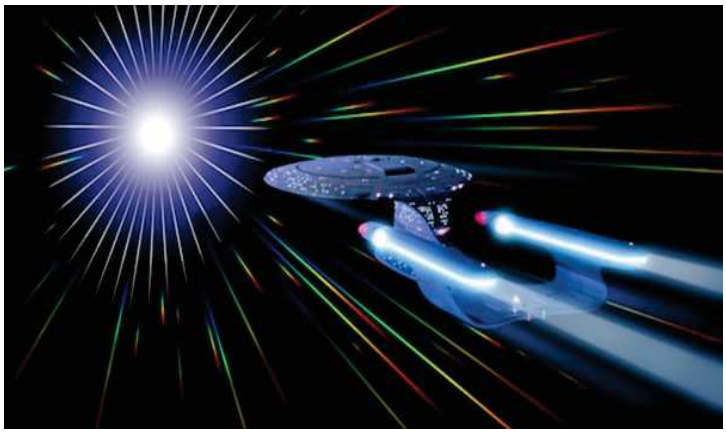
3D printing II.

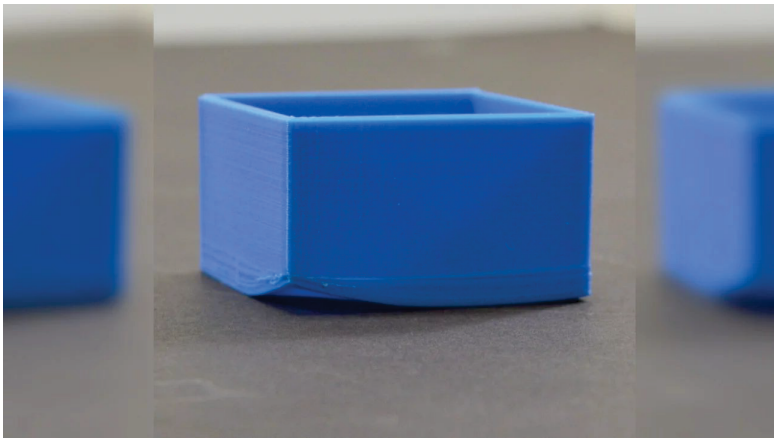
Harmonogram

6. 3D printing I.
7. Prieskum + 3D printing II.
8. 3D scan
9. CNC
10. Generatívny dizajn
11. Arduino
12. Prezentácie -> skúškové obd.

