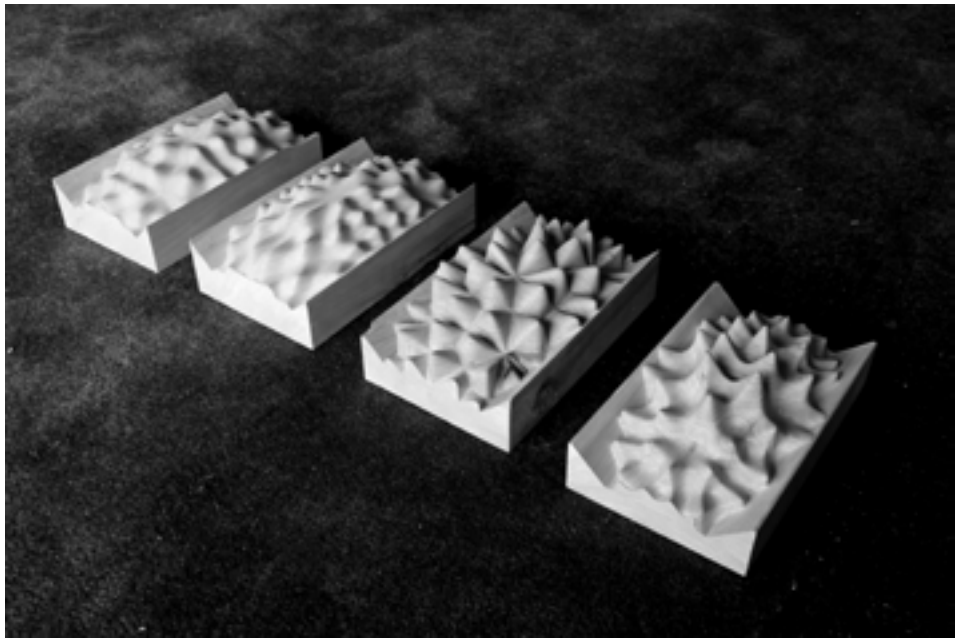


What is a CNC router?

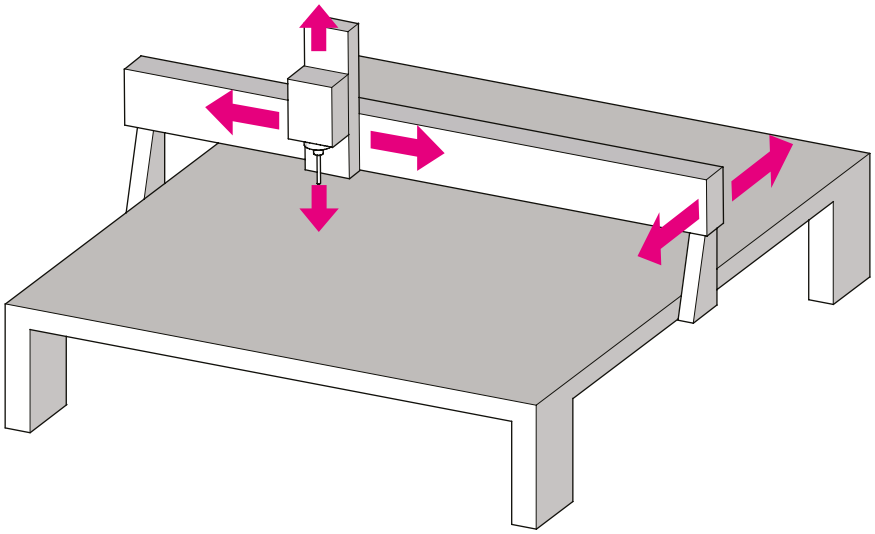
A CNC (computer Numerical Controlled) router is a computer controlled machine for cutting diffferent materials along a path, or 3D shape, generated by a software.

There are many advantages to using CNC Machining. The process is more precise than manual machining, and can be repeated in exactly the same manner over and over again. Because of the precision possible with CNC Machining, this process can produce complex shapes that would be almost impossible to achieve with manual machining. CNC Machining is used in the production of many complex three-dimensional shapes. It is because of these qualities that CNC Machining is used in jobs that need a high level of precision or very repetitive tasks.

