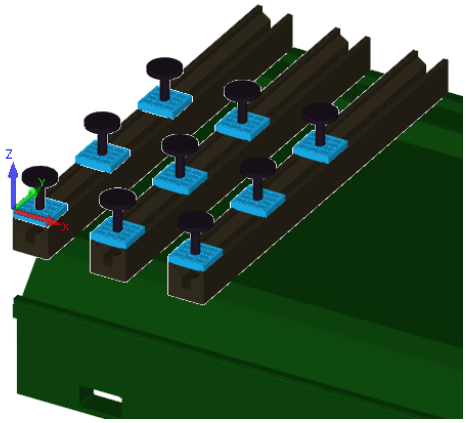


Figure 76 - Three rail section example file

When creating clamps and fixtures there is a relationship between all the parts so that they can link and work with each other.
In this working example, we will be creating four separate sections of clamps

- The Main Bed.
- Moving Rails.
- Moving vacuum pods.
- Pop up clamps.

Main Clamping Dialogue

Using **MACHINE > Clamps/Fixtures > Define Clamps/Fixtures**  you are prompted to select the item that will become a clamp from the on screen solids or geometries.
<LClick> on the largest item, the Main Bed of the clamping set up.

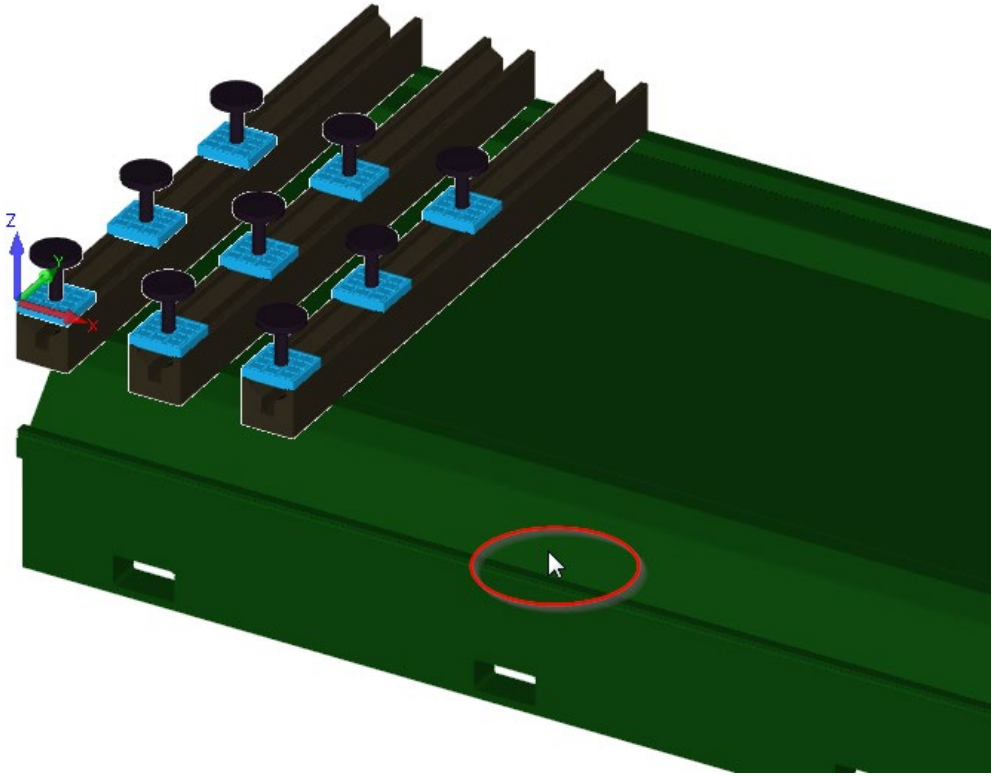


Figure 77 - Selecting the Main Bed component

You are now presented with the main clamp definition dialogue that is used throughout this section of the training.

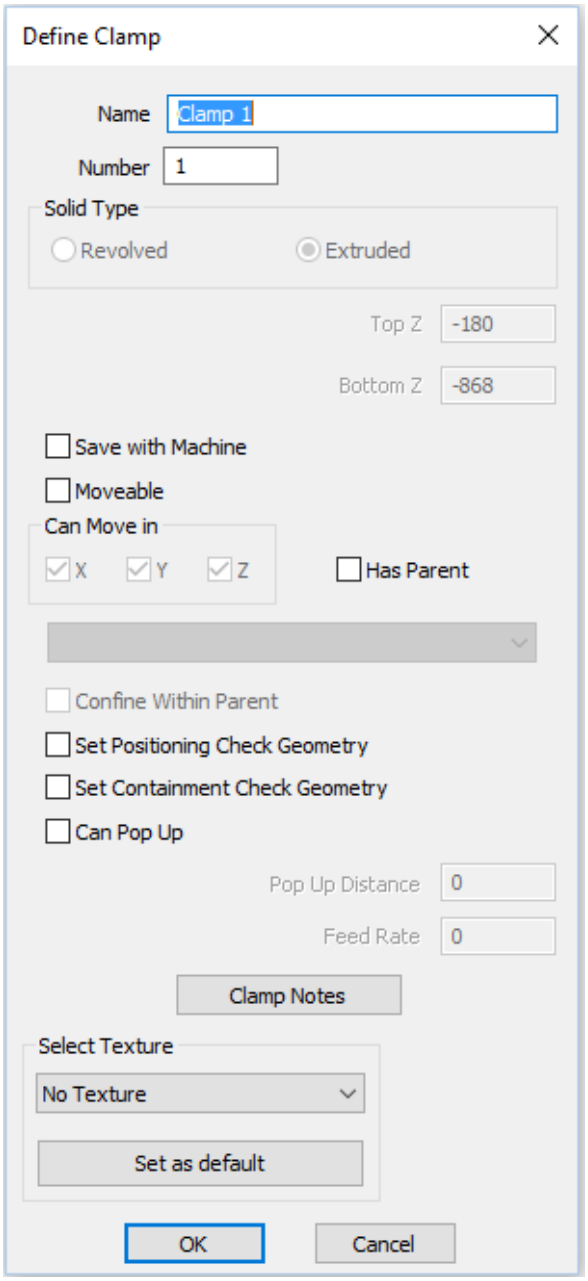
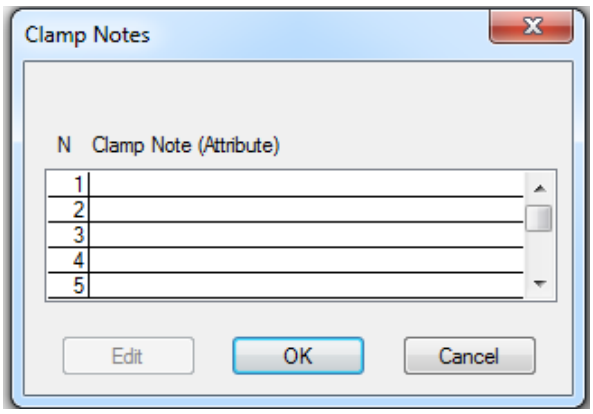


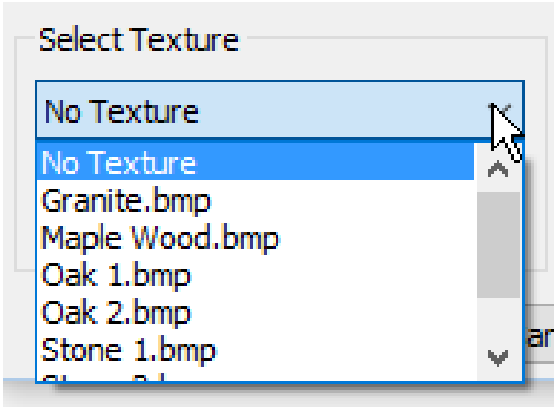
Figure 78 - Define Clamp configuration dialogue

Name	Your choice of clamp name.
Number	A sequential number to identify the clamp, this can be altered to suit any requirements.
Solid Type	Indicates either a revolved or extruded 2D geometry or if greyed out, a 3D solid model.
Z Values	The top and bottom Z values for extruded 2D geometries that can be altered or the fixed positions of a solid model.
Save with Machine	Allows the clamps to become part of a dedicated machine simulation.
Moveable	Can the clamp move? If ticked then the X, Y and Z options become available.
Has Parent	Is the clamp linked to another in the build?
Confine within Parent	The selected clamp cannot move outside of the selected parent item.
Set Positioning Check Geometry	Allows for the use of a specific 2D geometry to check against instead of the outer extremity of the model or geometry.
Set Containment Check Geometry	To restrict the movement of a clamp to simulate any specific limits on the machine.
Can Pop Up	The clamp can move up and down to simulate a clamping motion.
Pop Up Distance	How far in Z the clamp can move up or down. Negative values are allowed.



Clamp Notes

Allows for the addition of specific attributes that can be referenced by the post processor for specific requirements



Select Texture

Allows for the application of any image (png, bmp jpg etc.) to be applied to the clamp parts for a more realist impression of the clamp.

Set as default

This option will apply the chosen texture to all chosen clamp items.

Main Bed

Alter the name of this first selection to **Main Bed**, then **<LClick> [OK].**
Make the reference point for this part as X0 Y0 Z0.
The reference point is the section of the clamp that the mouse pointer attaches to when you start to reposition the clamps, as this unit will never move, the reference point is not important.
The item will now turn red to indicate that it has moved from being a part of the drawing to a unit of a clamp or fixture.