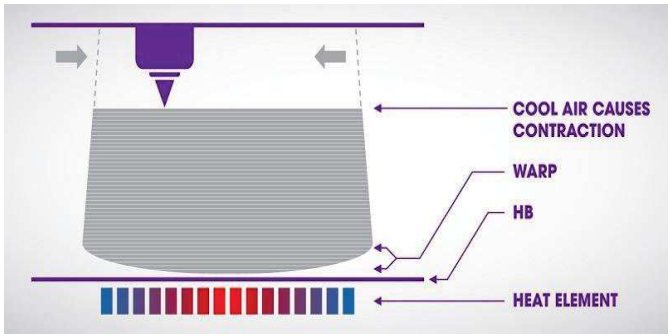
Warping



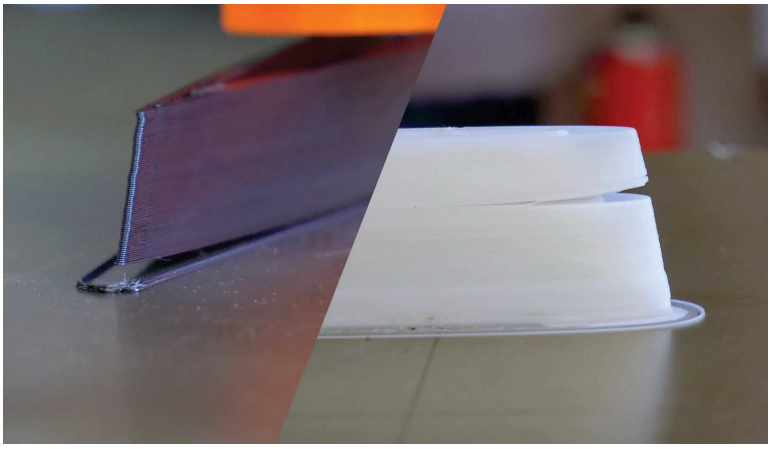
Warping - zmršťovanie

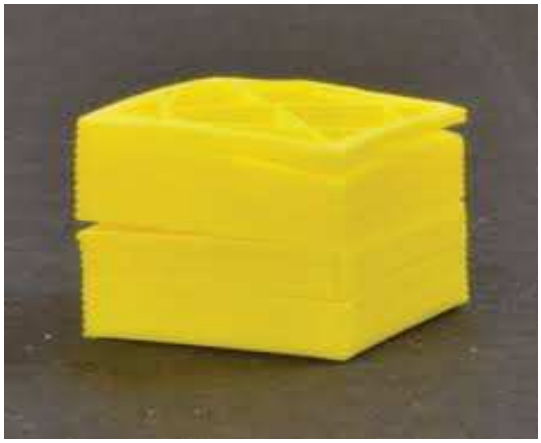


Warping

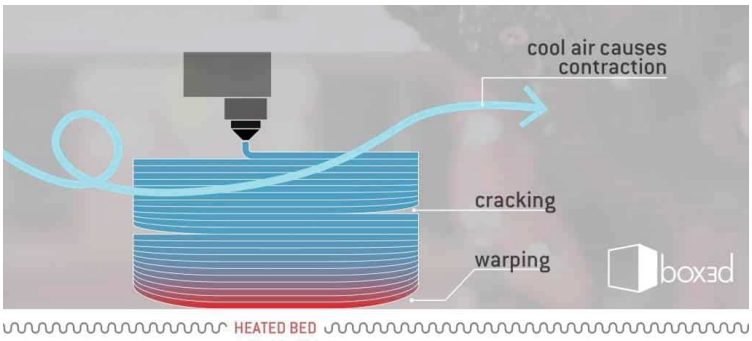


Cracking





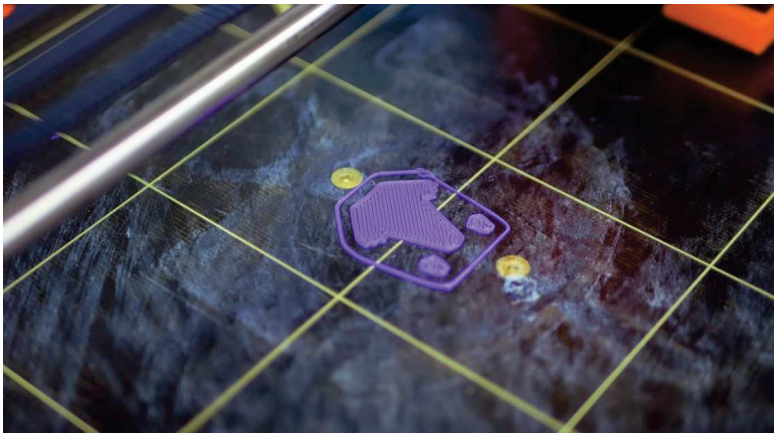
Cracking / Delamination



https://youtu.be/HVdvKfIHtS0

Skirt suknička

First layer only
– steady flow can be established
– watch for homogenity



Skirt suknička

Pros:

- Primes the extruder
- Detects issues while printing
- Uses less material than rafts or brims
- Simple check before the actual printing starts, which can save time, effort and money
- Helps in defining the print area

Cons

- No value addition to the print
- Makes use of additional material apart from the print, which is waste material

https://all3dp.com/2/3d-printing-raft-brim-and-skirt-all-you-need-to-know/

Brim - šilt

Brim - šilt

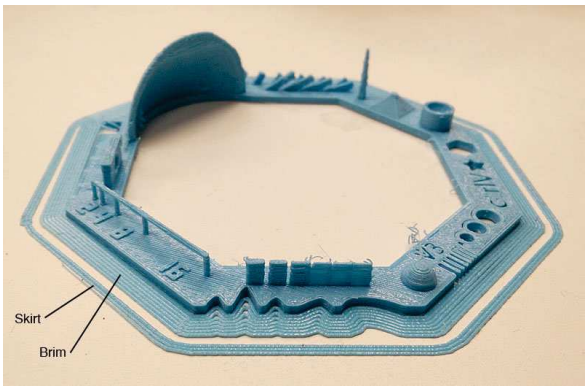
Pros:

Prevents warping issues with materials like ABS

- Improves bed adhesion leading to higher chances of a successful print
- Comparatively easy to remove when compared to a raft
- Doesn't interfere with the bottom layer of the print
- Uses less material compared to a raft

Cons:

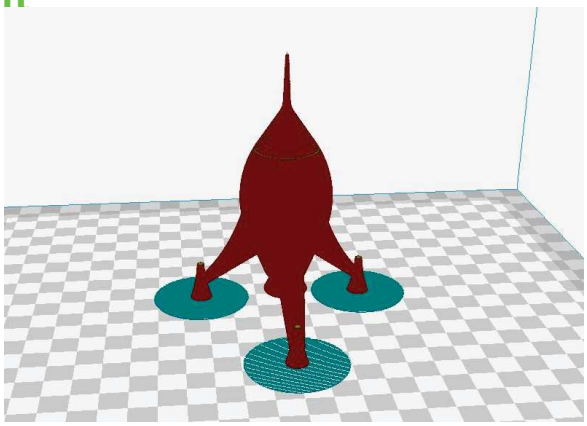
- Produces a small amount of waste material
- Touch points must be sanded to get a smooth surface finish
- Possibility of breaking the part while removing the brim



https://all3dp.com/2/3d-printing-brim-when-should-you-use-it/

Raft

Raft



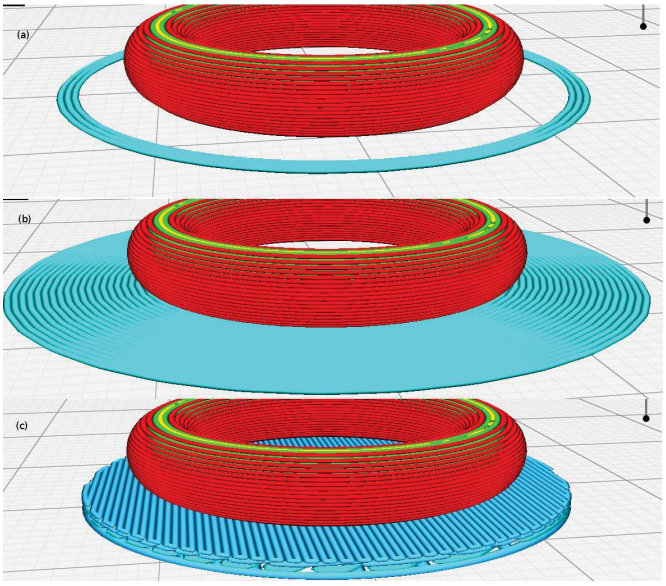
Raft

Pros:

- Fewer warping issues with stubborn materials like ABS
- Improved bed adhesion leading to higher chances of a successful print
- Consistent print output
- Stronger first layer

Cons:

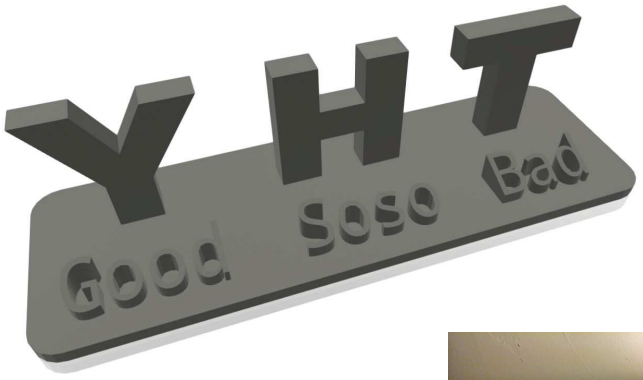
- Rough finish on the bottom layer of the model
- Difficult to seperate from model, especially with a denser raft
- Extra waste material
- Possibility of breaking the part while removing the raft, especially with tiny model components



