

Gyroid Fin Infill Pattern

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12/04/2019

This infill is often found at a microscopic-level in butterfly wings. Its elastic strength is omnidirectional and uniform. The target weight for a carbon-fibre based part (according to OpenRocket) is 176.5g. For titanium and aluminium, this is 447g and 268g respectively.

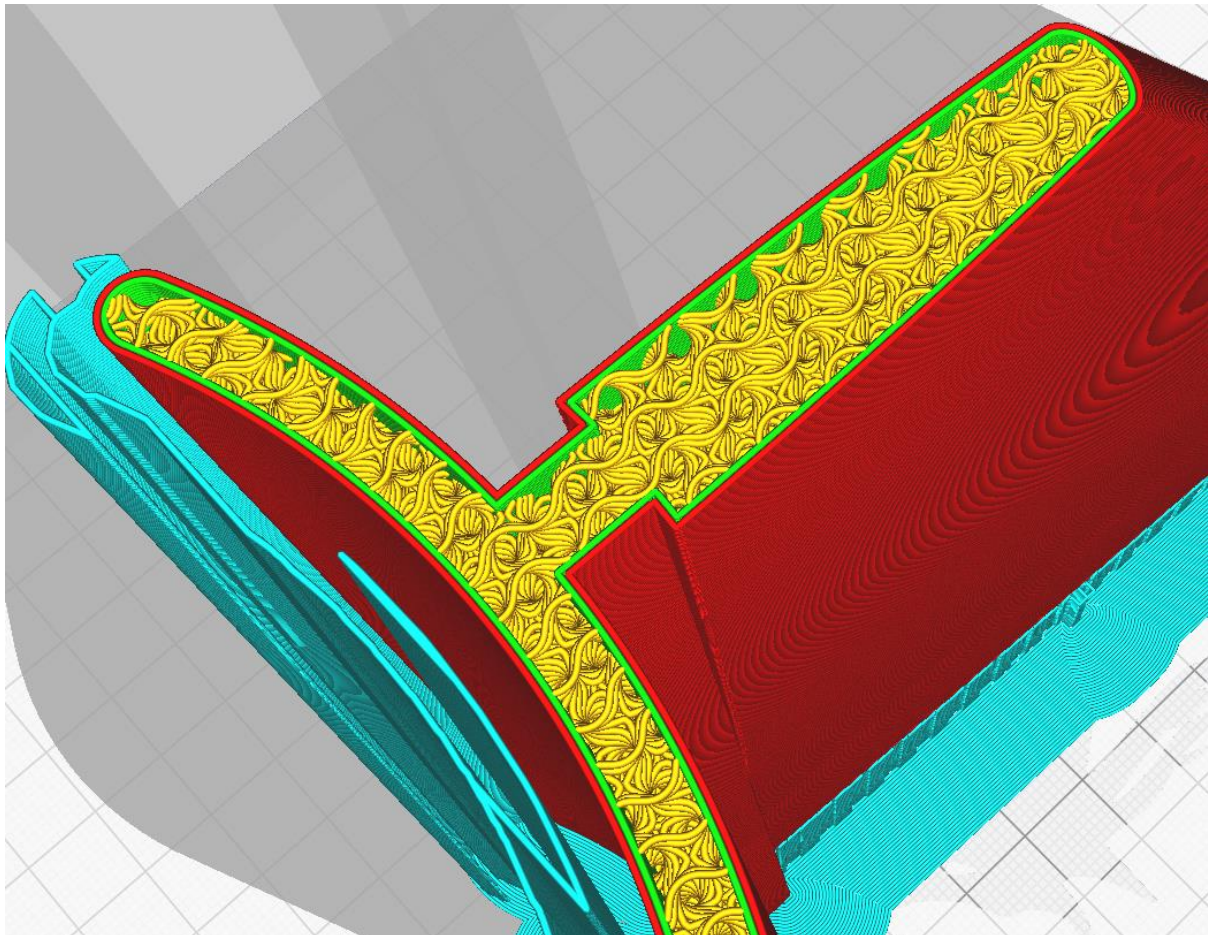


Figure 1 | 20% Gyroid Infill Pattern with Shell

Infill Type	Infill Density	Theoretical Tensile Strength Reduction	PLA Weight (1.25g/cm ³)	Equivalent Titanium Weight (4.52g/cm ³)	Equivalent Aluminium Weight (2.7g/cm ³)
Gyroid	20%	25%	80g	289.28g	172.8g
Gyroid - Skeleton	20%	?	39g	141.02g	84.24g
Solid	100%	0%	204g	737.6g	440.64g