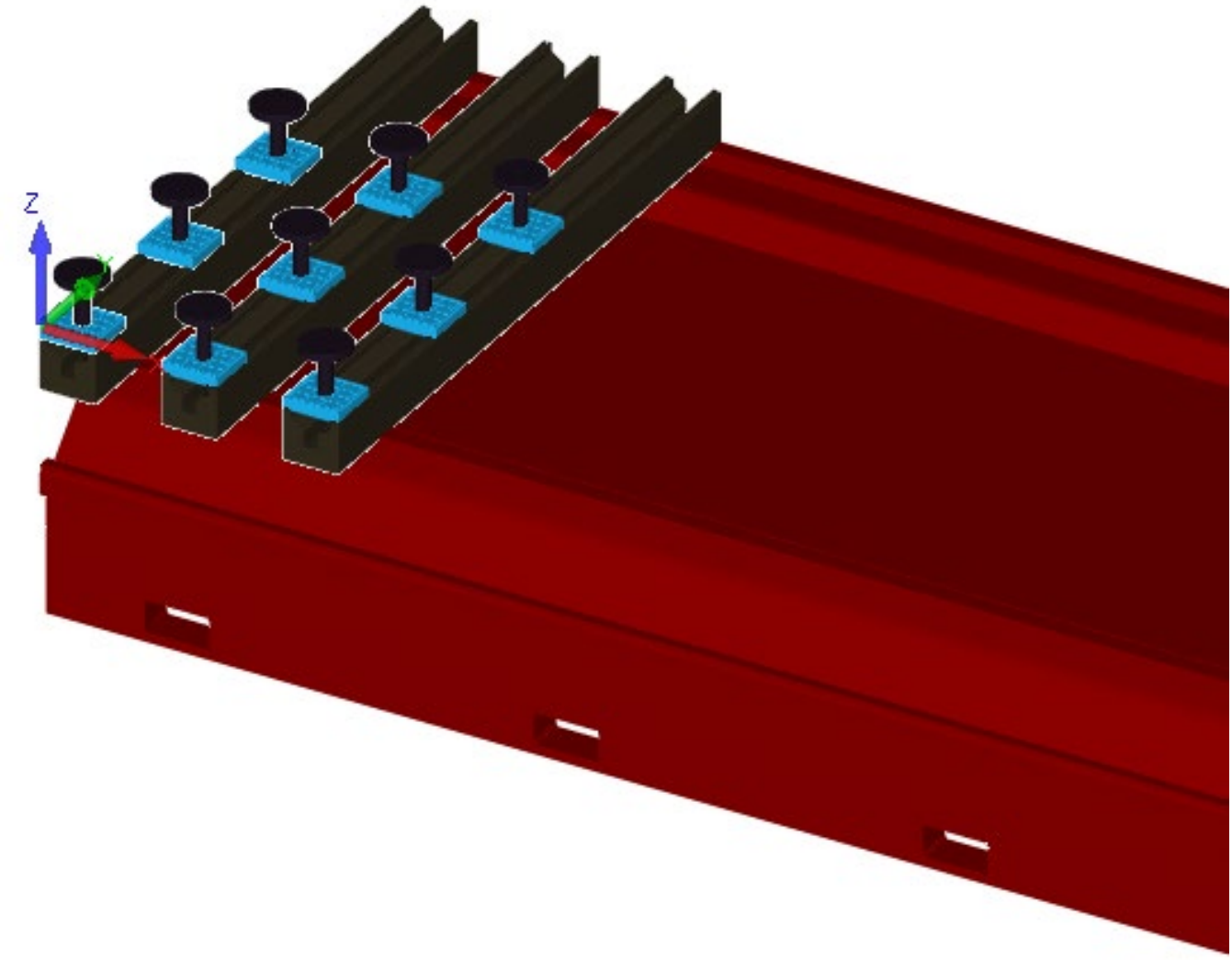


Figure 79 - Main Bed component created

Rail 1

You are now asked by the prompt bar to select the next clamp in the process.
<LClick> on the left hand cross rail.

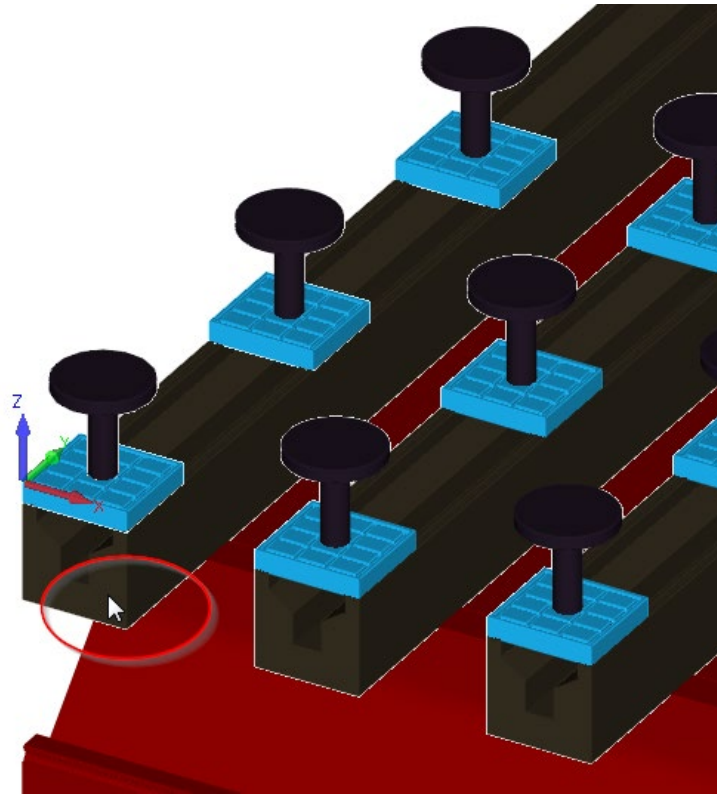


Figure 80 - Selecting the first Rail component

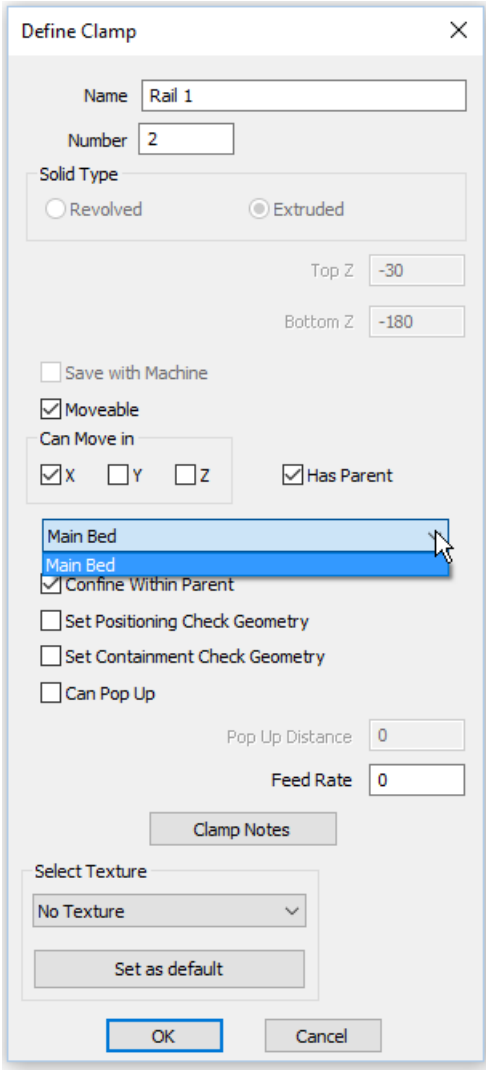


Figure 81 - Options to set for Rail 1

Alter the name to **Rail 1.**
This clamp can move, but only along the X axis, so set;
☑ Moveable,
☑X,
☑ Has Parent.

> Whenever a clamp component has the option ☑ Has Parent set, you must use the drop-down list below the option to choose which component it will be linked to. This list develops as you add more and more clamps to the process.

From the drop-down list, select the **Main Bed** as the parent item.

☑ **Confine Within Parent** will ensure that the cross rail remains on the bed.

To make this work correctly the item to be confined does have to be smaller than the parent, so if the parent was 1000mm from front to rear, make the cross rail 999mm, using 0.5 clearance front and back.

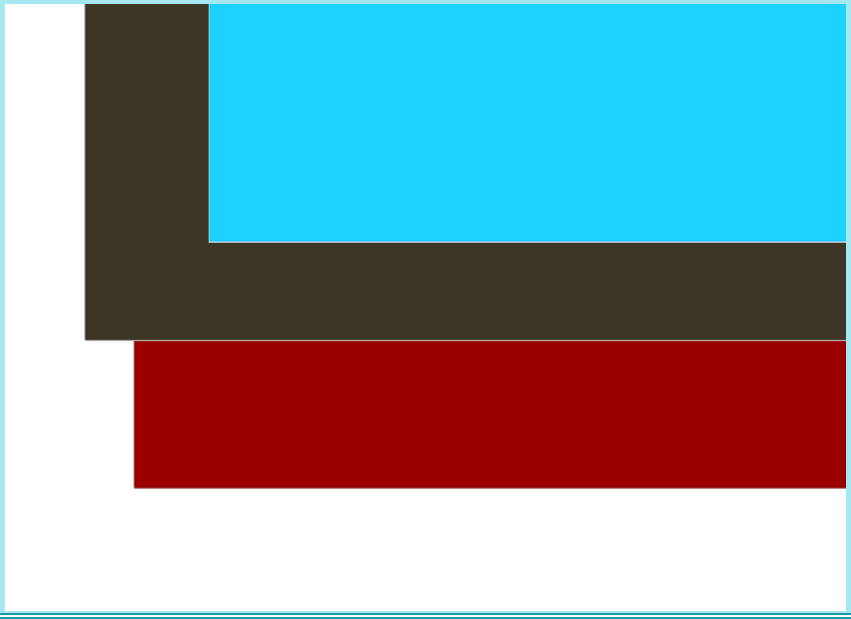


Figure 82 - Confine Within Parent clearance settings

The **Feed Rate** option allows for a more accurate visualisation when viewing in the Simulation. If left without a value, then the clamps will move in the simulation at the default rapid feed rate leading to an unrealistic view.

Placing a value in the dialogue will apply that value as a feed rate for that clamp when using the simulation routine. Only clamps that are created with the ☑ **Moveable option** active have the Feed Rate option enabled.

<LClick> [OK] and when prompted for the reference point, using **<F7> (MID-point of)** select the midpoint of the cut out channel to make the handle for this unit to be the front and centre of the unit.