https://all3dp.com/2/3d-printing-raft-brim-and-skirt-all-you-need-to-know/

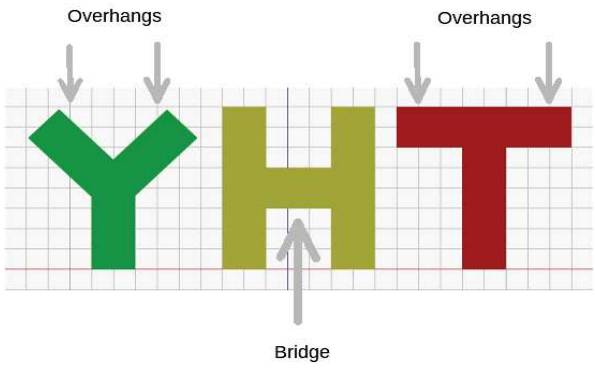
Support and orientation

https://all3dp.com/1/3d-printing-support-structures/



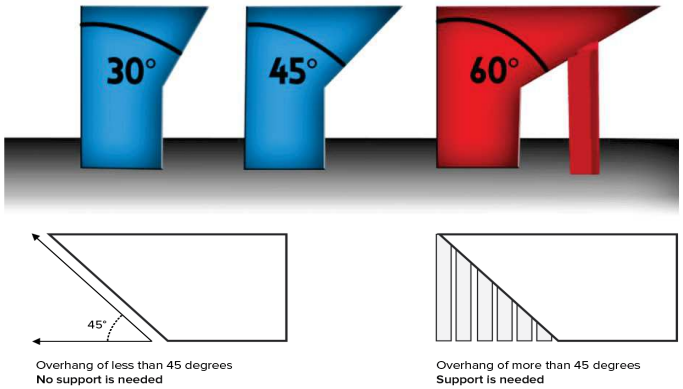
https://youtu.be/wMoxwfjgioQ

Support and orientation



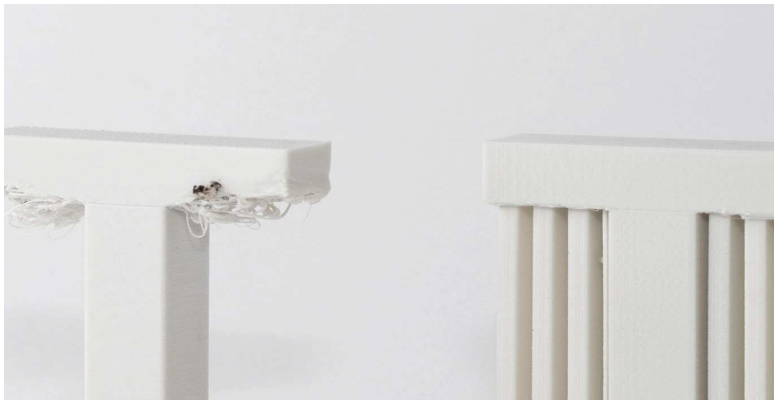
https://all3dp.com/1/3d-printing-support-structures/

Support and orientation



https://all3dp.com/1/3d-printing-support-structures/

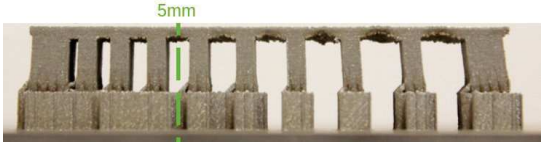
Support and orientation

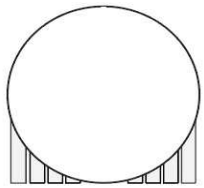


https://all3dp.com/1/3d-printing-support-structures/

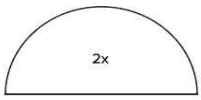
Not all overhangs need supports:

