

# FAB

## FABRICATION SHOP

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## DIGITAL FABRICATION SERVICES

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## FABRICATION CREDIT AND USER DATA BASE

First time users create an account in our user database in order to start using the Fabrication Shop including the shop tools, tool checkout, laser cutting, CNC and 3D printing. User accounts can be created in the Fabrication Shop or the laser cutting room using a valid SSA ID card.

Every semester each student is provided with a virtual sum of money, as a Fabrication Shop credit for the free use of CNC and 3D printing machines (Laser cutting is only limited by weekly reservations.) The total credit may be used for CNC milling and a maximum of 25% of the credit can be spent on 3D printing. After each CNC or 3D printing job, you will be charged in your account. After the free credit has been used, the students can pay for the services after the job is finished. An individual can only use his/her own credits. Those who share their credits risk losing the privilege of Fabrication credits for up to two semesters.

## LASER CUTTING

- a. The SSA Fabrication Shop has two Universal Laser Cutters with 18" by 32" beds. They are the most commonly used machines for building architectural models. Using a limited weekly reservation system, the laser cutters are self-service under the supervision of the staff. Starting from March 2017.
- b. In order to use the laser cutters the students are required to attend an orientation. The users will be added to the Fabrication Shop user database in order to document their laser cutting certificate.
- c. The Laser Cutting service is **only** available for school projects; personal projects and commercial use are strictly prohibited.
- d. The files should be prepared in DWG format, according to the template available on the SSA website.
  - The file units must be inches.
  - The stock material should be measured carefully and drawn within the 18"x 32" boundary of the laser bed located at the top left corner.
  - The pieces should be scaled and placed within the stock with a ¼" margin around the material outline to ensure a safe cutting operation; lines must be trimmed beyond the margin lines.
  - Limit your layers to the following: 0(Black/White color for borders, notes, etc.), CUT (default Cyan), ETCH(default Green), and ENGRAVE(default Blue).
  - The lines on the CUT layer will be cut out of the stock material.
  - The etch and engrave operations are similar and create the line pattern on the surfaces; etching draws thinner lines.
  - The drawing should be checked to avoid duplicate lines both with the "Overkill" command and manually. Doubled lines result in longer cut times and over-burning of the material.
  - The laser cut line is about 1/32" thick and thus parallel cut lines must be more than 1/16" apart.
  - Pieces smaller than ¼" x ¼" may fall into the laser bed's honeycomb.
  - All fonts should be the AutoCad's "romans"- otherwise the laser cutter wouldn't read it or creates a hatch within the font area resulting in a significant time waste.
  - Save your DWG with a 2010 format. (Save As)
- e. Prepare your material. Carefully measure the width, length and thickness. Maximum sheet thickness depends on material type. The average maximum limit for material thickness is 1/8" but you can consult

the shop staff for more information. Thicker sheets may be etched but cutting may need more than one path. Re-cutting results in poor cut quality and burns. The material piece must be flat with consistent thickness; warped sheets will result in cutting problem and fire hazard. The materials that can be cut on the laser cutters are Basswood, Balsa, Chipboard, Museum board, Plexiglass and paper. The use of any other materials should be coordinated with the shop staff. Lexan, PVC, styrene, polycarbonate, vinyl, glass, foam core, and metal is not allowed. Prohibited materials could melt on the laser bed, cause fire or release toxic gas which, beside health hazards, could damage a machine. Plastics can release carcinogens such as benzene.

- f. There is a 1 hour limit for reserving the laser cutter including the time spent preparing the file, material and machine. Reservation may be made in 30 mins periods two weeks in advance. If a laser machine is free, it may be used on a first come first serve basis until the next booked hour (sign up is still mandatory).
- g. To reserve a time slot go to the room 212 with your valid SSA ID and the file you intend to cut.
- h. We recommend finalizing your file with the staff beforehand in order to avoid wasting time during your reserved slot. However, that is limited by the availability of the staff. Preparing the files is the students' responsibility and file adjustments should be done on the users personal computer.
- i. The users should be present with a valid ID to sign up for a time slot and only that individual may operate the machine during the reserved time.
- j. Reserved time slots are canceled after 10 minutes if not used.
- k. Canceled or free time slots may be used on a first come first serve basis.
- l. The laser cutters are located on second floor. Bring your SSA ID with you along with your file and material.
- m. Plan to arrive 5minutes prior to your reserved time.
- n. Each user should log in to their account to use the machine.
- o. Only use the preset plot options for the materials. They may not be altered under any circumstances. Ask the staff if you need help.
- p. The students are responsible for time estimates of their files. Unfinished jobs must be aborted if a machine is reserved by another user during the next time slot.
- q. Clean up after using the machine.

## **3D PRINTING**

There are three MakerBot 3D printers at the Fabrication Shop with a 6"x11" bed and 6" high print volume. These prototyping machines are a fast way to create complex forms from three dimensional modals. The printers use 1.75 PLA Filaments provided by the users. Students from the Third year undergraduate level and higher have the priority for 3D Printing. The printers are operated by the shop staff only. The 3D printing service is only available for school projects and personal or commercial projects are not allowed. 3D printing is charged per cubic inch of material (filaments provided by the students). The guidelines for submitting the files are as follows:

- a. Preparing the 3D model is the user's responsibility. The shop computer systems may not be used for correcting the files and they should be prepared in advance.