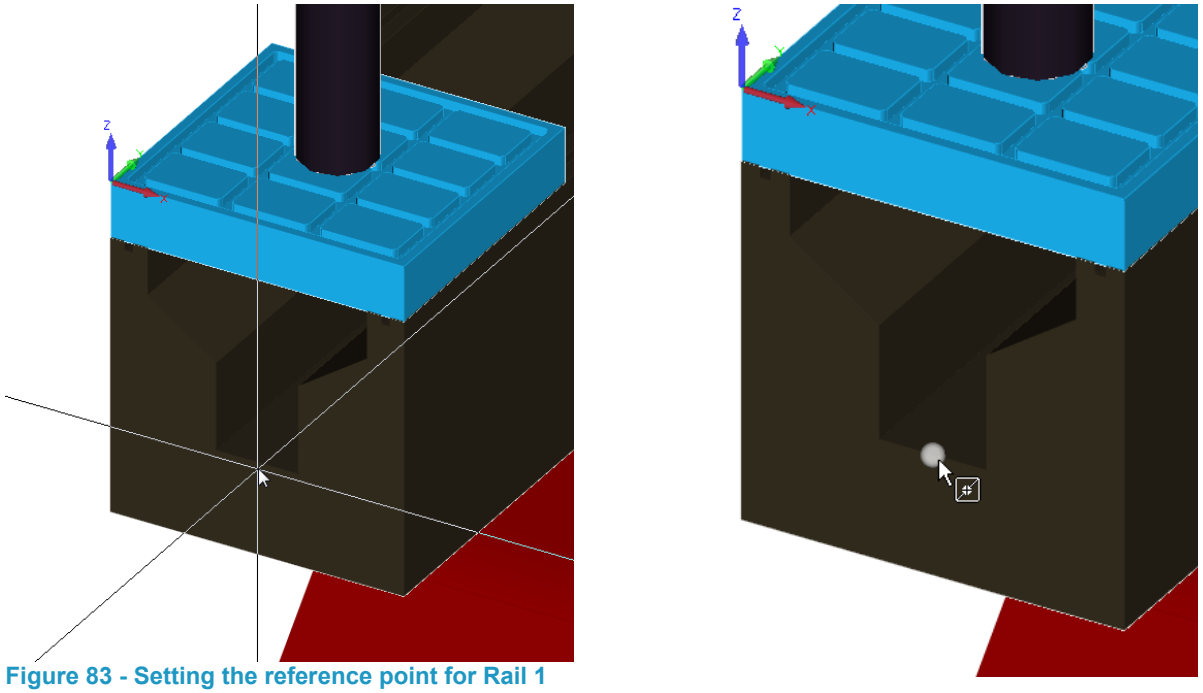


Figure 83 - Setting the reference point for Rail 1

<RClick> to exit the clamp definition as this next definition needs some additional geometry adding to it.

Additional reference geometry

The use of additional geometry in creating clamps is to allow different sections to be used for location and to allow secondary clamp shapes to be used.

For instance, in this example the vacuum pods are a square shape; there may be the requirement for larger items to be used. Adding a geometry that is larger and setting this as an **Alternate Geometry** from the **<RClick>** pop up menu will then transform from the small vacuum to the larger vacuum pod when required.

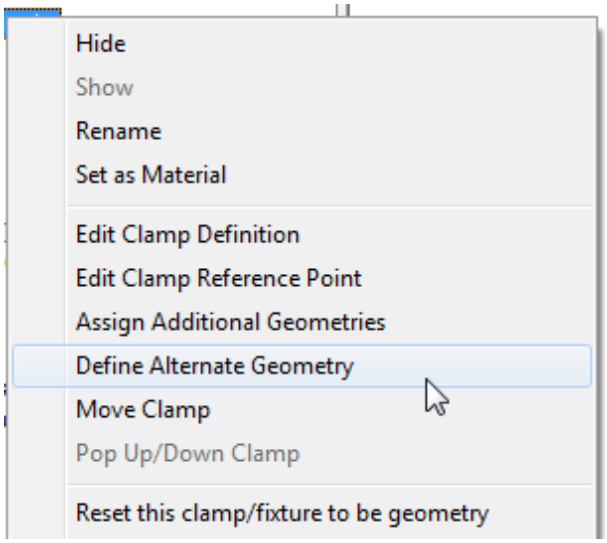


Figure 84 - Clamp <RClick> pop up menu options

In this example, we need to manipulate the **Positioning** geometry of the unit so that it will be the smaller diameter of the pop up clamp that touches the part and not the outer larger diameter of the pop up or the square profile of the vacuum unit.

In this instance because of the shape of the clamp solids, it would be the larger diameter that would be detected as touching the actual part first and not show a true representation of the process.
Adding the **Alternate Geometry** allows the part to pass the first collision detection section and use the smaller diameter of the clamp as a stop location.

Pod 1-1

Using **SOLID MODEL EXTRACT > Projected Face Outlines to Work Plane**  select the bottom face of the pop up clamp. You should hide the other elements of the fixture to see this face.

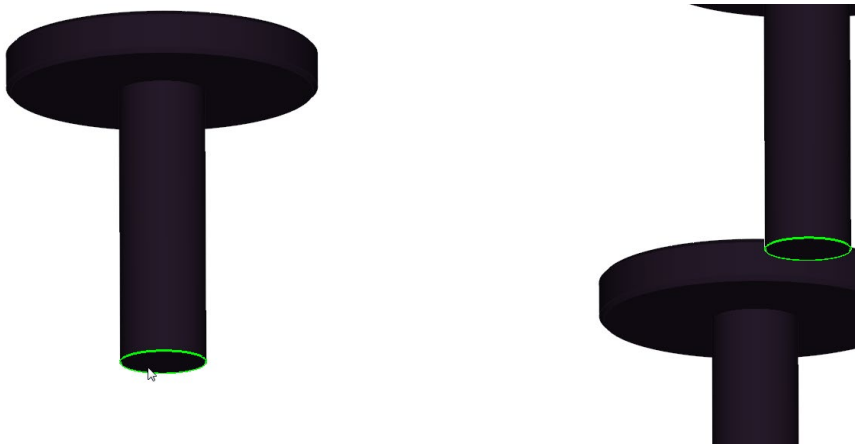


Figure 85 - Creating smaller diameters on the clamps

Make all the elements of the build visible once more.

Using **MACHINE > Clamps/Fixtures > Define Clamps/Fixtures**  you are prompted to select the item that will become a clamp from the on screen solids or geometries.

<LClick> on the front square unit on the left hand rail.