SECTION 1

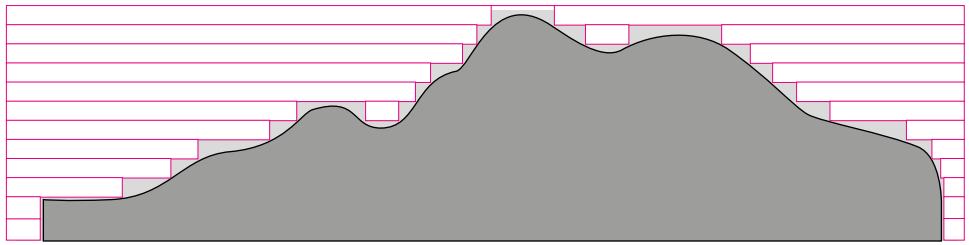
General Properties

Tooling Constraints



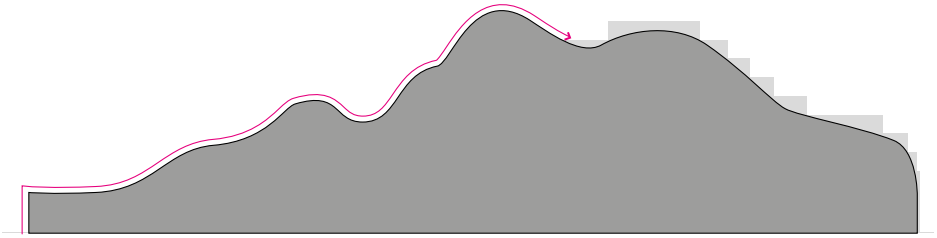
HOW IT WORKS: 3D Cutting

The spindle holds the tool and move along X,Y znd Z azis, following the paths generated by the software. In a 3 axis router, the tool is always vertical, and undercuts are not possible.



Roughing tool path

Roughing



Finishing tool path

Finishing

HOW IT WORKS: 3D Cutting

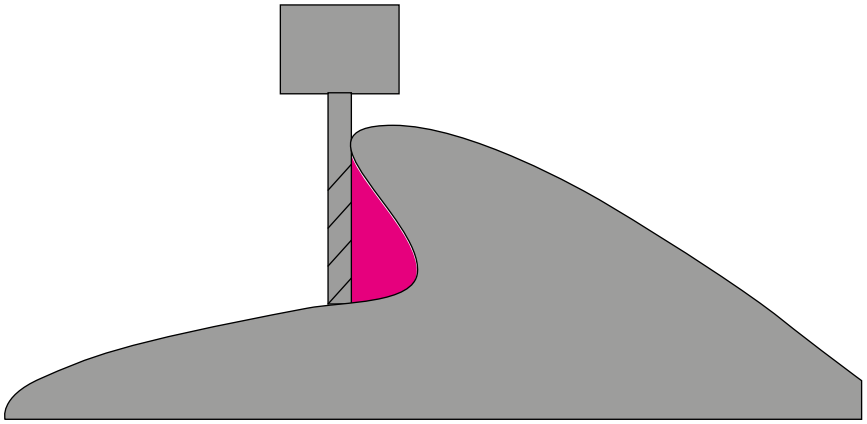
The machine runs different cutting paths:

- **Roughing** cut, removing successive layers of material around the model

- **Finishing** cut, along the surface of the model

Note:

Other cutting paths can be eventually performed:
- for refining concave edges that have been cut rounded with a rounded tool,
- for adding an engraving on the surface of the model (a road on a site model, for example).



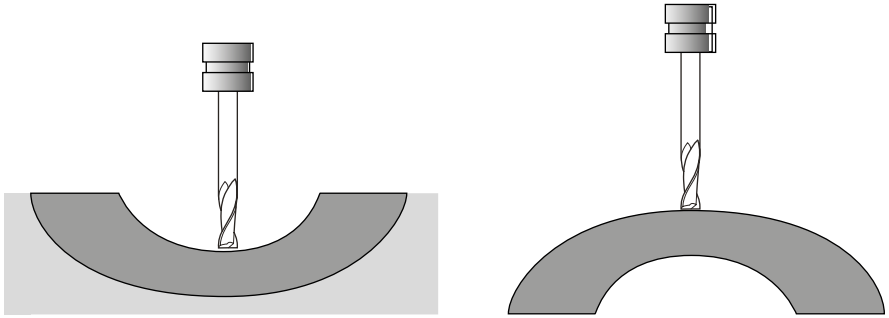
1.