1. the 45 degrees rule
2. the 5 mm rule for bridges

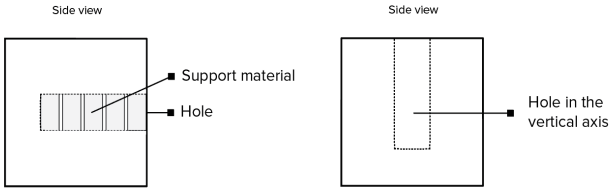




Printing as one object
Support is needed



Slicing in two parts
No support is needed



https://www.3dhubs.com/knowledge-base/how-design-parts-fdm-3d-printing#overhangs

Support - nevýhody

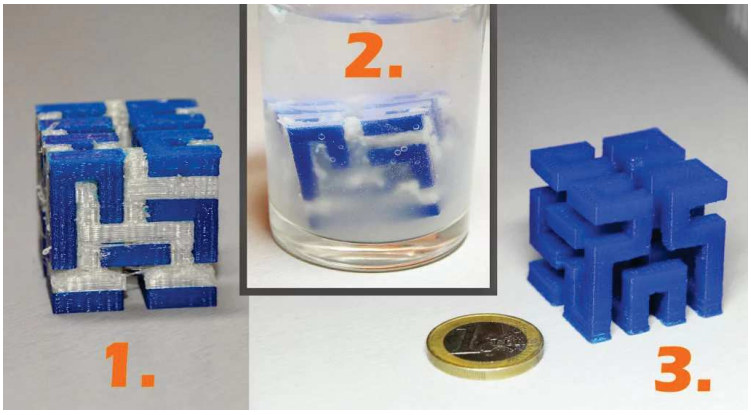
Odpad

Dlhší čas

Práca navyše

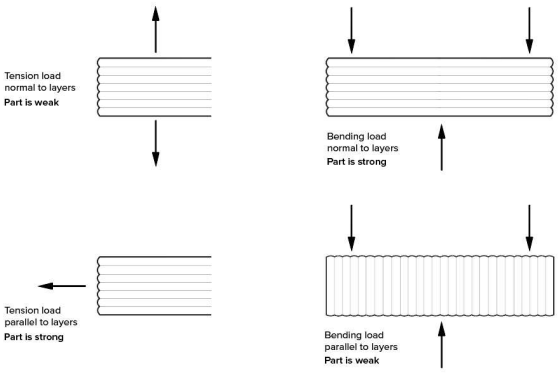
Riziko poškodenia

Dissolvable 3D printing support structures



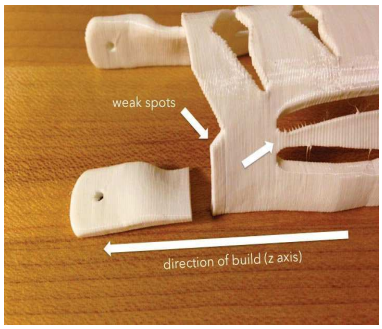
https://all3dp.com/1/3d-printing-support-structures/

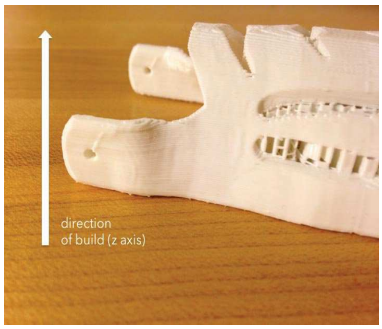
Build direction



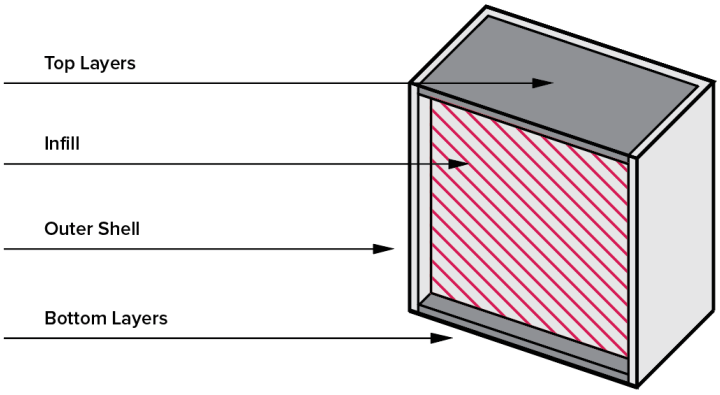
Due to the anisotropic nature of FDM printing, understanding the application of a component and how it is built are critical to the success of a design. FDM components are inherently weaker in one direction due to layer orientation.

