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BSc in Mechanical Engineering,
University of Lagos, Nigeria.

Expected graduation: 2028
(2029 with a 12-month placement)

TARGET ROLE

Engineering Intern: Design, FEA and CFD
(motorsport, automotive, motorcycles)

AVAILABILITY

Internship or placement year starting in April
2027. Open to relocation or remote.

TOOLS

SolidWorks (CSWA certified) · ANSYS
Mechanical & Fluent · PTC Creo · FEA, CFD,
DFM

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Lagos, Nigeria



198-part twin-cylinder motorcycle: modelled in SolidWorks, surfaces in Creo, analysed in ANSYS, redesigned where it failed, and planned for production.

-76% peak frame stress after a load-path redesign, rechecked with corrected loads (FoS 0.27 → 1.14)

1.74 output-shaft fatigue FoS; hand calc and FEA reactions within 3%

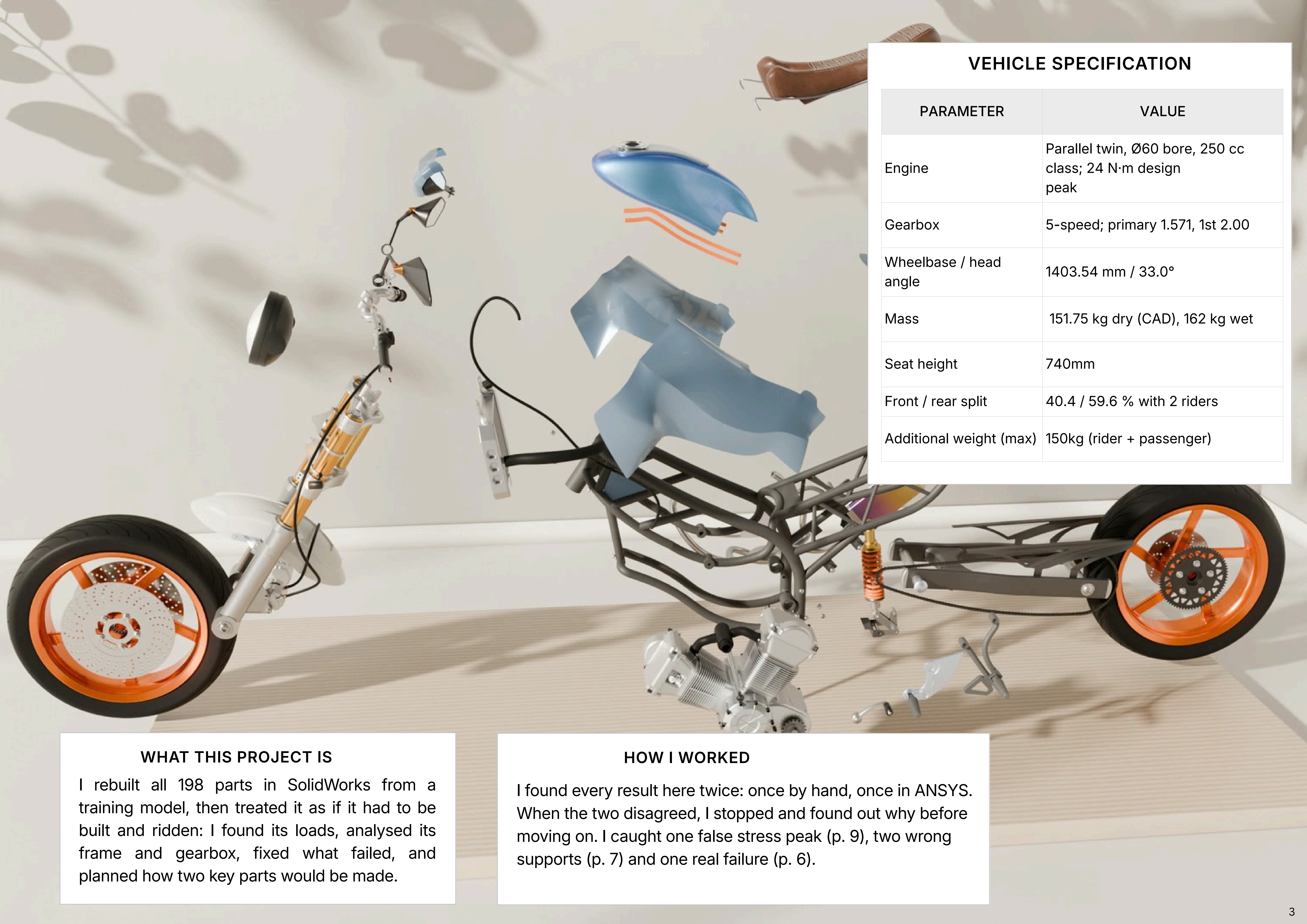
2 parts taken to a full manufacturing plan and drawing review

Contents

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[PLAY VIDEO](#)



VEHICLE SPECIFICATION

PARAMETER	VALUE
Engine	Parallel twin, Ø60 bore, 250 cc class; 24 N·m design peak
Gearbox	5-speed; primary 1.571, 1st 2.00
Wheelbase / head angle	1403.54 mm / 33.0°
Mass	151.75 kg dry (CAD), 162 kg wet
Seat height	740mm
Front / rear split	40.4 / 59.6 % with 2 riders
Additional weight (max)	150kg (rider + passenger)

WHAT THIS PROJECT IS

I rebuilt all 198 parts in SolidWorks from a training model, then treated it as if it had to be built and ridden: I found its loads, analysed its frame and gearbox, fixed what failed, and planned how two key parts would be made.

