



Build Team

3D Printing Tips & Tricks

Overview

We'll review the following:

- 3D Printers Access
- Computer-Aided Design (CAD) to Slicer
- Materials
- Using available STL files
- Common design considerations



3D Printing Access

Where can I get parts 3D printed?



High school supports
Plymouth-Canton
Community Schools
(P-CCS) FIRST Tech
Challenge (FTC) Teams



Online Services

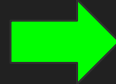
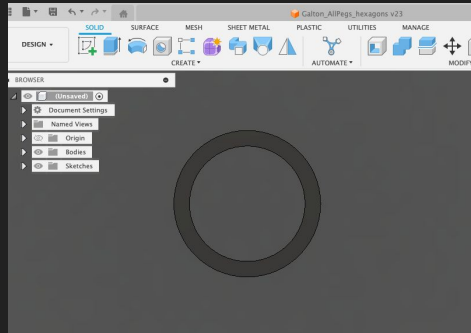


Purchase



Computer-aided Design (CAD) to a Slicer

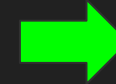
What is a slicer?



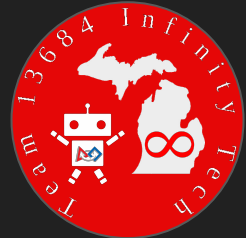
```
Fan speed setting,      ;Layer count: 25
                        ;LAYER:0
Nozzle travel speed     M107
(without extrusion)     G0 F9000 X52.235 Y55.800 Z0.300
                        ;TYPE:SKIRT
Nozzle printing speed   G1 F2340 X56.093 Y55.800 E0.18815
(with extrusion)        G1 X56.346 Y55.605 E0.20373
                        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
```

Annotations in the G-code block:

- Fan speed setting:** Points to the `F9000` value.
- Nozzle travel speed (without extrusion):** Points to the `M107` command.
- Nozzle printing speed (with extrusion):** Points to the `F2340` value.
- X, Y Coordinates:** Points to the `X56.093 Y55.800` values.
- Layer height:** Points to the `Z0.300` value.
- Extrusion length:** Points to the `E0.18815` value.



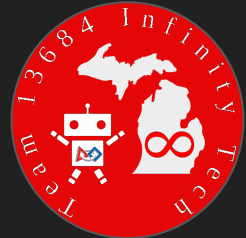
A slicer translates CAD so the 3D printer can lay down the filament



Computer-aided Design (CAD) to a Slicer

Slicers available to download

	Cura	▼		Slic3r	▼		PrusaSlicer	▼
	Simplify3D	▼		ideaMaker	▼		OctoPrint	▼
	AstroPrint	▼		KISSlicer	▼		Repetier-Host	▼
	Fusion 360	▼		netfabb GmbH	▼		SelfCAD	▼
	Slicer	▼		Craftware	▼		IceSL	▼
	Kiri:moto	▼						



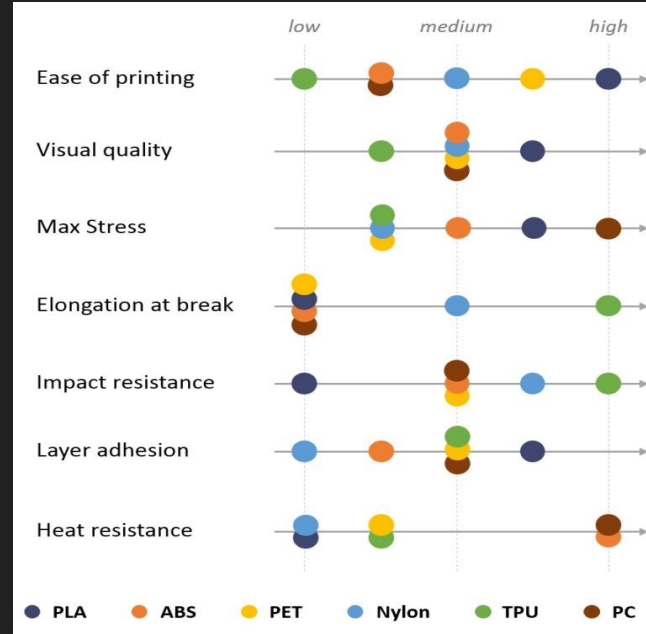
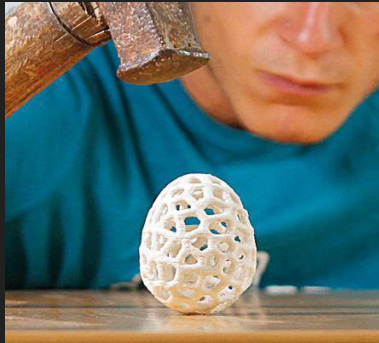
Computer-aided Design (CAD) to a Slicer