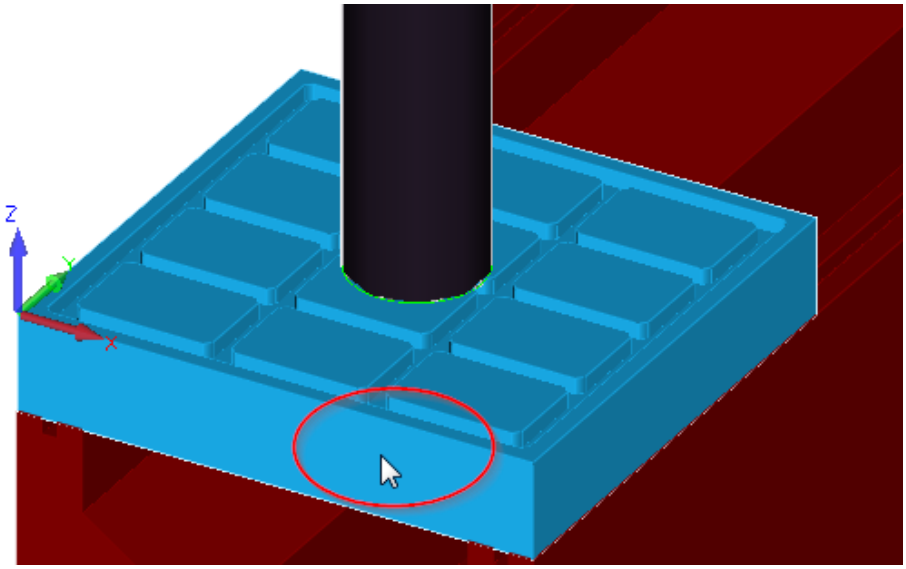


Figure 86 - Selecting the component for the first Pod

The settings for this new unit are as follows,

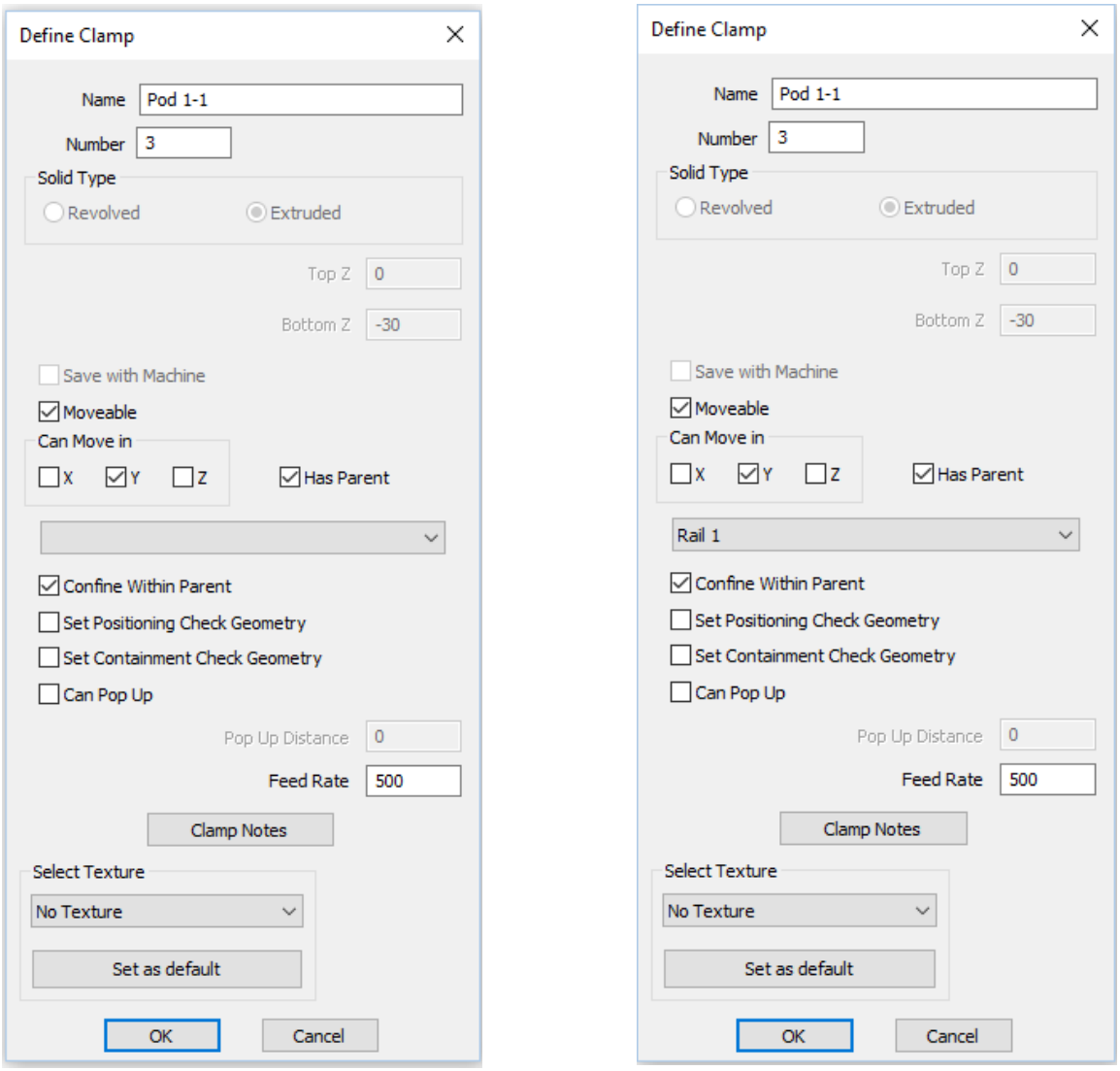


Figure 87 - Option settings for Pod 1 on Rail 1

The name is set as **Pod 1-1,** this identifies it as the first pod on the first rail, this will progress across the whole unit to include **Pod 1-2, Pod 1-3, Pod 2-1** etc. this helps to identify the items in the future and to reference against the physical machine we are simulating. Should the machine have specific references for the units, then these could be used as the naming convention instead.

The option for **Moveable** on this item refers to its ability to move within the confines of the parent part, as the parent is **Rail 1**, and this can move across the **Main Bed in X**, the only direction we need to assign for the pod unit is in the Y direction.
<LClick> [OK] and when prompted for the reference point, use the **<F8> (arc centre)** and select the centre of the extracted geometry.

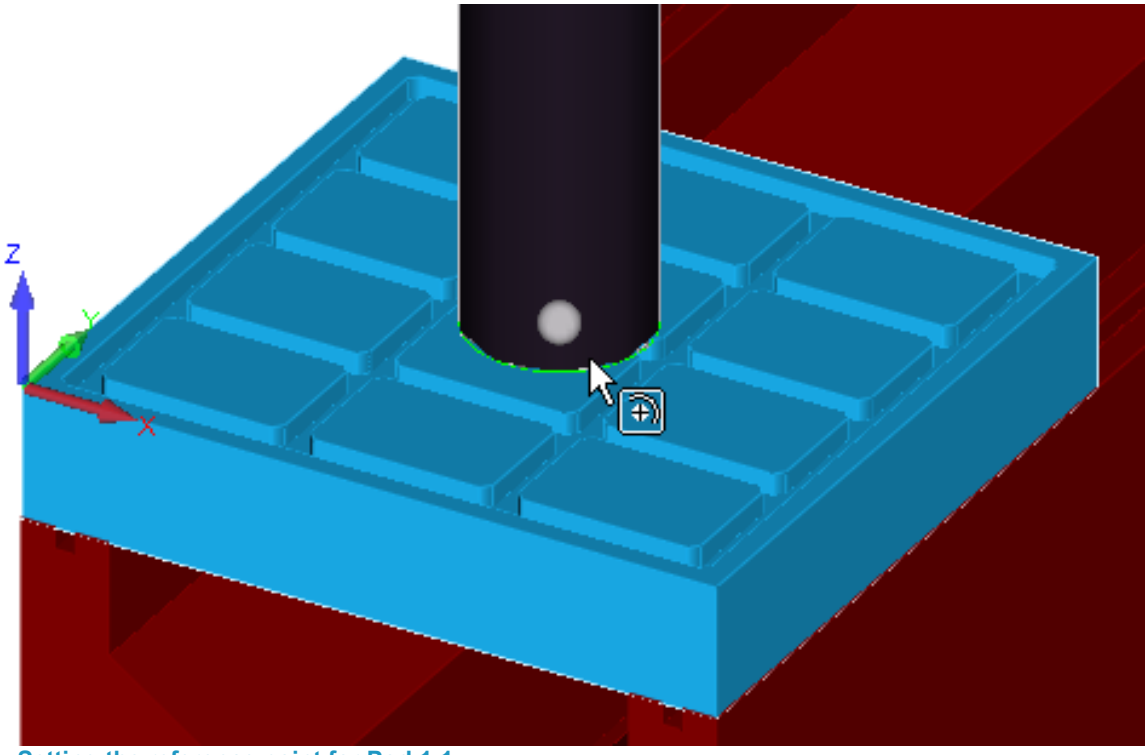


Figure 88 - Setting the reference point for Pod 1-1

Pop Up 1-1

Using **MACHINE > Clamps/Fixtures > Define Clamps/Fixtures**  you are prompted to select the item that will become a clamp from the on screen solids or geometries.

<LClick> on the first pop up on the left hand rail.