HOW I WORKED

I found every result here twice: once by hand, once in ANSYS. When the two disagreed, I stopped and found out why before moving on. I caught one false stress peak (p. 9), two wrong supports (p. 7) and one real failure (p. 6).

THE MODEL

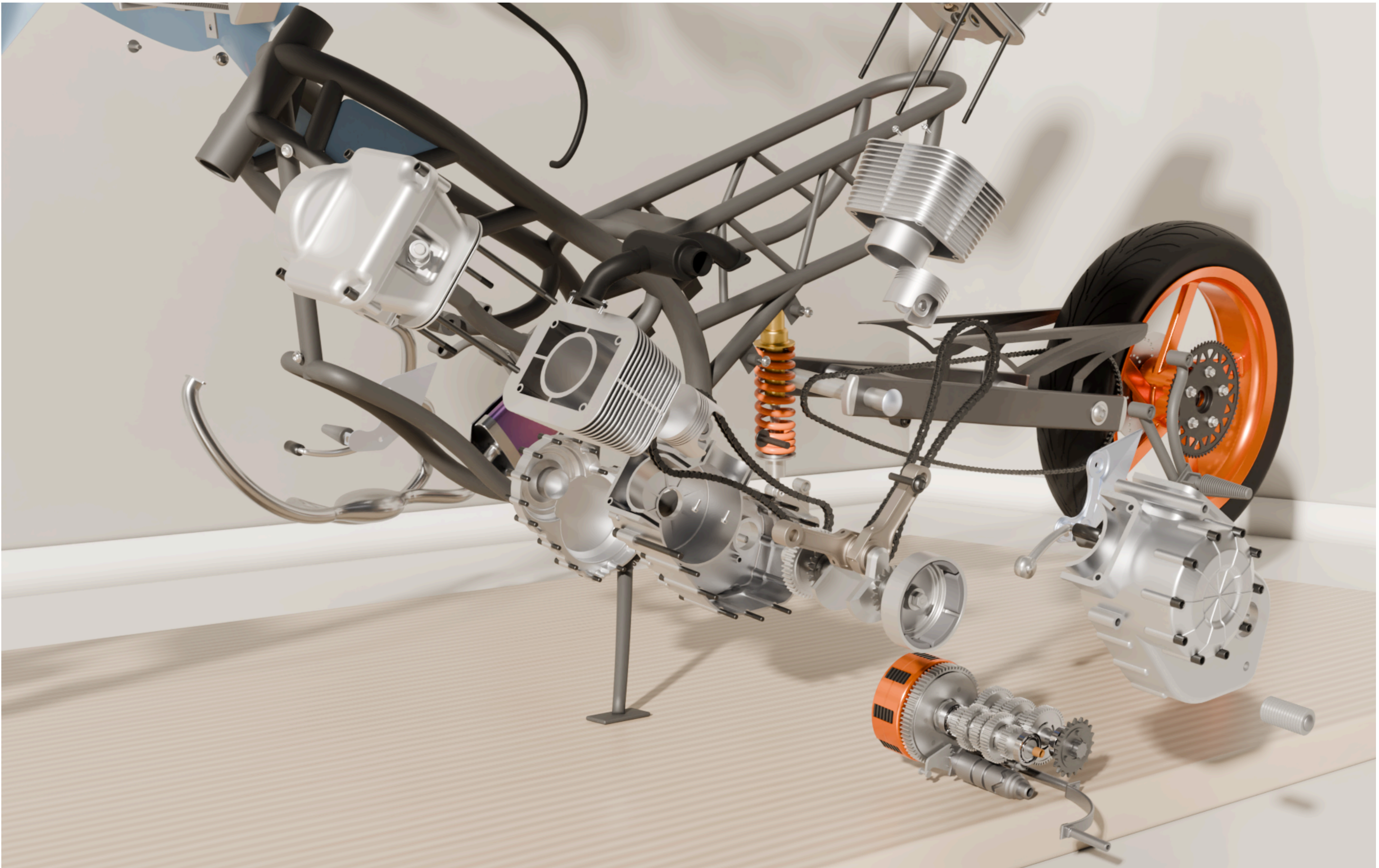


SIDE PROFILE

RENDERS



NIGHT VIEW

