PRESENTED BY :
Simon LUO, Yuchen LIANG

ISDN 2400: Physical Prototyping 24-25 Spring
Additive Manufacturing Lab I

ADDITIVE MANUFACTURING FDM

LAB
OBJECTIVE

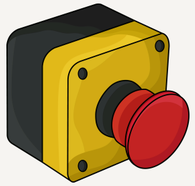
OBJECTIVE

In this lab, you will learn some knowledge about additive manufacturing, more importantly, how to operate the FDM printers in the lab from beginning to the end. After this lab, you should be able to operate the printers on your own.

HEADS UP !!!!!

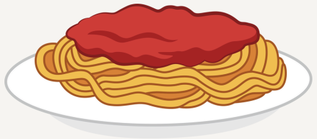
NO UNSURE ACTION

Do not perform any actions if you are unsure. If you have any doubts, contact the TAs or Staffs FIRST.



FIND THE EMERGENCY STOP

Before use any machine, always know how to turn it off in case of emergency.



DAMAGE? INFORM!

It is normal to damage a machine, if this happened, please inform the relevant Person In Charge. DO NOT HIDE the problem!

ASK FOR PERMIT

Always ask for permission before you use the machine, a word, an email, a message will be enough.

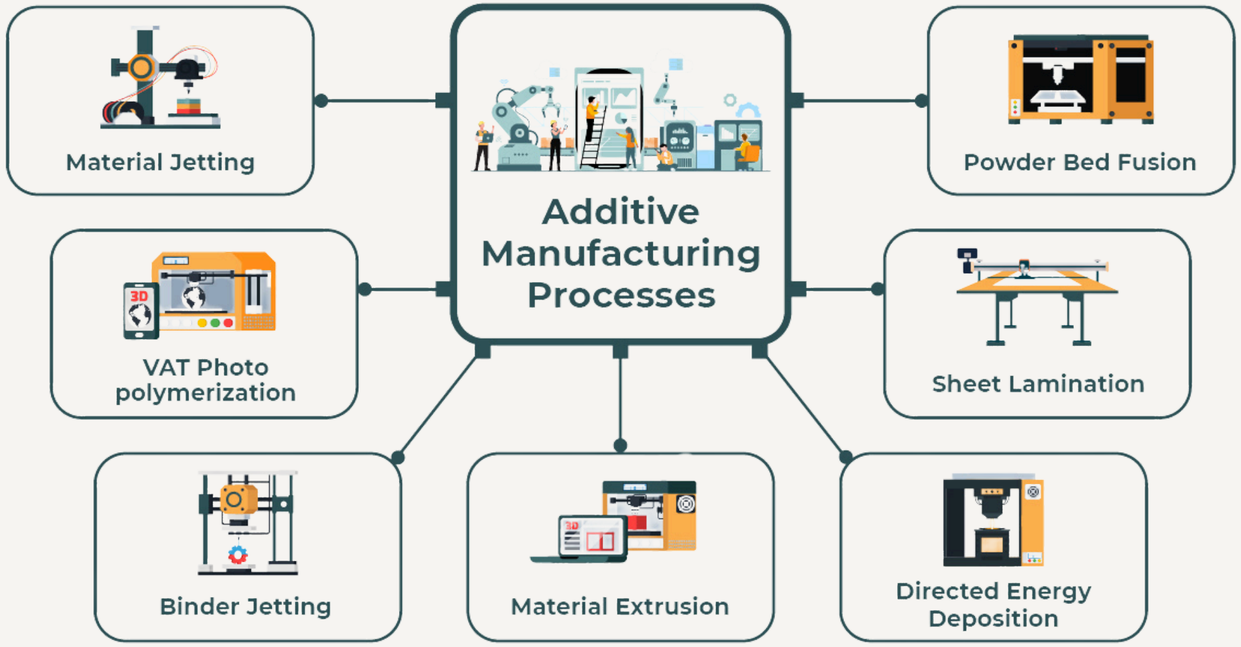
FOLLOW THE INSTRUCTION

We will be posting and updating tutorials on notion website, please follow the instruction everytime you operate the machine.

REVISION
AM TECHNOLOGY

ADDITIVE MANUFACTURING

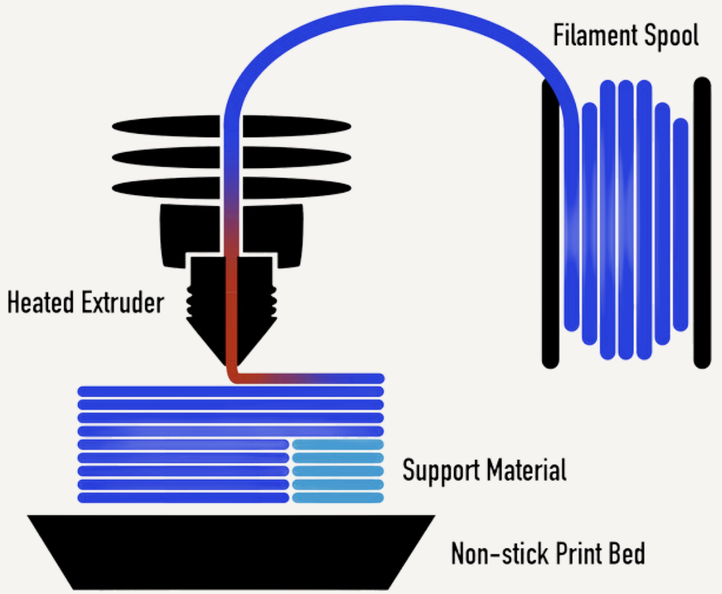
3D printing, or additive manufacturing, is the construction of a three-dimensional object from a CAD model or a digital 3D model. It can be done in a variety of processes in which material is deposited, joined or solidified under computer control, with the material being added together, typically layer by layer.



MATERIAL EXTRUSION **FDM**

FUSED DEPOSITION MODELLING (FDM)

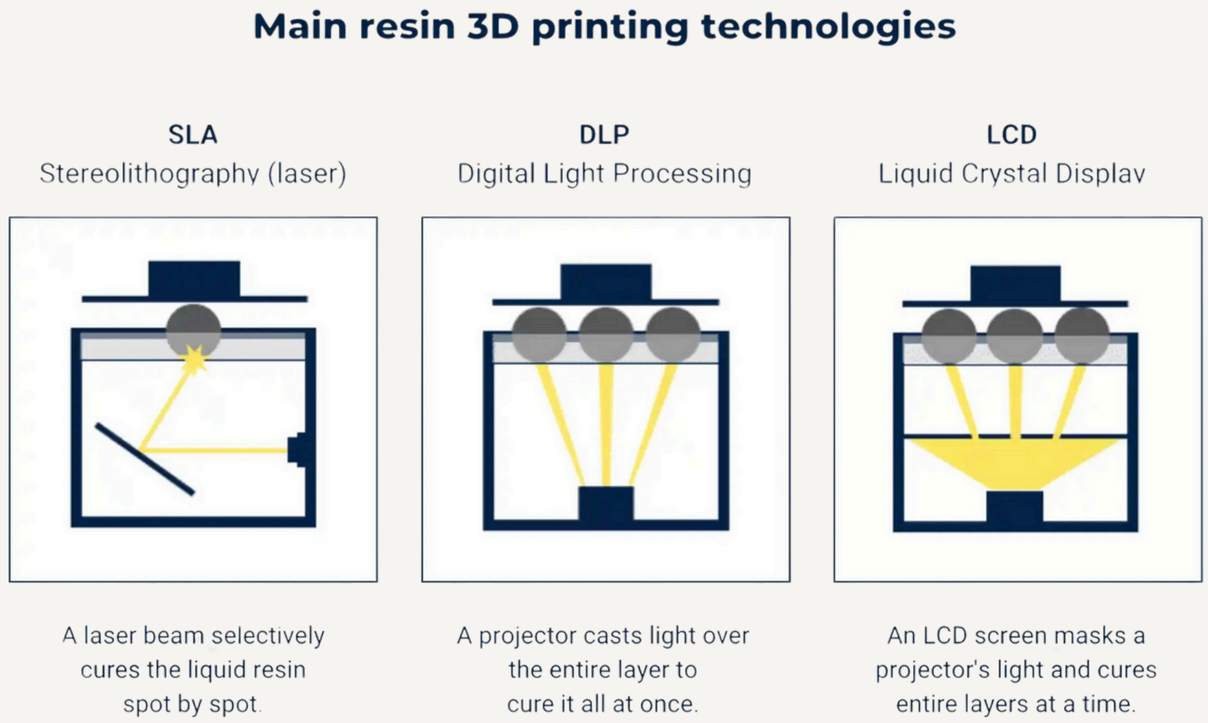
Fused deposition modeling (FDM) 3D printing, also known as fused filament fabrication (FFF), is an additive manufacturing (AM) process within the realm of material extrusion. FDM builds parts layer by layer by selectively depositing melted material in a predetermined path. It uses thermoplastic polymers that come in filaments to form the final physical objects.



