CNC Mill

The U-SoA Fabrication Lab will foster a culture of learning through making. Its principal purpose is to serve students and faculty in existing and future research pursuits, by providing robust training and broad access to a host of digital and analog tools. The Lab aims to continually improve, incorporating new technologies and expanding its capacities, growing into a resource equal to the substantial ambitions of a top-tier architecture program.

U_SoA_CNC Milling

CNC Aspire Appointent
1 hour

July 07

July 2020

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25

Select staff (optional)

Anyone

12:00 pm   1:00 pm   2:00 pm

Add your details

Name

Email

Phone number (optional)

Address (optional)

Please let us know if you have any special requests. Thank you.

Notes (optional)

Book

Usage

The Formlabs 3B printer is available to all within the School of Architecture. To use the equipment, users must create their own 3d models, set up their preform files, and pay for the materials. Fabrication lab staff will send the materials and handle the machines. The printing process requires the handling of toxic chemicals and should only be handlded by trained Fabrication Lab staff.

To use the equipment, users should submit an appointment for an initial consultation with the trained staff members. To do this follow the steps below:

-Access the University of Miami School of Architecture website.

-Access the page for resin printing.

-Fill out the form and click the link to "Booking"

-Click initial Consultation.

-Select a trained staff member from the dropdown "Select Staff List"

-Select an appointment date and time based upon availability.

-Fill out all additional information and click "Book". Users should get an immediate confirmation when clicking book. If they did not, the appointment was not successfully created.

The user should show up to the appointment with the model they would like to print complete, set up in preform, and an idea of what type of resin they would like to use. If the Fabrication Lab has the type of resin available, the print will be sent during the appointment. If the Fabrication Lab does not have the resin available the student may have to wait for the shipping of the resin and a new tank before the model can be sent to the printer.

Procedures

Setting Up Aspire Files

Before starting Aspire, it will be helpful to make sure your model is orientated in the correct direction and close to the X, Y, Z datum point. In Rhino and AutoCAD, the X, Y, Z datum point is how the program lines your model up in Aspire. So if you create your model 10 miles away from that point (usually there is some sort of marker on the screen where it is) then that is how far it will be away from the X, Y, Z datum point in Aspire. This generally causes people to not be able to see their models. Even if you zoom to extents, it will be hard to find. It is much easier to make a bounding box the size of your virtual work piece and have the bottom left hand corner align to 0,0,0 (the datum point). Remember: the bed of the CNC is a rectangle (4'x8') and the lower left corner is the 0,0,0 position. This is how your model should be orientated in your programs (Rhino, Aspire, or AutoCAD).

Computer Station

+Y (Max 48")

```
CNC BED
```

0,0,0   +X (Max 96")
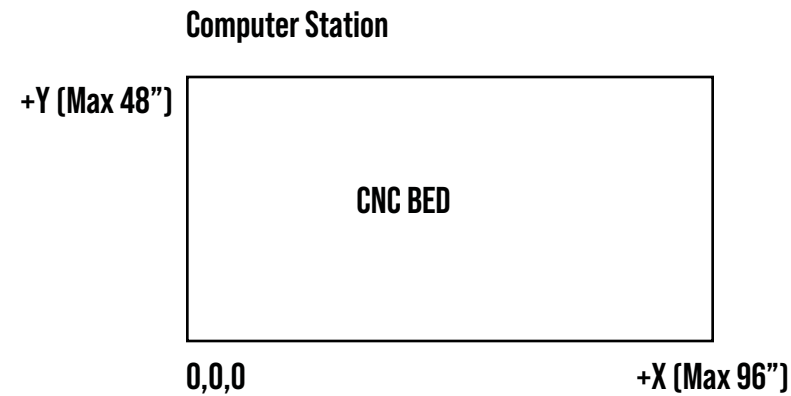
HOW TO INPUT A 2D MODEL INTO ASPIRE

Step 1: Open Aspire from desktop

**Step 2:** Select "Create a new file"

Step 3: Job Setup Panel

Job Size (X & Y): Input values. Overall material length and width of work piece.
-Refer to "X" and "Y" labels on ShopBot surface to ensure your material orientation will correctly align with the "X" and "Y" values you input to aspire. (For PRS Alpha – X has a max of 96" and Y has a max of 48")

Procedures

Material (Z): Input value. Thickness of material. Ensure the lower bubble below "Z Zero" is selected. This will ensure the project is zeroed from the spoil board and not the surface of the material. This is very important as it determines where the machine starts in a vertical position.