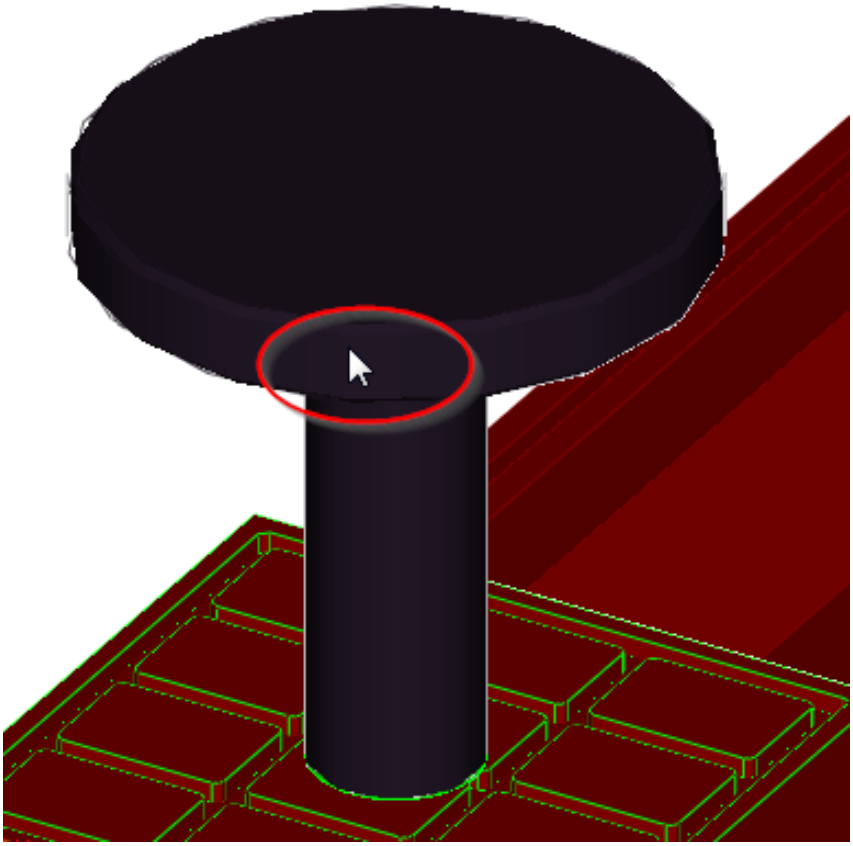


Figure 89 - Selecting the component for the first Pop Up clamp

The settings for this new unit are as follows,

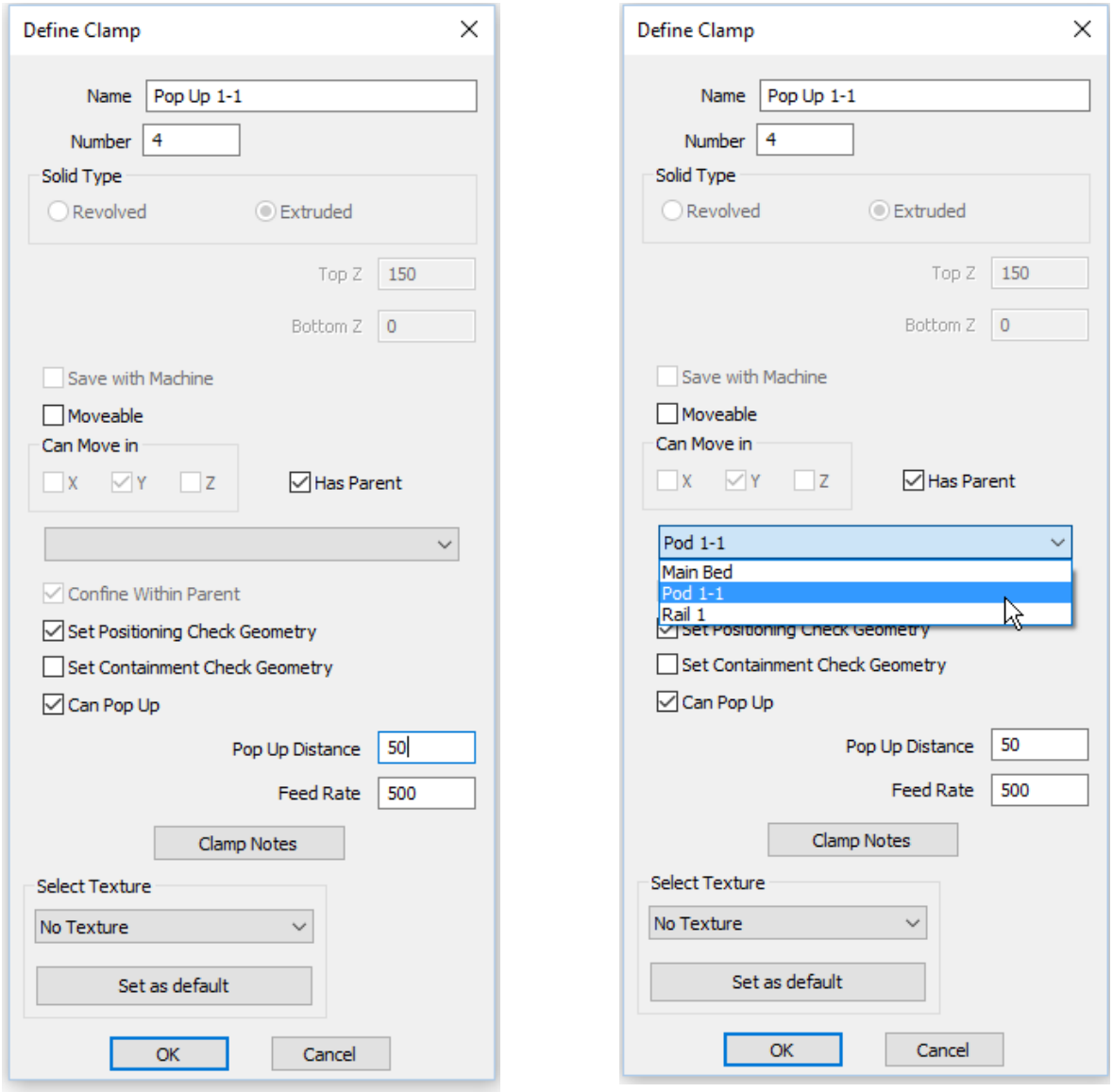


Figure 90 - Option settings for Pop Up 1 on Pod 1-1

This unit has the ☐ **Moveable** un-ticked as it does not move on its own but is controlled in the X axis by Rail 1 and in the Y axis by Pod 1-1.

Set ☑ **Can Pop Up** and add a value to the Pop Up Distance box.

<LClick> [OK] and when prompted for the reference point, use the **<F8> (arc centre)** and select the centre of the Positioning Check Geometry.

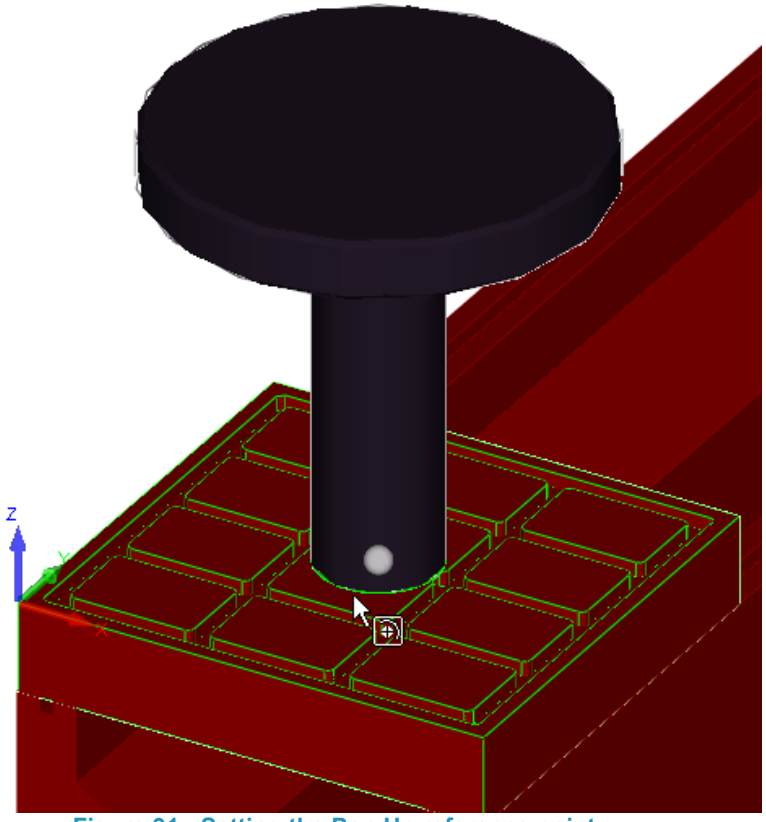


Figure 91 - Setting the Pop Up reference point

When requested, **<LClick>** on the extracted geometry for the **Positioning Check Geometry.**
Continue to set the clamp options for the remaining items on the unit.
Using the naming convention

- Rail 2, Pod 2-1, Pop Up 2-1 etc.
- Rail 3, Pod 3-1, Pop Up 3-1 etc.

> Be wary of using the Undo button.
>
> If you have not exited the Clamping definition options then using the Undo option, should you have made an error, will undo **ALL** your work on the clamps back to when you started defining the clamping system.

Manipulation and Simulation

To allow us to correctly simulate the movement of the clamps we need to **Insert** a drawing to this set of clamps.

Using **HOME > Insert**  , load the **"…..ALP TRG 112 2D Machining 2020\Examples\Clamps and Fixtures\Drawings\Curved Window Frame"** drawing into the current open ALPHACAM session.

For the location point use X1000 Y750 Z0.

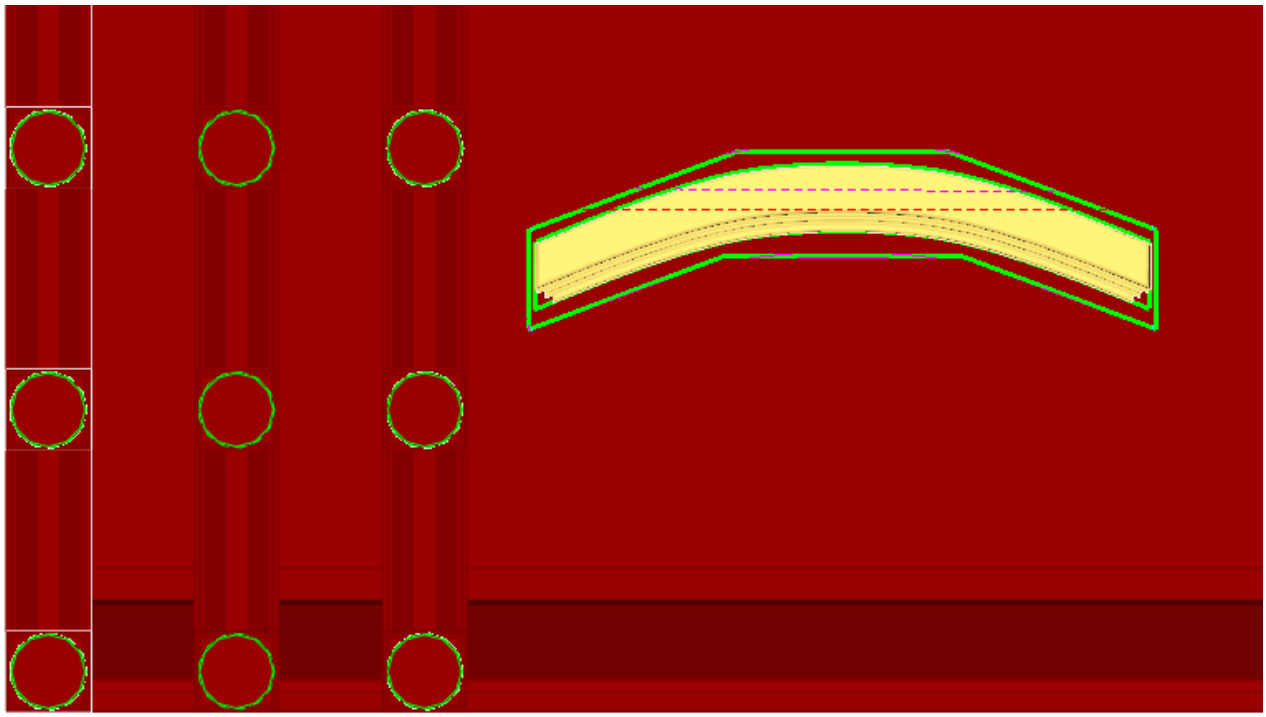


Figure 92 - Part located prior to clamp set up

> This is purely for this training example, if you were working for real, you would position to suit your machines requirements

Create a new material for this part using the green outline geometry.
Make the Z Top = 120 and the Z Bottom = 0

> Depending on the nature of your part(s) you will need to create a material based on 2D geometry after inserting the part to the fixture set up so that it is recognised.
>
> Solid models cannot be used as materials in this type of processing.
>
> Previously created materials may also fail to be identified.

Setting and moving the Clamps

From the initial designing positions, you now need to adjust the positions of the clamps so that they are set for the loading phase of the process.
Once this is set, we can then delete the moves from the operations as they are not required in the process.
A second set of moves is then required to alter the positions so that the part can be machined on the second side.
Finally, the moves will need to be in the correct positions within the Operations tree so that the process works correctly.

Initial Positioning

Using the option **MACHINE > Clamps/Fixtures > Move Clamps/Fixtures**  , select the three pod units at the back of each rail and move them as far up the Y axis as they will go.