VAT PHOTO-POLYMERIZATION **SLA**

STEREOLITHOGRAPHY (SLA)

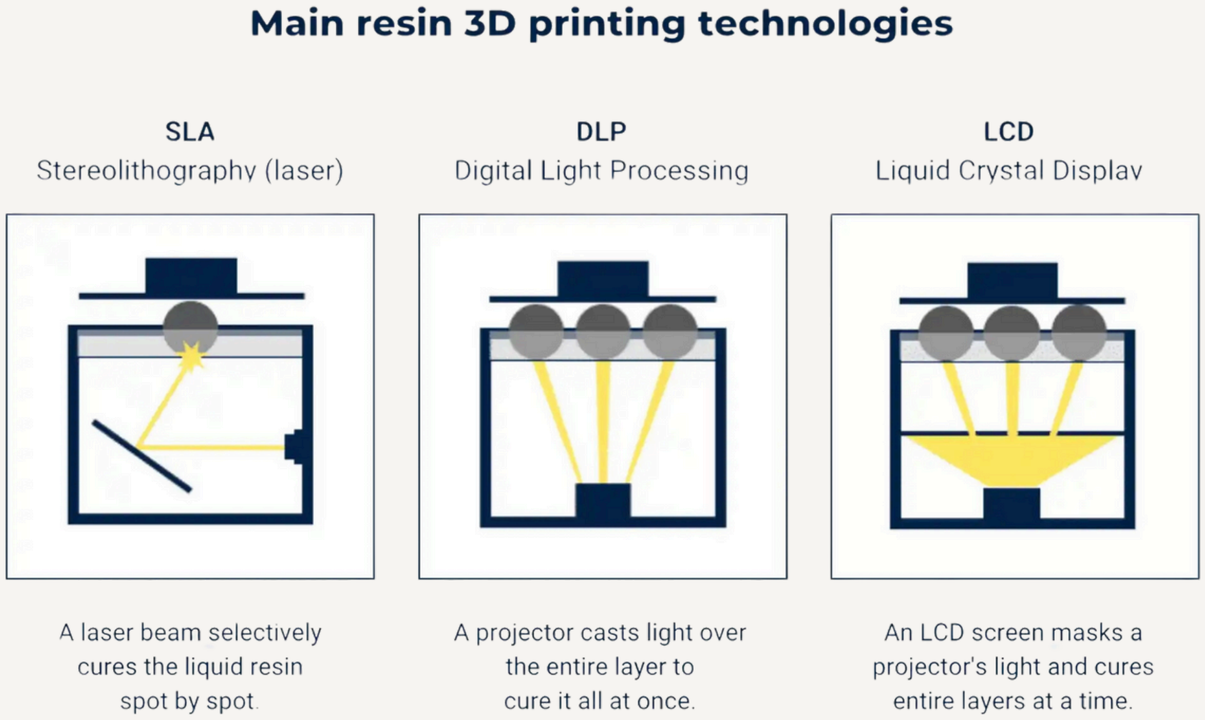
Traditional SLA printers used large vats of liquid resin with a laser above to cure each layer. These systems were expensive and complex, limiting their use to large companies. In 2011, Formlabs introduced inverted SLA printing with Form 1, where a laser cures resin through a transparent-bottomed tank. This allows for compact desktop printers using minimal resin.



VAT PHOTO-POLYMERIZATION **DLP**

DIGITAL LIGHT PROCESSING (DLP)

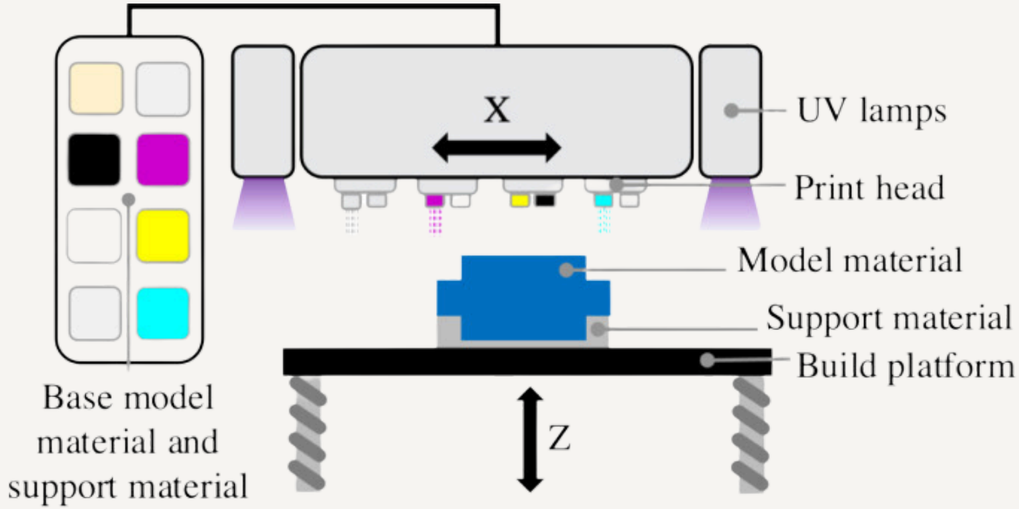
DLP 3D printing uses a light projector to cure liquid resin layer by layer. The projector uses micromirrors on a semiconductor chip, with each mirror representing a single voxel. The resolution depends on the number of mirrors and build area size.



