

CNC DM2 Handout:

To make a CNC appointment:

1. Have a drawing, sketch or precedent image to show Digifab staff. Think about what you want to say or do, and what materials you want to work with.
2. Email digifab@sala.ubc.ca to set up a time to talk, so we can make a more focused plan
3. The shop fills up at the end of term, and all the CNC appointments get booked up. Plan ahead, we have very limited attention to give you at certain times.
4. You are only allowed 4 hours max per week of CNC time, less if demand is high.
5. Complete your drawing, send to digifab@sala.ubc.ca
6. When this succeeds, we will book your CNC appointment. Staff will need about 24 hours to program the tool path.
7. You prepare your materials for milling. This can easily take a few hours.
8. On the day of your appointment, you will need to sit with the machine during operation.
9. Bring safety glasses. You can work on your laptop during the operations. You will sweep up the sawdust after.

File preparation requirements:

- A complete model in Rhino for any CNC work. This will be a new, separate file from your design drawing with just the part to CNC. Staff will export it to Fusion360 for processing.
- Ensure your tolerances are appropriate (.0001" or .001mm)
- Scale everything to the model size.
- Ensure the construction plane agrees with your World Coordinates
- Eliminate all things that are not needed- extraneous layers, lines etc. Zoom Extents and SelAll (read the results in your command line) to ensure you don't have anything extra.
- The stock material needs to be drawn as a joined, closed polysurface. Make sure it is co-located with the model, which is also a joined, closed polysurface.
- Put your name (or teammate names) and the date in the file name.
- Think about the router bit size you will use. If it has a radius of 0.125" that means it won't really benefit from line segments below 0.005" in length.
- Huge files crash and they are very subject to glitching. If your file is too big to email, it usually won't CNC. Simplify, simplify, simplify
- Move everything to the origin¹
- Set the view to Flat Shaded to see what will actually be produced
- Join every curve, merge every surface²
- Every separate functional surface (for instance the road, the sidewalk and the topo) needs to have a closed curve defining the boundary³
- If your model is one big mesh, it is impossible to fully control what the CNC does. Avoid meshes if you can.
- A 2D element is any feature that exists at ONE Z level. It could be the bottom of a building footprint in a model, a single stair in a public plaza or the bottom of a pocket in a part being cut from plywood. If you have lots of these at different heights, it is best to

put the drawing elements (which may be a surface, a closed curve or both) at the exact height you want cut.

- Trees can be placed on a topo by drilling holes in your surface. This can be very time consuming- consider that you might be better off just doing it by hand instead of drawing the individual holes.
- Cutting shapes out is very tricky to do on the CNC. Other options may be better for you
- It is very much worth your time to get to know the differences in surface types if you don't already. Breps, surfaces, polysurfaces, meshes, NURBS surfaces and SubD surfaces have different names because they do things differently. The quality of your knowledge will affect the quality of your drawing and it will definitely show up in the final product.

The following are some helpful commands to have in your repertoire:

- Use the *CheckNewObjects* command. Once invoked, it checks (and attempts to repair) all the objects you draw. This can prevent you from going too far with a bad object in your model.
- Use *What* to get a detailed description of any selected geometry.
- Use *SelBadObjects* to identify any objects that have problems. Joining and Booleaning can create bad objects.
- *RebuildEdges* can build a new surface from edges.
- *SelOpenPolySrf* will help find any open polysurfaces
- *ShowEdges>NakedEdges* is good to identify edges of surfaces or mesh edges that aren't fully joined to something else
- For meshes, *ReduceMesh* if you have too many polygons and *UnifyMeshNormals* if the polygons' normals point in different directions. In Rhino7, turning a mesh into a quad mesh can also make it easier to work with. *MeshRepair* brings up a dialog where you can do several operations at once.
- *Drape* can be used to get a NURBS surface from a mesh, but it often just recreates the problems the mesh had. Use it carefully and verify it did what you wanted. Rhino 8 now has *Shrink Wrap*, which may be better than *Drape*

If you have favorite commands or ways to fix drawings, let us know. We keep a list of these tips for students to use! Email digifab@sala.ubc.ca with subject line "Rhino tips"

1 Move to the origin: Type *SelectAll* then *BoundingBox* then *SelectAll* again to add the bounding box to the selection. You can then type *Move* and select a bottom corner of the bounding box. Type '0' as the copy-to location and it will all go to the origin. Having the origin of your drawing at a defined place is very important for the CNC.

2 Merged Surfaces: If the isocurves of your joined/merged surfaces don't look like one continuous surface, you might need to rebuild them. You can duplicate the edges of the bad surface and often use them as a starting point to rebuild a good surface. Just make sure they make a closed curve.

3 Selectable and bounded: If you select a surface and type *DupBorder* and then *Join*, it should result in a closed curve. If it does not, then your surface is not ready for the CNC. It needs to be repaired or it won't do what you expect.



SALA CNC Router

SALA's CNC

DM2 Training