Slicer Settings for Fast, Accurate, and Strong Prints

	Value
Nozzle Opening	0.6 mm
Infill Fill Pattern	Adaptive Cubic
Elephant Foot Compensation	0.4 mm
Perimeters	3
Support Material (Style)	Organic
Bridge Flow Ratio	0.95 (95%)



3D Filaments Materials and Properties



Takeaway: Determine the use then decide what material works best

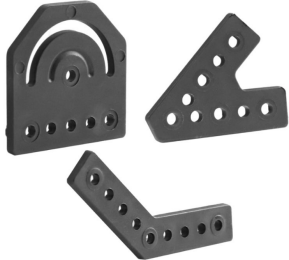


Existing CAD / Step Files

revrobotics.com/ftc/structure/brackets/

15mm Plastic Brackets

\$4.50



Type: Required

- ☐ (REV-41-1308-PK8) 15mm Plastic 30 Degree Bracket - 8 Pack
- ☐ (REV-41-1307-PK8) 15mm Plastic 45 Degree Bracket - 8 Pack
- ☐ (REV-41-1306-PK8) 15mm Plastic 60 Degree Bracket - 8 Pack
- ☐ (REV-41-1305-PK8) 15mm Plastic 90 Degree Bracket - 8 Pack
- ☐ (REV-41-1311-PK6) 15mm Plastic 120 Degree Bracket - 6 Pack
- ☐ (REV-41-1310-PK8) 15mm Plastic 135 Degree Bracket - 8 Pack
- ☐ (REV-41-1312-PK6) 15mm Plastic 150 Degree Bracket - 6 Pack
- ☐ (REV-41-1318-PK4) 15mm Plastic Variable Angle Bracket - 4 Pack

Quantity:

[Add to Cart](#)

revrobotics.com/ftc/structure/brackets/

channel increasing joint alignment, strength, and rigidity.

The 15mm Plastic Variable Angle Bracket (REV-41-1318) has a larger arced channel allowing two pieces of extrusion to be adjusted to any angle. The smaller arc indentation is a drill alignment mark so once the angle is set, an additional bolt can be added to lock the bracket angle in place.

Specifications

- Material: Nylon (PA66)
- Thickness: 3mm
- Hole Diameter: M3 clearance
- Hole Grid Spacing: 8mm