FLIPPING THE MODEL

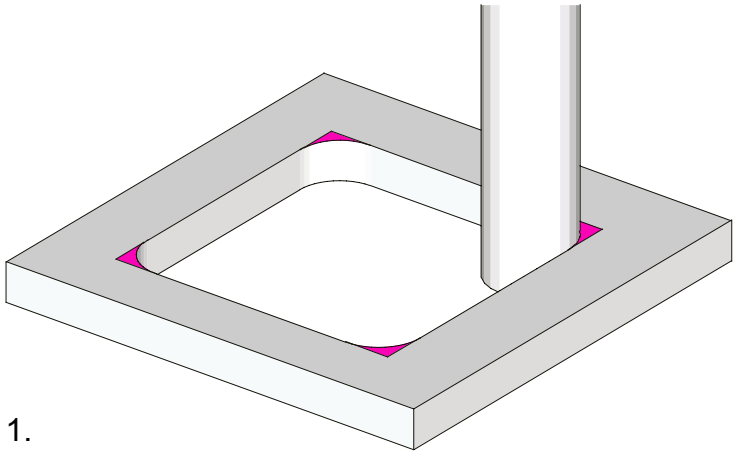
1. Since the tool is in a vertical position, undercuts are not possible.

2. However, in some cases the model can be flipped and machined on different faces, provided that it has a stable face to lay on.

In this case it is extremely important to center the piece properly.



2.

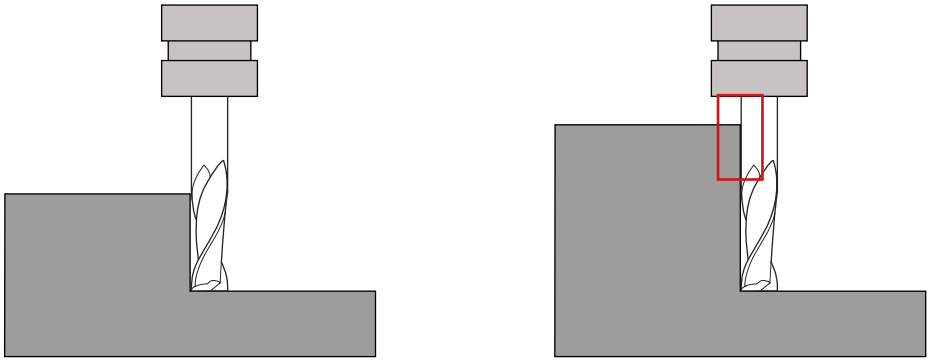


1.

LIMITS

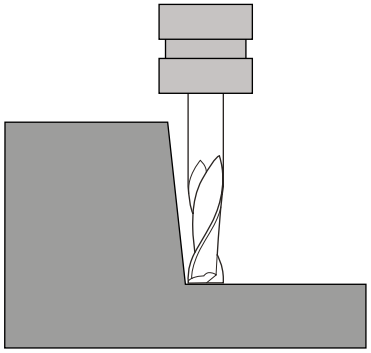
1. the tools have a circular section, it means that the internal corners, seen by the top, are always rounded, only the radius can change.

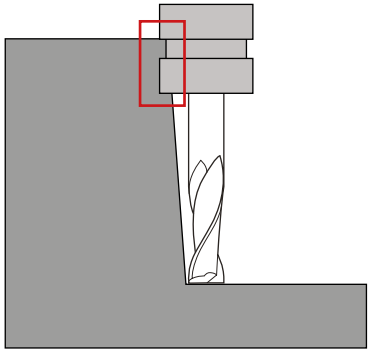
2. Vertical walls can only be as high as the cutting part of the tool, not as the tool itself.



2.

YES **NO**

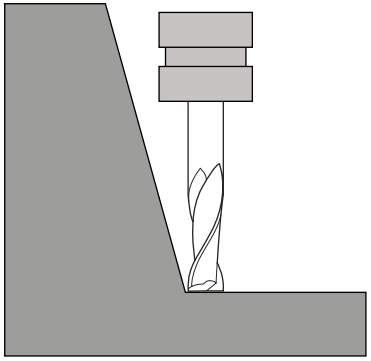


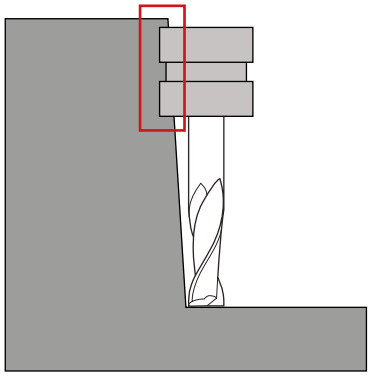


3.