Build direction

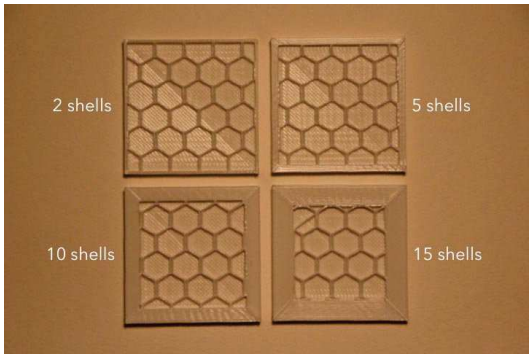




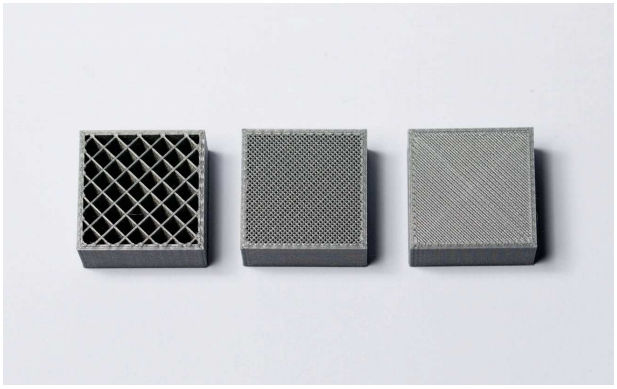
Walls – shells



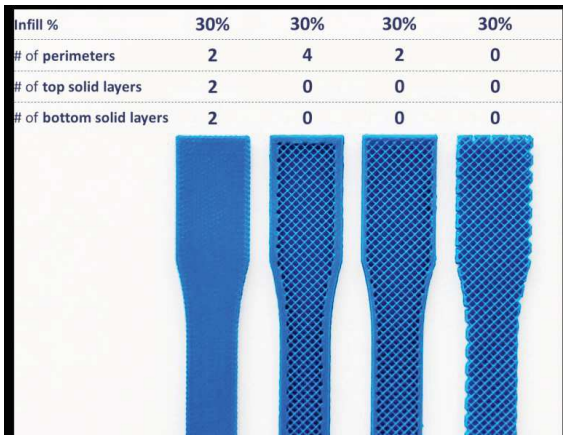
Walls – shells



Infill - výplň

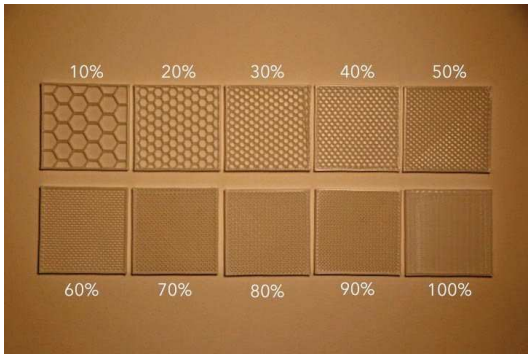


Walls + infill

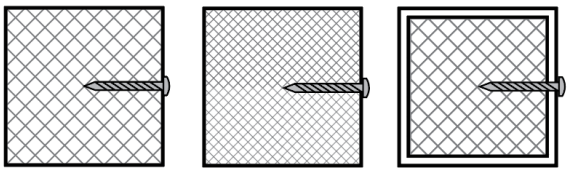


https://my3dmatter.com/shells-matter-more-than-meets-the-eye/

Infill

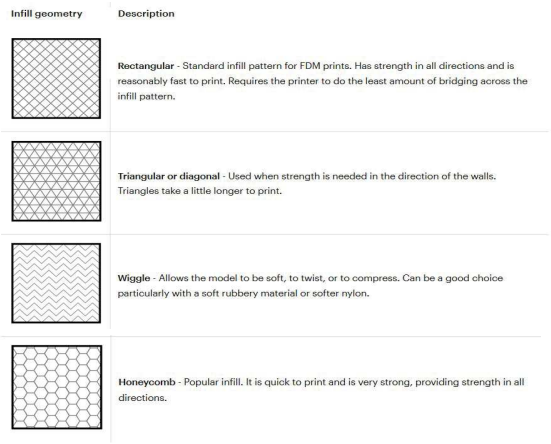


Infill – výplň – ANCHOR

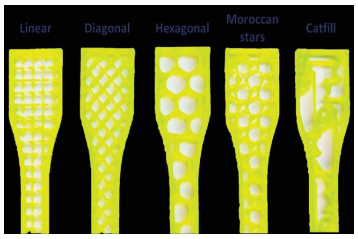


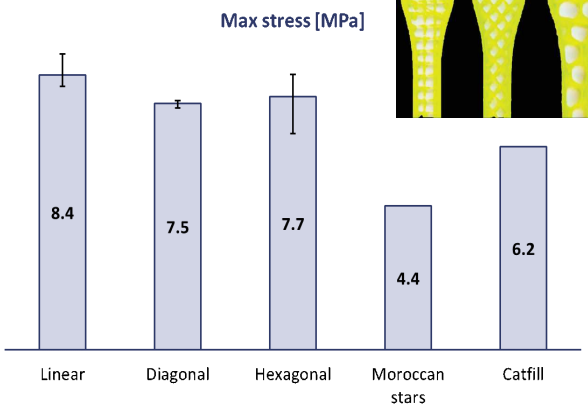
A. Poor anchoring for screwing, B. Increased infill allows for better anchoring, C. Increased outer shell is a cheaper solution and offers improved anchoring over the option on the left

Infill – výplň – GEOMETRY



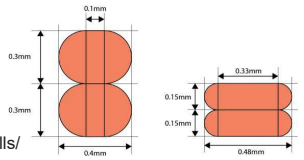
Infill – výplň