Documentation

- BuildingGuide

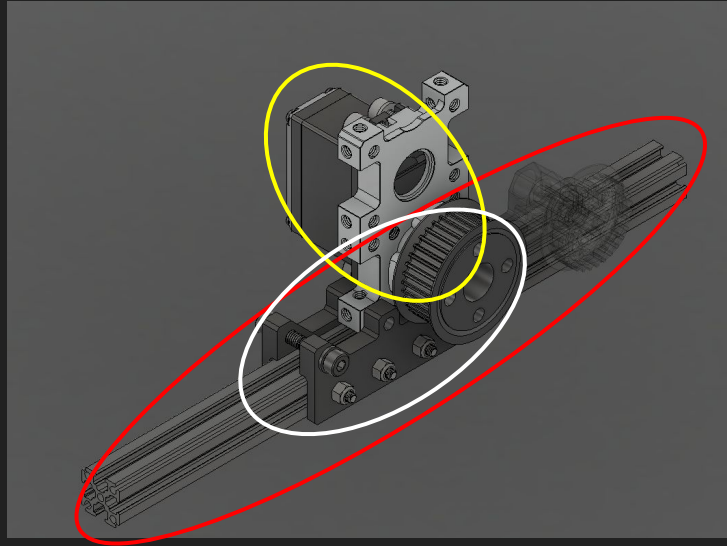
Product Options

SKU	PRODUCT NAME	CAD & DRAWINGS
REV-41-1308-PK8	15mm Plastic 30 Degree Bracket - 8 Pack	STEP FILE ONSHAPE DRAWING
REV-41-1307-PK8	15mm Plastic 45 Degree Bracket - 8 Pack	STEP FILE ONSHAPE DRAWING
REV-41-1306-PK8	15mm Plastic 60 Degree Bracket - 8 Pack	STEP FILE ONSHAPE DRAWING

Takeaway: Can directly print parts, via a slicer, for quicker assessments while an order is being delivered



Existing CAD / Step Files



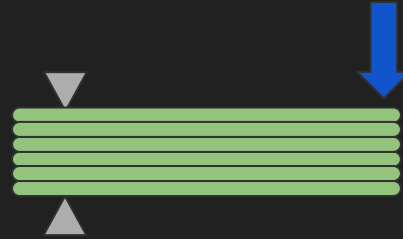
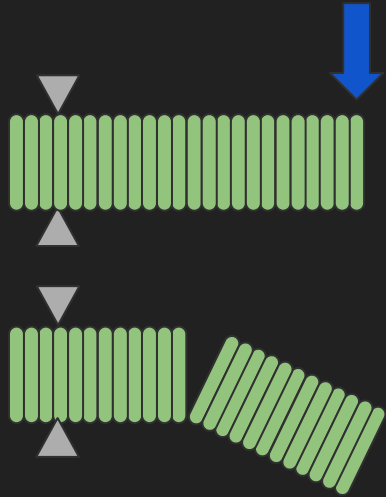
- GoBilda
- REV
- Adapter

Takeaway: Can print nearly any adapter using components from two different companies



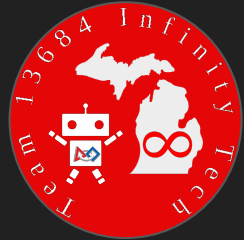
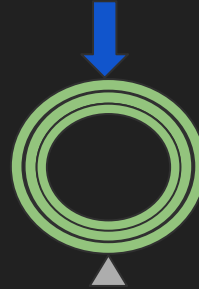
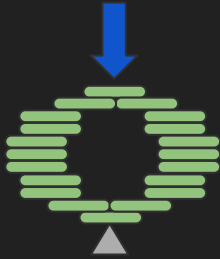
Considerations When Designing

What is the direction of the force & how can I print it?