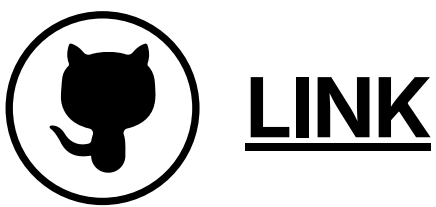


ENGINE EXPLODE



ENGINE ON

Loads and model: a 3 g bump with two riders



A: Static Structural
Static Structural
Time: 1. s
10/1/2026 11:13:50 PM

A

 Acceleration: 29430 mm/s²

B

 Point Mass

C

 Point Mass 2

D

 Point Mass 3

E

 Remote Force: 23215 N

F

 Remote Force 2: 22551 N

G

 Remote Force 3: 13457 N

H

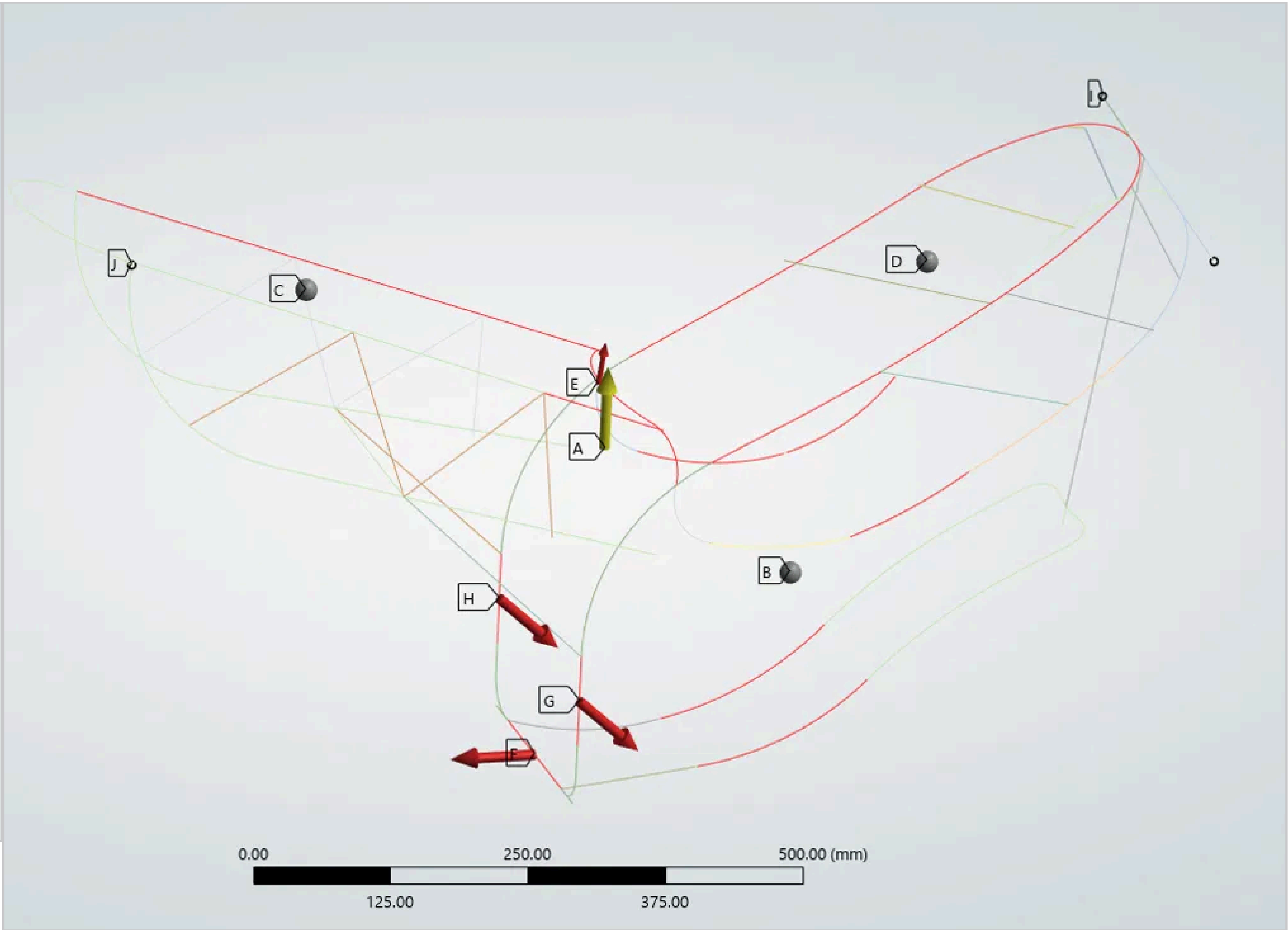
 Remote Force 4: 13457 N

I

 Displacement

J

 Displacement 2



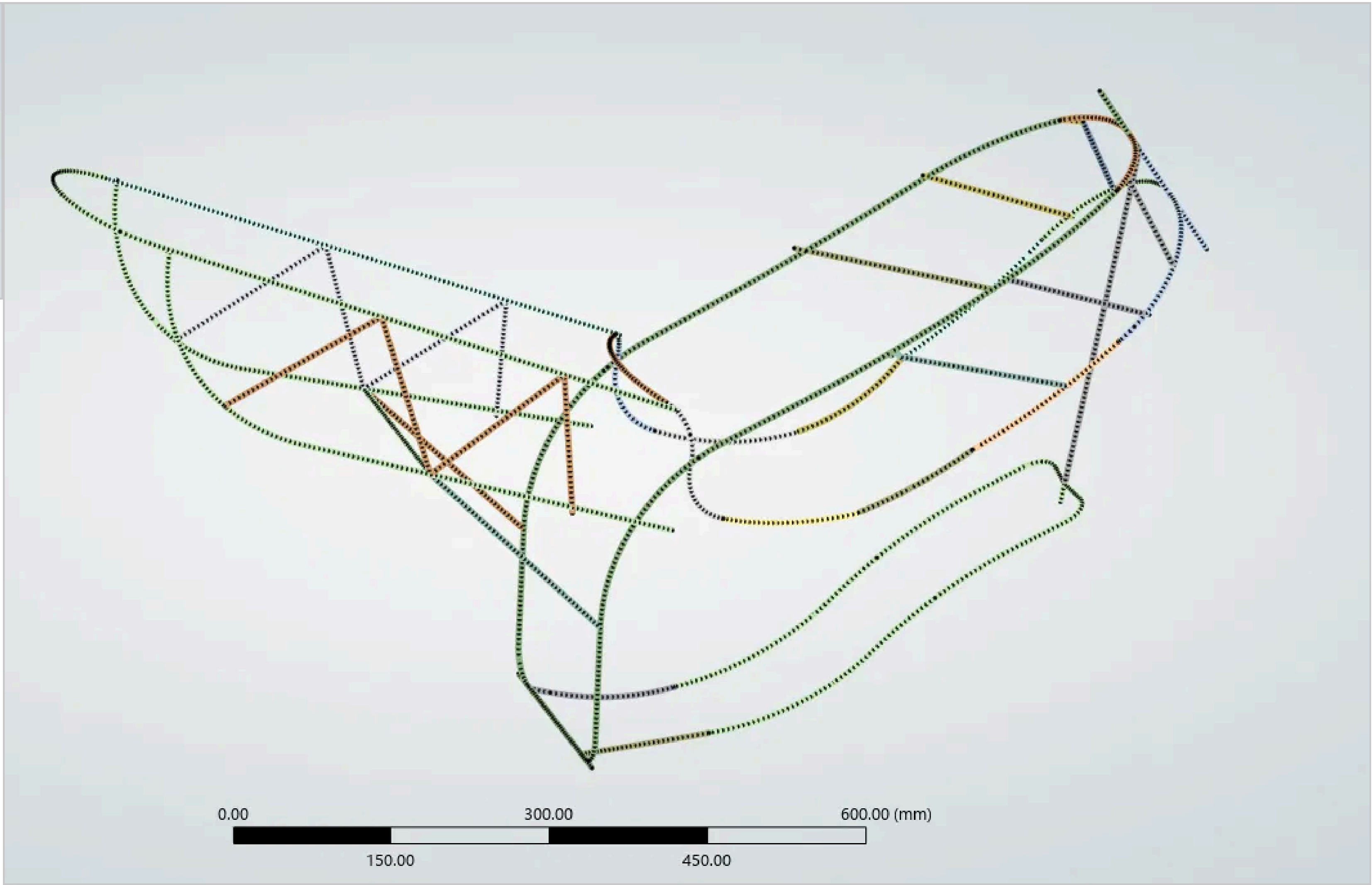
WHY 3 G AND TWO RIDERS

A hard bump briefly triples every weight on the bike. I stacked that on a rider and a passenger (312 kg in total) so the frame is sized for the worst day, not an average one.