https://my3dmatter.com/influence-infill-layer-height-pattern/

Infill – výška steny



https://mattshub.com/2018/12/01/demystifying-thin-walls/

Strength [MPa]	Infill % 10	30	50	70	80	90	100
0.1	8	12	17	25	29	33	39
Layer 0.15	9	14	20	28	33	38	44
Height 0.2	10	15	21	30	35	40	46
[mm] 0.25	10	15	22	31	37	42	49
0.3	10	15	22	31	36	42	48

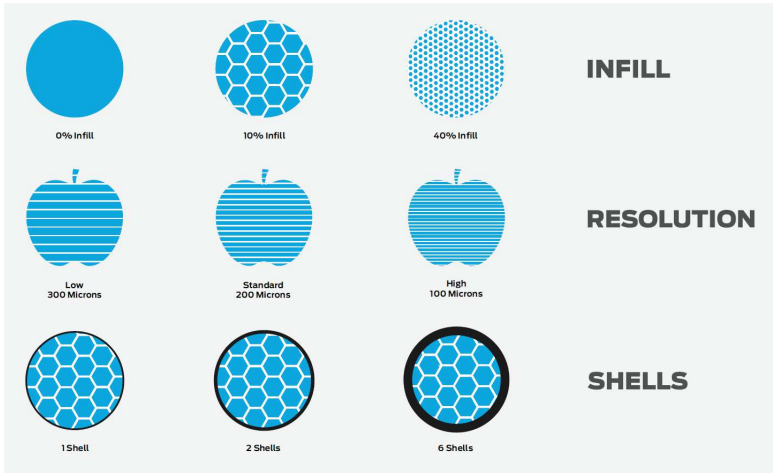
Speed [mins]	Infill % 10	30	50	70	80	90	100
0.1	21	35	47	61	68	74	80
Layer 0.15	14	23	32	41	46	50	54
Height 0.2	10	18	24	31	35	38	41
[mm] 0.25	8	14	20	25	28	31	33
0.3	7	12	16	21	24	26	28

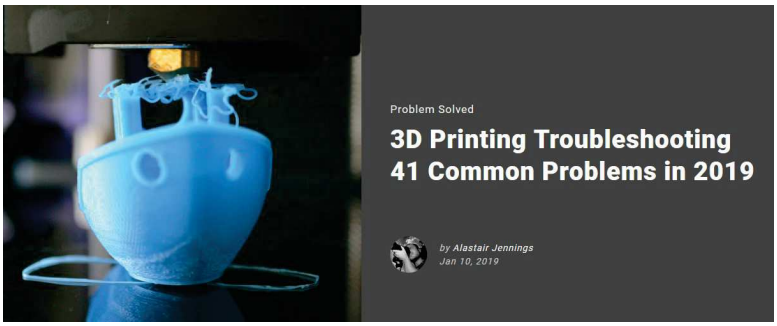
Cost [cents]	Infill % 10	30	50	70	80	90	100
0.1	6	9	13	17	18	21	22
Layer 0.15	6	10	14	18	19	21	23
Height 0.2	6	10	14	18	20	22	23
[mm] 0.25	6	10	14	18	20	22	23
0.3	6	10	14	18	20	22	23