YES

NO





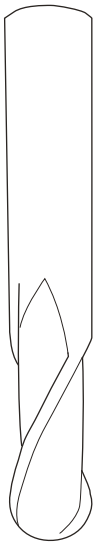
4.

LIMITS

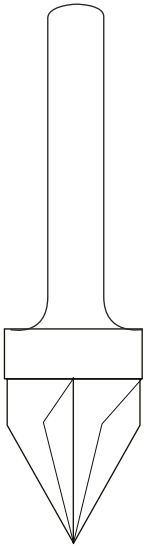
3. If the wall is steep, but not vertical, it can be as high as the tool

4. If the geometry of the model allows the space for the spindle, the cut can be deeper than the tool itself.

1.



2.



3.

TOOLS

The tools used for cutting are many different kinds.

The most commonly used are:

1. endmill, with the flat edge, are mainly used for the roughing cut, and for refining flat orizontal surfaces and sharpe corners;

2. ballnose, with a rounded edge, mainly used for finishing smooth surfaces;

3. veemill, used for engraving and for tapering edges;
-drill bits, for making holes.

Some features to keep in mind:
- a big tool can usually be longer then a small one;
- a big tool can cut faster than a small one;
- a big ball-nose tool can’t reach small valleys, but makes a smoother finish.

SECTION 2

Available Machines

LARGE CNC MACHINE

Location: Digital Facrication workshop

The larger CNC machine is operated by technicians in the digital fabrication workshop (Level 1 architecture building).

LARGE CNC MACHINE

What do we need?

• Save your model in Rhinoceros .3DM or .STL format
• Make sure your model has no holes, the volume must be fully enclosed.
• Model dimensions must be able to fit in the milling bed constraints (width, height and depth).

FILE SET UP 2D

File formats 2D Cutting:

Rhino 3D (.3dm), .dxf, .dwg, .ai, eps...

Max dimension:

1200 x 2400 x 50mm

FILE SET UP 3D

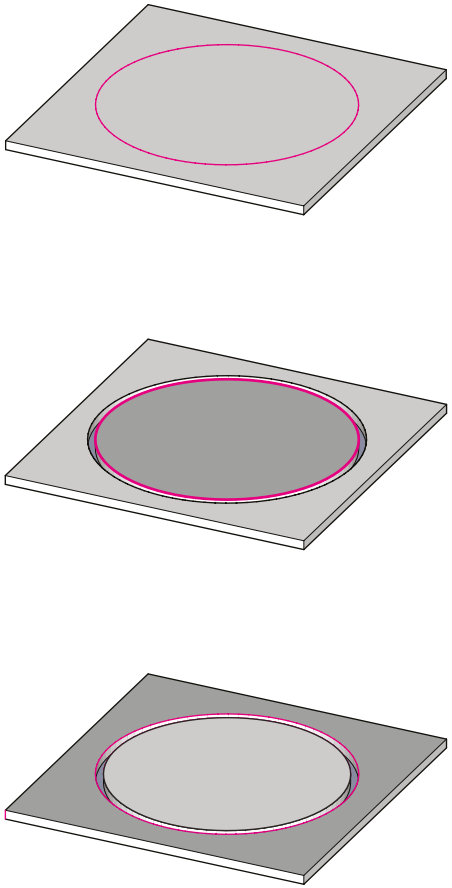
File formats 3D Cutting:

Rhino 3D (.3dm), .stl

Max dimension:

1200 x 2400 x 200mm

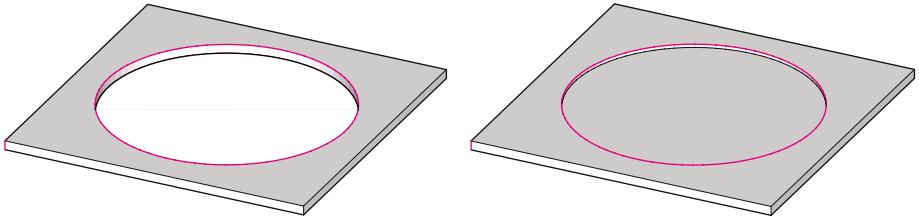
(in some cases the Z dimension can be up to 250, depending on the tools used).

