KBD

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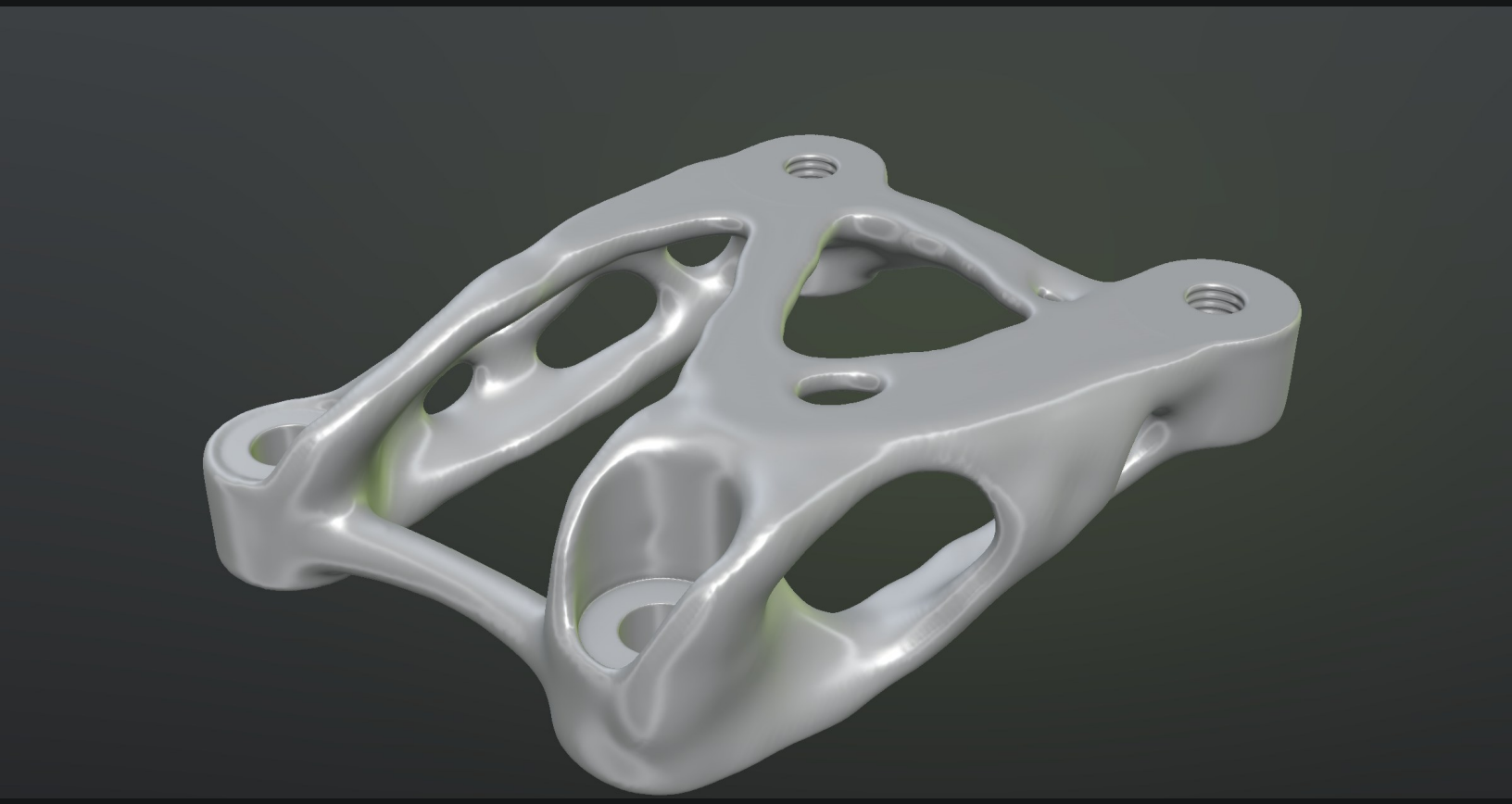


ENGINEERING CASE STUDY // DESIGN FOR METAL ADDITIVE

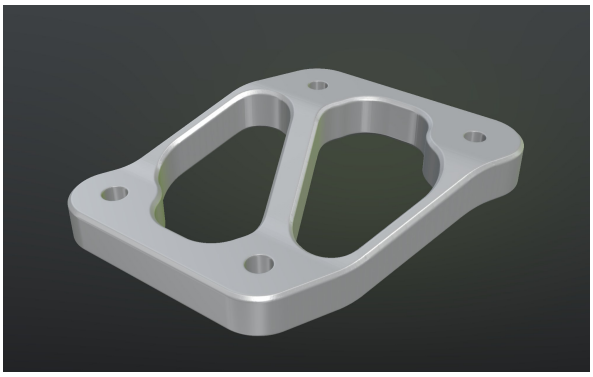
From a billet bracket to a part built for 3D printed metal.