- b. The 3D printer is only able to print volumes. Any unclosed surface in the 3D models should be given a thickness.
- c. The volumes should be 'water tight.' If you are working in Rhino, it means they should be closed polysurfaces. If you are having a problem with your model you may consult the staff at the Fabrication Shop.
- d. Make sure your units are in inches.
- e. Scale the model to fit inside the printing limits of the printer. (6x11x6")
- f. Lay your volume flat on the XY plane (with the least Z height), on the most stable side and with minimal overhangs to avoid supports.
- g. Export only the printable volumes in STL format.
- h. Name your file with this format: "Last Name-First Name\_Professor\_Model Name"
- i. Bring both your ".3DM" and ".STL" file to the Fabrication Shop on a flash drive. To make sure about the correct printer settings, ".x3g" and ".thing" files exported from the Makerbot software are not accepted.
- j. Mark your filament with your name (the person whose name is on the sign up sheet.)
- k. Submit your file to the staff at the laser/3D printing room (located on the second floor.) We will review your file to make sure it is printable. You will be notified about the cost of printing and we can inform you about the credit remained on your account. Credits may not be shared.
- l. Our staff prepare the file as soon as they are available and a Machine is free. Nevertheless, make sure to submit your files 72 hours in advance of your deadline. This time may also increase during the busy periods such as the final weeks.
- m. Models with more than 10 hours of printing time may not be accepted during the busy times in order to give everyone a chance of using the machines.
- n. If a submission takes longer than 5 hours and there are more files left for that user, (s)he will be moved to the end of the line until the next submissions have been printed.
- o. You will receive a text once your job is ready.
- p. Come to the Laser-3D Room, if applicable, pay for your job and pick up your model and filament.

## CNC ROUTER

The SSA has a large CNC router with a functional bed size of 4.5 feet by 8 feet. It can be used for fabrication purposes as well as models, topographical bases, etc. After preparing the file the students and faculty schedule a meeting with the shop staff to discuss their project. You can make an appointment by coming to the Fabrication Shop in person. The CNC routers are operated by the shop staff only.

The CNC service is only available for school projects; personal and commercial projects are not allowed. CNC cutting fees are on an hourly basis (see p.4, Fabrication Credit and User Database).

- a. First step for a CNC project is to determine the appropriate material. You can consult the shop staff in order to find the best material option for you. Materials are provided by the users. The CNC machine is commonly used for cutting flat sheets such as Foam, MDF, Plywood and Wood. A variety of foams may be used on the CNC machine; we suggest the use of foam for projects with no structural requirements (such

as architectural models) as the time of cutting is significantly reduced and thus the possibility for the shop staff to be able to schedule your project is higher. Metal or glass cannot be cut on the CNC machine.

Discuss the use of any other materials with the director of Fabrication Shop. If possible, the material should be larger than the intended final size. A 1" margin will allow for fixing the material on the bed.

- b. The combined maximum height of material and cutting tool (i.e. depth of cut) is 8". The material itself may be up to 6" high (in which case the cut depth can be only 2"). The depth of cut may not exceed 4".
- c. Laminating the boards should be done 24-48 hours in advance under pressure and using a material-appropriate glue. It is common that an inadequate preparation results in the delamination of materials.
- d. It is crucial to check the material and make sure there are no metal pieces such as nails, screws and staples. The metal pieces can be dangerous during the operation and will damage the tool. Loose knots should be removed or glued in advance.
- e. Bring your Rhino (.3dm) file to the Fabrication Shop for further directions. The file name must be formatted as: "Last Name-First Name Professor Material Model Name"
- f. After your file has been approved, an appropriate time should be allowed for the toolpath to be prepared. You may be asked to be present when your file is being processed.
- g. The size of file that can be accepted varies during different periods of semester. Material type and size are the two factors of the timing of a job. Large projects should be discussed with the director of the Fabrication Shop before planning to cut them. They may not be accepted if it is estimated that they will disrupt the normal workflow of the services for other users, when it will be a great burden on the machine or the staff are not available for those services.
- h. For large/group projects, you may be asked to provide your own tool.
- i. Students from the third-year undergraduate class and higher have the priority for using the CNC routers.
- j. The students are added to the Fabrication Shop user database in order to use the CNC machines.
- k. Once the file is ready for milling you will be notified (in person or via text) to schedule a cutting time.
- l. Bring your material to the shop on the same day. The Fabrication Shop does not accommodate material storage in advance.
- m. Users are required to be present at the time of cutting. That is to clean the material and also in case of any complications during the operation.
- n. Wear safety goggles and ear protection when you are in the vicinity of the router.
- o. It is the user's responsibility to clean up after the milling is complete. All scrap material must be taken to the outdoor dumpster and all debris/dust must be swept and discarded.
- p. You will be notified of the fees after milling (you may also ask for an approximate estimate before milling.) You may use your fabrication shop credit for your CNC jobs. Students may not share their credit. If applicable, pay for your milling job at the front desk and pick up your model.

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