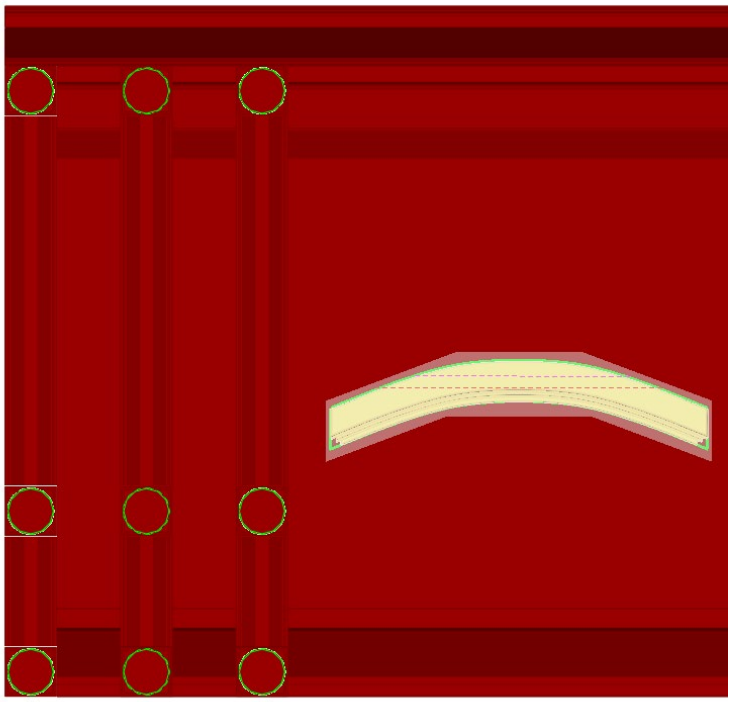


Figure 93 - Unused clamps moved to a suitable clear location

This now allows the Rails to be moved in the X axis to a position where they are to work from.

If you do not move the rear pods first, they will prevent the rails from moving past the material due to the **Positioning Check Geometry**.

Now using the same moving command, position the rails as shown below.

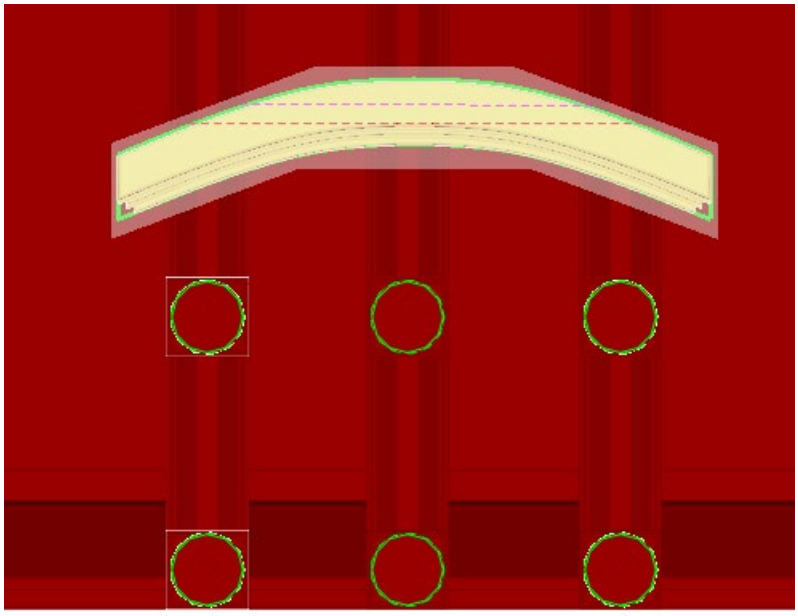


Figure 94 - Three rails moved to correct machining locations

Finally move the three middle pods up to the material.

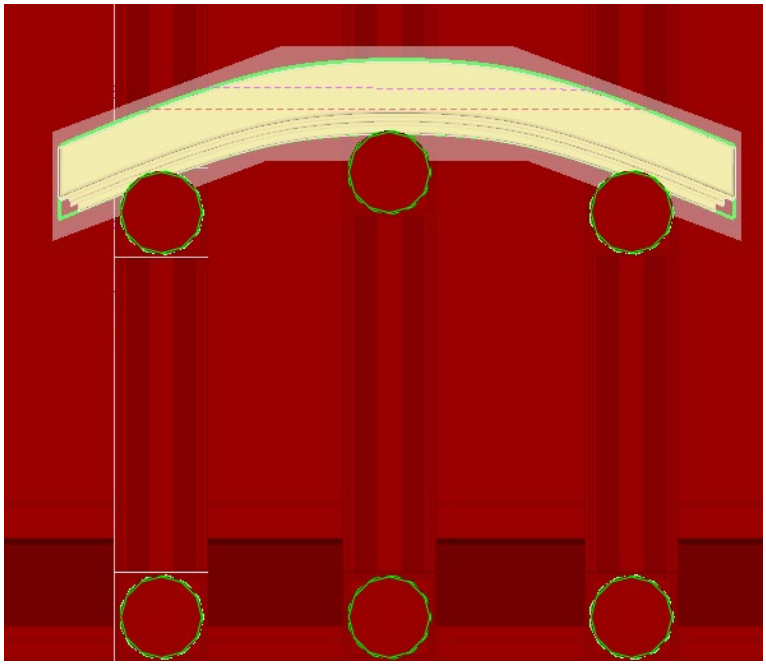


Figure 95 - Centre Pop Up clamps moved to correct starting location

These positions form the location of the units prior to any work commencing so we do not need to keep all the records of the clamp movement that is listed in the Operations page of the project manager.

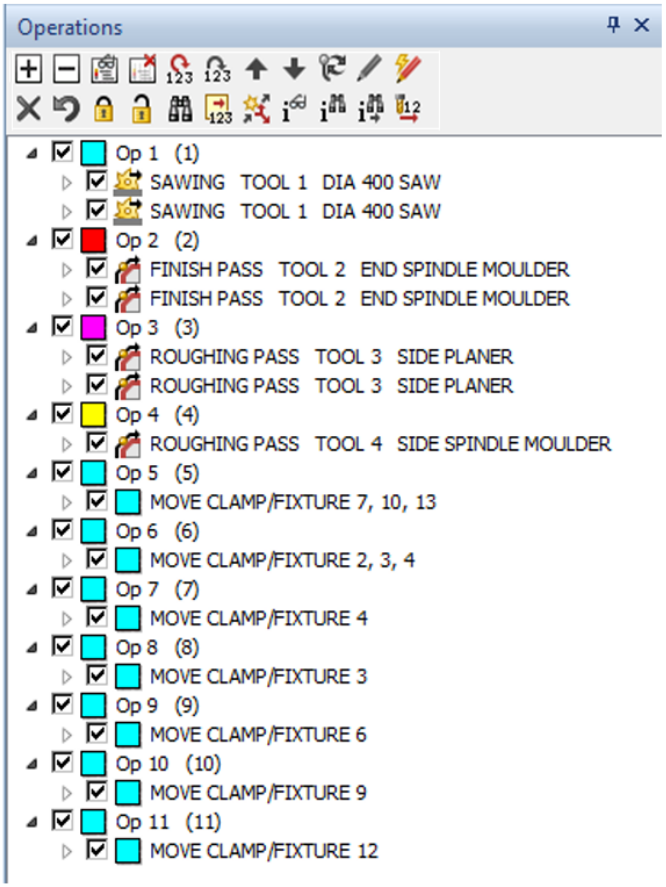


Figure 96 - All clamp moves are added to the Operations list

Using **MACHINE > Clamps/Fixtures >Set Initial Positions**  removes these set up moves.

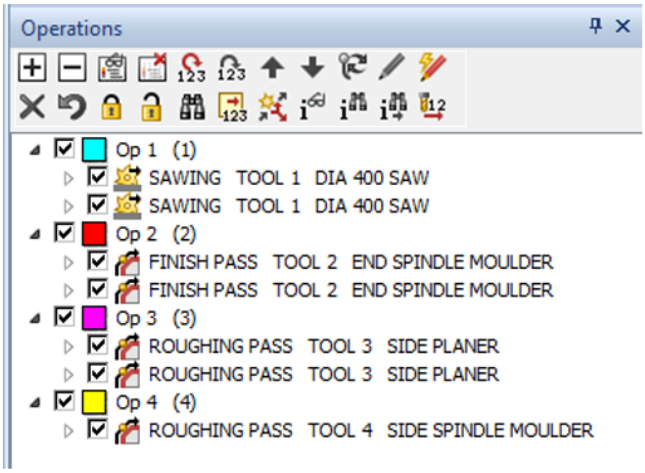


Figure 97 - Initial moves deleted using Set Initial Positions

Operational Moves

Now we must consider the actual process that is involved on the machine and how we need to instruct the clamping units.

The process for this part is as follows.

1. Front Clamps Pop Up.
2. Load raw material.
3. Front Clamps Pop Down.
4. Machine item left and right hand ends.
5. Machine item rear profile.
6. Rear Clamps Pop Up.
7. Move rear clamps to positions for second op.
8. Rear Clamps Pop Down.
9. Front Clamps Pop Up.
10. Move Front Clamps clear of part.
11. Run second stage machining.
12. Rear Clamps Pop Up to unload.

Using **MACHINE > Clamps/Fixtures > Pop Up/Down Clamps**  select all three of the front Pop Up units, **<RClick>** to finish.

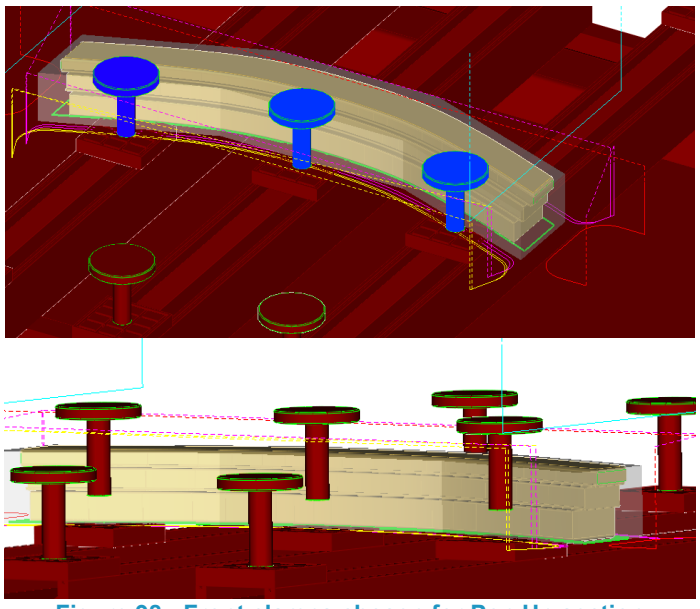


Figure 98 - Front clamps chosen for Pop Up section

This allows for loading, use the same command again, and select the same three clamps to set up the clamping section of the process.