Quality	Infill % 10	30	50	70	80	90	100
0.1	very high						
Layer 0.15	high						low
Height 0.2	medium						
[mm] 0.25	low						
0.3	very low						

BEST ⟷ WORST

https://my3dmatter.com/influence-infill-layer-height-pattern/

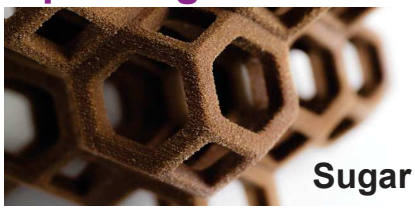


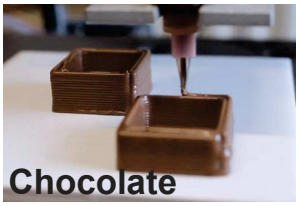


https://all3dp.com/1/common-3d-printing-problems-troubleshooting-3d-printer-issues/

3D printing materials

Plastic: ABS, PLA

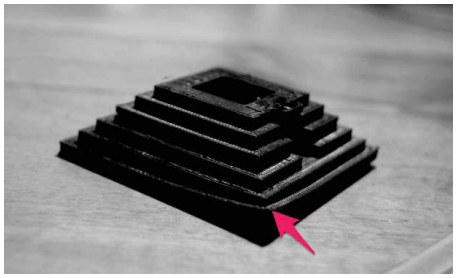




PLA vs ABS: Print-Relevant Information

Temperature	PLA	ABS
Print bed temperature	20-60°C (optional)	80-110°C (mandatory)
Glass transition temperature	57°C	104°C
Melting temperature	150-160°C	N/A*
Printing temperature	180-230°C	210-250°C

PLA vs ABS: Print-Relevant Information



warping

PLA vs ABS: Product-Relevant Information

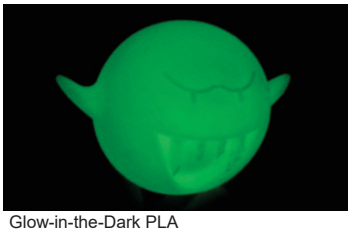
Temperature	PLA	ABS
Printing Temperature	180-230°C	210-250°C
Print Bed Temperature	20-60°C	80-110°C
Print Bed heating	Optional	Mandatory
Printer Enclosure	Optional	Recommended
Clogs/Jams Nozzle	Occasionally	Never
First Layer Adhesion	Minor problems	Minor problems
Fumes	Little to none	Bad and intense
Absorbs Moisture	**Yes**	**Yes**

PLA vs ABS: Print-Relevant Information

Material	PLA	ABS
Strength	Decent Strength	Above Average Strength
Flexibility	Brittle	Moderately Flexible
Impact Resistant	No	Yes
Heat Resistant	No	Yes
UV/H2O Exposure	Degrades Over Time	Degrades Over Time
Biodegradable	Yes	No
Recyclable	Yes	Yes
Cutting, Filing, Sanding	Possible	Possible
Painting, Gluing	Kinda Possible	Possible
Acetone Treatment	Not Possible	Possible
Colours	Wide Range Available	Wide Range Available
Exotic Varieties	Some Available	Some Available

Standard Types of 3D Printer Filament

3D Printer Filament	Easy to Use	Physical Properties		
		Strength	Flexibility	Durability
PLA	YES			
ABS				
PETG (PET, PETT)				
Nylon				
TPE, TPU, TPC (Flexible)				
PC				



Glow-in-the-Dark PLA

PLA + Iron

Photochromatic PLA
Changes color when exposed to UV-light, like sunlight.

Temperature Sensitive ABS

PLA + Brass

PLA + Bronze

PLA + Brick

Zhrnutie

PLA (Polylactic Acid)
biodegradable thermoplast,
it's easy to print.

ABS (Acrylonitrile butadiene styrene)
oil-based thermoplastic
slightly higher strength, flexibility, and durability
slightly more complicated print process + fumes