LOADS GO WHERE PARTS BOLT ON

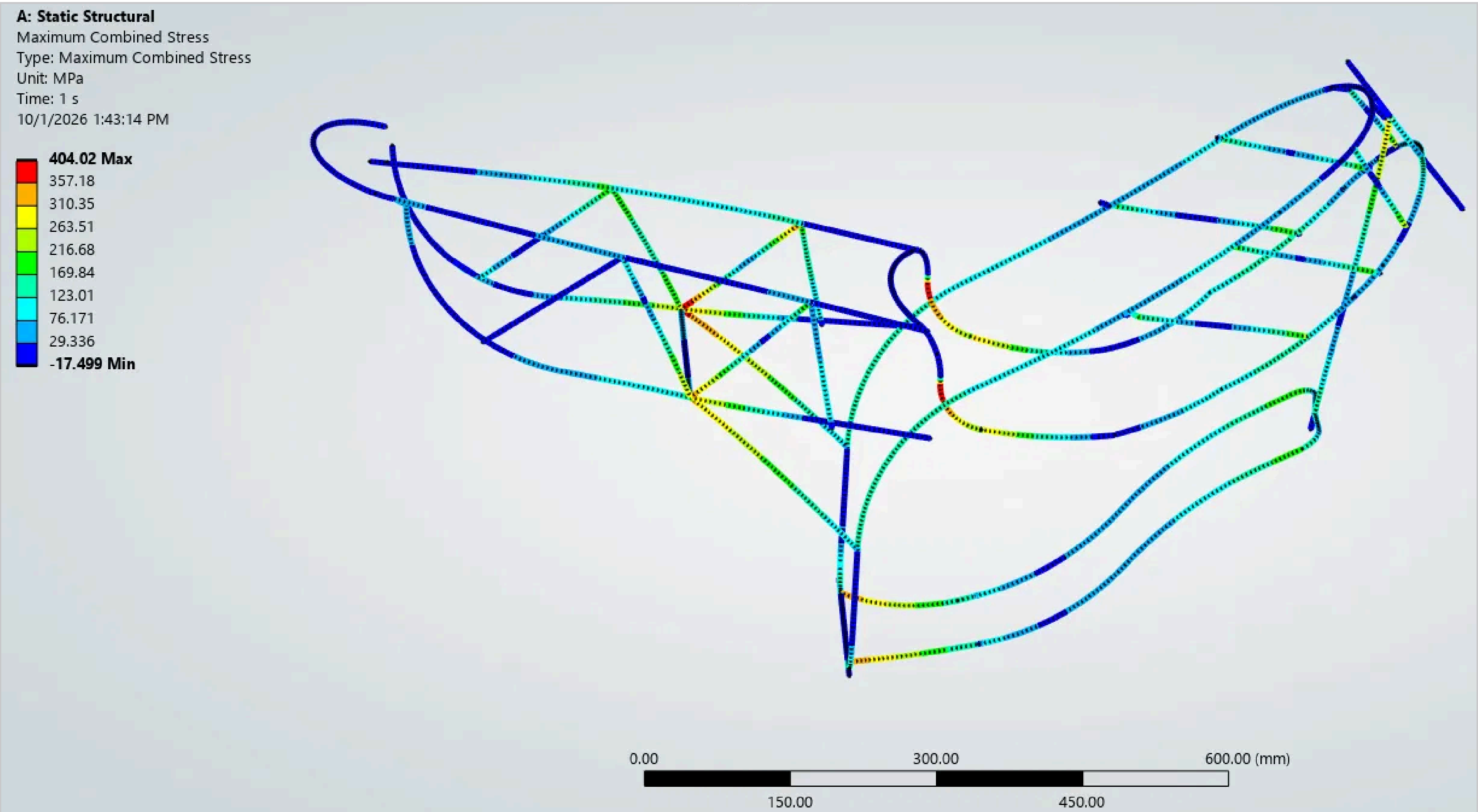
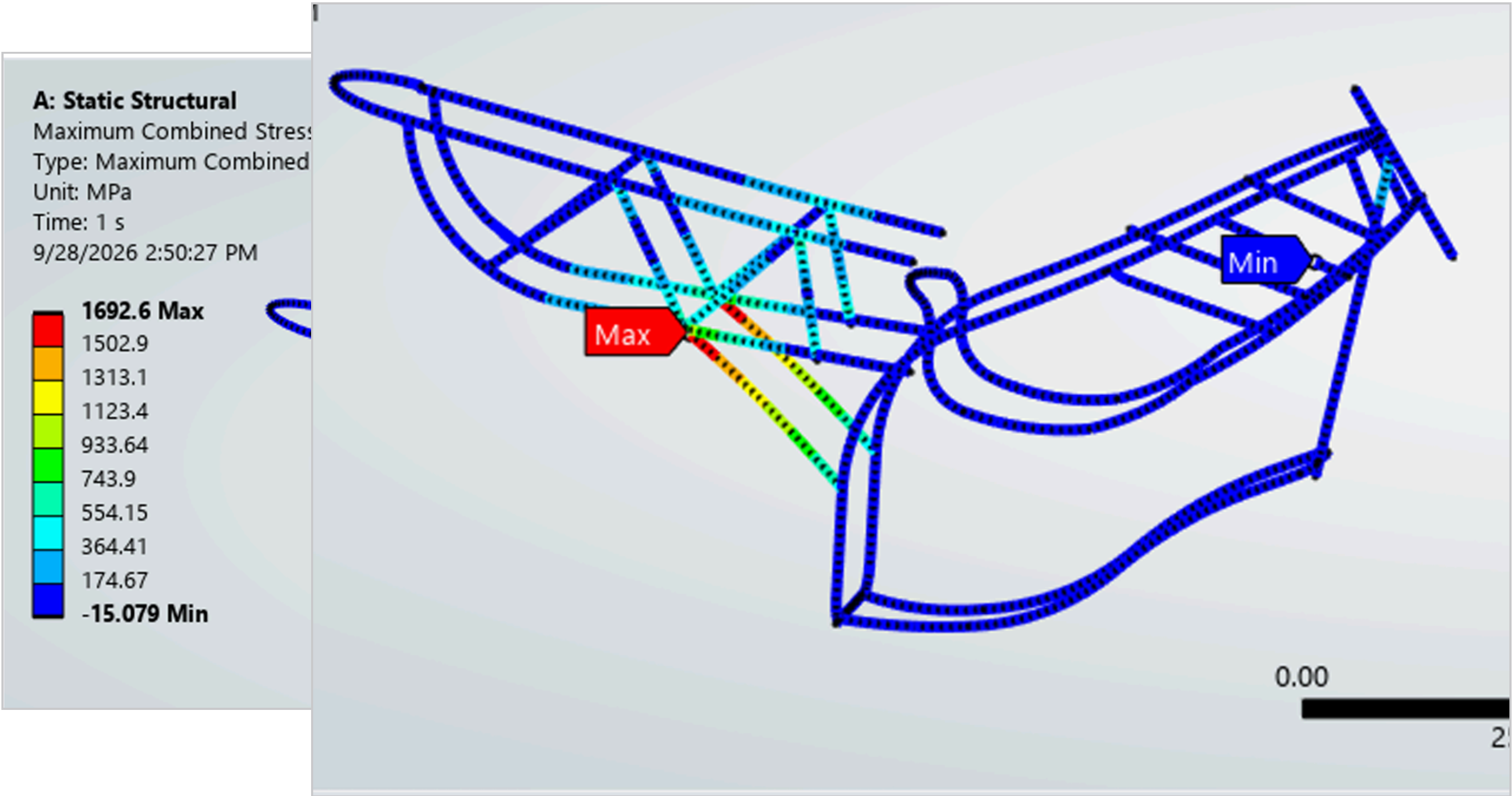
A frame only feels force through its mounts, so the engine went into its 4 mounts, the riders onto the seat rails, and the suspension forces onto the shock tab and linkage bracket, each solved by hand through the linkage.