Passenger peg extension brackets for a motorcycle riding school's Yamaha MT-10 fleet. The CNC version was quoted first. This is the redesign for metal printing, from topology optimization to a clean, production-ready solid.

THE ASK

A fleet bracket, and a better question.

A motorcycle riding school runs a fleet of Yamaha MT-10s and needed passenger peg extension brackets, left and right. They supplied STEP models and a drawing for a pocketed 6061-T6 billet part. I quoted the CNC batch through my sourcing partner.
Then they asked what the part would look like if it was designed for 3D printed metal instead, with the M8 holes tapped by hand after printing.



The customer design, rendered from their STEP file.

FIXED BY THE BIKE

What could not change

Interface	Requirement
Bike mounts	2x Ø.35 in (8.9 mm) thru at the original pattern, flat face at z = 0
Peg bracket mounts	2x M8x1.25-6H at the original pattern, flat face at z = 35
Envelope	Same footprint. Thicker at the mounts is fine, thin in the middle
Mirror pair	Left and right hand parts from one design
Load	5 kN track and abuse load, 40 mm outboard of the peg face

APPROACH

How the shape was found

1. **Design space**
   Expanded the allowed volume to the full 35 mm depth, kept clear of the bike side except at the mount end.

2. **Topology optimization**
   SIMP optimization on three load cases: 5 kN fore-aft, 5 kN vertical, 2 kN lateral. Minimum member size 4 mm.

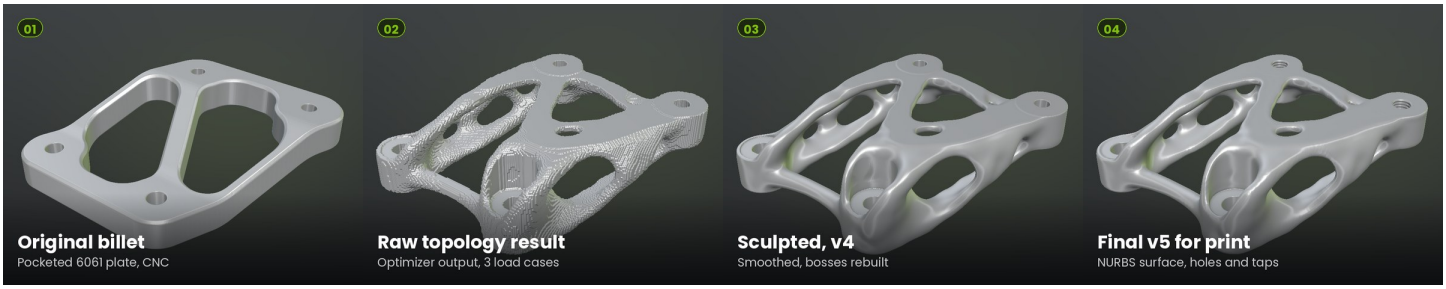
3. **Reinforce and trim**
   Re-ran FEA every iteration. Thickened only where stress peaked, trimmed spurs carrying almost nothing.

4. **Sculpt**
   Smoothed the raw voxel result into a continuous surface, rebuilt the bosses as true cylinders with 2 mm blends.

5. **Clean solid**
   Converted to a quad cage and a T-spline in Fusion, exported as a smooth NURBS solid, finished in Inventor.

EVOLUTION

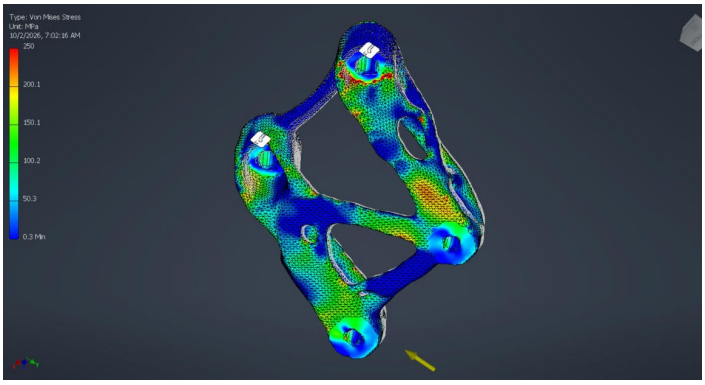
Four steps from billet to print-ready.



