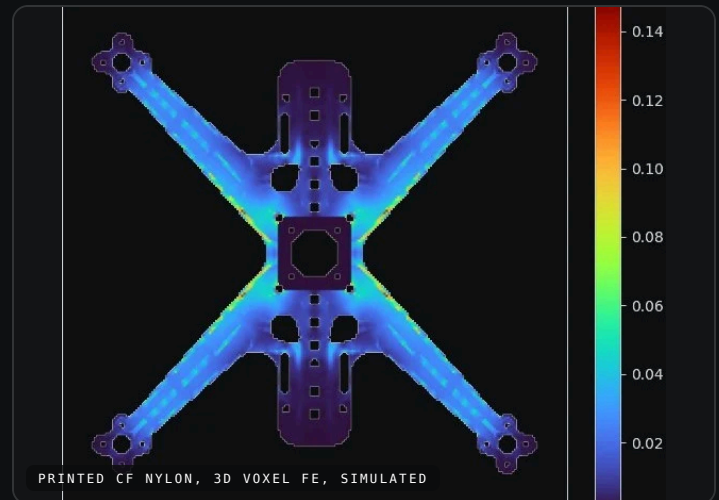


— FEA // TOPOLOGY OPTIMIZATION // COMPOSITES

Lighter by simulation, not by guesswork.

A client wanted the lower frame of their multirotor as one carbon fiber plate, as light as it could be. I built the load cases from how it flies, let topology optimization find the load paths, and checked every revision in a plate FE model validated against hand calculations first. Then I designed a printed version to compete with it.



// CARBON PLATE, WEAVE ALONG THE ARMS

Revision	Mass	Tip	Mode	SF
Rev 3, traced solid	92g	0.80mm	110Hz	16
Rev 4, skeleton	63 g	2.00mm	71 Hz	5
Rev 5, uniform trellis	65 g	2.42mm	64 Hz	4
Rev 6, load-path trellis	72g	1.09 mm	95 Hz	13

// FINDINGS

- Stiffness sets the design, not strength. Strength safety factors ran 4 to 16
- Rev 6 keeps the arms solid near the root and opens the low-load body. About 2x stiffer than the skeleton for about 9g.
- Cutting the blank with the weave along the arms roughly doubles stiffness on every version.
- A ribbed printed CF nylon version comes out about 20 percent stiffer than the carbon plate at about the same weight.



Got a part that is heavier than it needs to be?

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[READ THE CASE STUDY](#)

PROCESS

Load cases in, only the useful material out.

① Trace and clean up

The original scan traced, de-skewed and mirror-averaged into a clean outline with every mounting hole kept exactly.

② Load cases and clamp

Per-motor thrust, roll twist and battery inertia, plate clamped over the flight stack. Tip mass for the motor and prop in the vibration check.

③ Plate FE

Orthotropic Mindlin plate model on a 1 mm grid for woven carbon. Checked against a cantilever hand calc within 2 percent.

④ Topology optimization

SIMP optimization across all three cases set the trellis layout. A uniform rib pattern proved the floppiest option.

⑤ Printed alternative

Ribbed CF nylon version in 3D voxel FE with quarter symmetry, checked against beam calcs within 3 percent. Prints flat, no supports.

⑥ Handoff with findings

STEP, DXF and a one-page load check per revision, the weave orientation call and the open items before a flight test.

// PRINTED VERSION, SAME LOAD CASES

Version	Mass	Tip	Mode	SF
Rev 6 carbon, weave along arms	72g	1.09 mm	95 Hz	13
Rev 6 carbon, weave square	72g	2.67 mm	61 Hz	5
Printed CF nylon, ribbed	about 73 g	about 0.9 mm	about 105 Hz	about 7

Material properties are typical published values and the printed nylon datasheet, not tested. Crash loads and in-plane knocks were out of scope.

// WHAT THIS MEANS FOR YOUR PART

Lightweighting

Brackets, plates, arms and housings. Real load cases, topology optimization and an FE check on every revision, with the model validated before you see a number.

Composites and printed parts

Weave orientation on a cut plate, rib direction on a print, layer lines in a crash. The handoff tells your cutter or your printer what matters.

What you get

Native CAD, STEP, DXF and a load check per revision. One round of revisions included. NDA first if you want one.

Send me the CAD and what it has to survive.

Reply within 2 business days



START A PROJECT