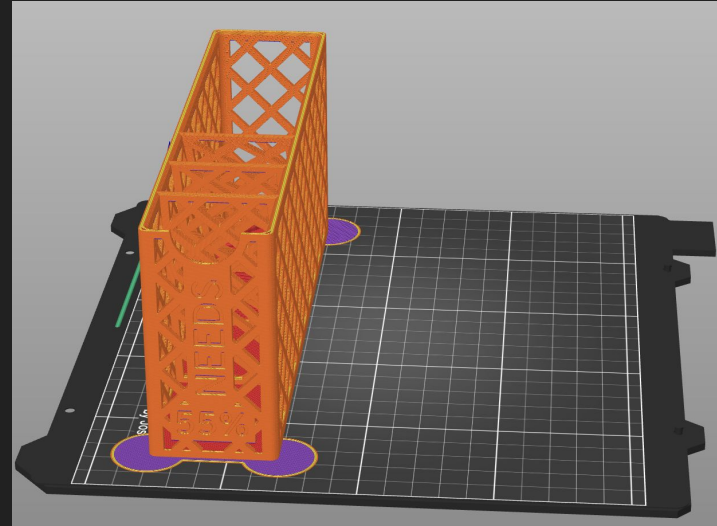
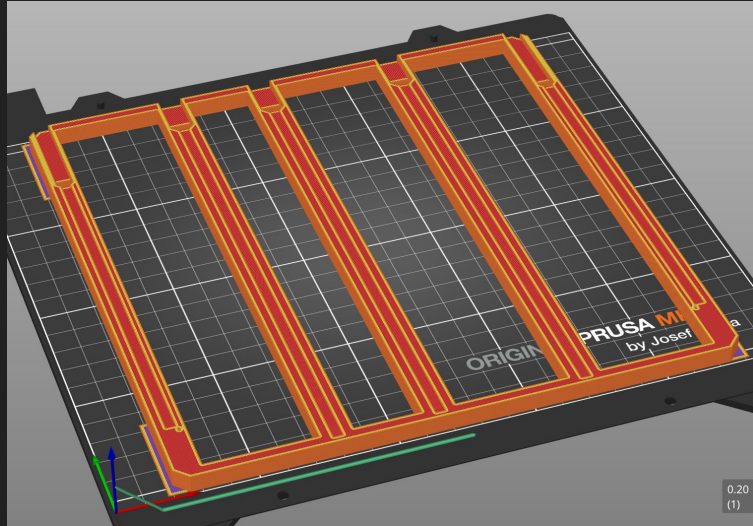


Considerations When Designing

What is the direction of the force & how can I print it?



Common Considerations: Print Time



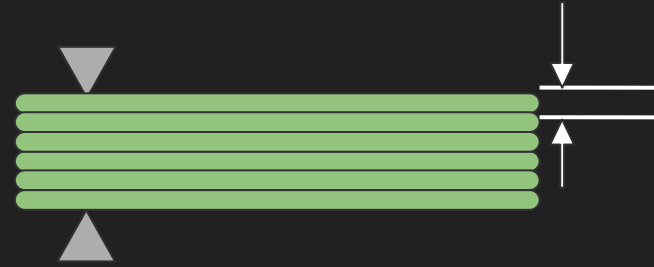
Takeaway: Prints requiring higher z-axis positions take longer to print



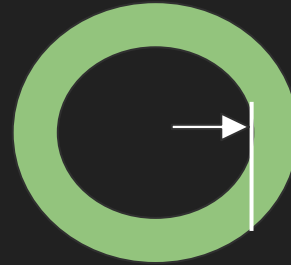
Common Considerations: Tolerances & Nozzle Width



