TERRAPIN WORKS

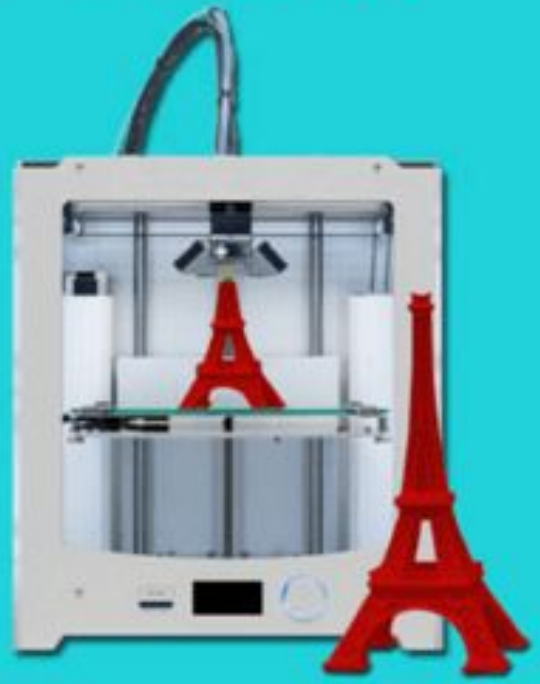
Intro to FDM 3D Printing

Students please sign in for the TW Workshop!

https://go.umd.edu/TWSP25

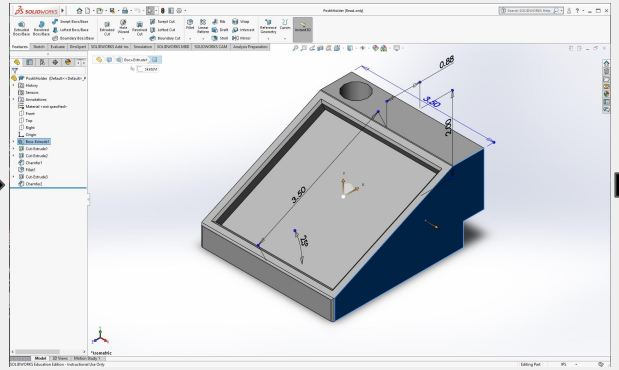
What is 3D printing?

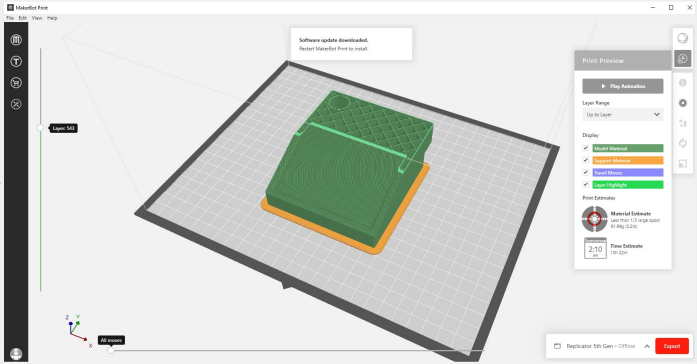
2D Printing Vs 3D Printing



DREAM IT!!!

SLICE IT!!!

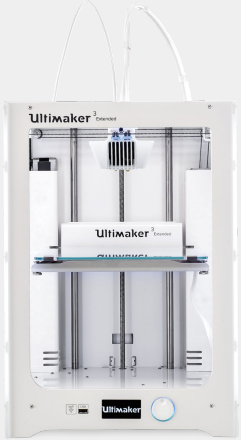


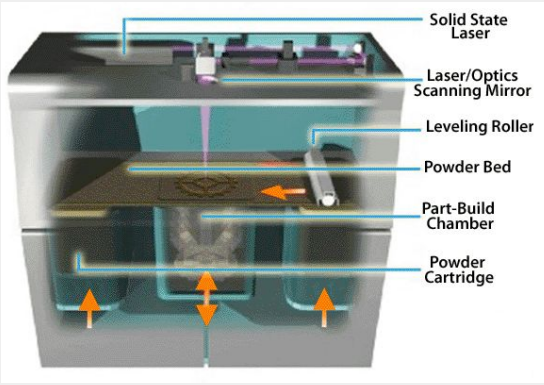


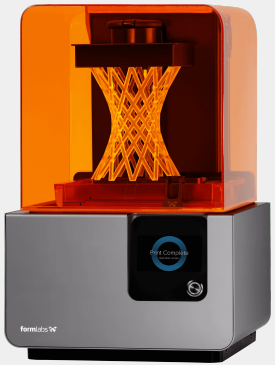
DESIGN IT!!!

Various ways to 3D print

1. Fused Deposition Modeling (FDM)
2. Stereolithography (SLA)
3. Polyjet printing
4. Multi Jet Fusion (MJF; For plastics)
5. Selective Laser Sintering (SLS; For plastics)
6. Direct Metal Laser Sintering (DMLS; For metals)







Breakdown of 3D Printing Methods

- FDM: uses thermoplastic filament that's extruded in layers
- SLA: uses a liquid photopolymer resin with a UV laser in layers
- Polyjet: uses a wide range of materials (rubber, plastics, human tissue) and extrudes via inkjet heads and sures them via a UV light
- MJF: powder bed fusion technology that fuses thermoplastic particles with heat
- SLS: uses a laser as the power and heat source to sinter powdered materials
    - DMLS: printing method that uses a laser to fuse powdered metal i

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Our various additive spaces…

Advanced Fabrication Lab (AFL)

- Has the widest variety of 3D printers both Consumer grade and Industrial.
- Many materials are available for various needs
- Submit parts for manufacturing through maker.umd.edu

Fabrication Farm (Fab Farm)

- Our most popular & affordable space with~30 Prusa i3 MK3S+ printers!
- Available materials include:
  - Flexible PLA
  - Standard PLA
  - ABS
  - And PETG
- Submit parts for manufacturing through maker.umd.edu

Rapid Prototyping Center (RPC)

- Allows for training and independent work on many machines including:
  - Prusa
  - Raise3D N2 Plus
  - Formlabs Form 3
  - Epilog Fusion Laser Cutter and Engraver
- Stop in to get a safety tour and start your training

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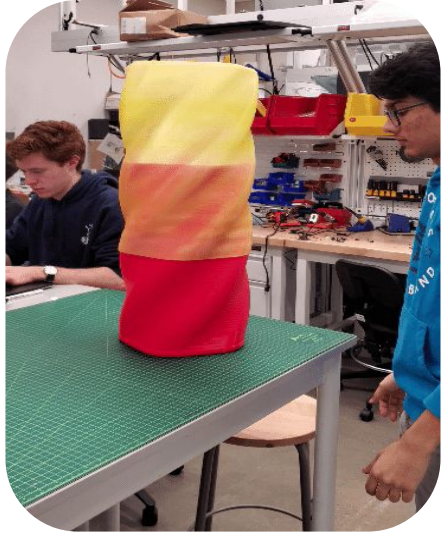
Applications

- High quality prototyping for research, business proposals, and personal use
- Figurines, models, and made-to-use parts
- 3D scanning (AFL and RPL)
- Printable materials include:
  - Plastic
  - Nylon
  - PC
  - PPSF
  - ABS
  - Resin
- Laser cutters also available



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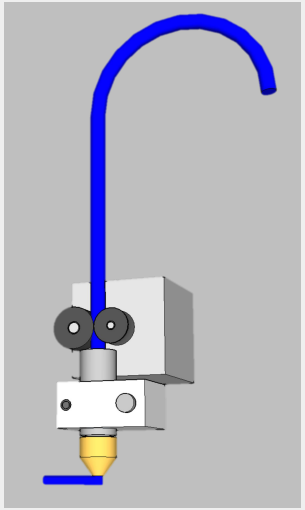
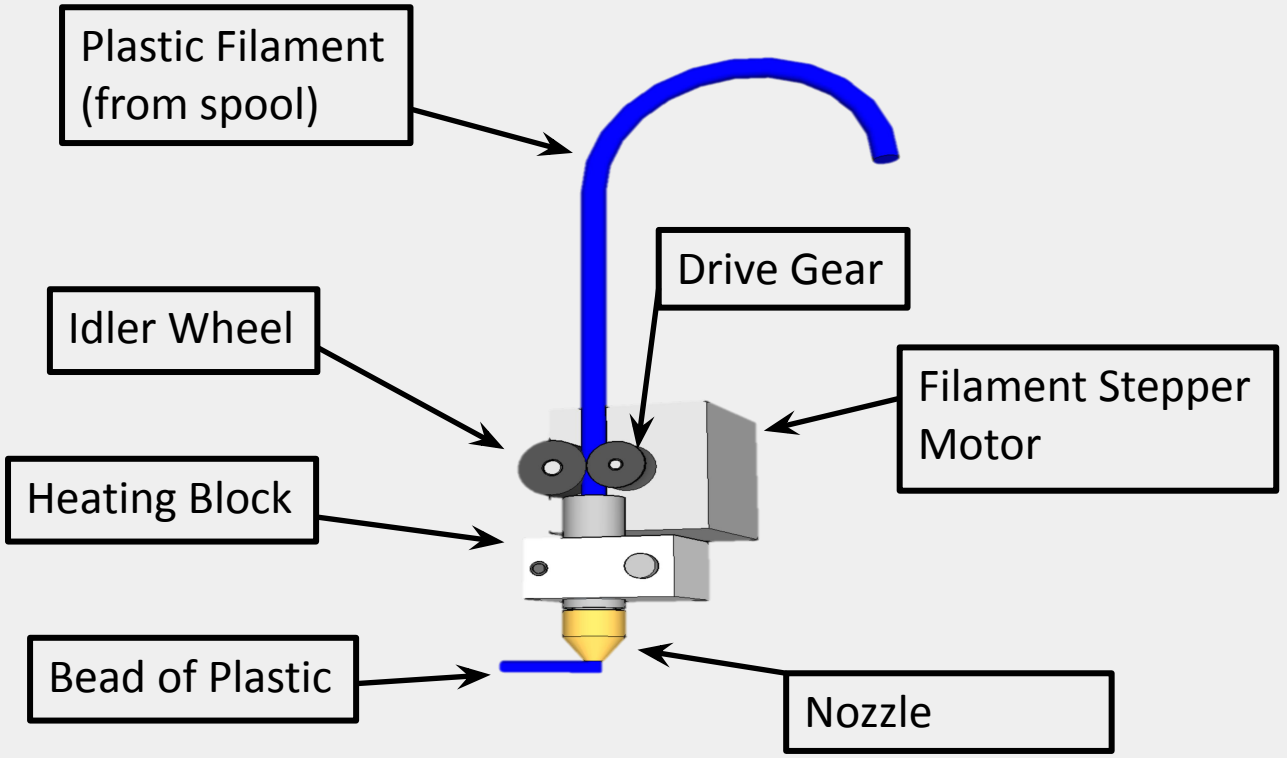
Fused deposition modelling