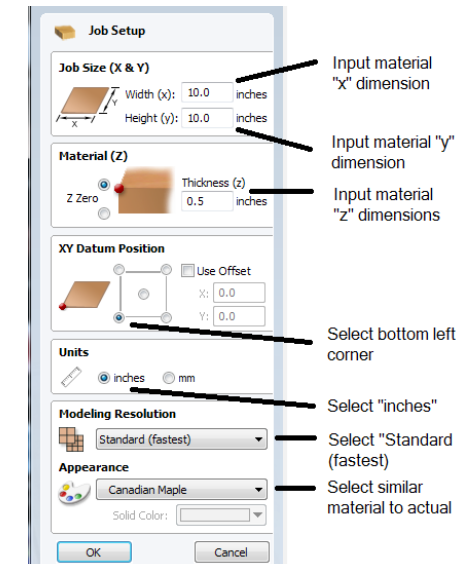**XY Datum Position:** Selecting position that has a positive X and Y axis.
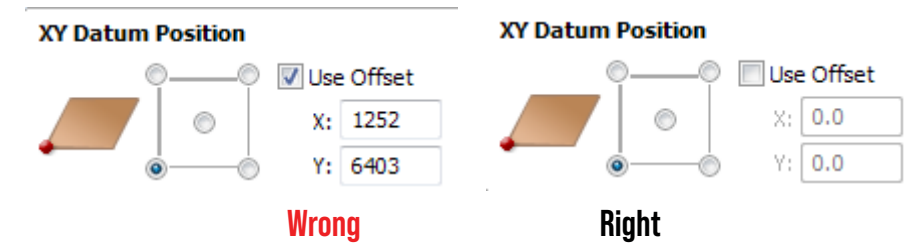
Wrong   Right

Units: Select "inches".

Model Resolution: Select "Standard (fastest)"

Appearance: Use default, "Canadian Maple".
                    Click "OK" when finished.

Step 4: Import Project/Model

Note: If you need to return to "Job Setup" page, select "Edit" in toolbar then "Job Size and Position" or go to the drawing tab, look at the top group of buttons and click on the one on the second row all the way to the left.
-        Select File in toolbar, then select Import -> Import Vectors...
-        Locate the 2D model file on computer and open file. i.e. Box or thumb drive

Setting Up Aspire Files

Step 5: Model Orientation

If model needs to be rotated, select all of the vectors that need to be rotated and then click on the rotate button (It is on the drawing tab, in the Transform Objects group, the third button from the left).

HOW TO PREPARE TOOLPATHS FOR A 2D MODEL

**Step 1:** Select the element you wish to cut. Element should be highlighted in red.

Step 2: Click "Toolpaths" tab located in top right corner of Aspire. Note - clicking the pin icon will lock the toolpath menu to an open position.
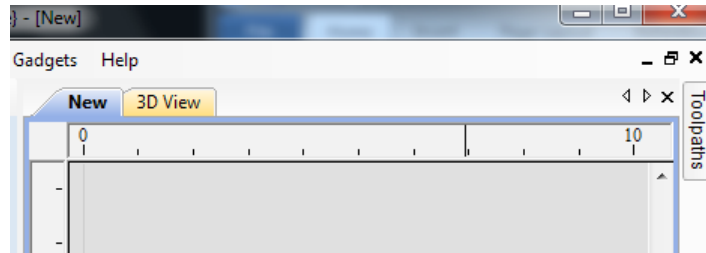
Step 3: Select the toolpath you wish to use. See below steps for instructions using each toolpath

PROFILE CUT

Step 1: Select the profile toolpath from the tool path operations
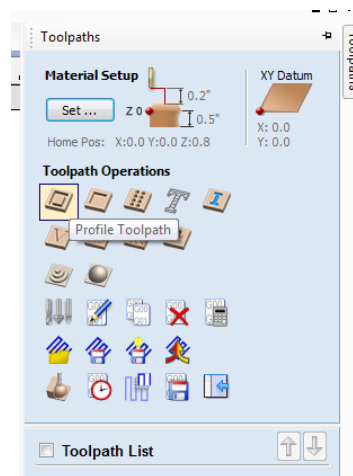
Step 2: Specify your cut depth.