Nozzle width → | | ← 0.4 mm



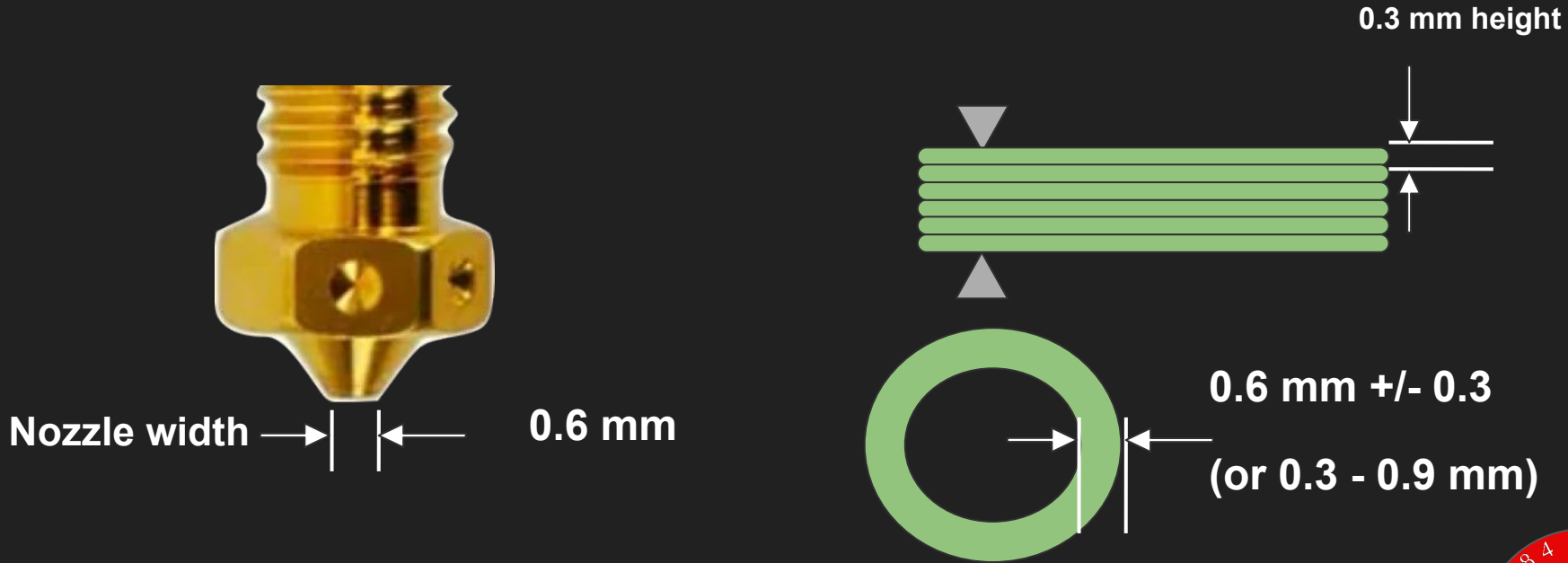
0.2 mm height



0.4 mm +/- 0.2
(or 0.2 - 0.6 mm)

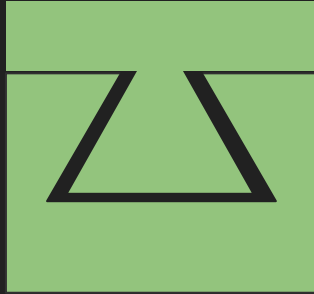


Common Considerations: Tolerances & Nozzle Width



Common Considerations: Tolerances & Nozzle Width

Examples Gaps for Joints with a 0.6 mm nozzle



Dovetail: 0.5 mm gap



Hole: 0.4 mm gap

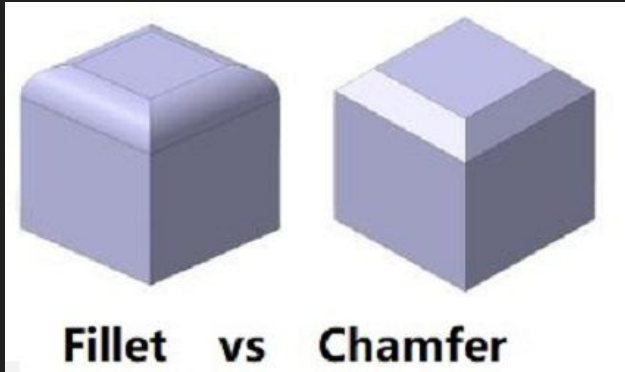
Takeaways:

- Tolerance is roughly one half ($\frac{1}{2}$) of the nozzle width
- If possible, we recommend a 0.6 mm nozzle as a good balance of print time, strength, & appearance



Common Considerations: Chamfer vs. Fillet

When to fillet and chamfer in 3D printing?