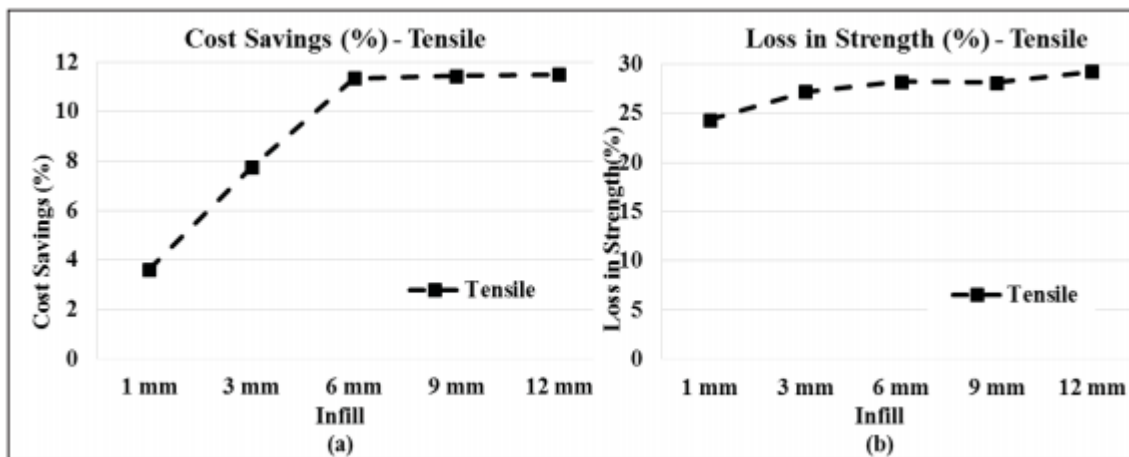


Figure 2 | Cost Savings and Strength Loss for different infill line distances (air gaps) (Baich, 2016)

The theoretical tensile strength reduction is 25% for a 20% infill, resulting in a 2mm line distance for the fins. This reduces cost by ~6% whilst resulting in a 25% loss of tensile strength. Printing with a shell thickness (wall) of zero results in a skeleton, which can be reinforced by wrapping with carbon fibre.

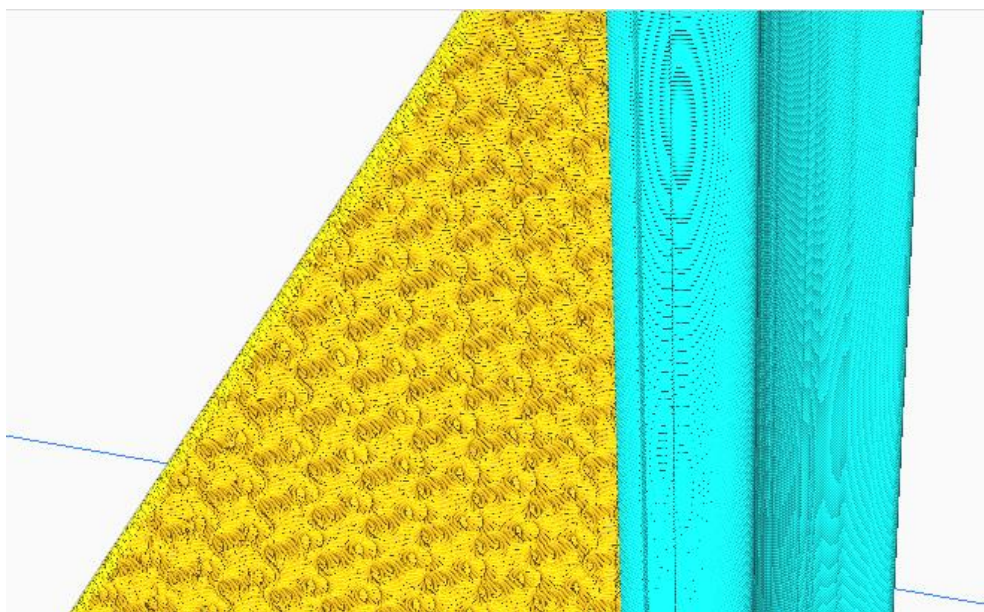


Figure 3 | 20% Gyroid Infill Skeleton (no-shell)

Printing the fin in solid titanium or aluminium with a shell will be acceptable to meet the requirements of the model. Both a gyroid aluminium infill with shell or titanium skeleton wrapped with carbon fibre will thus likely have the equivalent weight of setting the material to Carbon Fibre in OpenRocket.

References

- Baich, L. (2016). *Impact of Infill Design on Mechanical Strength and Production Cost in*. YOUNGSTOWN STATE UNIVERSITY.
- Tyson, E. (2019, April). *How to Use 3D Print Infill Settings - Increase Strength, Save Filament*. Retrieved from Rigid.ink: <https://rigid.ink/blogs/news/optimum-infill>