- When cutting through your material, set the cut depth as the thickness of the material. Only go deeper if it does not cut all the way through (remember, not all materials are a consistent thickness throughout).

Step 3: Select the size and type of bit used to make the cut: endmills, ballnose, and engraving (text done as a profile toolpath) are the most commonly used bits for this type of toolpath. Go to the endmill, ballnose, and engraving bit info sheet more info on them.

-S elect the correct bit based off how deep you have to cut (not every bit can cut as deep as what might be needed, measure the cutting head portion of the bit if you are unsure if it is the right size bit for the job).

- The tool database should already have the correct "depth per pass" if you have to change this setting or any other setting in the tool database, DO NOT HIT APPLY, just hit ok. Hitting Apply will change the values in the database permanently.

Step 4: Select the orientation of the cut. Set direction to climb.
-Outside/Right will cut outside the perimeter of the selected element and will leave the area of that element intact.
-Inside/Left will cut along the inner perimeter of the selected element.
-On will cut on the line of the element

Step 5: Tabs (only for small parts or if the vacuum table is down)

d)   Click on Edit Tabs
e)   Enter the number of tabs needed and click Add Tabs. Note tabs can be moved, added, and removed by clicking on the selected element vectors.

Step 6: Name the cut and click Calculate.

Note: If cut depth is set greater than the material thickness, a warning will pop up. Review the cut depth is not too much larger than the material thickness and click OK.
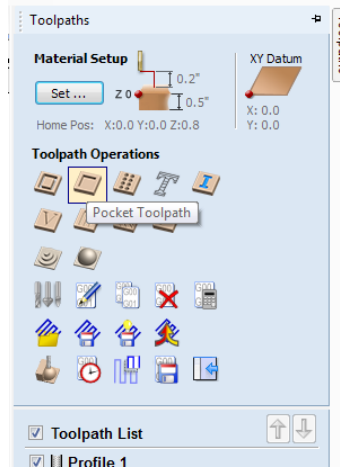
Step 7: Previewing Toolpath
-See instructions on previewing toolpath in the Preview Toolpaths section below.

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
90

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
91

Setting Up Aspire Files

POCKET CUT

Step 1: Select the pocket toolpath from the tool path operations.

Step 2: Specify your cut depth.

Step 3: Select the size and type of bit used to make the cut: endmills are the most common bit used for this toolpath. Go to the endmill info sheet for more info.

    -Select a bit that has a cutting head that is long enough to handle the depth needed to be cut. Remember – endmills are the preferred bit of choice for this since they will leave a flat surface wherever it cuts. BOTH UPCUT AND DOWNCUT BITS CAN BE USED, BUT DOWNCUT BITS WILL GO MUCH SLOWER AND SHALLOWER DEPTHS.

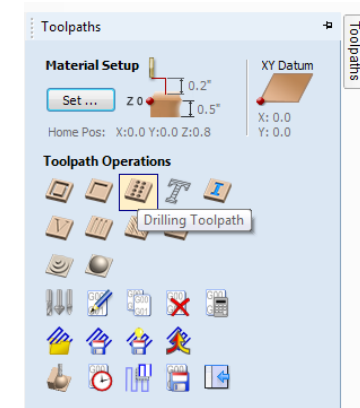**Step 4:** Select Offset and Climb for the direction of the cut.

Step 5: Name the cut and click Calculate.

Step 6: Previewing Toolpath - See instructions on previewing toolpath in the Preview Toolpaths section below.

DRILLING

Step 1: Select the drilling toolpath from the tool path operations.

Step 2: Specify your cut depth.

When cutting through your material, set the cut depth slightly more than the thickness of the material to ensure holes are drilled completely through the material.

Step 3: Select the size and type of bit used to make the cut.

DO NOT CHOOSE A DOWNCUT BIT OR A COMPRESSION BIT FOR THIS TASK. Upcut endmills or ballnose are most commonly used for this toolpath. Go to the endmill and ballnose info sheet for more info.
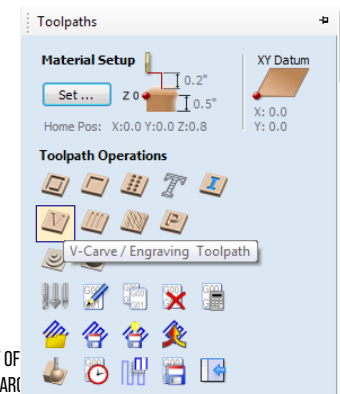
    Note - Downcut and compression bits WILL start a fire if used for this task.