Fillets:

- Pros
 - Soften corners that face the sides
 - Reduces stressors in corners
- Cons
 - Prints can be messy and/or misprint

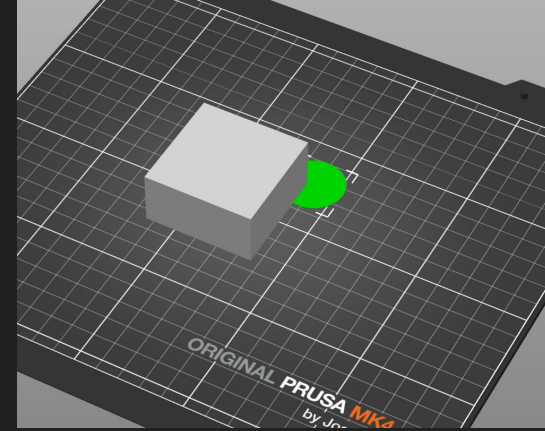
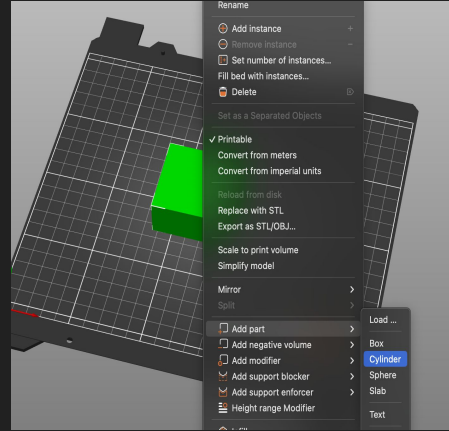
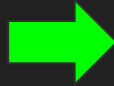
Chamfers:

- Pros
 - Ease for assembly
 - Cleaner prints
- Cons
 - No stress reduction

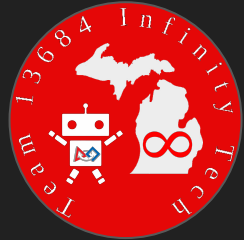


Common Considerations: Lifting corners

Ways to address corners lifting off the build plate

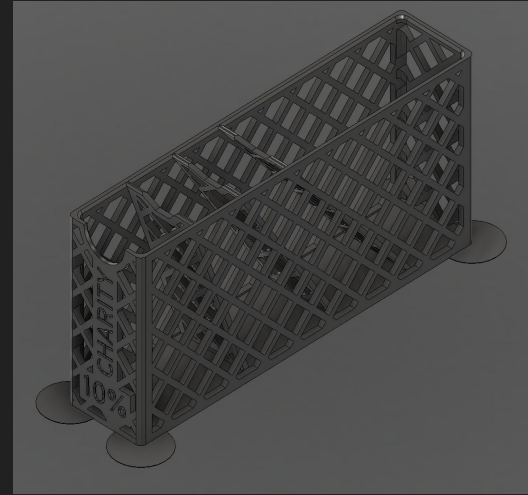
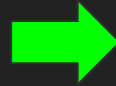
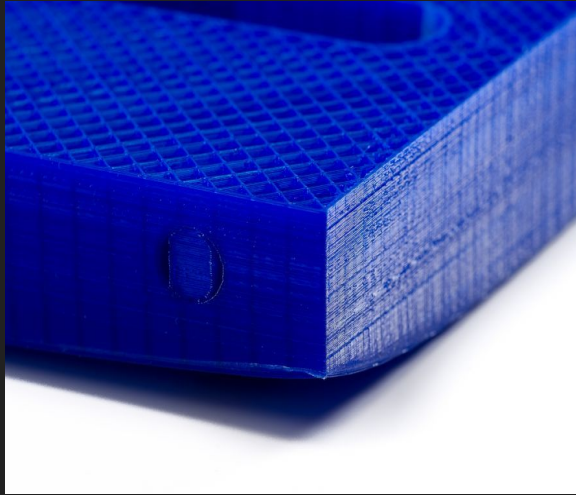


Takeaway: “Mickey ears” is a targeted way to reduce corners lifting

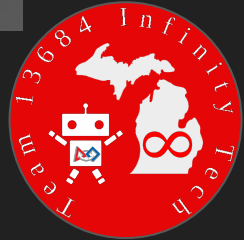


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Ways to address corners lifting off the build plate