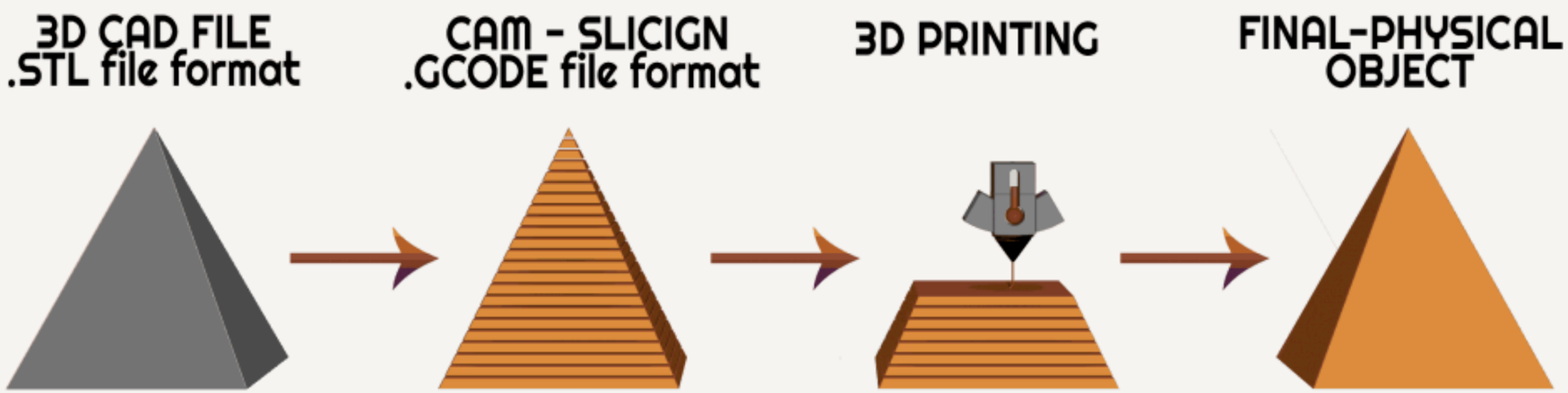
MATERIAL JETTING MJ

POLYJET™

PolyJet is a revolutionary multi-material jetting photopolymer 3D printing technology that brings your ideas to life with exceptional precision and versatility. From prototyping to production, PolyJet offers a wide range of capabilities, including the creation of complex geometries, intricate details, full-color combinations, transparencies, and flexible parts - all in a single model. PolyJet 3D Printing is an advanced technology that quickly creates precise parts using photopolymers, UV light, and inkjet heads. It achieves accuracy by layering resins to form digital materials. The process starts with a CAD model transformed into a printable format. Drops of photopolymer are jetted onto the build platform, then cured with UV lamps to bond layers. Support materials are dissolved or manually removed for the finished PolyJet model.



STEPS FOR
CAD TO OBJECT



3D CAD FILE FORMATS **STL IGES STEP OBJ 3MF**

Format	Key Features	Main Uses	Limitations
STL	Surface geometry only	Most common 3D printing format	No color/texture information
IGES/IGS	Complex curved surfaces	Engineering and CAD exchange	Limited metadata support
STEP/STP	Comprehensive CAD data with metadata	Professional engineering and manufacturing	Large file sizes
OBJ	Geometry and texture information	3D graphics and animation	Limited support for manufacturing data
3MF	Materials, colors, textures, and manufacturing properties	Modern 3D printing workflows	Newer format with limited legacy support

CAM
FILE FORMATS
G-CODE

Fan speed setting

Nozzle travel speed (without extrusion)

Nozzle printing speed (with extrusion)

X, Y Coordinates

Layer height

Extrusion length

```
;Layer count: 25
;LAYER:0
M107
G0 F9000 X52.235 Y55.800 Z0.300
;TYPE:SKIRT
G1 F2340 X56.093 Y55.800 E0.18815
G1 X56.346 Y55.605 E0.20373
G1 X57.299 Y55.078 E0.25684
G1 X58.540 Y54.758 E0.31934
G1 X59.404 Y54.719 E0.36152
G1 X60.320 Y53.688 E0.42878
```

SLICER
FDM

ORCA SLICER

Prusa Slicer

Bambu Studio

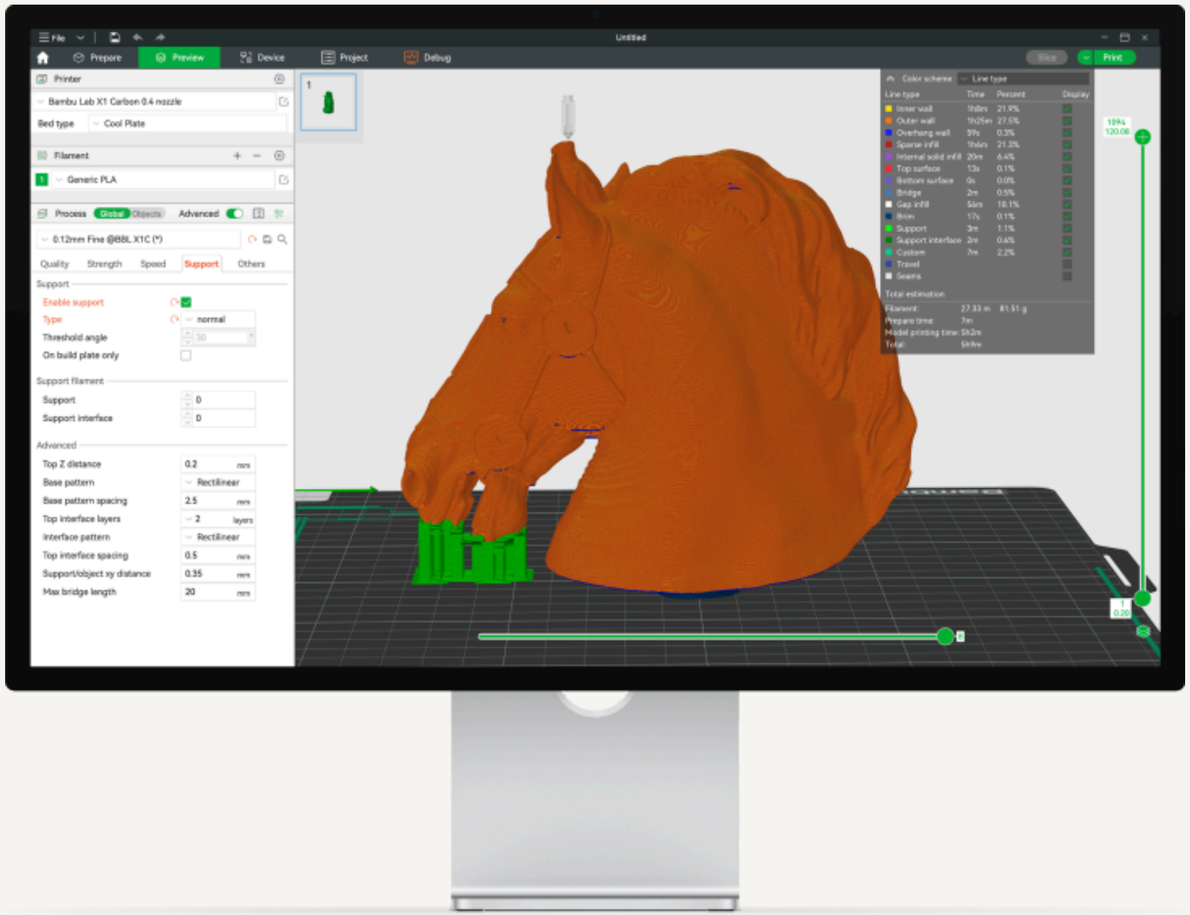
formlabs

cura.