Step 4: Name the cut and click Calculate.

Step 5: Previewing Toolpath -See instructions on previewing toolpath in the Preview Toolpaths section below.

V-CARVING

Step 1: Select the V-Carve toolpath from the tool path operations.

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
92

UNIVERSITY OF
SCHOOL OF AR
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
93

Setting Up Aspire Files

Step 2: Select the size and type of bit used to make the cut: V-bits, engraving, and ballnose bits are most commonly used for this toolpath. Go to the v-bit, engraving, and ballnose info sheets for more info.

    -For text with thin vector lines, V-bits and engraving bits are best to use

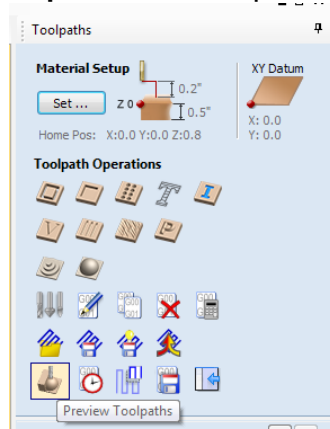   -For drawing lines, or thicker text, a narrow ball-nosed bit can be used

Step 3: Name the cut and click Calculate.

Step 4: Previewing Toolpath

    -See instructions on previewing toolpath in the Preview Toolpaths section below.

PREVIEWING YOUR TOOLPATH(S)

**Step 1:** Under the toolpaths tab select Preview Toolpaths.

Step 2: Select the toolpath(s) you want to preview under the Toolpath List.

Step 3: Select Preview Visible Toolpaths to watch a preview of the cuts selected.

    -Speed can be adjusted with the sliding bar.

    -Hit Reset Preview to reset the model.

TOOLPATH SUMMARIES

Step 1: Under the toolpaths tab select Summary of all Toolpaths.
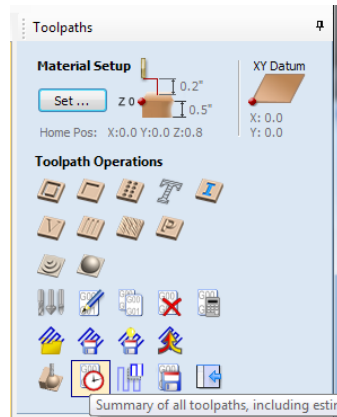

Setting Up Aspire Files

Step 2: Select all the tool paths to be cut in the Toolpath List.

Step 3: Record the total running time to complete all cuts on the project sheet.

    -Account for time changing bits and setting up material when estimating the total project time.

    -Times for each individual cuts are also shown.

SAVING TOOLPATHS FOR SHOPBOT

Step 1: Under the toolpaths tab select Save Toolpath.
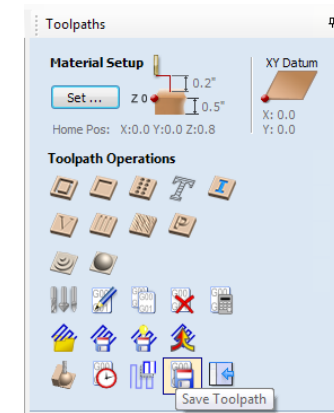
Step 2: Check Output all visible toolpaths to one file. If not using the tool changer, the files can be saved individually, then run one at a time.

Step 3: Under Post Processor, select ShopBotTC (inch)(*sbp). (TC stands for tool changer, if it is not selected, it will run every file using the same bit and not change in between toolpaths)

Step 4: Select the cuts to be saved. Cuts to be selected will show under Toolpaths to be saved...

Step 5: Review everything to make sure the correct cuts have been selected. Click Save Toolpaths. Place the files in the same folder as the main file.

HOW TO INPUT A 3D MODEL TO ASPIRE

NOTE: CNC Operator should become familiar with customer's project to assist with orientation of material.

Step 1: Open Aspire from desktop

Step 2: Select "Create a new file"

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
94

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
95

**Setting Up Aspire Files**

Step 3: Job Setup Panel

Job Size (X & Y): Input values. Overall material length and width to be cut by CNC.
-Refer to "X" and "Y" labels on ShopBot surface to ensure your material orientation will correctly align with the "X" and "Y" values you input to aspire.

