Manafish Ultimate Guide to Infill Patterns

I was completely shocked when I found out that I could have saved 60% filament on some big prints I did just by changing the infill pattern. I also found out that the pattern I have been using to make “strong parts” has been *completely* wrong, and that I could make most of my parts a lot stronger with just some simple clicks.

Therefore, I made this guide where I will tell you everything you need to know about infill patterns for 3d-prints, so you can get way better prints without the hassle of doing deep research.

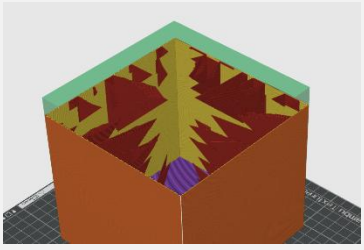
A recurring theme when picking an infill pattern is that there is a central tradeoff between speed/material usage and strength. The fastest patterns create very weak parts, then you can choose progressively stronger patterns at the cost of longer print times and more material usage.

In this guide we will start with the fastest patterns, then gradually move towards the stronger ones. Then we will look at special cases like intentionally flexible parts, what pattern to use for 100% infill and what pattern to use for aesthetic parts with transparent filament. Let’s get started!

Fastest Print Time / Least Material Usage: Lightning

Lightning is BY FAR the fastest pattern. It works by creating a mostly empty “tree-like” structure that only provides support directly under the top surfaces of your part.

Because it doesn’t actually fill the part, it effectively creates just an empty shell, so don’t expect any strength from it. It should only be used for 100% decorative parts. Think statues, figurines or miniature house models that will just stand on a table and look cool 😎.



Fast but some strength: Support Cubic 

Support cubic is almost as fast as lightning, while still retaining some strength. It works by creating a cubic structure that gives top layers something to sit on while still being mostly empty and using very little filament. Unlike lightning, it distributes support a bit more evenly through the model, which makes it slightly tougher if you bump it around.

This should also be used only for decorative parts, but they will have a bit more strength. Think statues, but you don't want to break them just by grabbing them too hard or accidentally dropping them from your desk.

Best strength to weight ratio: Adaptive Cubic 

Adaptive cubic often has the best strength to weight ratio. This is especially the case for parts with a large volume that needs to be filled with infill. Adaptive cubic works by automatically adjusting the size of the cubic cells depending on how far they are from the walls of your part. Near the outside, where stresses are higher, the cells are small and dense. Deeper inside the part, where stresses are low, the cells become bigger so it's mostly empty.

This makes the infill very efficient: you get strength where you need it without wasting plastic in the middle of the part where it does very little. It's a great choice for parts with large infill volumes that need strength but also need to be light.

Speed and strength tradeoff: Grid  and Cubic 

The best patterns to get relatively fast prints that still have useable strength are grid and cubic.

Grid works by creating straight lines in two directions per layer, usually at 90°.

Cubic solves that by making a three-dimensional lattice instead of just a flat one. The pattern repeats in all three axes, giving your part more balanced strength.

I would recommend these for parts that need to be durable but where strength isn't a limiting factor, like for a headset stand.

Best all-round strength: Gyroid and Cross Hatch
The best options for all-round strength are gyroid and cross hatch.

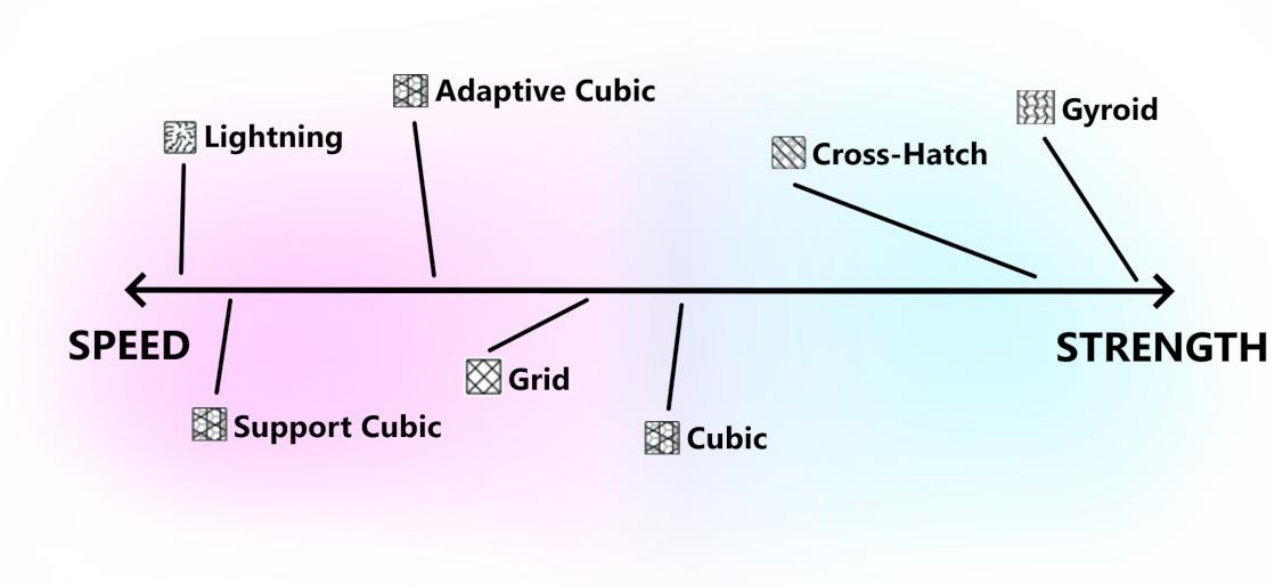
Gyroid is a wavy, continuous 3D surface pattern that looks like an endless swirl inside your print. The main advantage of gyroid is that it's isotropic, meaning it provides almost equal strength in all directions.