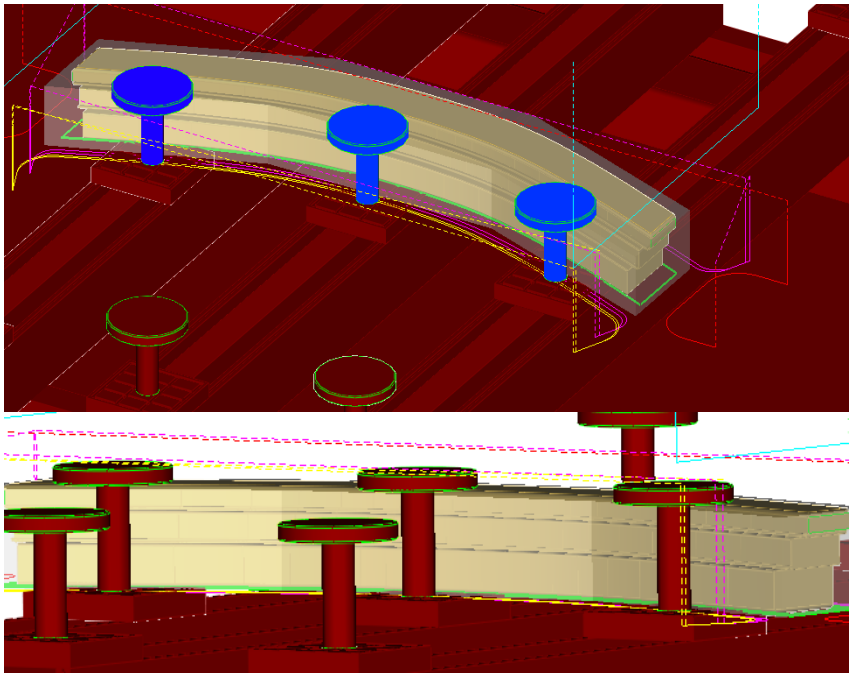


Figure 99 - Clamps set down to hold part for first stage machining

As with all machining operations, the clamp moves or options will always be placed at the bottom of the Operation listing.
In the **Operations** page of the Project manager, move the new added Pop Up and Pop Down Clamping operations to the very top of the toolpath listing.

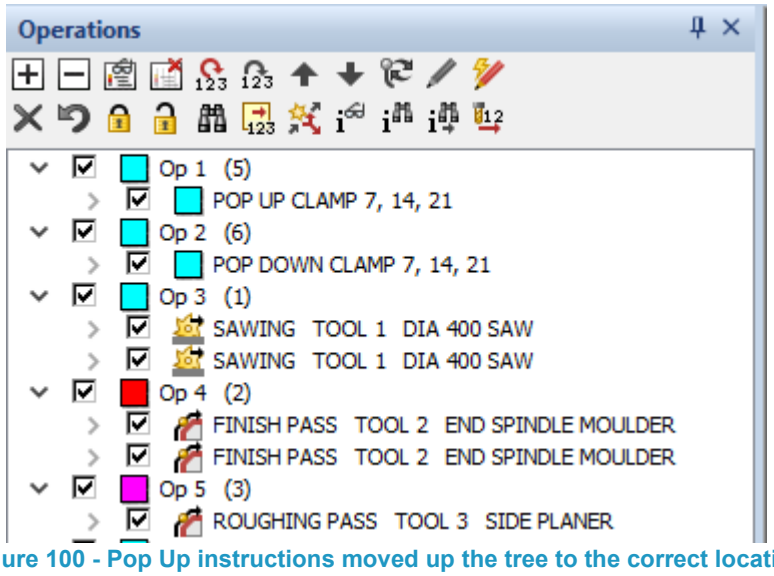


Figure 100 - Pop Up instructions moved up the tree to the correct location

Do the same process of Popping up, Moving and Popping Down as detailed from point 6 to point 10 on the list of process operations.

Once you have made the necessary move entries, these will need to be correctly located in the Operations listing. This is in between the two Side Planer operations, so these two machining cycles also need to be separated into their own separate groups as shown below.

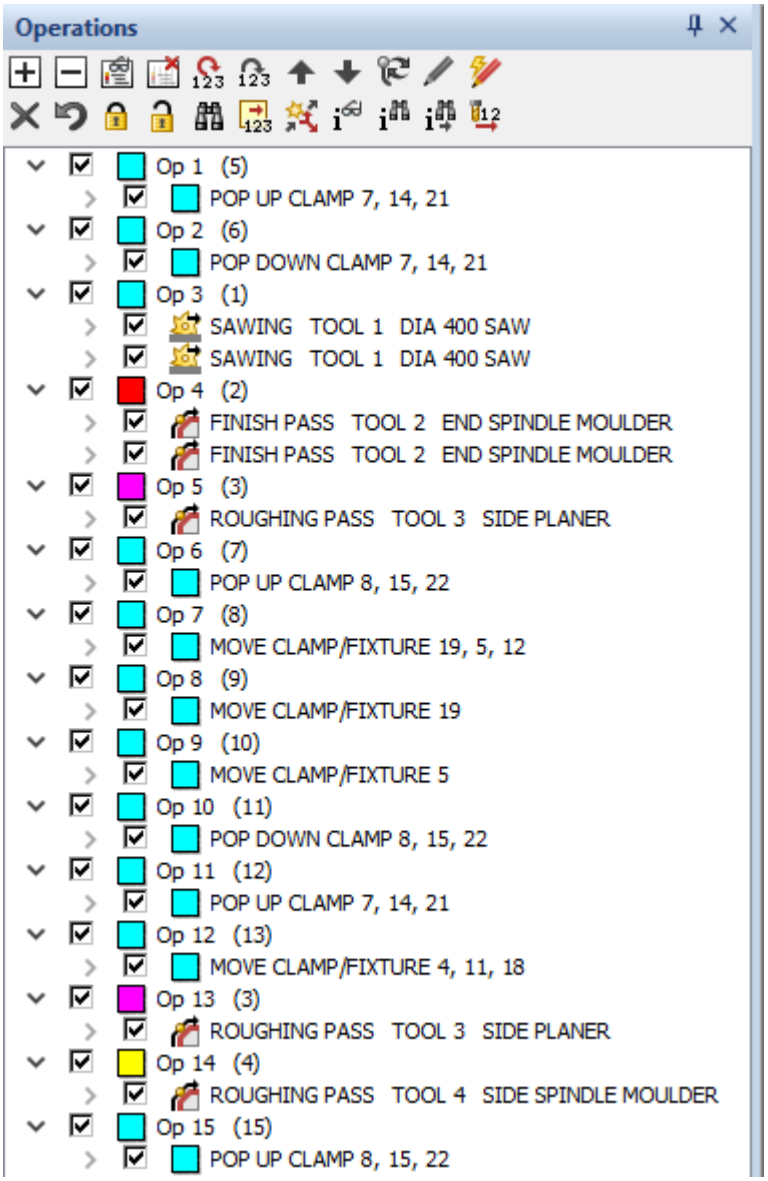
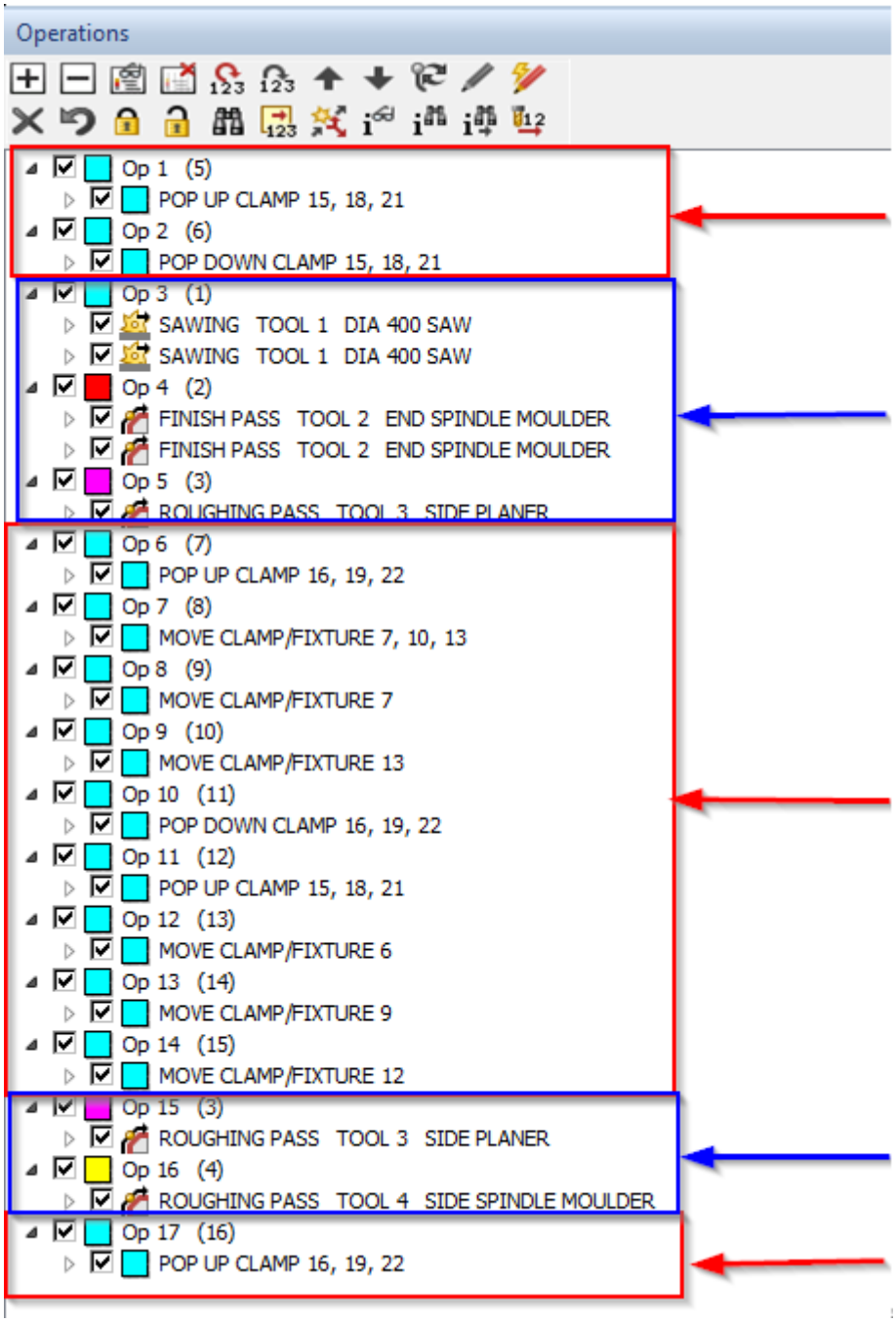


Figure 101 - Listing including all correct Pop Ups/Downs and moves

Lastly add in a Pop Up command for the rear Clamps so that the part can be removed when complete.