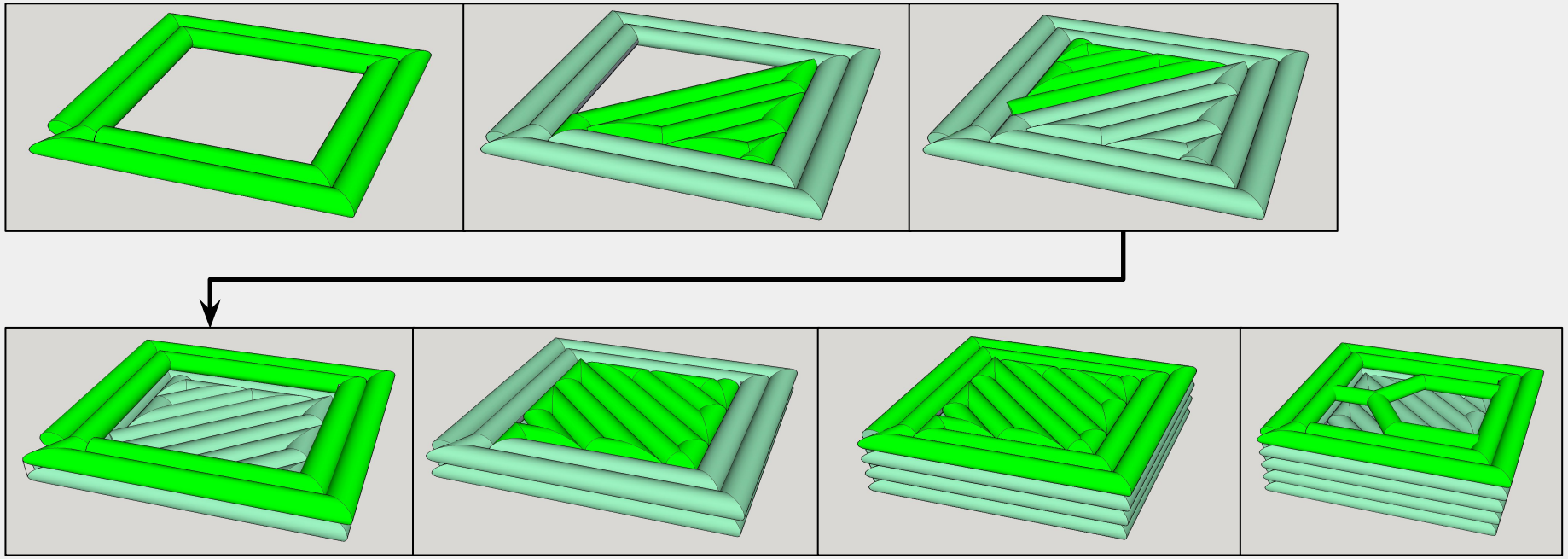
The Extruder: Tiny computer controlled hot glue gun on Steroids



FFF/FDM Process: Extruder

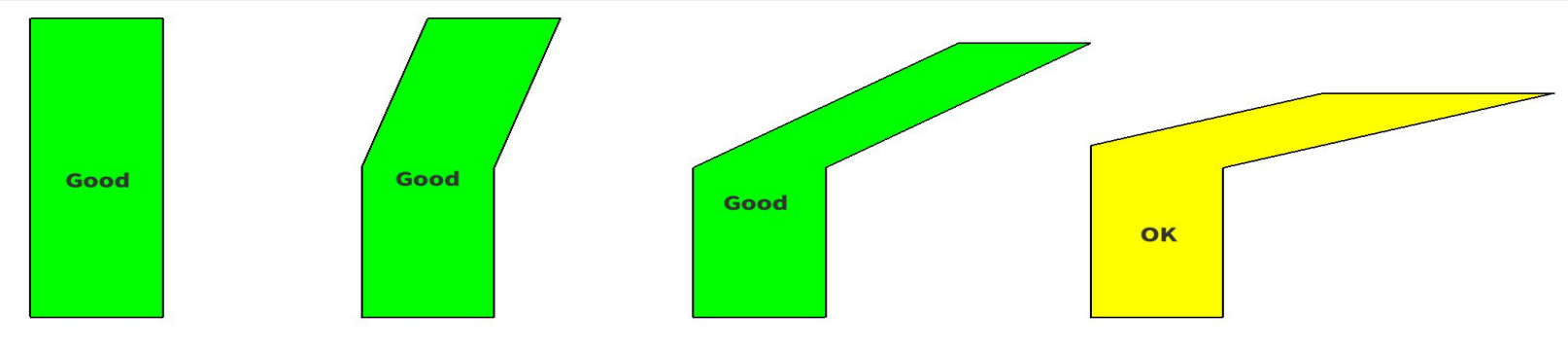


FFF/FDM Process: Toolpath



Overhangs

≈30°

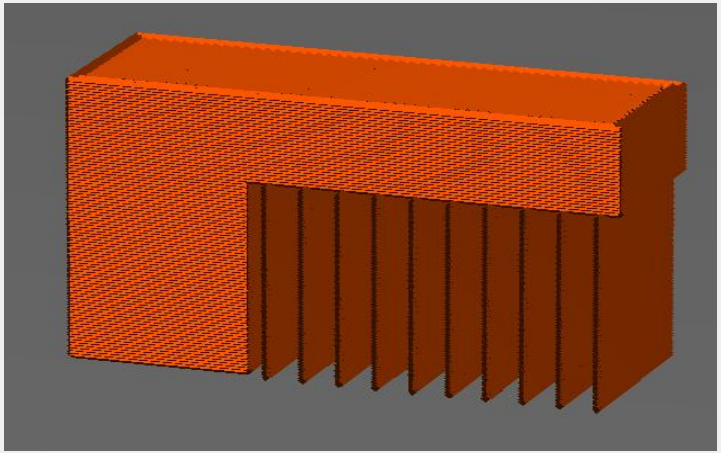


- 45 Degree Rule
- Candy Cane
- Bridging
- Automatic/User Created Support Material