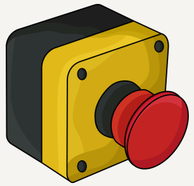
ideaMaker

GRABCAD
PRINT

SLICER
BAMBU STUDIO



SLICER
BAMBU STUDIO



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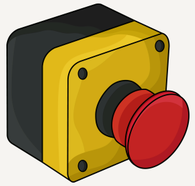

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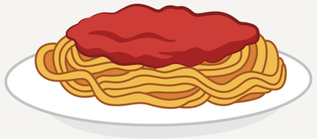

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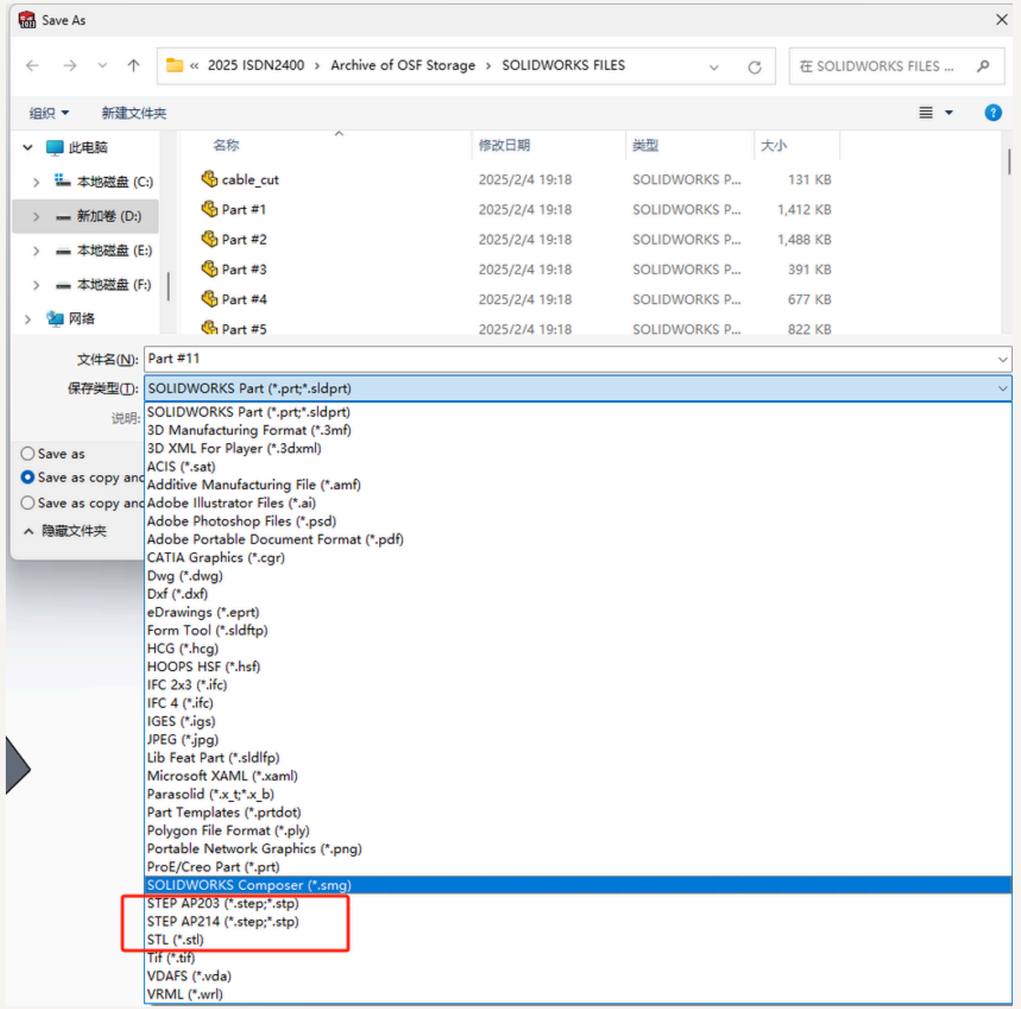
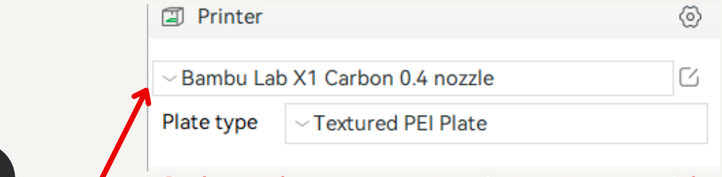
SLICER
BAMBU STUDIO

Double-check your draft before printing.
Don’t waste time and material !!!



Save as ‘STEP’ or ‘STL’

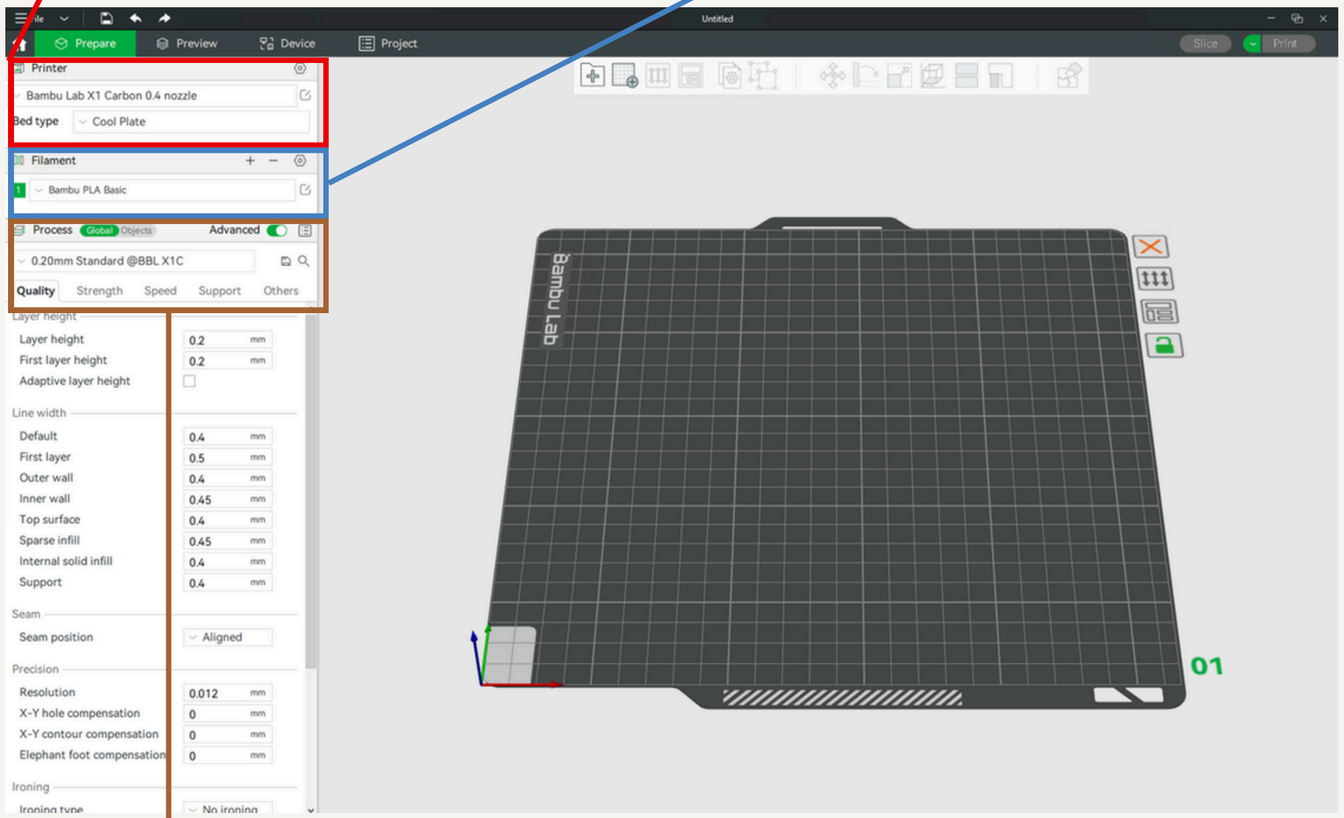
SLICER
BAMBU STUDIO

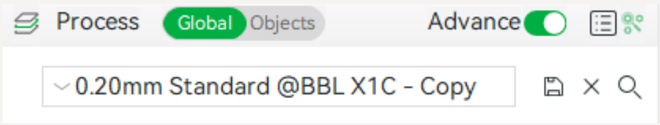


Select the correct printer type with the correct plate

The filament to print

Ensure all the printing settings in the software match the printer you choose !!!