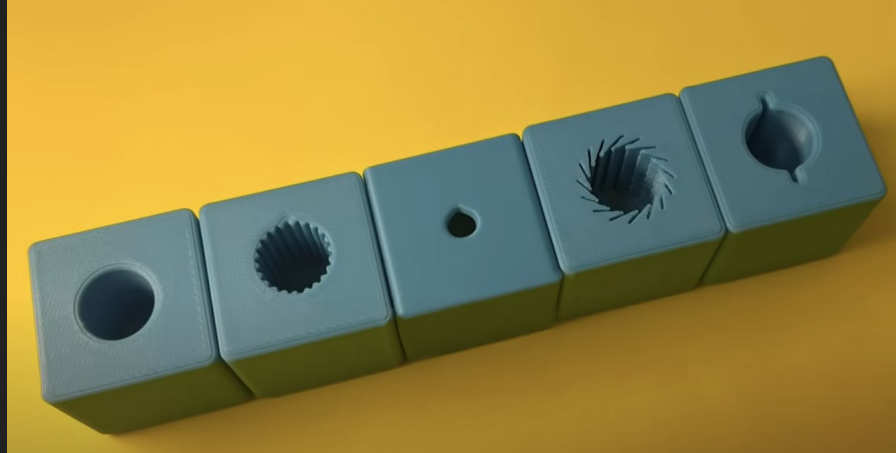
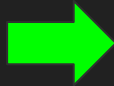
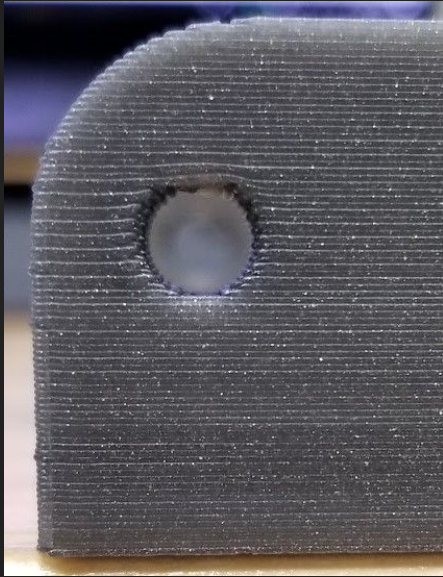


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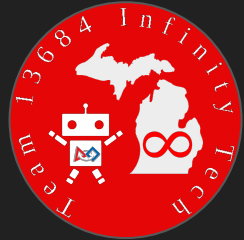


Common Considerations: Printing holes on side of object

Ways to make holes that can accept cylindrical objects

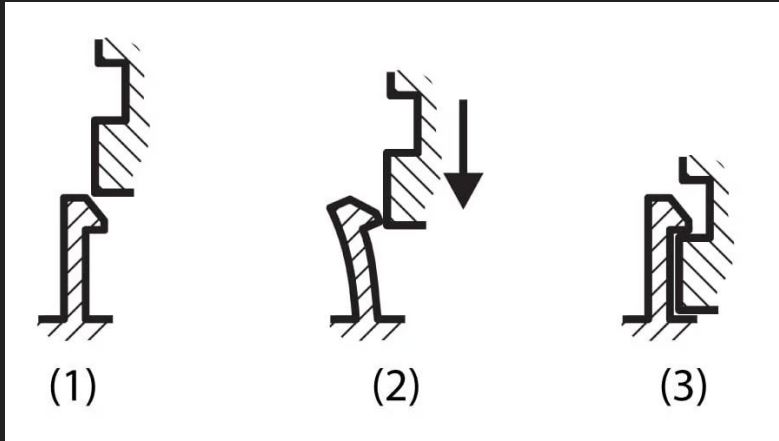


Takeaway: Apply modifications for side holes to keep the hole circular



Common Considerations: Attaching two parts together

Ways to 3D print attach two components together mechanically



Snap fit



Dovetail



Summary

- How to go from CAD to slicer to 3D print
 - Recommended slicer settings
- Uses and materials
- Leveraging available STL files from vendors
- Common design considerations