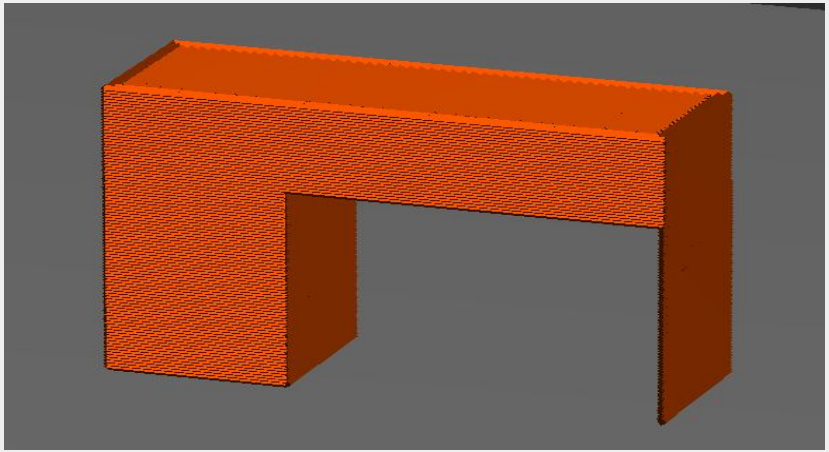
Overhangs

≈30°

Automatic/User Created Support Material



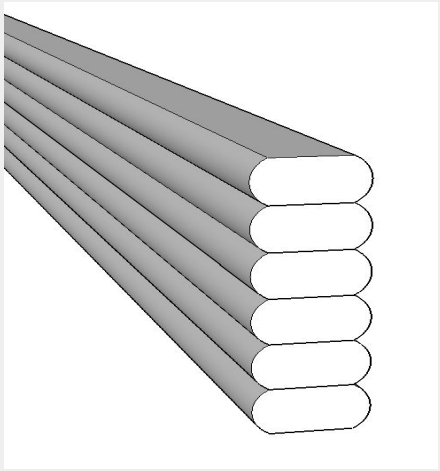
Auto

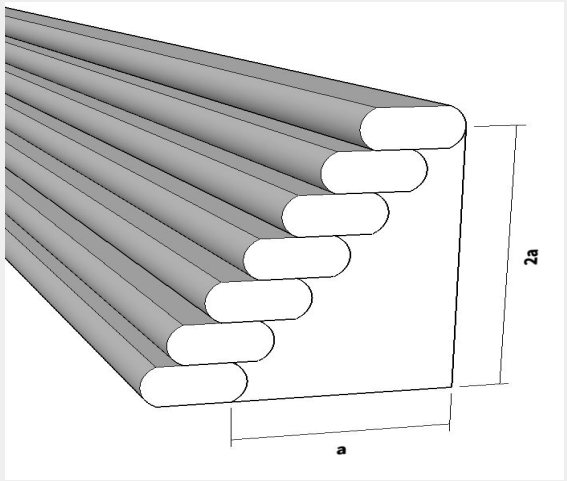


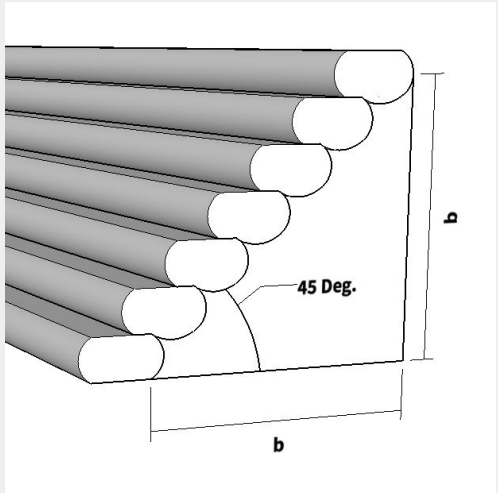
Designed in CAD

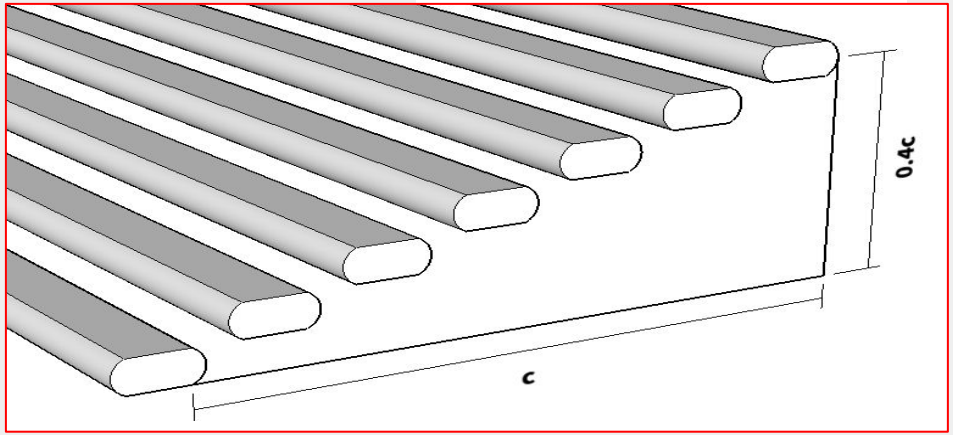
Overhangs

≈30°



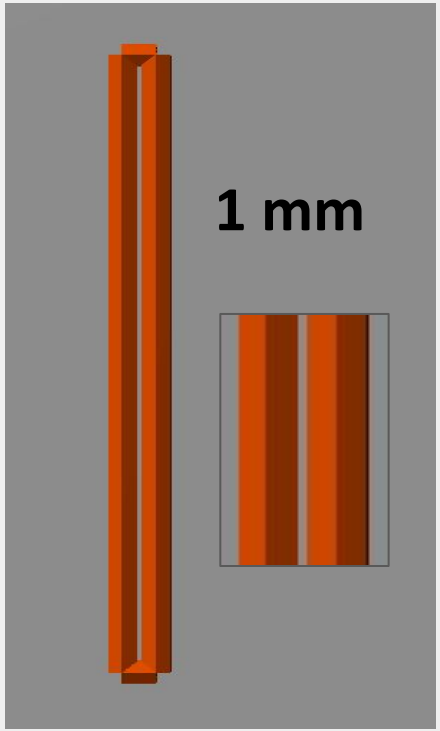


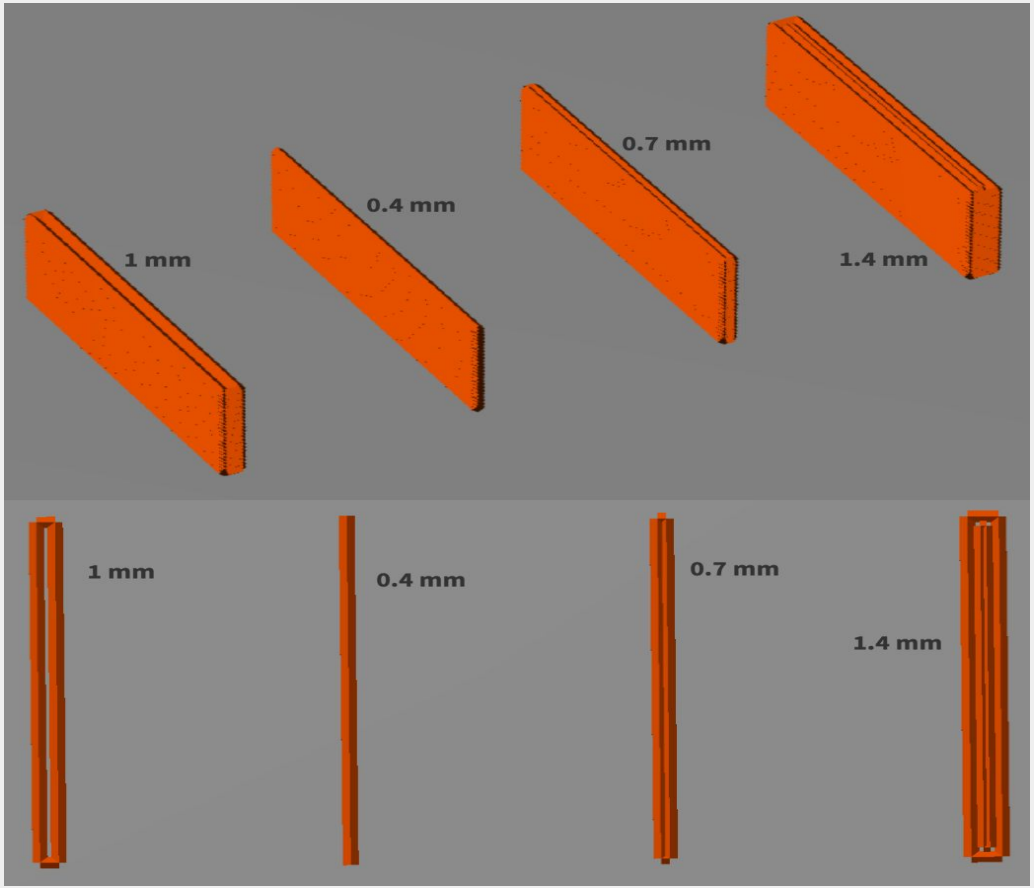




Thin Walls

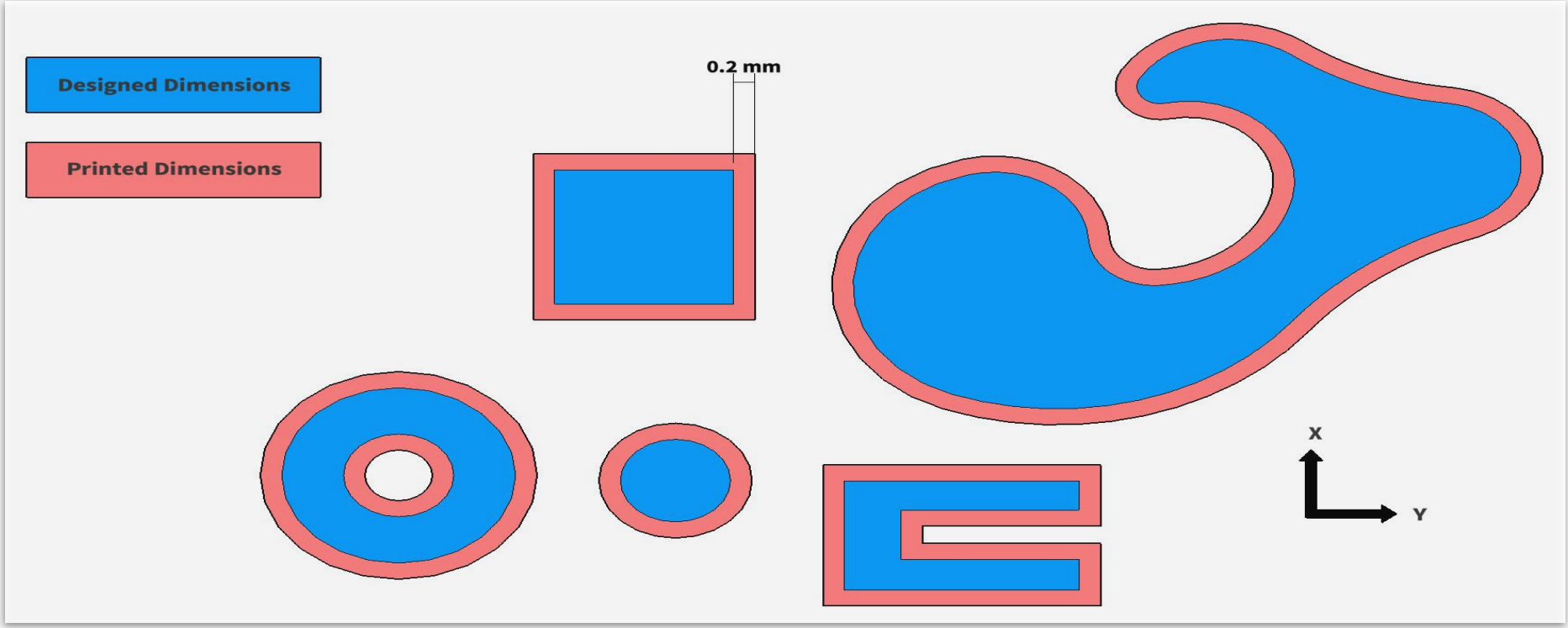
0.4 mm, 0.7 mm, 1.4mm





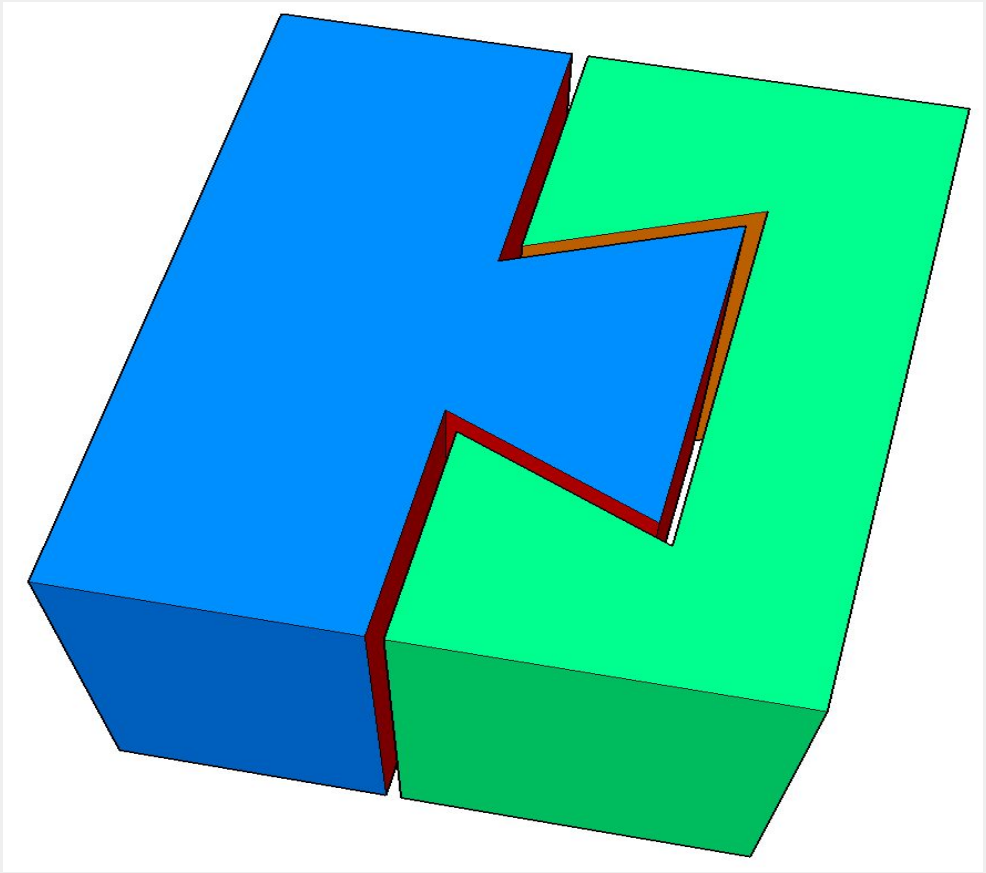
Tolerances

0.2-0.4 mm



Tolerances

0.2-0.4 mm



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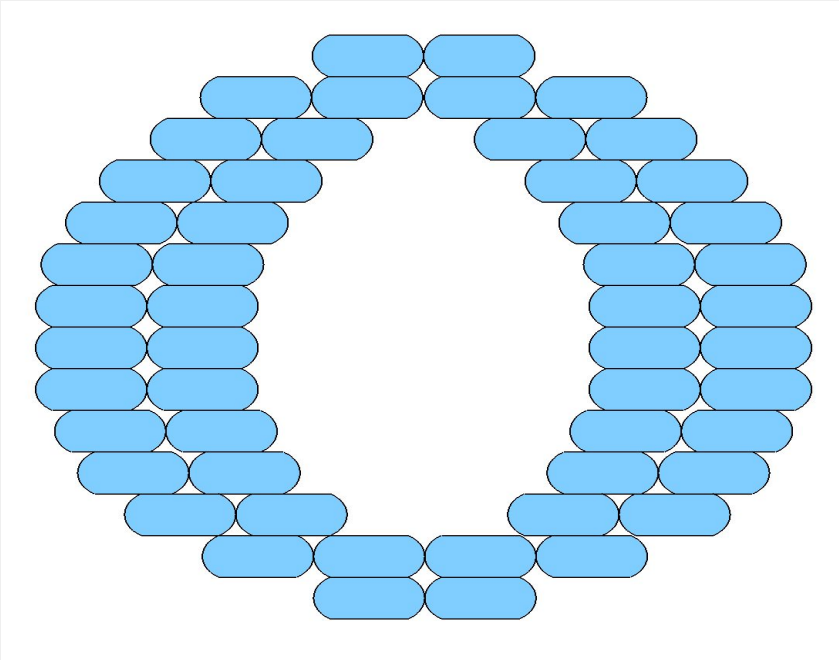
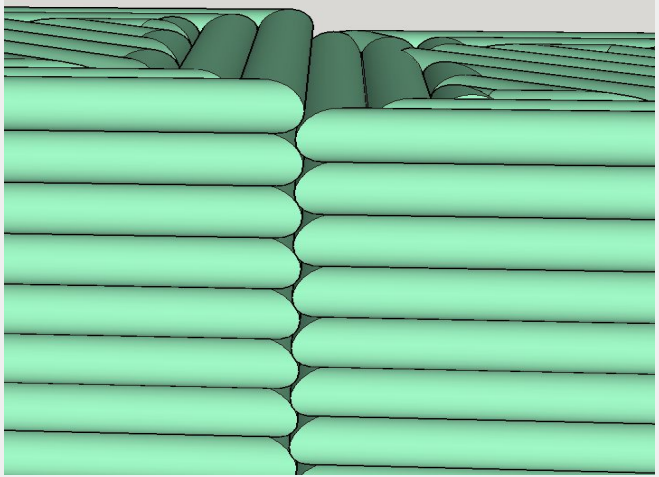
Part Directionality (Anisotropy)



- Moving Interfaces
- Strength
- Shaft Dilemma



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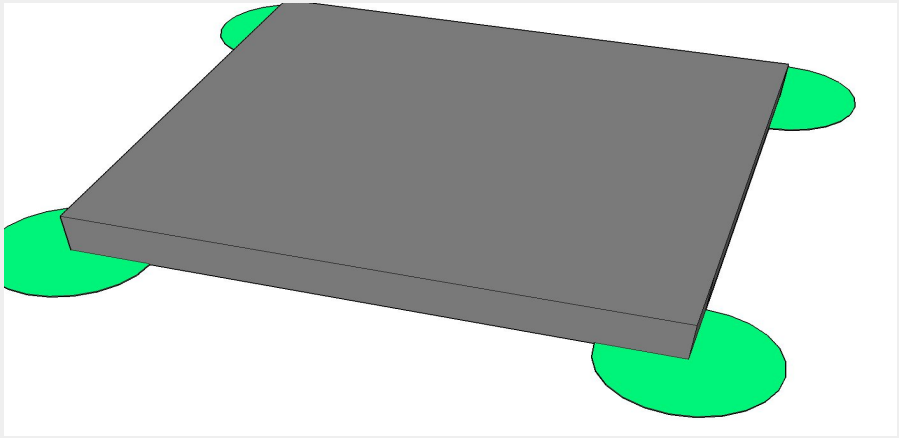
Warping

- Thermal Deflection
- Build Plate Surface
- Heated Plate/Chamber
- Raft/Brim



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Other Common Failure Modes

- Jams
- Dropped layers/layer adhesion
- X/Y shifts
- Part detachment
- File/data read errors
- The “I Used the Wrong Material” factor
- The “Someone Bumped the Printer” theorem
- And many, many more!

Advantages to FFF

- Extremely Rapid Prototyping
- Cheap Material
- Strong Parts (relative to other AM)
- High precision on complex parts (relative to doing it by hand)

Disadvantages to FFF

- Too slow for mass production
- Poor surface finish
- Weak parts (relative to MFG.)