Preset of the process: 0.2mm -> ejecting nozzle diameter 0.2mm; @BBL X1C -> Bambu lab X1 carbon (All printers in the lab are 0.2mm nozzles)

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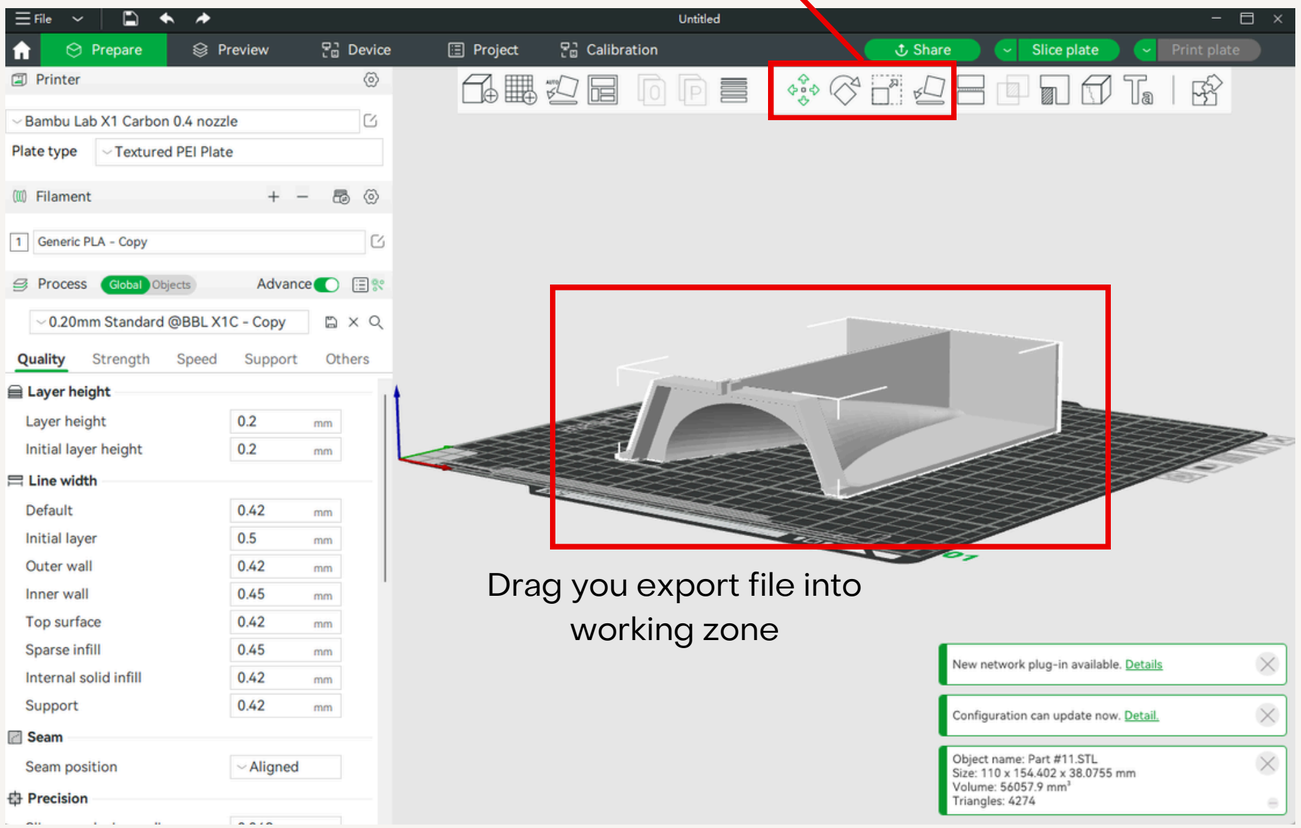
OBJECT OPERATION

Translation

Rotation

Scale

Lay on face



Drag you export file into working zone

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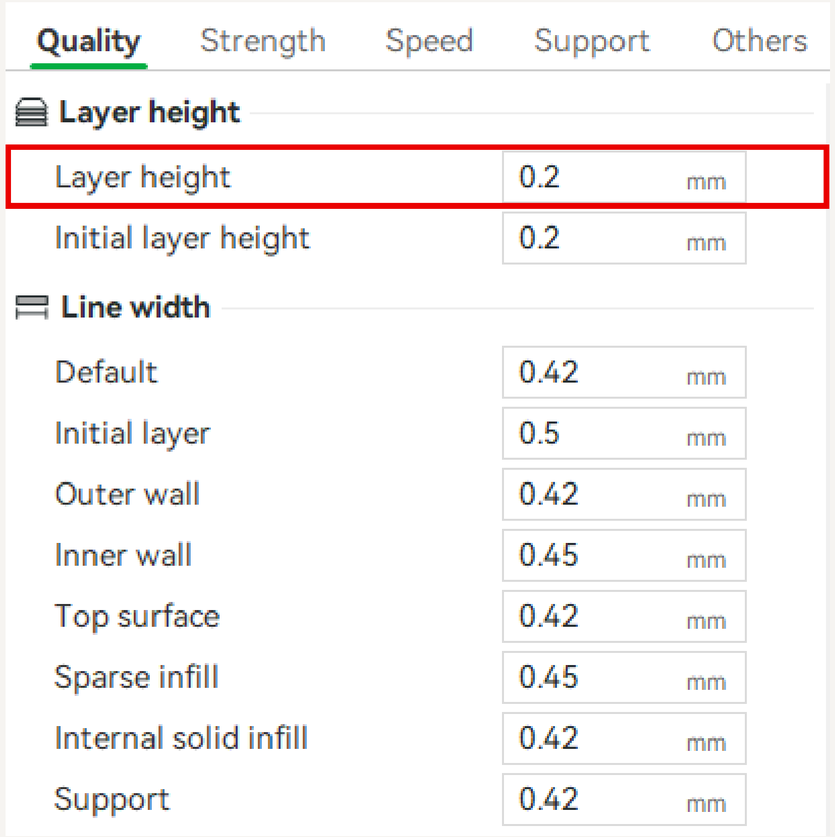
SLICER PARAMETER (QUALITY)