Material (Z): Input value. Thickness of material.

XY Datum Position: Selecting position that has a positive X and Y axis.

NOTE: Uncheck "Use Offset" and set "X:" and "Y:" to "(0.0)".
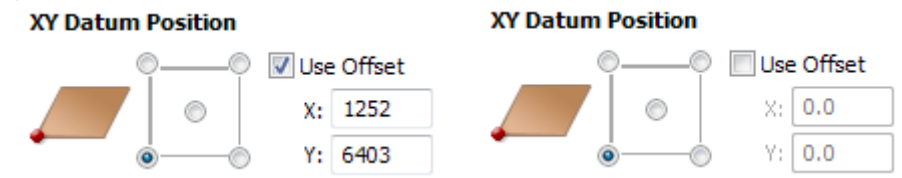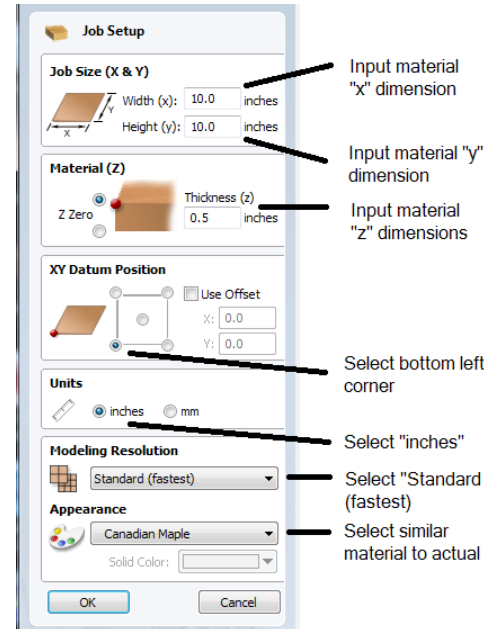

Units: Select "inches".

Model Resolution: Select "Standard (fastest)"

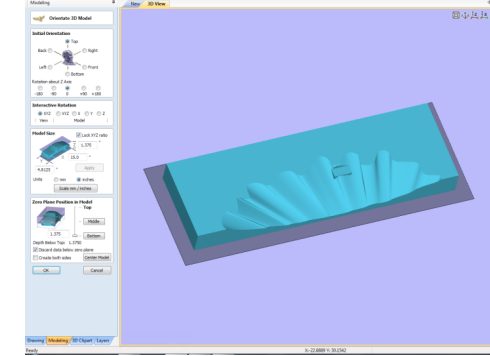**Appearance:** Use default, "Canadian Maple".
-      Click "OK" when finished.

Step 4: Import Project/Model

Note: If you need to return to "Job Setup" page, select "Edit" in toolbar then "Job Size and Position".

-        Select "File" in toolbar, then select "Import Component/ 3D Model" function-   Locate the 3D model file on computer and open file. i.e. Box or jump drive

**Step 5:** Orientate 3D Model Panel

Initial Orientation: Select "Center Model" to get model centered on the "virtual work piece" Depending on the file, you might have to rotate the project, look below for those directions.
Model Size: Select "Lock XYZ ratio". This feature locks the projects proportions for scaling purposes.
-      "x", "y", and "z" measurements should automatically appear.
-   Select "inches"

Zero Plane Position in Model:
-      Unselect "discard data below zero plane".
-      Click "OK" when finished.
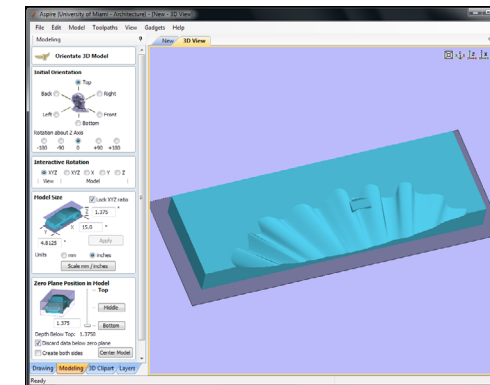
Setting Up Aspire Files