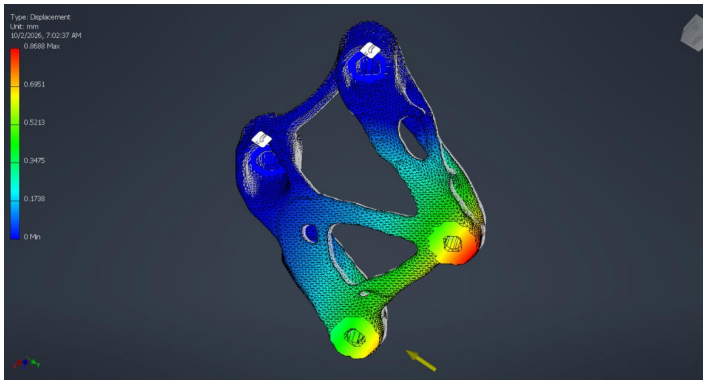
01 Original billet // 02 Raw topology result // 03 Sculpted v4 // 04 Final v5, smooth NURBS solid with machined features

VALIDATION

Checked in FEA, twice.



Autodesk Inventor Stress Analysis, von Mises, 5 kN remote load. Sculpted v4 shape.



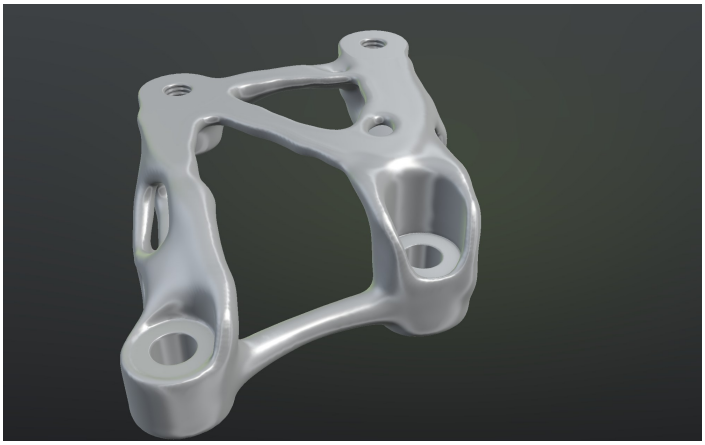
Displacement at 5 kN. Max 0.87 mm at the peg mount.

At 5 kN, 40 mm outboard	Original billet (6061)	Printed design (AlSi10Mg)
Mass	about 194 g	about 134 g
Deflection at the peg mount	-	0.7 to 0.9 mm
Peak stress (99.9th percentile)	-	about 230 MPa
Working load at 1.5 safety factor	-	about 2.9 kN

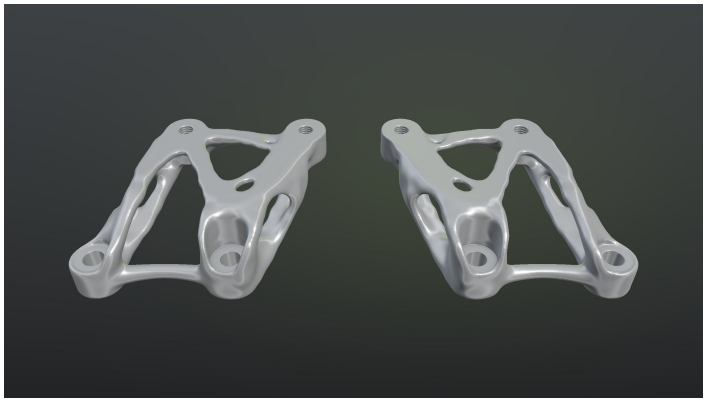
Billet mass is from the customer STEP. Design-loop numbers come from a voxel FEA used during the design. Inventor numbers are from a separate tetrahedral model of the sculpted shape. Static loads only. The full 5 kN with margin calls for Ti-6Al-4V from the same file, or a proof load test before release.

DESIGN FOR ADDITIVE

Built for the printer and for the shop after.



Open pocket over the rear bolt head keeps the stock bolt length.



Left and right hand parts, mirrored from one model.

Self-supporting truss
Members sweep at angles that print with minimal support when the part stands on its bike-mount end.

No trapped powder
Every opening is through. No enclosed cavities to clear.

Machining stock
Mating faces carry about 0.25 mm of stock so they are faced flat and to height after printing.

Holes finished after print
Bike mounts drilled to Ø9 (Ø.35 in per the drawing). M8 peg mounts printed undersize, drilled Ø6.8 and tapped M8x1.25-6H, 15 mm deep.

Open bolt pocket
The rear boss is scooped open over the bolt head instead of a deep counterbore, saving material and tool access.

Post-process
Stress relieve on the plate, remove supports, bead blast. HIP or T6 for better fatigue life.

PRODUCTION

From design to a quote.

The final solid, print orientation, finishing steps and a material recommendation went into a production quote for printed metal, alongside the CNC quote for the billet part. The customer gets to compare both on cost, weight and lead time with real numbers.

Have a part that should be lighter, stronger, or made differently?
Send the STEP and what it needs to do. kindofabigdill.com/quote