- Layer height: Height of one layer
- Line width: width of the extrusion



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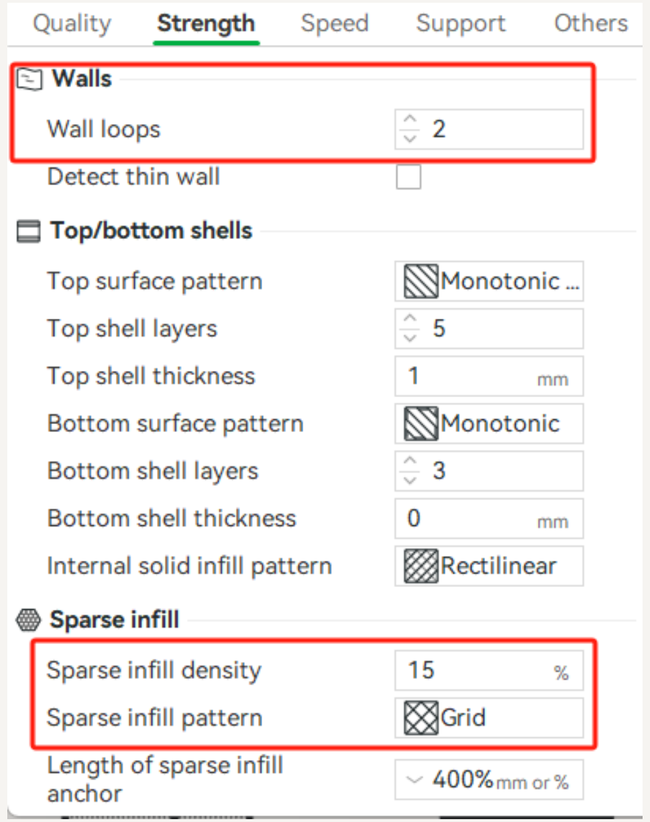
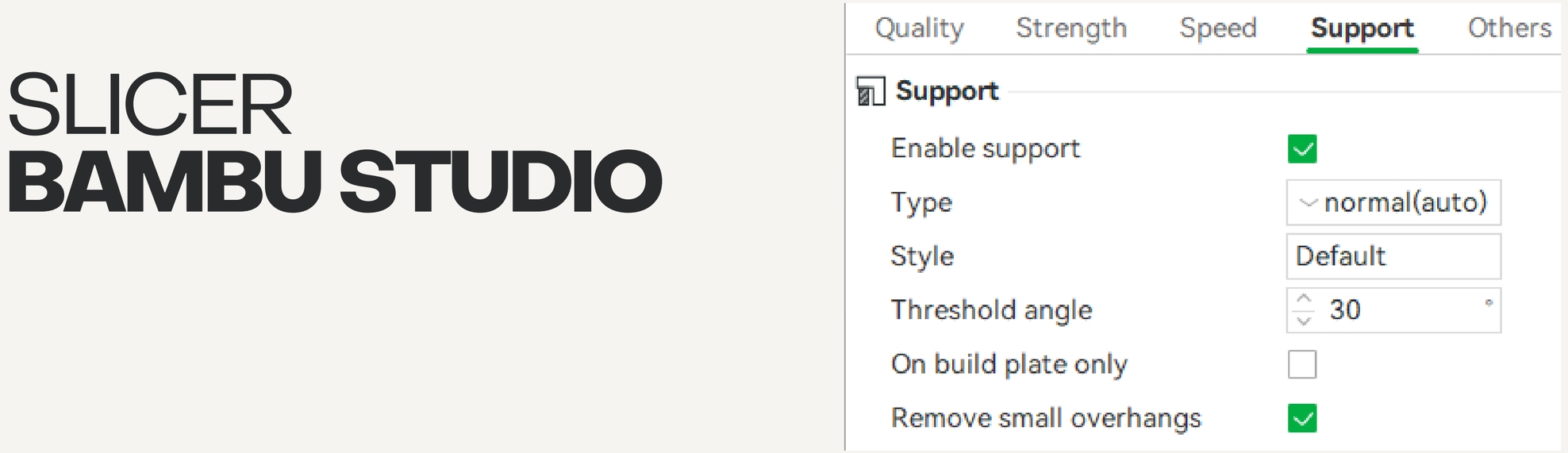
SLICER PARAMETER (STRENGTH)

- Wall loops: Number of loops for wall
- Infill
  - Type: the geometry type of infill (like monotonics, concentrics, etc.)
  - Density: The density of the infill structure (100% is fully solid, 0% is entirely void only print the wall)
- The part's strength is anisotropic (depends on printing orientation)

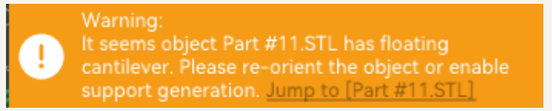


SLICER
BAMBU STUDIO



SLICER PARAMETER (SUPPORT)

- Enable support: No support will be generated if you do not click the button.
- Why do you need support? -> Support floating cantilever



- Type:
  - Normal： Straight-line support to hold the hangs-on the area of the part
  - Tree： The tree supports branches at an Angle, and each branch has only one thin tip touching the area to be supported
- Threshold angle: The larger this angle is, the more supports will be generated.

SLICER
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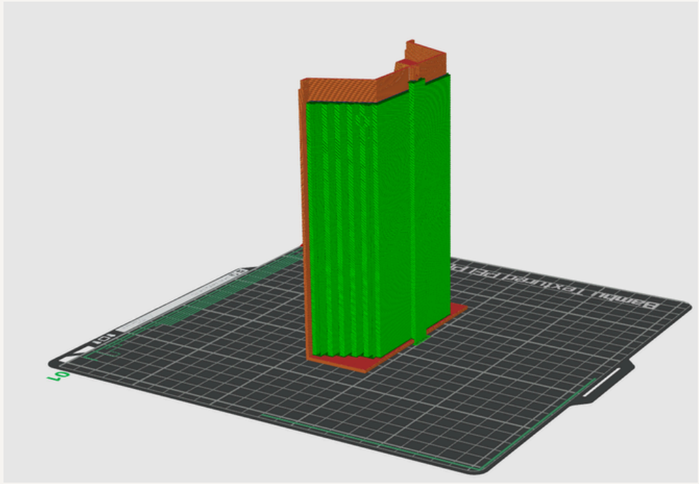
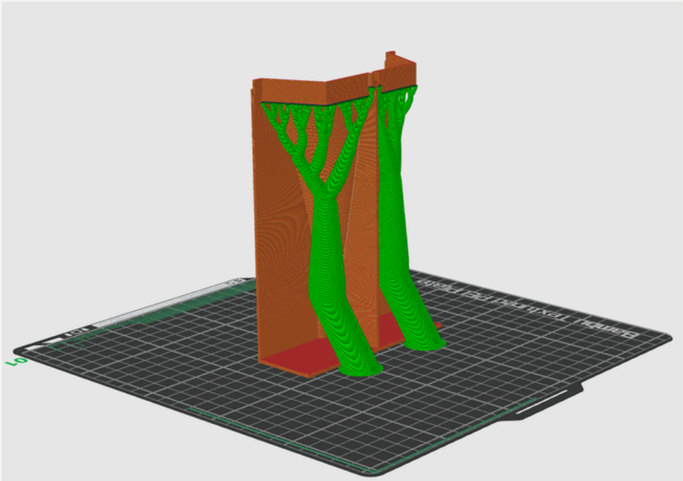