Step 6: Determining Proper Orientation
- -Click "New" tab
- -If project is orientated on virtual work piece and facing desired direction continue to "How to prepare Toolpaths for a 3D model" in directions. See image on left,
- -If project is NOT orientated above virtual work piece and/or NOT facing the desired direction continue to Step 7. See image on right.
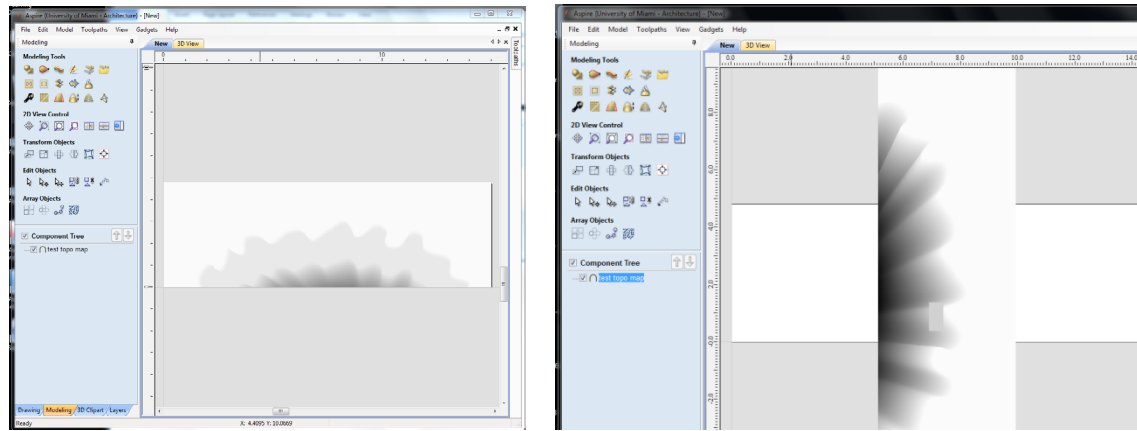
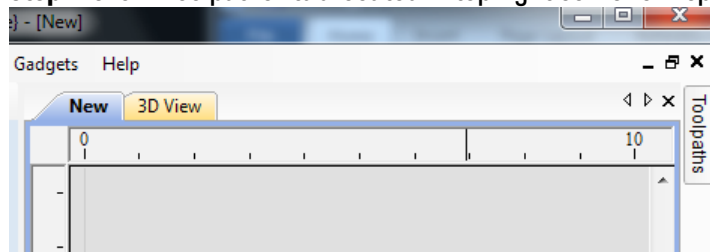**Step 7:** Orientate project to desired cutting position
- -Within "Transform Objects" select "Rotate Selected Objects"
- -Click on model in view port/ model space to activate rotation functions.
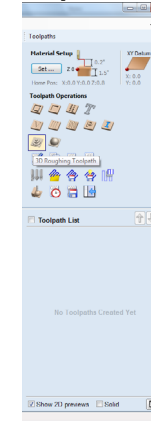- -See Image 6

Rotate Panel
- -Anchor: Select center circle.
- -Angle: Enter "90"

HOW TO PREPARE TOOLPATHS FOR A 3D MODEL

Step 1: Click "Toolpaths" tab located in top right corner of Aspire.

Step 2: Select "3D Roughing Toolpath" tool

Step 3: Toolpaths Panel for Rough Machining Toolpath

Tool: Click "Select" to choose bit type. See step 4 and Image 3 for information on inputting values for bits.

Machine Allowance: Set between .04 - 0. This determines material remaining for the "Finishing toolpath".

Roughing Strategy: For best results, repeat step 3 multiple times with a different "Roughing Strategy" and compare outcome for desired method.

- Z Level: Default toolpath option. Renders toolpath as a series of layered 2D pocket toolpath cuts. "Raster X" removes material by moving the spindle parallel to the x-axis, "Y-Axis removes material by moving the spindle parallel to the Y axis. "Profile" concerns with a profile toolpath cut that follows the pocket toolpath at each level to clean up the perimeter. "Last performs this action after the pocket toolpath, first does it before, none does not perform this action.

-"3D Raster": 3D rendered toolpath. Recommended only in special cases in which a shallow cut is desired. Will leave more material than "Z Level". Can select which direction the spindle will generally remove material in, "Along X" or "Along Y"

-Boundary Vector Offset: Set to zero "0". This determines material remaining around model.