Mesh
10/1/2026 11:10:14 PM



The rear wheel carries 5469.9 N at 3 g, but the shock pushes on the frame with 23215 N: 7.6× the weight of the whole loaded bike. I first used 17416 N from an assumed 159 mm lever arm; the swingarm study measured 119.28 mm, a 33% higher load.

Initial vs final: 1692.6 → 404.0 MPa



WHY IT FAILED

The shock pushes the frame up with 23 kN while the swingarm pivot, only 244 mm below, pulls it down. In the original frame that path ran through Ø12 solid bars loaded in bending. A Ø12 bar only needs the load to act 17 mm off its axis to reach 1692.6 MPa. Even standing still with two riders it sat at 564 MPa, above yield

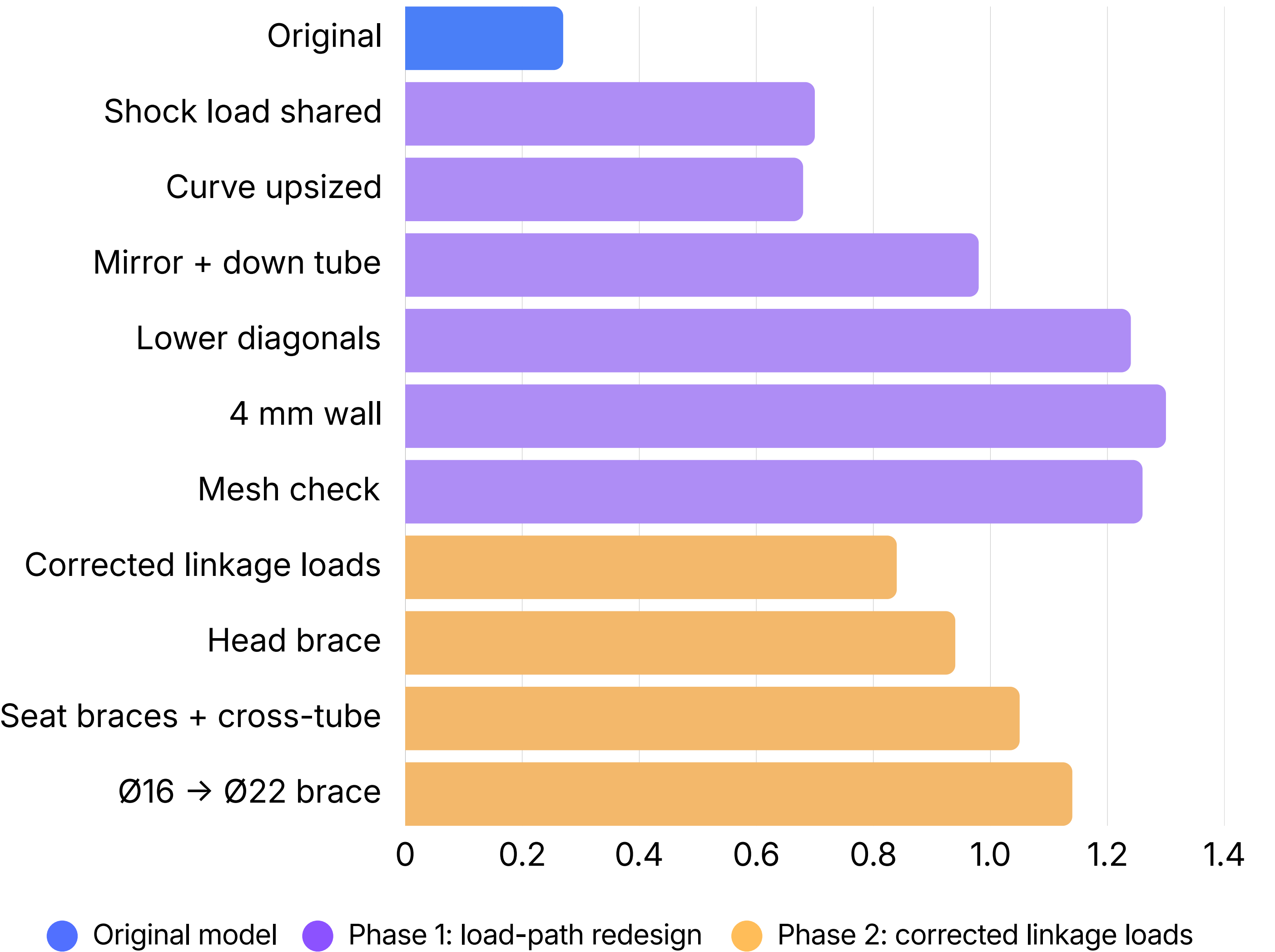
WHAT I CHANGED

FoS ≥ 1.1 in the worst case (3 g, two riders), frame mass under 21 kg. Material: AISI 4130, yield ≈ 460 MPa. Phase 1 moved the shock load off the Ø12 bars: shared the load, upsized the curved member, added a mirror + down tube and lower diagonals, 4 mm wall, mesh check. Phase 2, after correcting the linkage loads: head brace, seat braces + cross-tube; one brace Ø16 → Ø22.