- Limited materials
- Limited resolution/accuracy
- Geometrical constraints
- Failed Prints

Want to learn more?
Scan these to access
TW websites!

Terrapin Works Job Ticketing to Submit orders (Top Left) OR *https://maker.umd.edu/user*

Terrapin Works Official Webpage (Bottom Right) OR *https://terrapinworks.umd.edu/*

Email us!
terrapinworks@umd.edu

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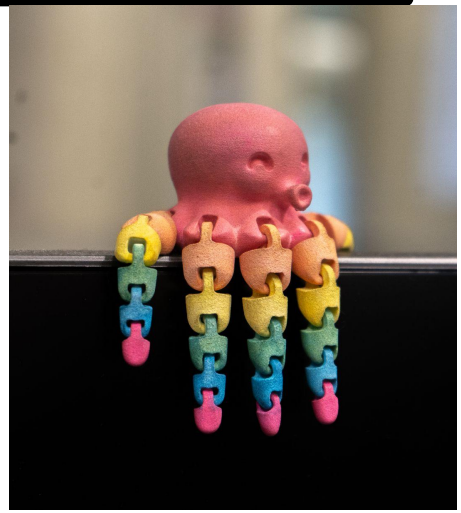


Papercut Print Request

1. Go to ter.ps/papercut
2. Select the machine you want the model you want your model to be printed on and select “Start Order”. (It’s usually Prusa)
3. Upload the stl. file(s), Name your print request sensibly, fill in all the other details.
4. Important: Include the maximum dimension of the part (sometimes STLs are scales too high or too small). Also include any notes you want the staff to be mindful of.
5. Click Submit and wait for your part to magically build itself into existence!
6. You would get an email when the part is ready for pick up. (The pick up location is usually mentioned in the Email. It’s either AFL or the FF depending on the printer selected.) AJCH 2123

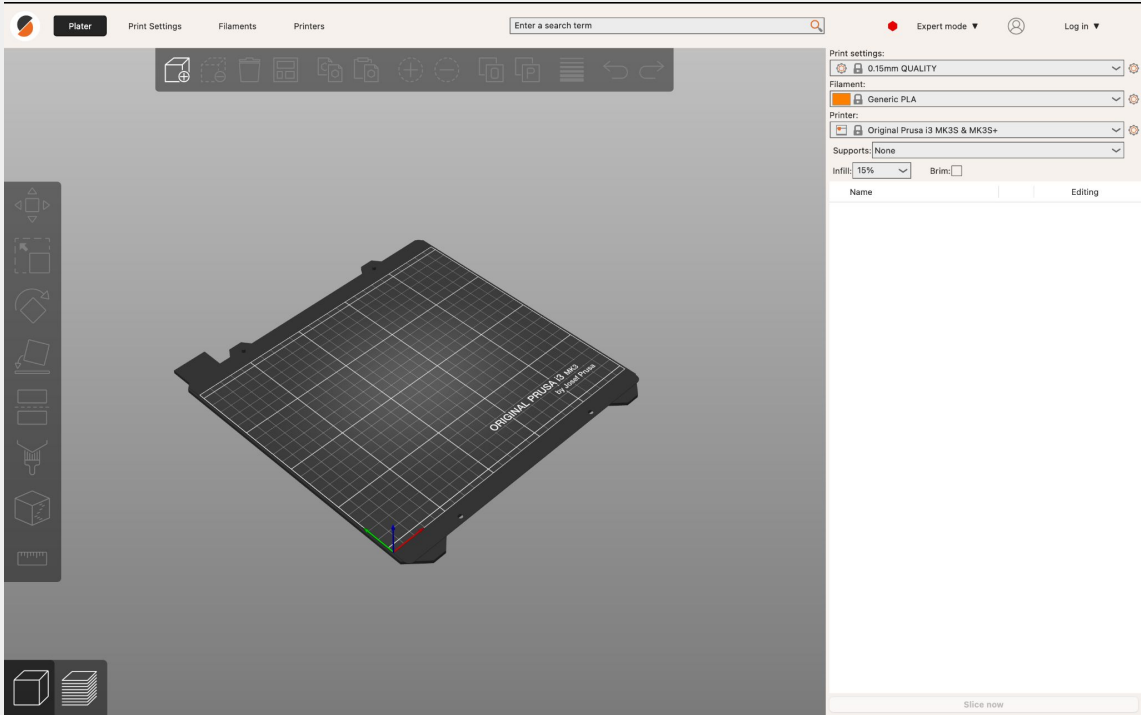
Slicing Your Print

- Now that you have a finished .stl it’s time to get your file ready to print.
- This process is known as Slicing
- In our case we will be converting our .stl into a .gcode
- A .gcode file is a file which contains your .stl, and the necessary information for the printer to read

We will be using Prusa Slicer!