Lift clamps to allow for Loading, lower clamps for machining

First stage machining of ends and far side profile

Lift far side clamps, move to holding positions, clamp down onto part.

Lift front side clamps and move away to safe position

Complete machining to finish part

Rear side clamps lift up to allow for removal of completed part.

Tips and Tricks

Location

If a full machine simulation is required or the setup is used for many different machined parts, the entire fixture set can be added to a machine configuration if required.
The machine needs to be loaded to ALPHACAM using the

MACHINE > Machine Configuration > Open Machine command.

Once the machine is loaded, **<RClick>**menu of the very first item on the clamps listing, in this case the “Main Bed”, use the Edit Clamp Definition option.

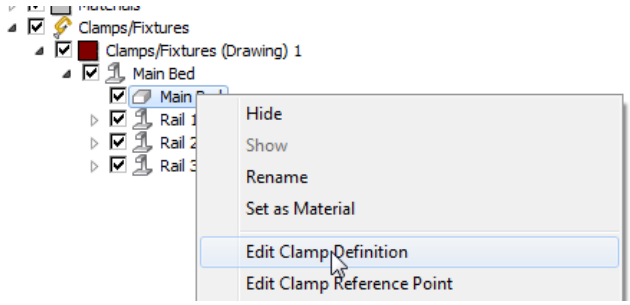


Figure 102 - Edit clamp definition from <RClick> menu

Here you will see the ☐ **Save with Machine option.**

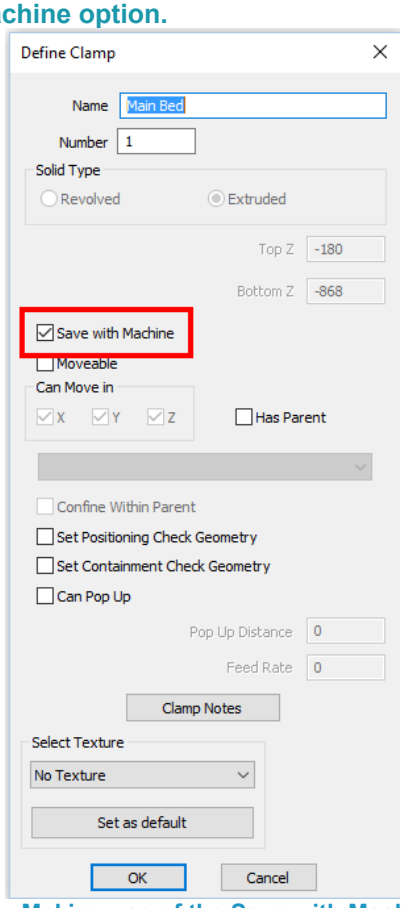


Figure 103 - Making use of the Save with Machine option

If this is ticked, then everything underneath and including this part will be moved from the **Drawing** section of the Project Manager Layers tab to the **Machine Configuration** section.
As you can see below.

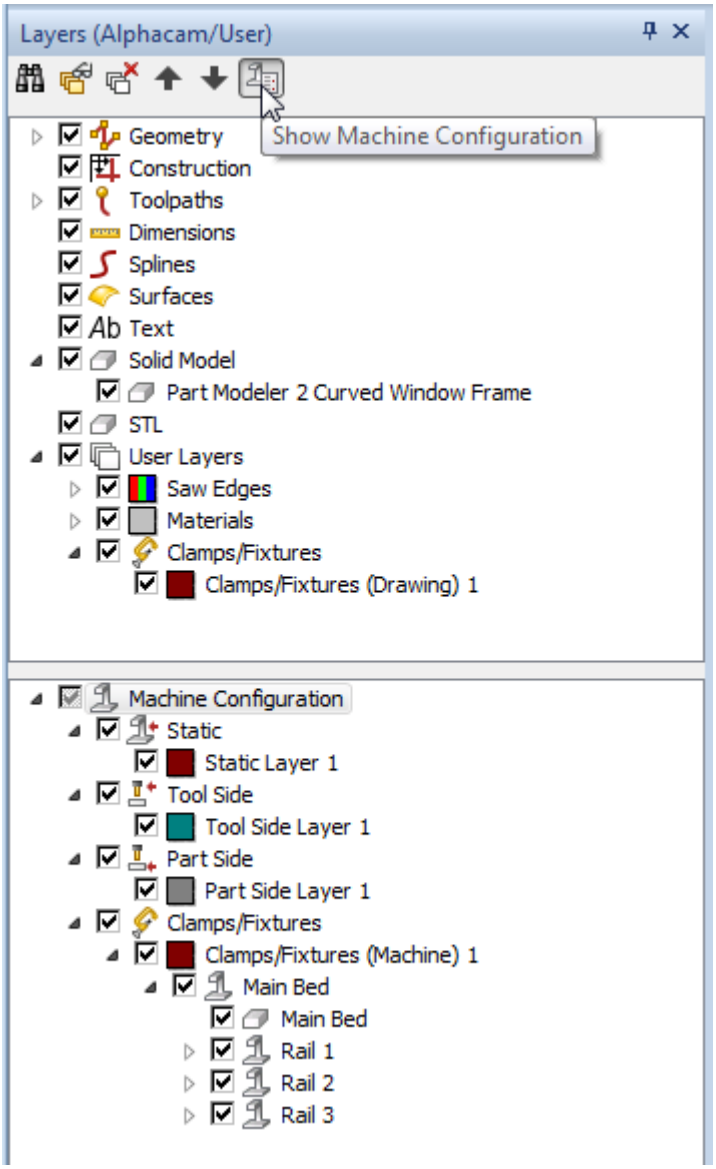


Figure 104 - Machine Configuration listing showing attached clamps

Additional Layers

Should you wish to manipulate the definition further, additional layers can be added in the same manner that you can add additional User Layers in a drawing.
For example, you could have all the clamps on a single layer, the pods on another and the rails on a third, this allows for altering the imagery from the default all dark red colour scheme to one that you prefer.

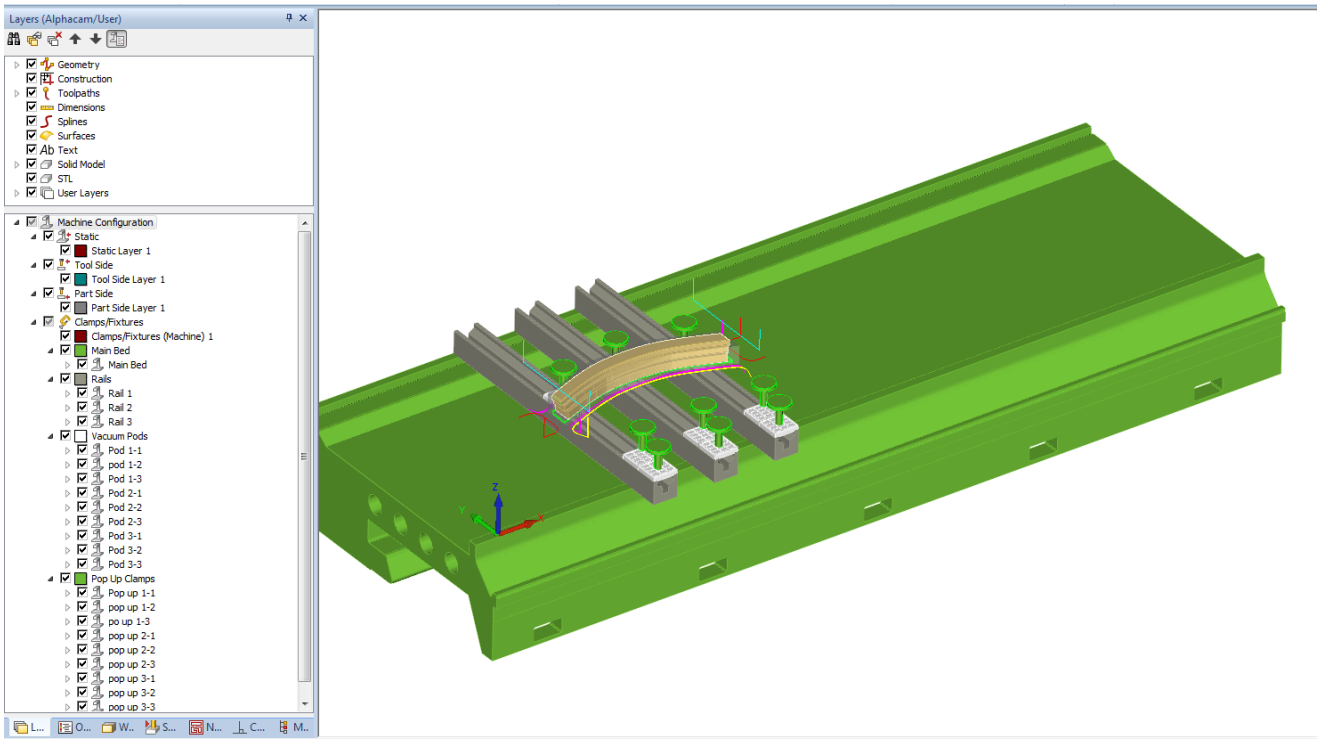


Figure 105 - Layers added to distinguish differing sections of clamp set up

Version amendments

V	Amendment Description	A	Software Version	Amended Date
8	Minor alterations to text formatting.	1	2020.1	02/10/2019
8	Template altered to Hexagon branding	0	2020.0	15/03/2019

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