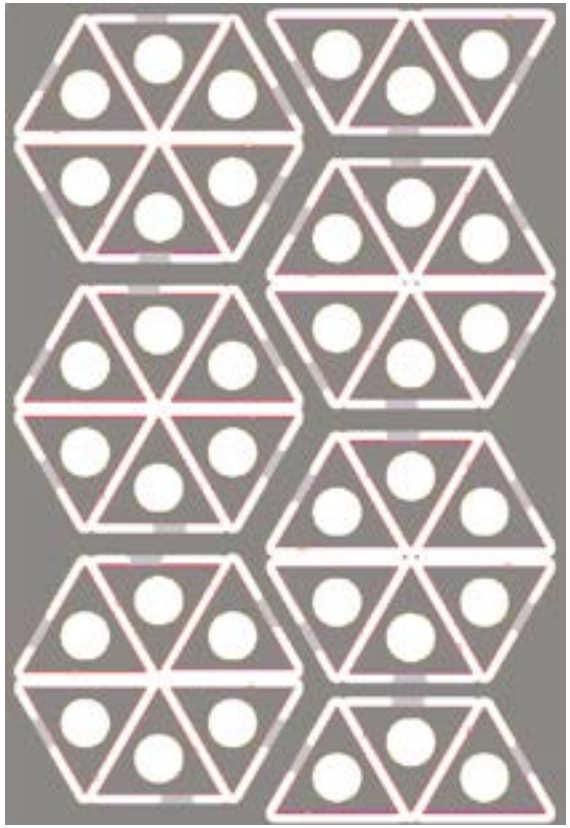


2D CUTTING

The drill cuts along a path, through the material or with a given depth (in this case the depth must be added as note to the
drawing).

Profiling: the tool follows a line, on either one or other side of the line and inside or outside a continuous closed shape.
The width of the cut depends on the tool used.



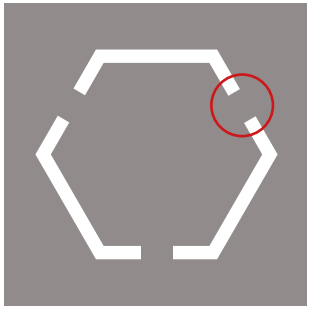


Pocketing: the tool removes all material inside an outline, to a specified depth. Pocketing tool paths only work within **closed** shapes, all lines must be **joined without any overlaps**.

When cutting several pieces within one sheet of material, you must allow space for the tool, the thicker the material, the bigger the tool.

If there are many small pieces, they must be arranged on the board so that all of them are connected with a solid frame, in order to leave a small part uncut (keep them in position).

If the model is to be cut out entirely from the material, remember to add tabs around the model to keep it in place while milling.



MATERIALS

In some cases, it may be useful to have some spare material for making some test before cutting the model.

- MDF is very good for 2D cutting, being very flat.
However the cut edges will have a fluffy surface finish not suitable for fine detail.

- Plywood is very good for 2D cutting.
It can be used also for 3D cutting, giving an interesting stripped result.
Solid wood is very good for 3D cutting.
Wood with a fine grain, like totara, are better for fine details models

- Cibatool-chemical wood is perfect for small (high cost) and high detailed 3D cutting.

- Polystyrene is good for big dimension-low details model.
The blue green one gives a better surface finish, but has a maximm height of 50mm, while the white one can be purchased in bigger dimension.

- Acrylic produces a reasonable finish but still requires a lot of wet sanding and polishing to get it clear again

- Aluminium can be 3D cut or engraved, but not cut through.

Other materials can be tested.

- Stone, concrete, glass and fiberglass **can not** be cut.

SMALL CNC MACHINE

Location: OML office

Smaller CNC machines are located in the OML office, hand in your files at the OML office (Level 4, 421 architecture building)

SMALL CNC MACHINE

What do we need?

• Save your model in Rhinoceros .3DM or .STL format
• Make sure your model has no holes, the volume must be fully enclosed.
• Model dimensions must be able to fit in the milling bed constraints (width, height and depth).

FILE SET UP 3D

File formats 3D Cutting:

Rhino 3D (.3dm), .stl

Max dimension:

1200 x 2400 x 200mm

(in some cases the Z dimension can be up to 250, depending on the tools used).