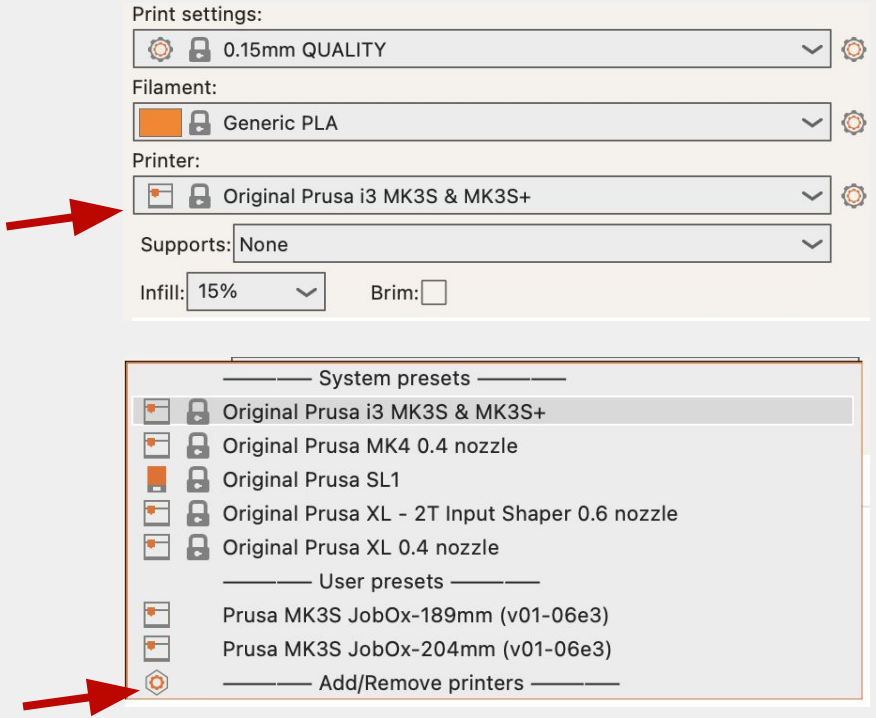
Welcome To PrusaSlicer!

- Upon entering PrusaSlicer, you will be presented with a screen similar to what is displayed on the right
- This is where we will add our files and prepare our parts



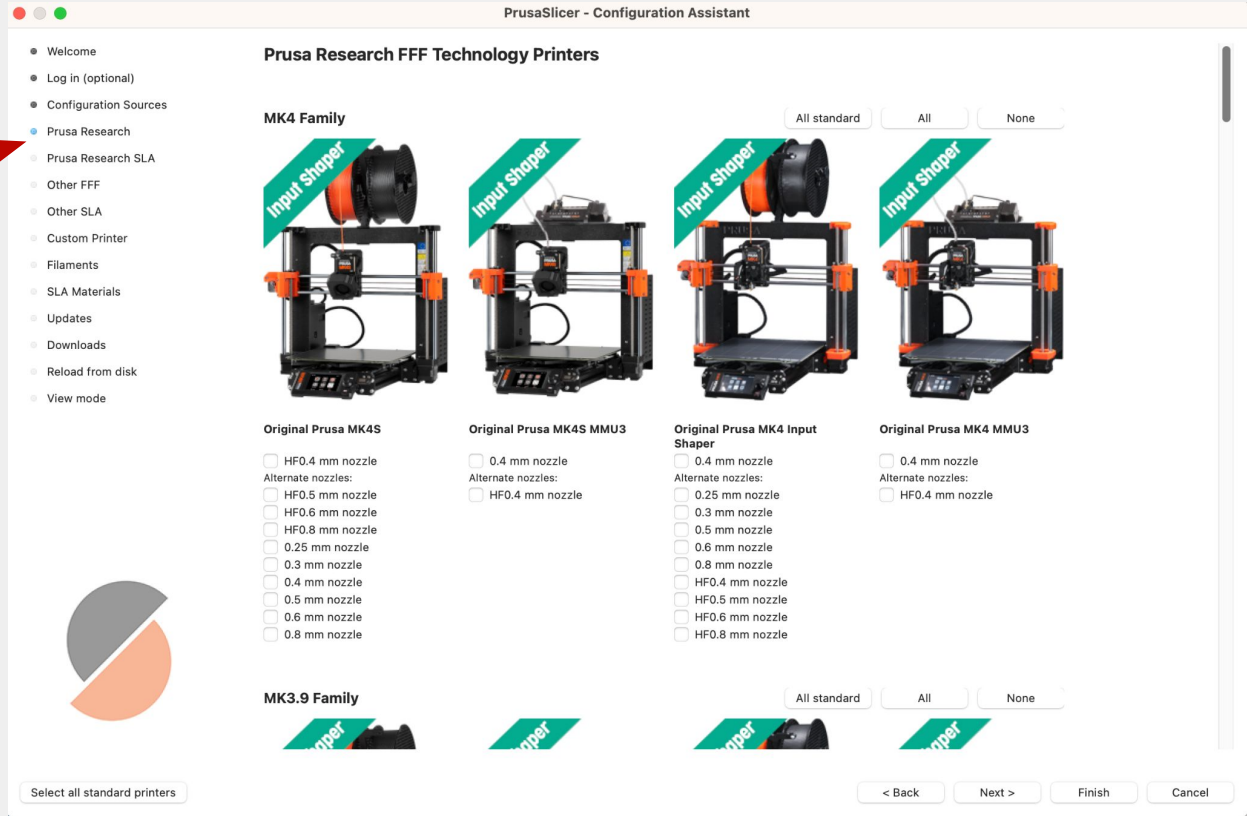
Preliminary Settings

- We first need to select the correct printer presets to prepare our file for printing
- Select Printer Dropdown
- Click Add/Remove Printers → Add/Remove Presets



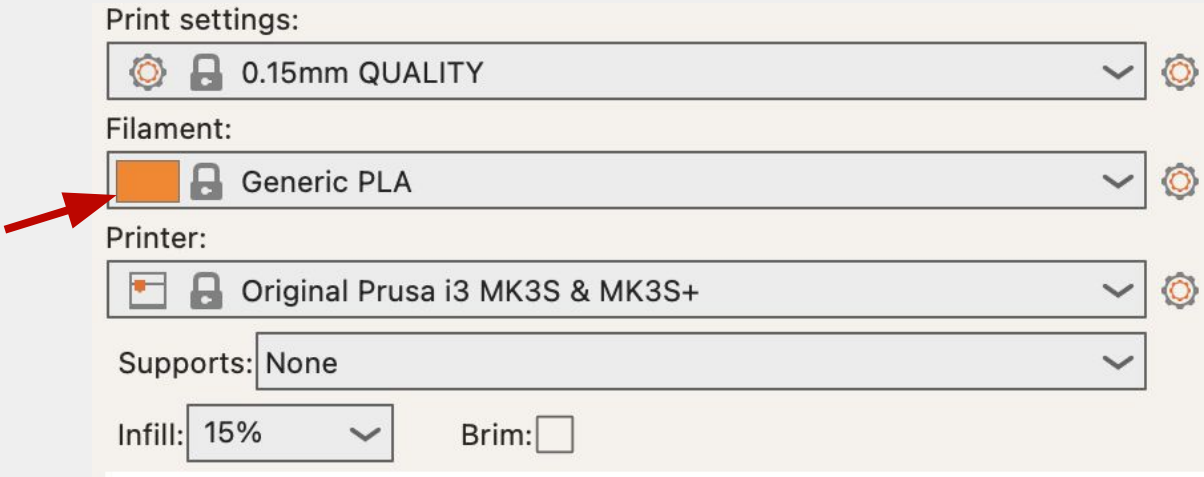
Preliminary Settings(cont.)

- Prusa Research → Select desired Prusa printer
- Nozzle size matters so make sure to choose the correct one!