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
98

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
99

Setting Up Aspire Files

- Click "Calculate"

- Click "Close"

Step 4: Tool Database Panel: DO NOT CHANGE ANY OF THE BIT INFORMATION IN THE DATABASE UNLESS YOU ARE EXPERIENCED. PLEASE ASK FOR HELP WITH THIS IF YOU ARE UNSURE OF WHAT TO DO.
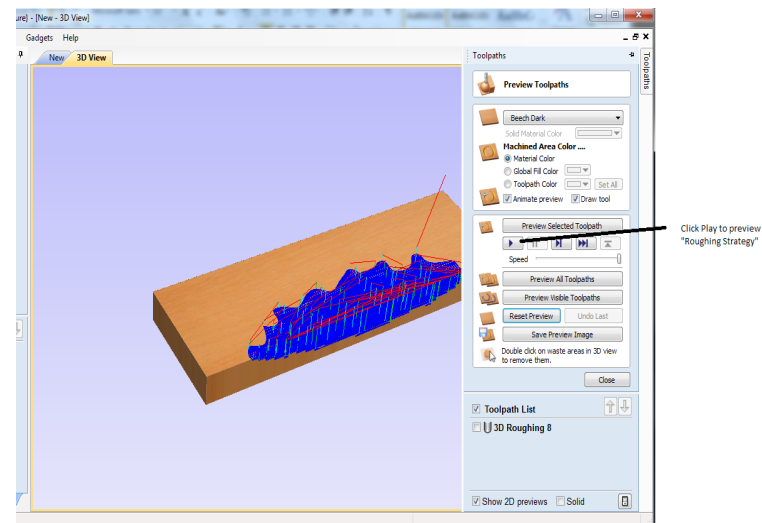
*The most commonly used bits for roughing tool paths are endmills or ballnose bits. Choose the biggest one that gets your first pass close to the finished model as possible in a decent timeframe. Go to the endmill and ballnose info sheets for more info.

-Click "OK"

- Complete Step 3

Step 5: Preview Toolpath

-	Click the Play Button Under the "Preview Toolpath" panel

Step 6: If satisfied with preview, Select Toolpath that you will use for the ShopBot under "Toolpath List" and click "Save Tool-path" tool (See image 5). Otherwise repeat toolpath process from step 1 and make necessary changes.

Step 7: Set File type as "ShopBotTC (inch)(*.sbp)"

Step 8: Click "Save Toolpath(s) ..." and save to desired location on computer.
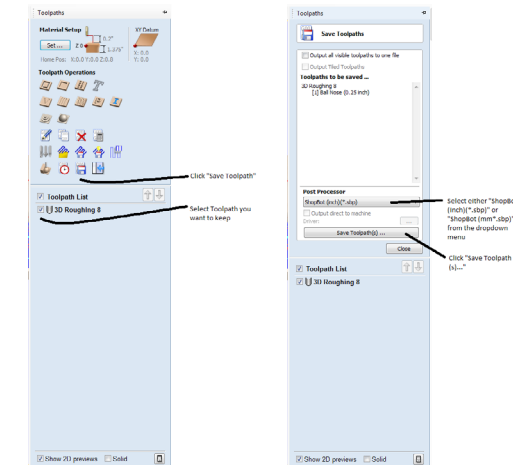
HOW TO PREPARE SHOPBOT HARDWARE

Step 1: Activate ShopBot
i.	Turn red on/off switch on front panel clockwise into 'on' position
ii.	Turn interlock key also located on front panel into 'engaged' position

**Step 2:** Open the ShopBot application on the attached desktop computer. Three windows will open ("ShopBot Preview", "Shop-Bot Console" and "Position")
	*Pop up will say "a port is open and do you wish to proceed?". Click ok.

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
100

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
101

HOW TO PREPARE SHOPBOT HARDWARE

Step 3: Before putting your material on the work surface of the spoil board, you need to home the machine using the x and y proximity switches.

