# 3D Printing Optimization

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# 1 Introduction

Resource Cost and Topology

# RESOURCES REQUIRED FOR 3D PRINTING

**Filament**

Differs in material and cost, ranging from metal to polylactic acid.

**Time**

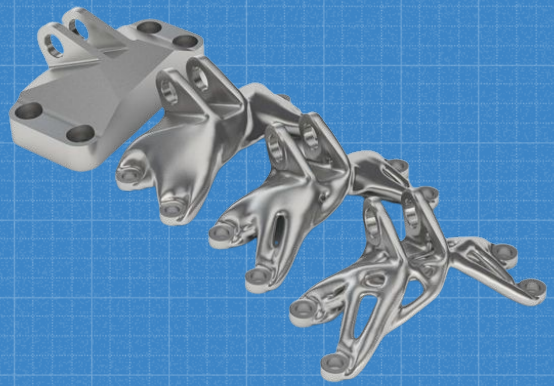
A print can take from 30 minutes to several days, depending on the size and detail.

**Energy**

The average printer uses one cent per hour, making energy a negligible factor.

# WHAT IS TOPOLOGY OPTIMIZATION?

- The method of finding the most efficient layout of material for manufacturing 3D objects.
- Objective is to get the best balance between ***strength***, ***weight*** and ***affordability***.
- Can reduce weight and cost to make 3D printed objects without sacrificing their structural integrity.



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# Factors in 3D Printing

Shell Thickness, Infill Percentage and Material

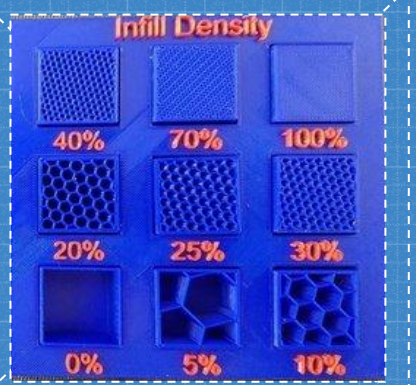
# STANDARD MATERIAL OPTIONS

| | PLA | ABS | PETG |
|---|---|---|---|
| Full Name | Polylactic Acid | Acrylonitrile Butadiene Styrene | Polyethylene Terephthalate Glycol |
| Pros | • Low Print Temperature<br>• Cheap | • Resistant<br>• Can distort and bend | • Food-safe<br>• Impact and heat resistant |
| Cons | • Low heat resistance<br>• Brittle | • Warps easily during prints<br>• Releases fumes | • Most expensive<br>• Strings easily during prints |

# INFILL

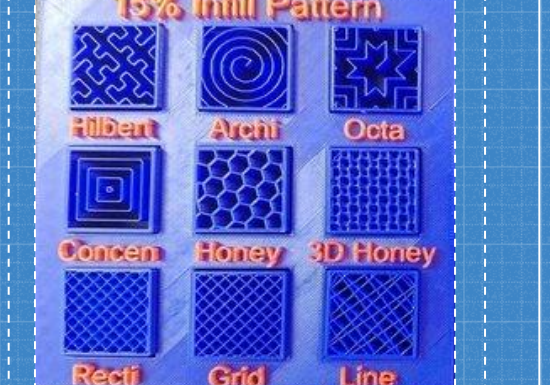
## PERCENTAGE

The “fullness” of a 3D printed object. This determines its overall strength, weight, print time and material usage.




## PATTERN

The shape of an object’s interior. This determines its overall strength, weight, flexibility, material usage and print time.



# SHELL THICKNESS

The thickness of an object’s shell is the amount of layers that its surface sides contain. This determines its outer strength, cost per piece and time to print.

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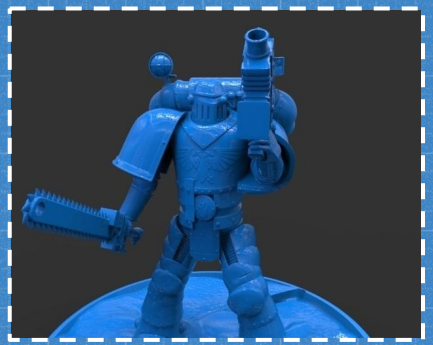
# Optimal Approaches

The best material, infill and shell options.

# MATERIAL OPTIONS

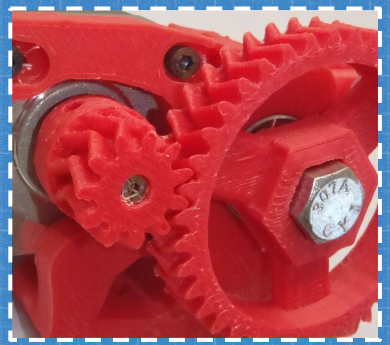
**PLA**

Best for creating objects that don’t have any functional requirements that need to be met.



**ABS**

Best used for functional items that will see a lot of wear or require a lot of durability.