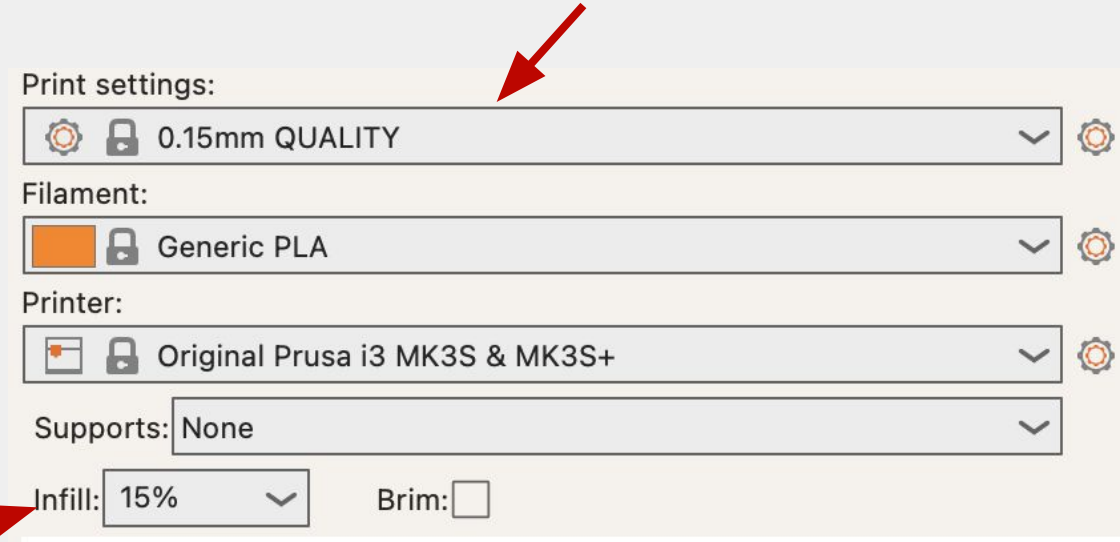
Filament Settings

- It’s also very important to select the right filament type. In almost all cases we will select the generic version of filament.
- We will use PLA for this guide



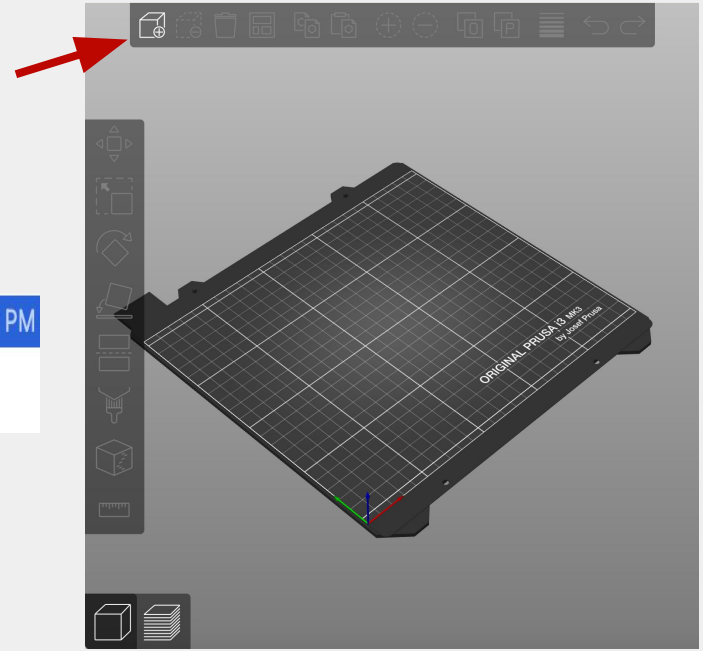
Resolution/Infill

- The default resolution for most print jobs is .2mm, however it can be lowered for finer details
- Infill percentage determines the part density, or its toughness. Higher infill means increased strength, but much more cost



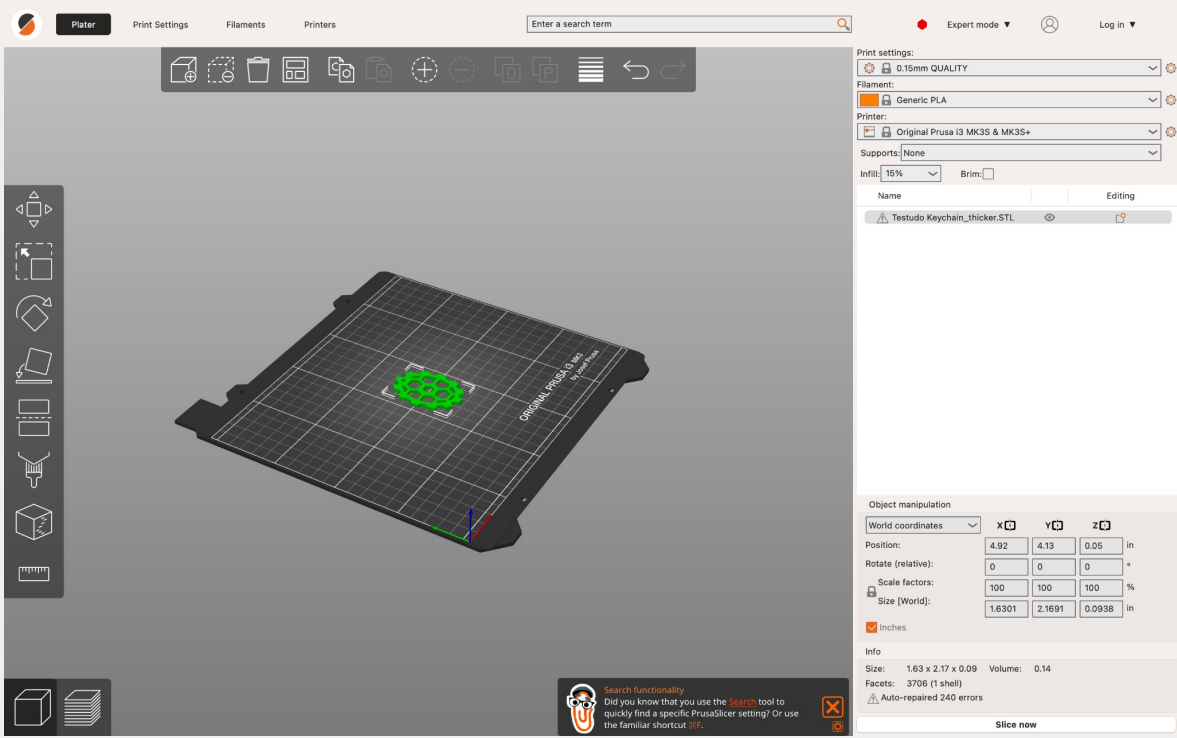
Adding our File

- Now that we are ready to add our .stl, lets navigate to the add part button and select our file



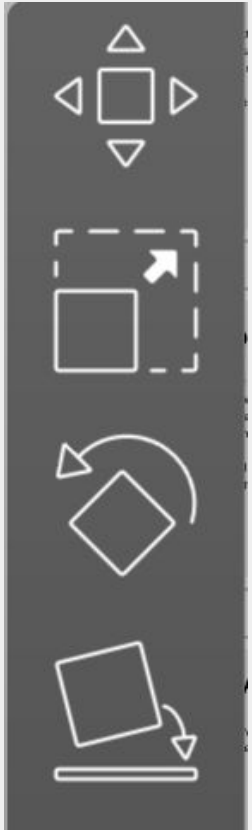
Adding our file(cont.)

- If all steps have been followed you will see your .stl file highlighted in green on the plate
- On the side bar you will see a variety of options which we will briefly cover



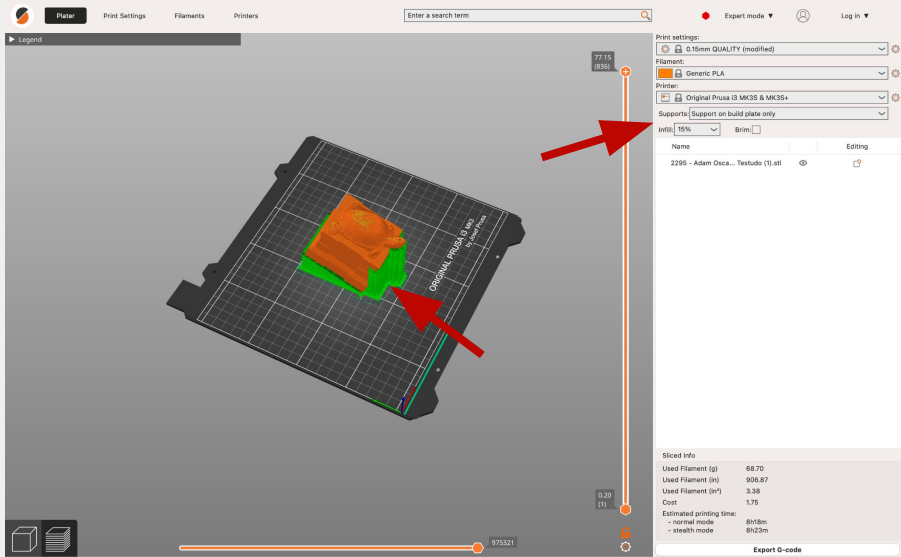
Main Functions(In order)

- Translate
  - Move your part
- Scale
  - Change part size
- Rotate
  - Rotate your part
- Bed Face
  - Choose which face is on bed



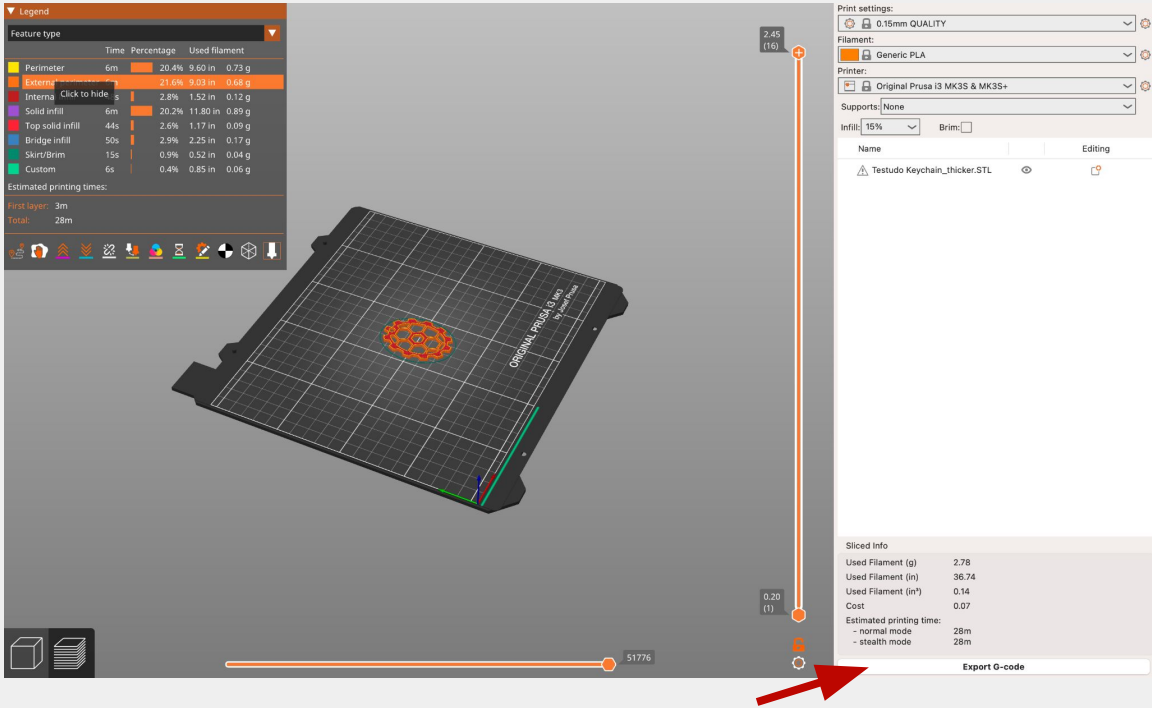
Supports

- When printing complex parts, you will need to add supports, there is a certain angle threshold where supports are necessary to print a part
- Luckily PrusaSlicer handles this for you when you select the supports dropdown
- Support on build plate
  - Supports can only generate from build plate
- Supports everywhere
  - Supports are free to generate anywhere
- Enforcers only
  - Manual Supports