Cross hatch is similar in performance but works differently: it creates overlapping angled line grids that alternate between layers, forming a very robust pattern. The straight lines makes it slightly faster to print.

If you just want a go-to infill pattern for parts that need strength, use these. They are safe choices for almost any load-bearing part. Gyroid is the strongest choice. Cross hatch is about 20% faster, and has almost equal strength to gyroid.

Overview

All the infill patterns we have gone through so far can be found on the line chart below, showing how they are placed on the speed–strength continuum.



Insulation and waterproof parts: Cubic

If you want parts that hold in heat or keep liquids out, cubic is a solid choice. Because it creates a 3D pattern consisting of many small separated air-filled cubes, it traps air well, which improves insulation.

The fact that there are many small air-filled pockets also makes it more waterproof, as the water needs to travel through more barriers to get through the part. But please note that untreated 3d-prints are generally not completely waterproof, even with this infill.

Liquid-filled parts: Archimedean Chord

Archimediean Chord will make an infill that has one big continuous void that snakes through the model. That means you can drill a hole one place in the part, inject for example epoxy into the hole, and there will be a way for the epoxy to flow and fill the entire part!

It is in a way the opposite of cubic: instead of lots of small pockets of air, you get one long connected cavity. This can be very useful for creating resin-filled or sand-filled weighted parts.

100% infill parts: Concentric

Concentric is usually the best infill pattern when you print parts with 100% infill. Most people use rectilinear when printing with 100% infill, but concentric will have more strength in 90% of the cases. That is because the filament direction follows the shape of your part, creating layers that are aligned with the geometry itself.

This reduces internal stress concentrations and gives excellent adhesion between layers. It’s especially good for parts like pressure vessels, load-bearing pins, or anything where you want the maximum structural integrity at full infill.

Flexible Parts

Octagram spiral, Archimedean chords, concentric and Hilbert curve all work well for TPU parts that you want to be “really squishy”, because all of these patterns have plenty of flexibility for the infill to bend. They create either long arcs or spiral-like patterns that naturally deform instead of resisting movement. Depending on what you want, you should test these and see what works best for your design.

If you want a part that is flexible, but also somewhat tough and durable, like the sole of a shoe, use gyroid infill. It is isotropic, so it distributes loads in all directions while still providing bounce and cushioning. This makes it great for wearable applications or soft robotics parts where you need both resilience and flexibility.

Transparent Parts

Usually you will not be able to see the infill, but with transparent or semi-transparent filament, you will. In that case, the infill becomes part of the visual design. Hilbert curve, honeycomb, concentric and octagram spiral all make for cool-looking effects when the infill is slightly visible.

Honeycomb gives a classic beehive look, concentric creates ripple-like rings, Hilbert curve looks like a digital maze, and octagram spiral gives a hypnotic geometric pattern. If you are printing lampshades, decorative vases, or transparent enclosures, experimenting with these patterns can add an extra layer of aesthetic value to your part.

P.S.

I hope you enjoyed the guide! It was manually written, because for things like this the AIs often yap a lot without cutting through the noise and actually showing the unique quirk of each thing. So it took a while to make, hopefully you found it useful <3

Since you downloaded this, you’re probably somewhat interested in 3d-printing and engineering and DIY projects and whatnot.

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