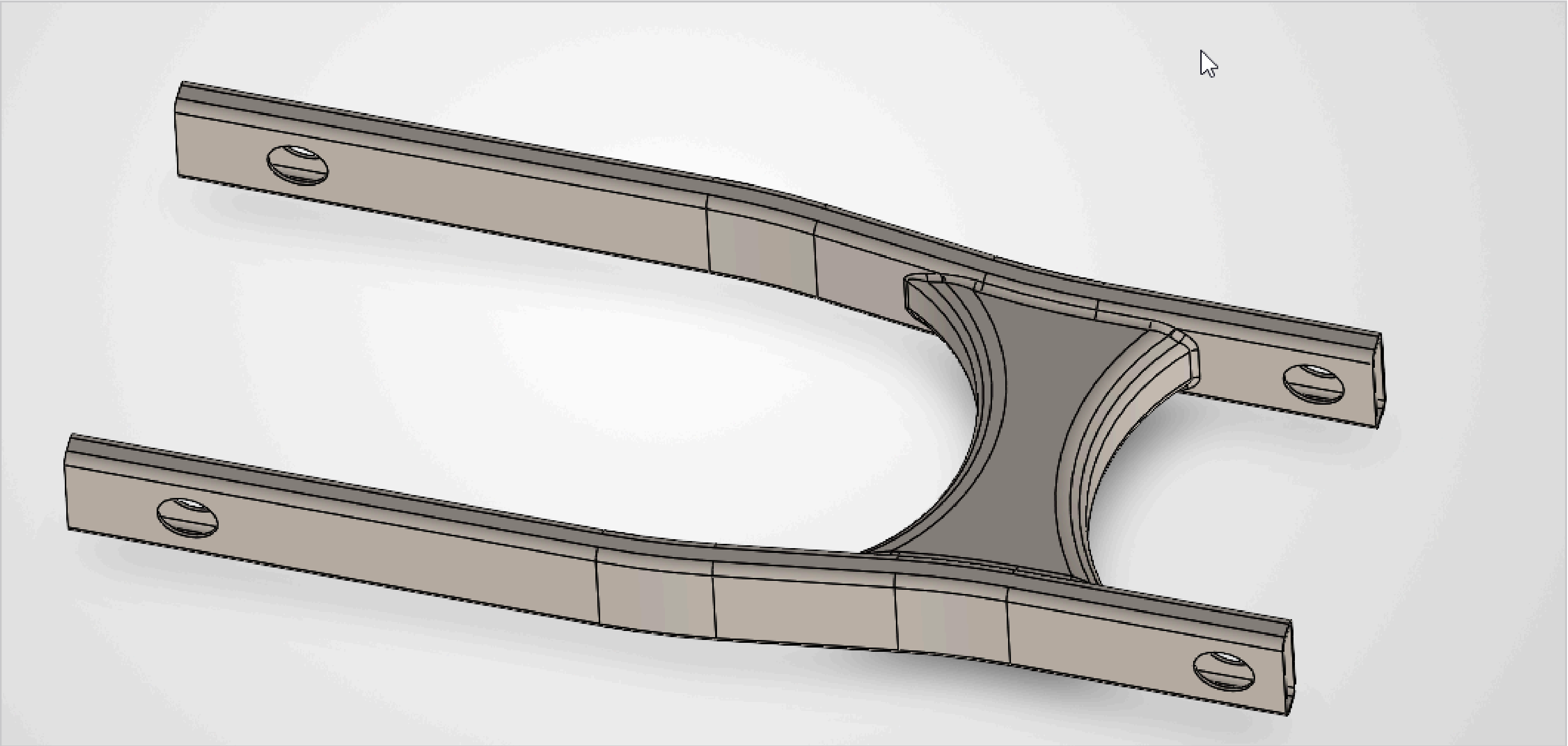
RESULT

FoS 0.27 → 1.14 in the worst case (3 g, two riders, corrected loads). Tail deflection 59.8 → 8.6 mm. Frame mass 18.1 → 20.5 kg (+13%) for 4.2× lower peak stress.

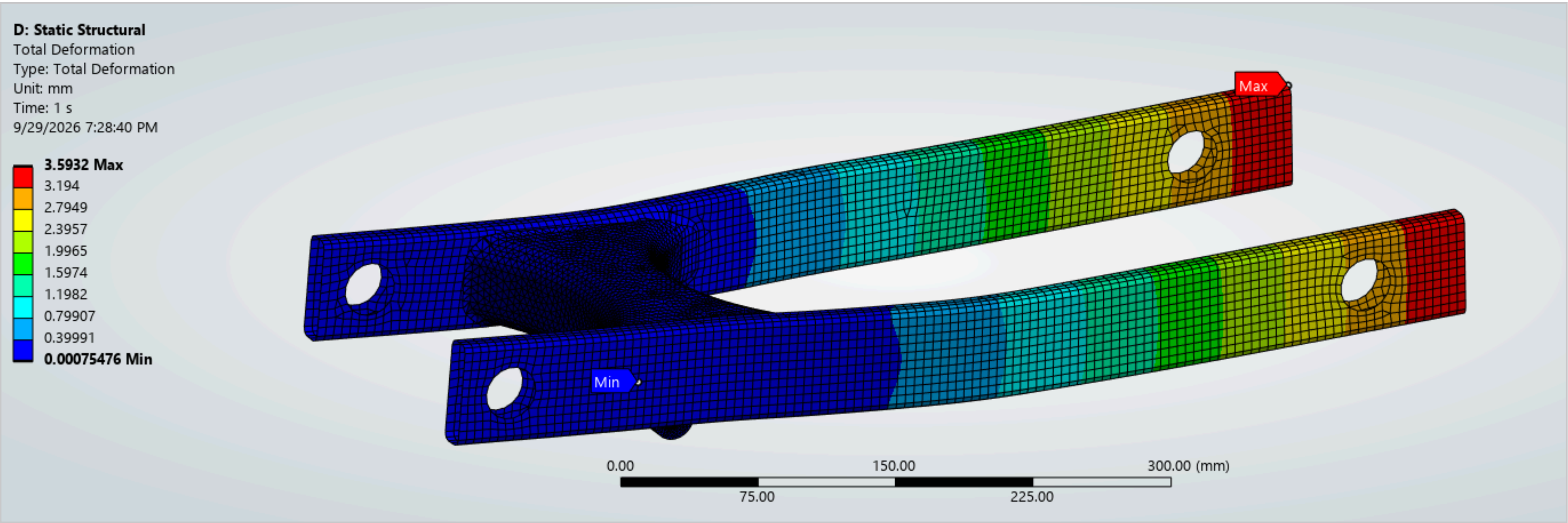
Peak stress per iteration. Phase 1 fixed the load path. The swingarm study then measured the link lever arm at 119.28 mm, not 159 mm: the link load rose 33%, the frame failed again (550.5 MPa), and four targeted changes adding about 1.4 kg restored FoS 1.14.



Validated baseline: the link carries 23,296 N, about a third above my assumption



Swingarm, AISI 4130 normalised, 7.659 kg. Two 18 × 60 × 2 mm box arms joined by a solid 50 mm crossmember that carries the shock-link lugs.



3 g bump, total deformation: 3.59 mm at the axle, ≈ 0 at the pivot. Vertical stiffness ≈ 1524 N/mm.