NORMAL

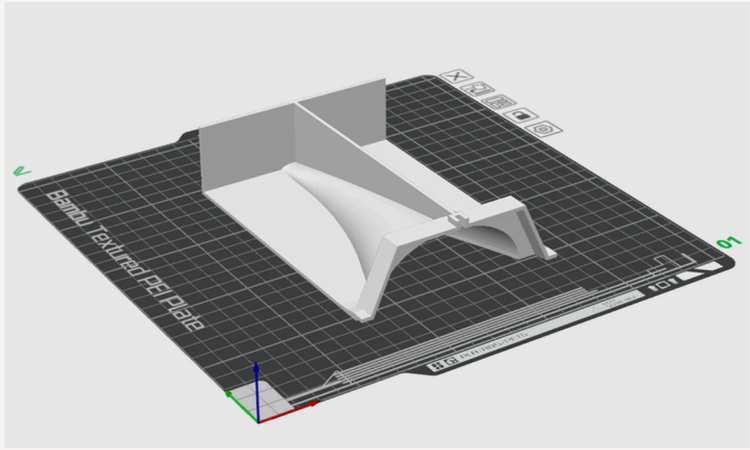


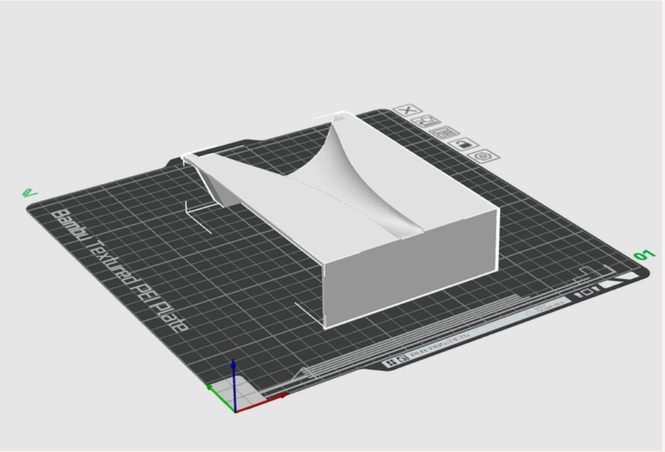
TREE

SLICER PARAMETER (SUPPORT)

- Type:
  - Normal： Straight-line support to hold the hangs-on the area of the part
  - Tree： The tree supports branches at an Angle, and each branch has only one thin tip touching the area to be supported

SLICER
BAMBU STUDIO





Question

Which one is better for mold printing? (Left or right)

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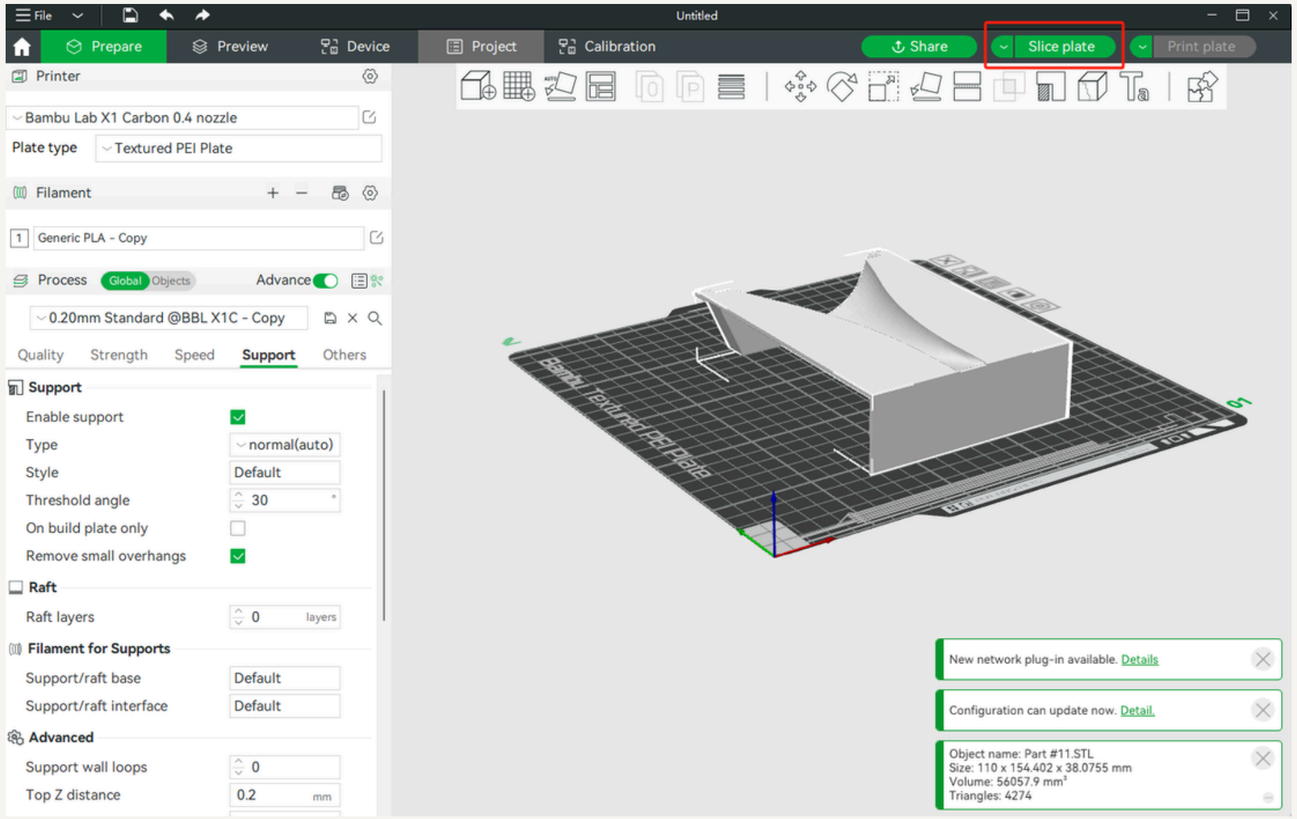
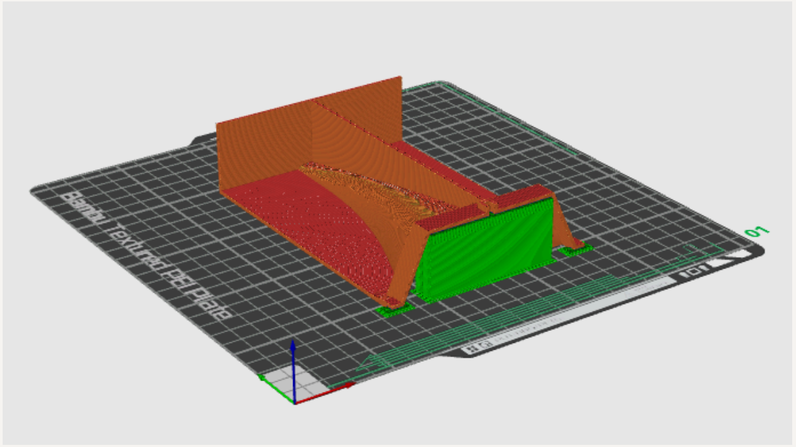
Please click the slice plate button each time you change parameters!!!