Slicing our Part

- Luckily our keychain is a simple part which can be laid flat on the print bed
- When you are pleased with your orientation, you can hit the slice now button
- This will generate a .gcode file which you can save and export to your desired printer



Submitting an Order

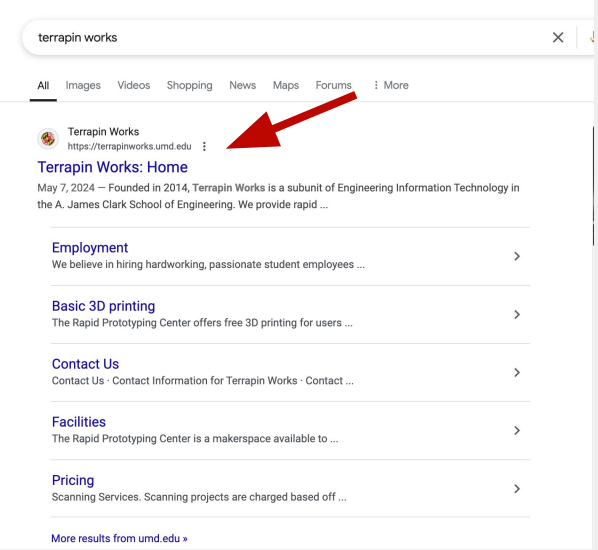
Alternatively, we can submit an stl to Terrapin Works and have them print our file!

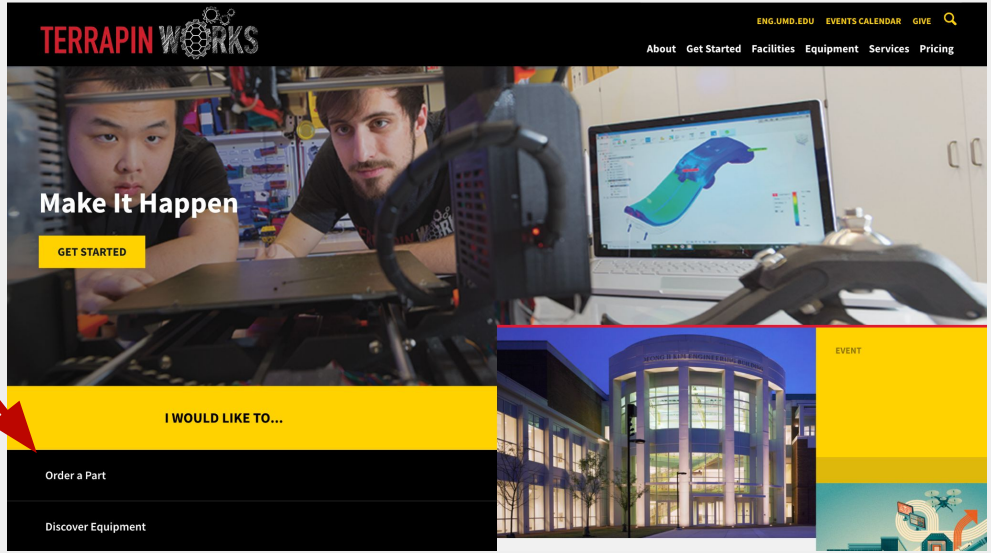
Wanna submit an order? Start here!!!

Let’s Start!

How To submit an order

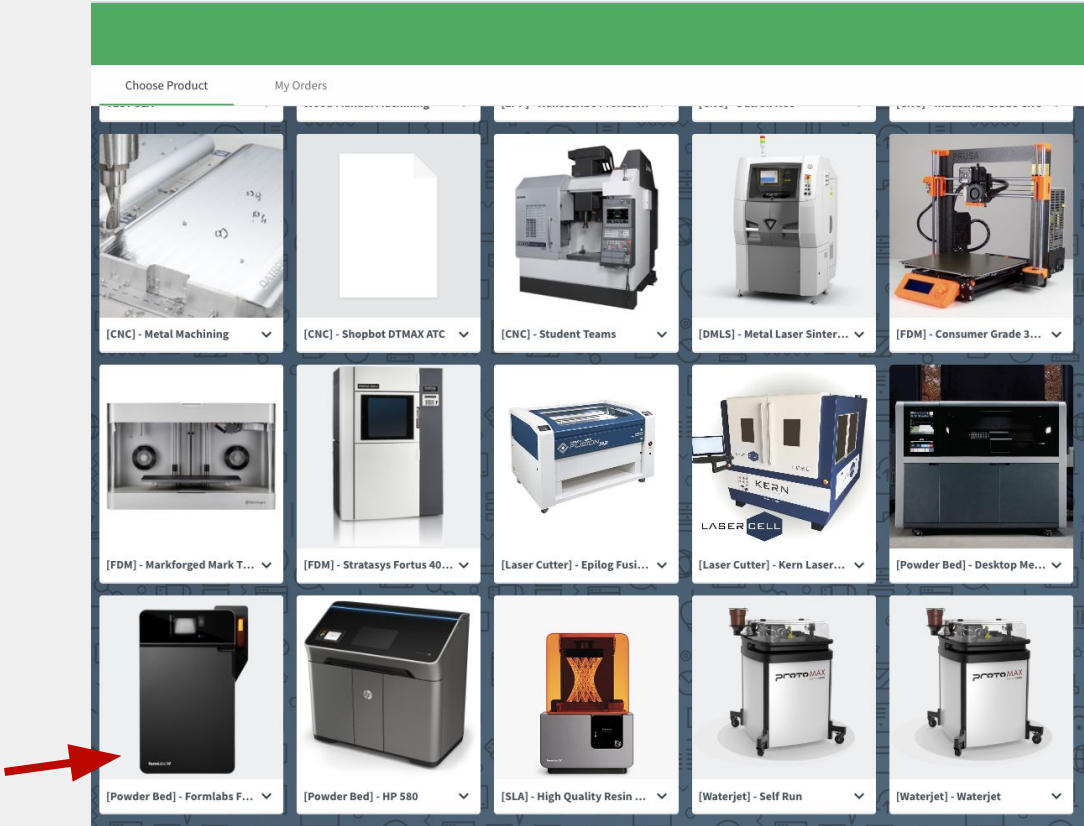
- To submit an order to Terrapin Works, you can directly access the order feature through this link: https://maker.umd.edu/job-ticketing/customer/rooms/1
- Or you can search up Terrapin Works → Navigate to our website → Order a Part





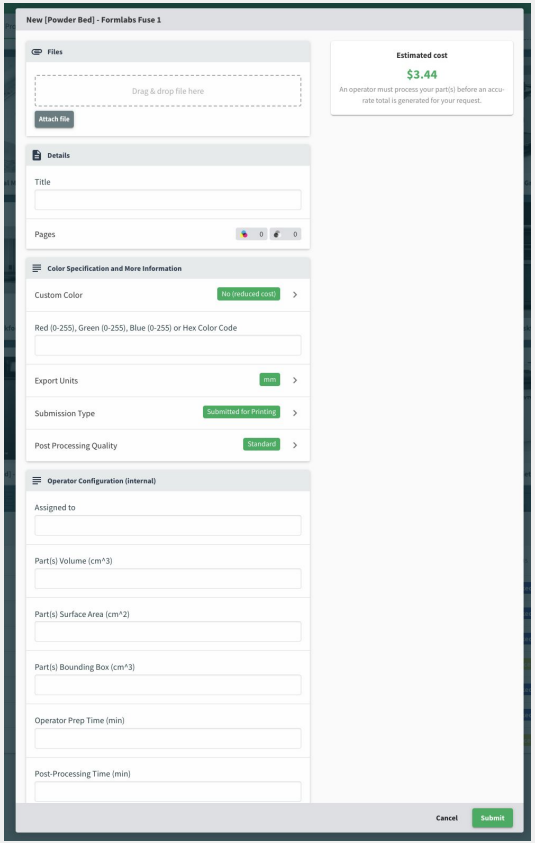
Select a Machine

- After following these steps, you will be shown a menu depicting all of our machines.
- In our case, we will be using the Powder Bed, also known as the Formlabs Fuse



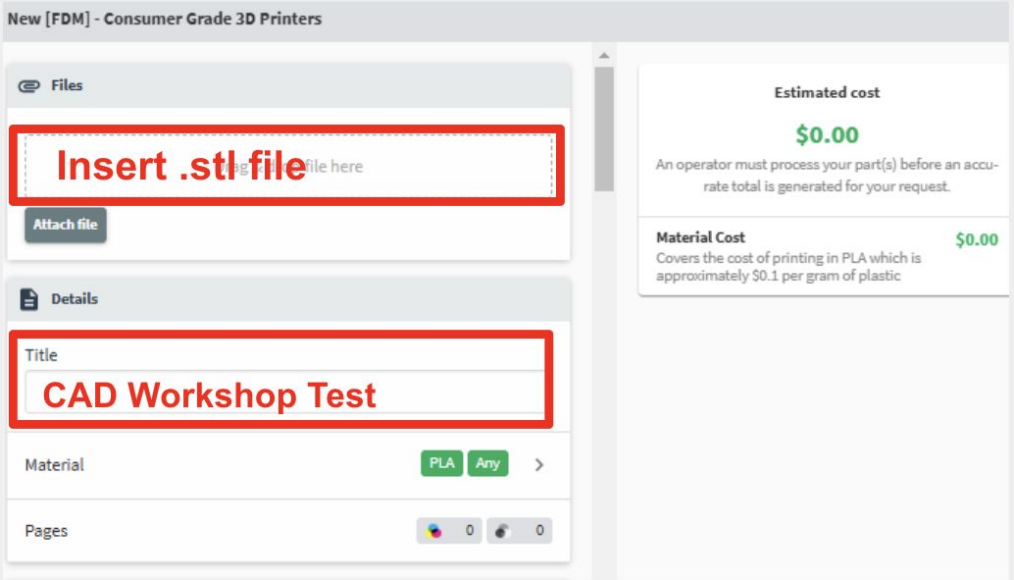
Preparing Your Order

- You will be taken to a screen like the one to the right which will ask you questions about your job.
- This is where you will drop your files, specify your submission type, and continue to be updated on your order.