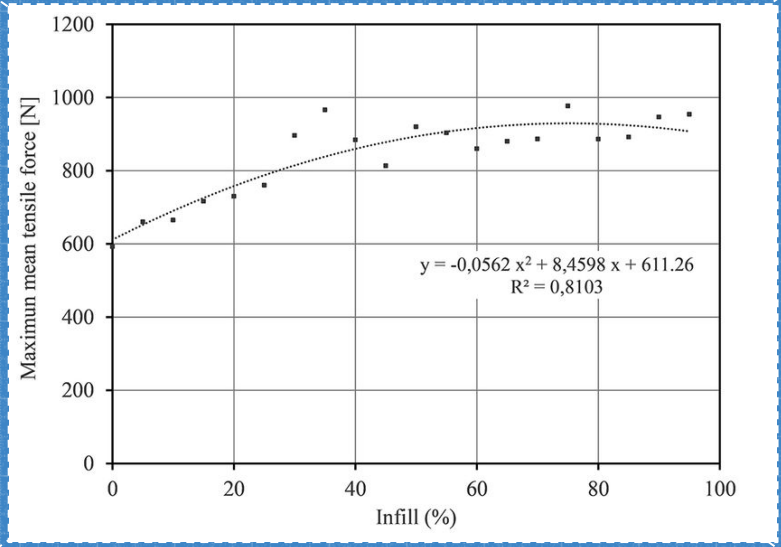
**PETG**

Great for durable, functional objects, especially ones that come in contact with foods and drinks.

# OPTIMAL INFILL PERCENTAGE

Increase in tensile strength is often negligible past 60%.

For non-functional prints, anything between 15% and 50% will work fine.



# OPTIMAL INFILL PATTERNS

**Lines** 

Best for producing quick, lightweight objects.

**Grid** 

Best for light objects with moderate strength requirements.

**Honeycomb** 

Best for fast prints with little material and some strength.

**Tri-Hexagon** 

Great for items that need to be very strong in two dimensions.

**Cubic** 

Perfect for objects to be strong in all three dimensions.

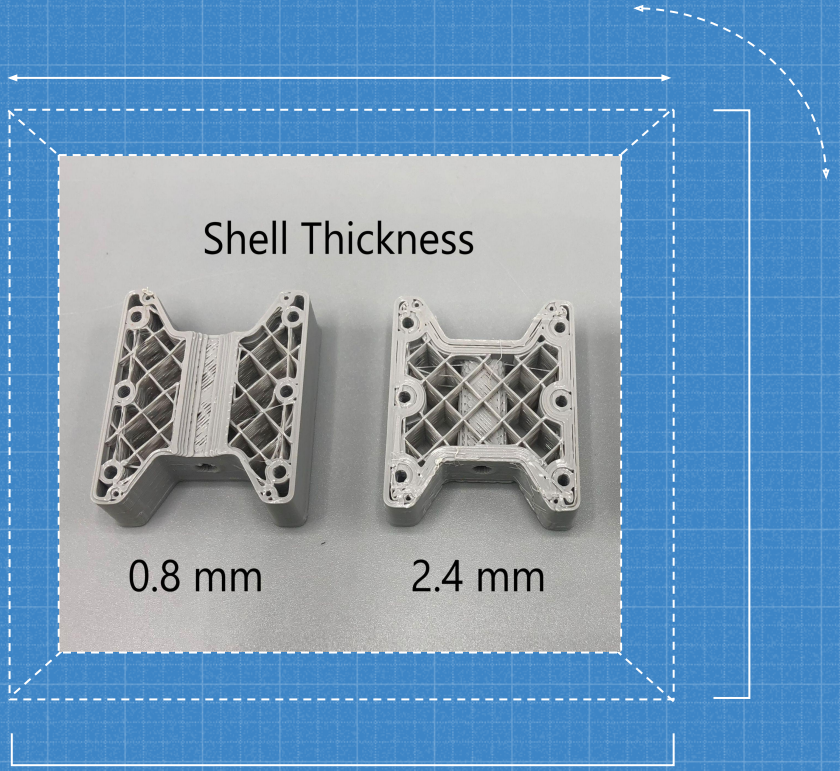
**Gyroid** 

Strikes a good balance between strength, material use and print time.

# OPTIMAL SHELL THICKNESS

This often varies depending upon the material you use and the functional requirements of the item being printed.

However, 1.5-2.0 mm is typically a good range to prevent deformations and breaks both during and after the printing process.



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# Conclusion

Recap and works cited

# RECAP

**Introduction**

Topology optimization is used to reduce the material usage, time and cost of 3D printing something.

**Printing Options**

The strength and cost of a print is directly tied to factors such as shell thickness, infill percentage, infill pattern and the material.

**Optimal Procedure**

While there are certain rules to follow when optimizing an object, this varies depending on what you want from a specific piece.

# Thanks!

ANY QUESTIONS?

# CREDITS

Sources


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