- Click on the "cuts" tab on the ShopBot screen. Click on "home x y using prox switches".
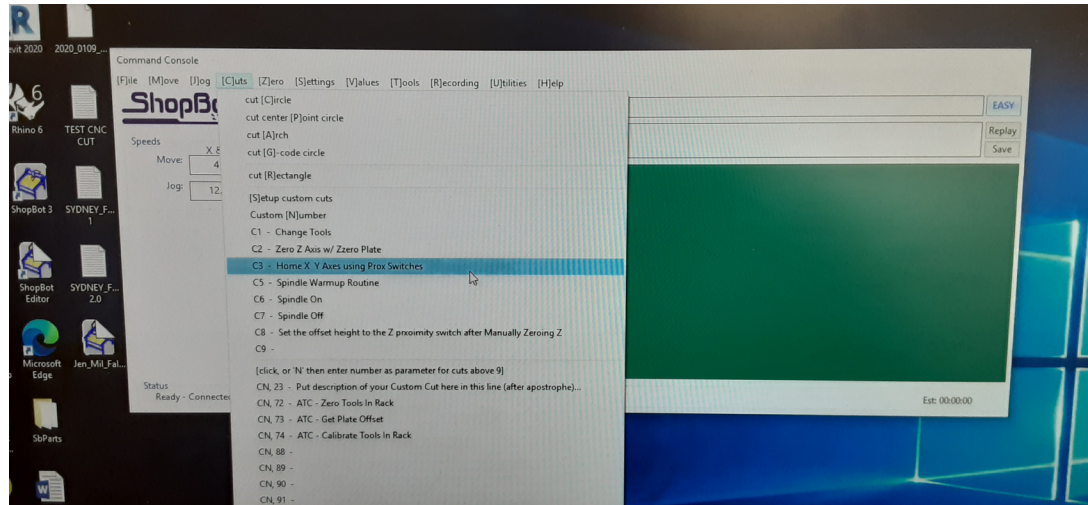
-After the machine moves and completes the homing sequence, ensure that the x and y 0,0 position is at the corner of the spoil board. If it is not, please ask for assistance.

Step 4: Zero the bit to the surface of the spoil board

-Using the yellow keypad, move the bit over clean area of the spoil board and lower the bit to 2 – 3" above the zero plate. Attach the alligator clip to the bit.

-Click on the "cuts" tab on the ShopBot screen. Click on "zero z axis with zero plate".

-Once the menu pops up, click "Ok". The machine will go through the zero process and make sure to remove the alligator clip and return it and the zero plate back to where they belong.

Step 5 – Use vacuum table to attach work piece to the spoil board

- Place your work piece on the spoil board in the correct orientation

- If the work piece does not fill the entire quadrant of the vacuum table, place scraps of wood around the perimeter to block off the unfilled areas . The vacuum will not hold to be cut otherwise

- Under the spoil board, ensure that only the main valve is open, press the green button on the vacuum panel on the wall. Once you hear the suction coming from the main valve, open the valve for the quadrant you will be using and then close the main valve. Ensure the work piece is secure to the table before moving forward. Repeat the process until it works.

Step 6 – If vacuum table cannot be used to secure work piece, use screws.

- Place work piece on table in desired location

- Using the prepared ShopBot file, place screws in areas where the bit will not be cutting. Make sure the screws are flush or below the surface of the wood just in case.

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
102

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
103

HOW TO PREPARE SHOPBOT HARDWARE

Step 1: With ShopBot hardware connected and zeroed. Press large green "Cut Part" on the red "Position" windows

Step 2: Navigate and open desired file from computer, a window emulating a yellow memo pad will open, leave all settings as default and select "Start"

Step 3: A window will open labelled "NOW STARTING SPINDLE !", DO NOT SELECT "OK" UNTIL SPINDLE IS ACTIVE !!!
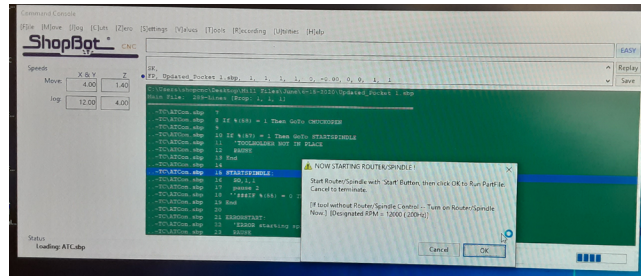
Step 4: Activate Spindle by pressing the green "START" button on the ShopBot remote.

- Wait a few seconds for the spindle to reach its top speed and then select "OK" to begin the cut.

- The remaining process is automated including bit changes. Remain attentive for this process, at any sign of trouble press the left-mouse button (automatically restricted to stop button on "Position" window), hit the spacebar, or press the red Stop button on the Remote if it is an emergency. Troubleshoot accordingly by zeroing axes, checking the toolpath in Aspire, or other situation specific adjustment.

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
104

UNIVERSITY OF MIAMI
SCHOOL OF ARCHITECTURE
FABRICATION LAB

FABRICATION RESOURCE
MANUAL
105