

CSC293 CS Improves 3D Printed Manufacturing

Getting Started with 3D Printed Manufacturing

Sreepathi Pai

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URCS

Outline

The Process

3D Printing Parts

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The Process

3D Printing Parts

Pre-3DPM Building Process

- Obtain all parts
 - Buy off the shelf parts
 - Make custom parts
- Obtain required tools
- Assemble!
- Test
- Deploy

Post-3DPM Building Process

- Obtain all parts
 - Buy off the shelf parts
 - Make custom parts [rare]
 - 3D print required parts
- Obtain required tools
 - 3D print some required tools
- Assemble!
- Test
- Deploy

Outline

The Process

3D Printing Parts

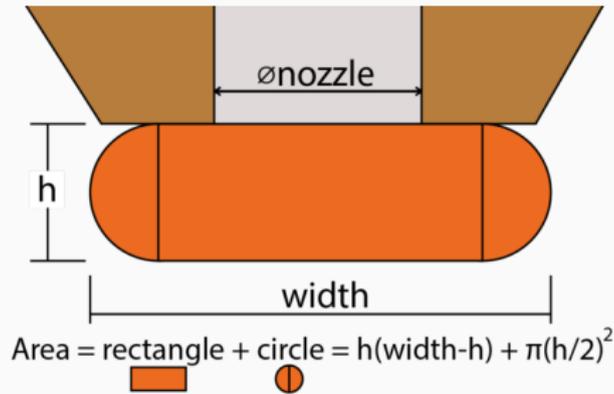
How it is supposed to work

- Download STL
- Print it!

Printing

- Obtain STL files
- Use slicer to produce G-code files
- Set print parameters
 - Layer height
 - Line width (depends on nozzle width)
 - Infill
 - Support
- Choose material: color, type, etc.
- Make sure printer can meet quality expectations
- Print it!

Print Parameters: Layer height and Line Width



- Closely related to and limited by nozzle diameter
- Layer height is the height of each plastic layer
 - 3D model is sliced into layers
 - Smaller layer heights, finer detail
- Line width is the width of the extrusion
 - The “round” extruded plastic is “squished” to form line width
 - Affects speed, detail, strength

Print Parameters: Infill

- A 3D model has solid portions
- But its 3D printed object is usually not solid
 - Less plastic
 - Faster printing
 - May affect strength
- Solid portions of the model are replaced with *infill*



Print Parameters: Support

- FDM 3D printers cannot print in air
- Structural features that are affected
 - Bridges
 - Overhangs
- These features require "support"
 - Slicer-inserted structures that must be removed after printing
 - Support bridges and overhangs during printing
- Sophisticated printers use two materials
 - Support material is designed to be dissolvable

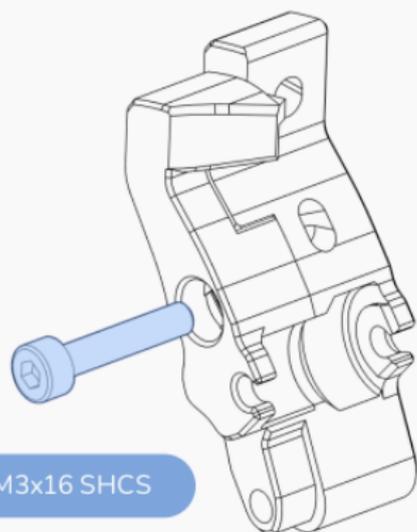
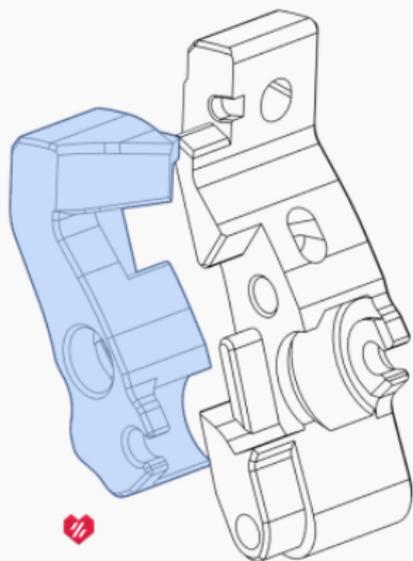
Avoiding Support

- Limit overhang angle
- Use built-in supports
 - E.g. Voron Stealthburner
- Design for 3D printing
 - Required reading: Ultimate Guide: How to design for 3D printing

Quality Assurance

- 3D printers are not standardized
- Can produce objects of wildly varying quality
 - Affects expected tolerances
- One solution: test parts
 - Voron test prints
 - ERCF calibration
 - Stealthburner guidler

Stealthburner Guidler



TOLERANCES, EXTRUSION MULTIPLIERS AND YOU

The part has tight tolerances. If it doesn't fit together well the printed parts are likely over-extruded.

Part Orientation

- STLs parts should be oriented correctly for printing
 - Placed on the bed as supplied
- But not all projects handle this correctly:
 - Haxophone Octave Rest
 - Haxophone Hook Rest

Plating Multiple Objects

- Small volume printers can print one object at a time
- Large volume printers can handle many more
 - But STL files usually contain a single object
- Slicers allow placing multiple objects on the plate
 - Increases throughput slightly (cooling/heating)
 - May increase failure rate

Technology to the rescue?

Can we make building easier?

Platers

- Given:
 - a set of objects
 - print settings/print profile
 - printer description
- Plates objects automatically
- Generates g-code using slicer command line
- Many platers available
 - Some now incorporated with slicers (e.g. BambuSlicer)
- I wrote one too:
<https://github.com/sree314/pj3d>



What about other kinds of users?

- I discussed the end user's workflow
 - aka the builder
- What about:
 - modelers
 - modders
 - documentation producers
 - testers
 - kit makers
 - ...