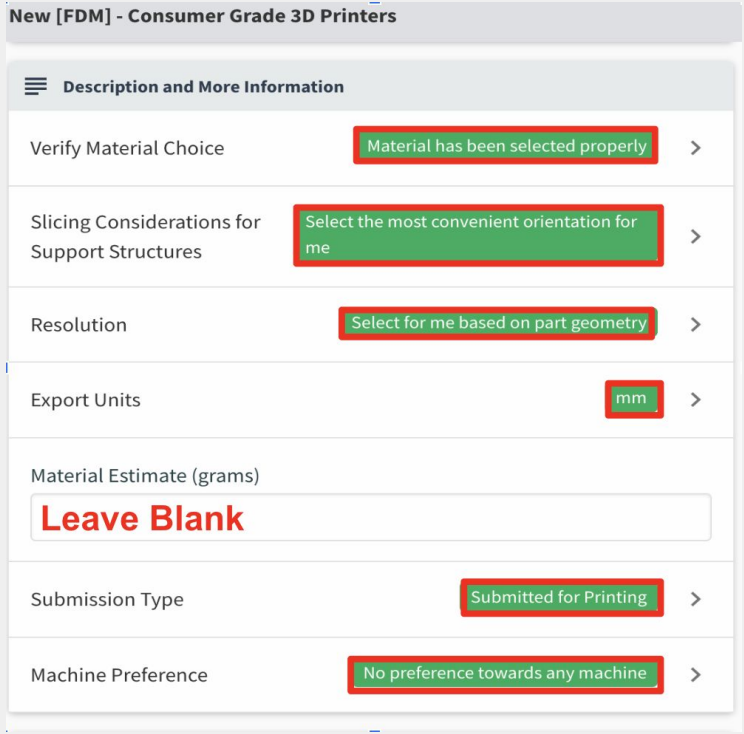
Files and Titles

- The first two things we will do is add our .stl files to the order, and to give our order an appropriate title
- Click on the attach file button or drag and drop your desired file(s) into the box
- Now add a title that can help you identify your part.



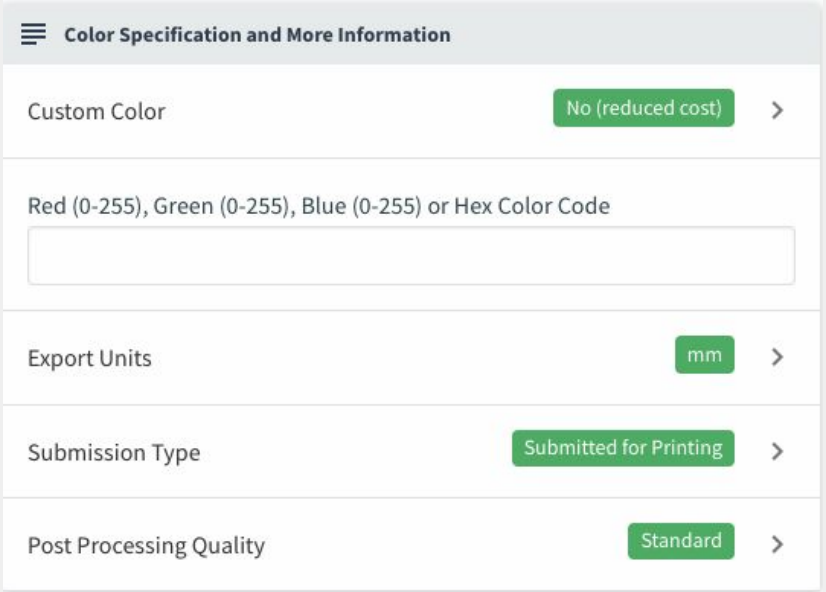
Information

- Next, we will add some details regarding the material and other specifications.
- In this menu, you can choose from a variety of materials, specify resolution(for FDM/SLA), units, and submission type



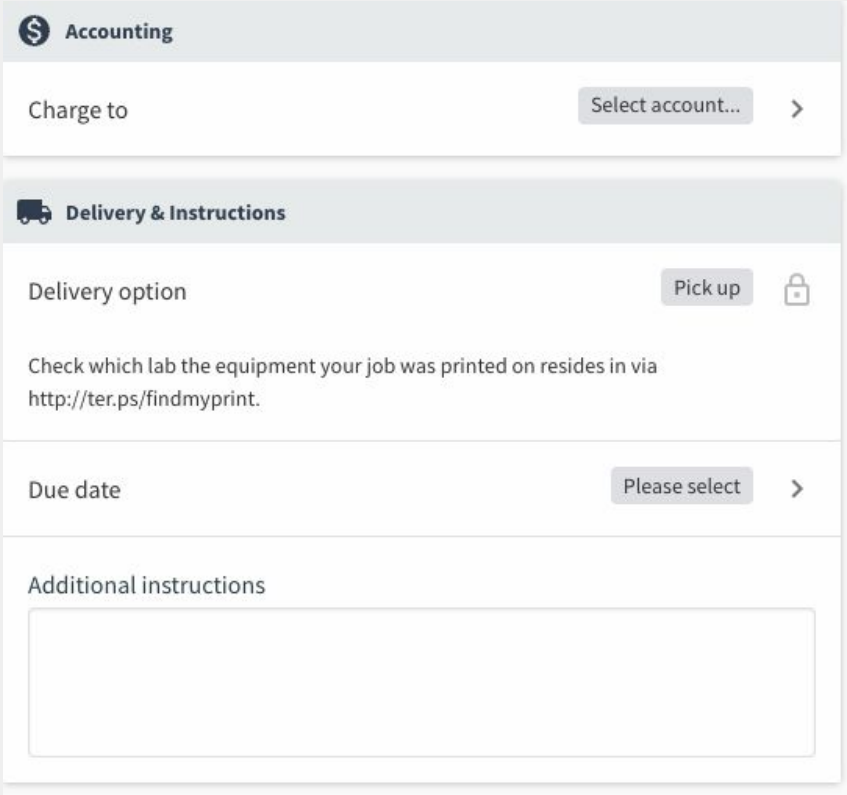
Information

- In the case of the Fuse, we only use Nylon PA 12 so no material selection will be available.
- Your only job is to select whether you would like your print to have a quote, or if you would like printing to start immediately.



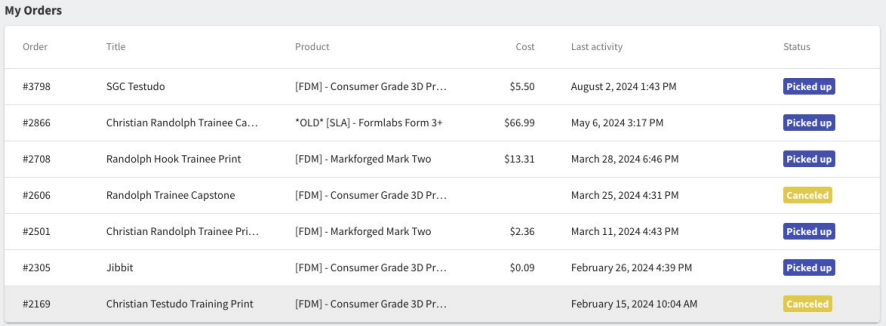
Finishing Your Order

- All that's left is to add any additional instructions that might not have been covered by the menu and add a due date
- Make sure you choose the correct account to charge(Personal, KFS, etc.)
- For KFS accounts please refer to this site for more information: https://portal.tw.umd.edu/external/set-up-or-request-access-to-a-kfs-account-in-papercut/



Order Tracking

- Once you have submitted your order, you can track its progress through the same site you used to order your part(s)
- Progress updates such as comments by employees and when your part is done will be sent to your email
- If you chose to receive a quote for your order, an employee will slice your part and send a comment with the price of your order. Once you approve of the price, the order will be sent to processing.



My Orders

Order	Title	Product	Cost	Last activity	Status
#3798	SGC Testudo	[FDM] - Consumer Grade 3D Pr…	$5.50	August 2, 2024 1:43 PM	Picked up
#2866	Christian Randolph Trainee Ca…	*OLD* [SLA] - Formlabs Form 3+	$66.99	May 6, 2024 3:17 PM	Picked up
#2708	Randolph Hook Trainee Print	[FDM] - Markforged Mark Two	$13.31	March 28, 2024 6:46 PM	Picked up
#2606	Randolph Trainee Capstone	[FDM] - Consumer Grade 3D Pr…		March 25, 2024 4:31 PM	Canceled
#2501	Christian Randolph Trainee Pri…	[FDM] - Markforged Mark Two	$2.36	March 11, 2024 4:43 PM	Picked up
#2305	Jibbit	[FDM] - Consumer Grade 3D Pr…	$0.09	February 26, 2024 4:39 PM	Picked up
#2169	Christian Testudo Training Print	[FDM] - Consumer Grade 3D Pr…		February 15, 2024 10:04 AM	Canceled

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