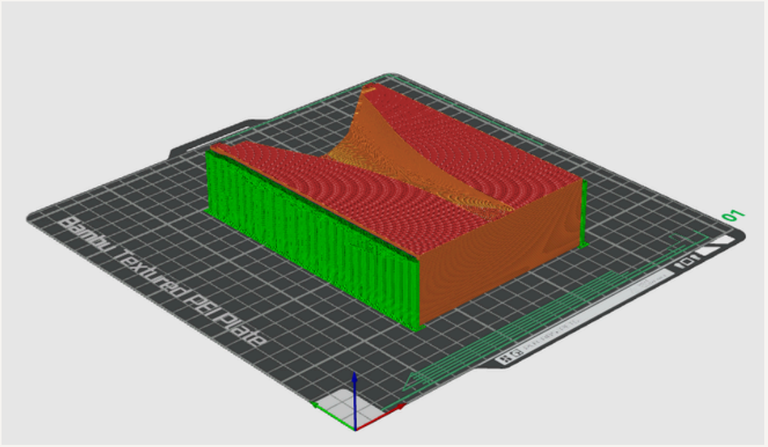
Slice plate (Get gcode and preview the process)



SLICER
BAMBU STUDIO



t = 2h 40min



t = 4h 30min

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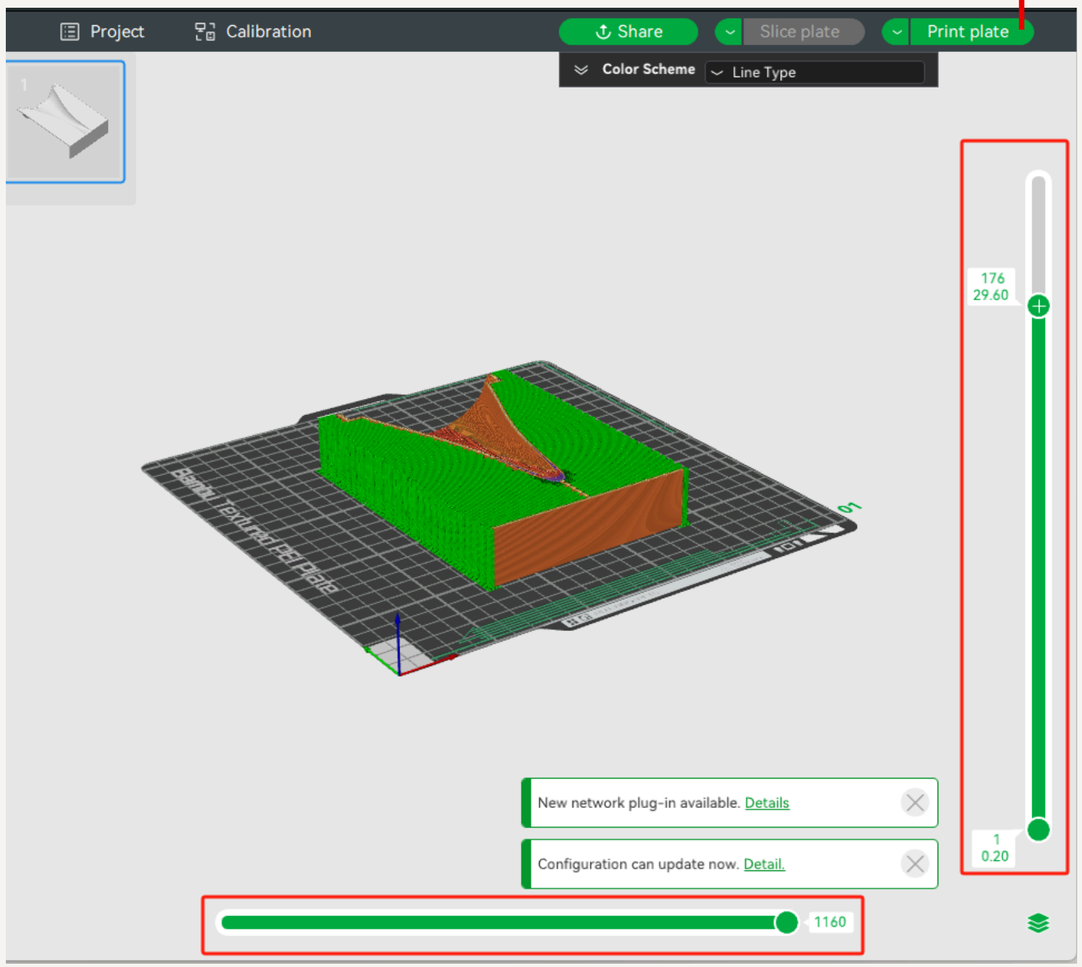
Send the printing job: (Check all the settings are the same as the reality)



Adjust the layer number

Path of nozzle for this layer

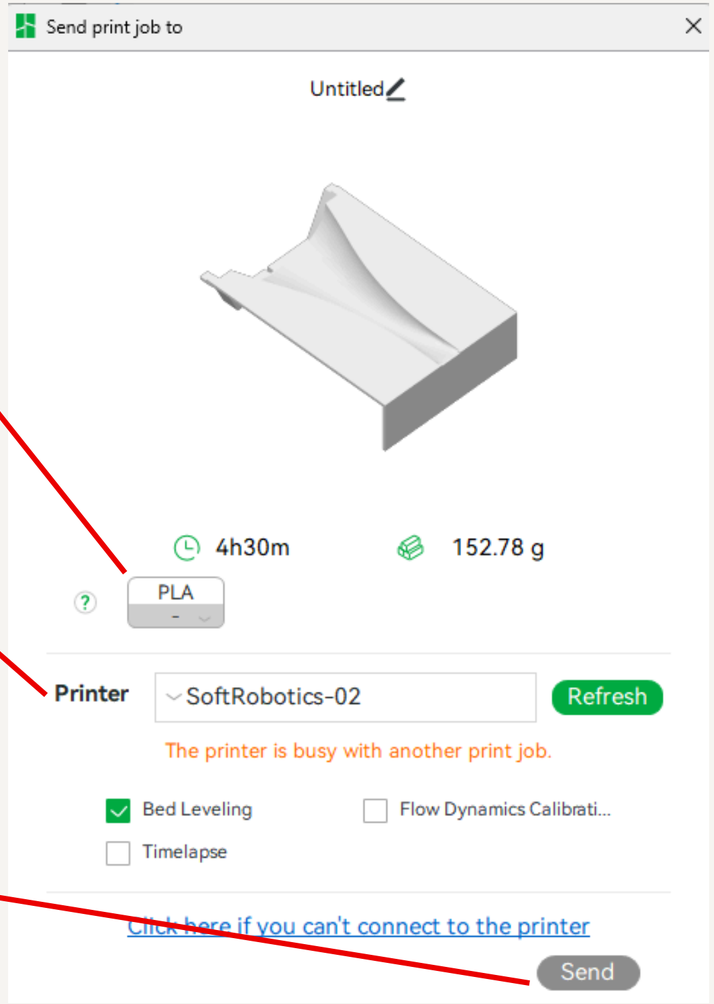
SLICER
BAMBU STUDIO

Double-check your draft before printing (including the CAD file in SolidWorks). Don't waste time and material !!!

Select the filament (Check filament here is the same as the setting in the preparation page as well as the reality)

Select the printer (The printer should be connected to your PC; It should be the same setting on the preparation page)

Send the job to the printer



3D PRINTING
ASSIGNMENT

- DOWNLOAD THE "ARCHIVE OF OSF STORAGE (ORIGINAL).ZIP" FROM CANVAS → ISDN2400 → FILES → RESOURCES
- OPEN SOLIDWORKS FILES → ASSEMBLY #2.SLDASM. INSIDE, YOU WILL FIND THE MOLD ASSEMBLY FILE CONTAINING THREE PARTS. EACH GROUP NEEDS TO PRINT ONE COMPLETE SET FOR THIS ASSIGNMENT.
- THINK ABOUT THE SURFACE FINISHING AND CONSIDER WHICH SETTING IS THE BEST.
- FEEL FREE TO MODIFY THE PARTS IF YOU WANT!

3D PRINTING **ASSIGNMENT**

Submission

- Submit a ZIP file containing:
- STL or STEP file of the three parts
- Your Group's Bambu Studio 3MF file
- A screenshot of your Group's slicing result (Example shown on the right side)
- A photograph of your group's printed mold part

DDL: 3rd Mar 23:59