PARAMETER	VALUE
Arms	Mid-surface shells, 2 mm (thin wall → shells, not solid tets)
Block	Solid, bonded to the arms (MPC, 3 mm pinball)
Mesh	120484 nodes
Pivot	Pin on the Ø30 holes: free to rotate about the axle line
Link lug	Pin on the Ø14 holes: vertical reaction only
Load	3 g bump: 5469.9 N up at the axle, 508 mm from the pivot

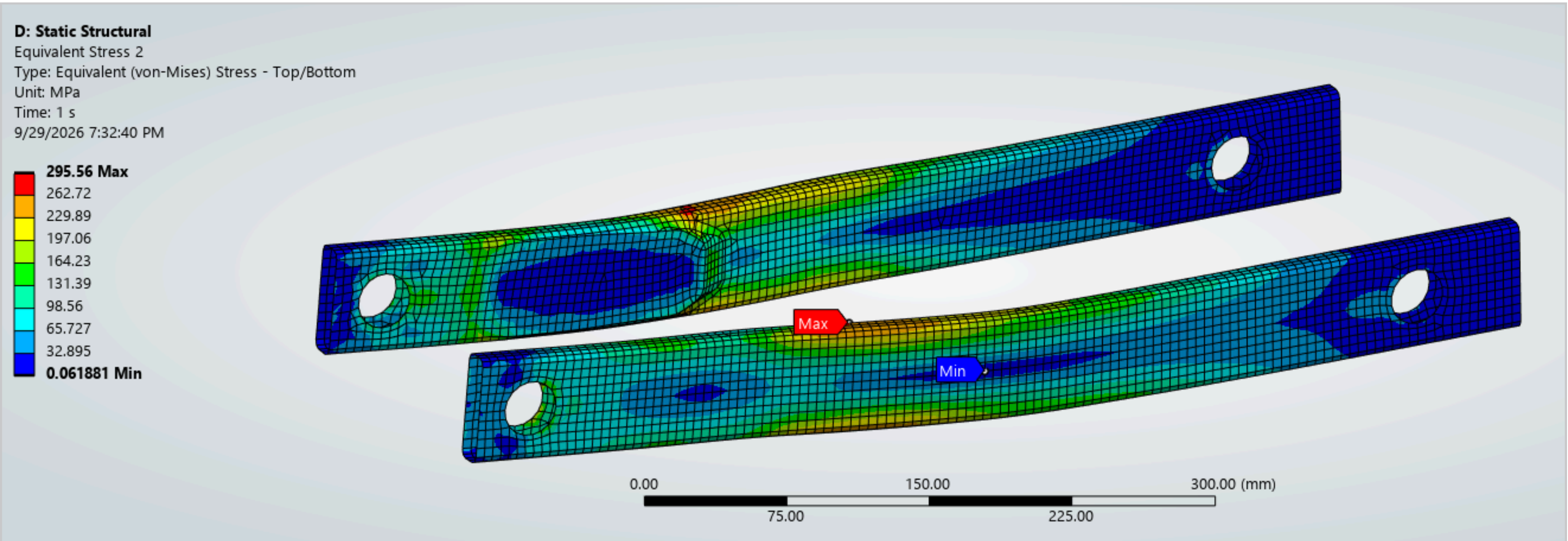
REACTION	HAND CALC	ANSYS
Shock link (lug)	23295 N	23296 N
Pivot	17825 N	17826 N
Moment at both pins	0	0

LESSON: TWO WRONG SUPPORTS FIRST

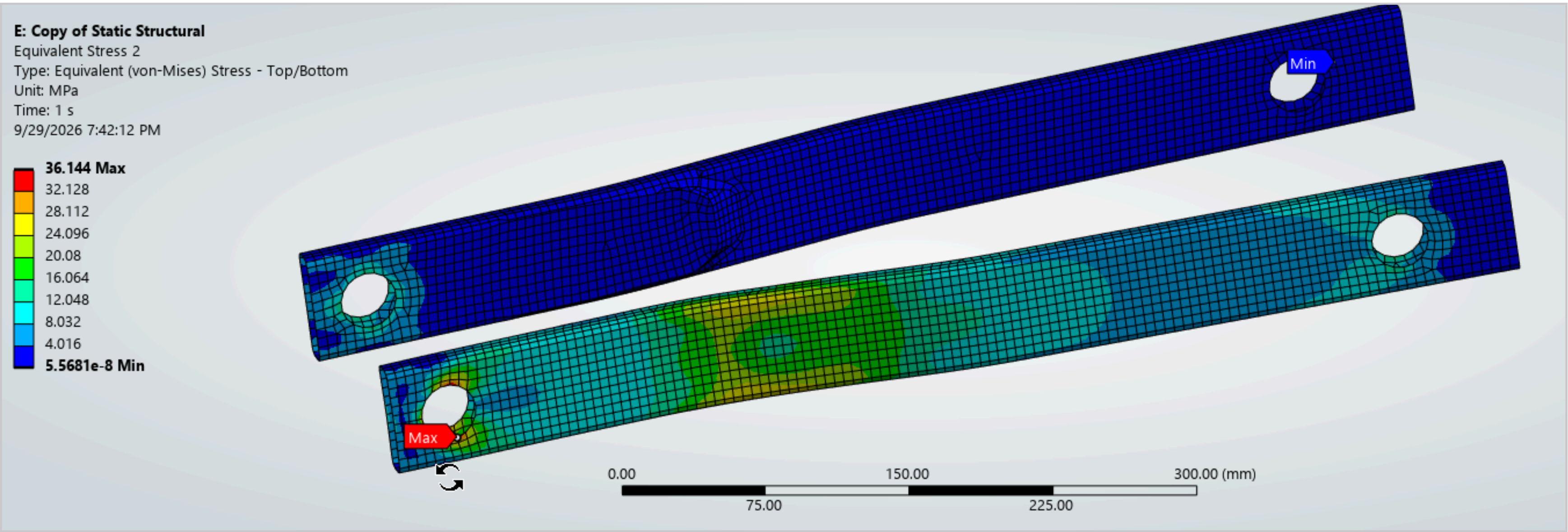
The first runs gave a 4.8 m deflection, then a link force of 18992 N against 23295 N by hand. Both were the supports, not the part: a free rotation with no restraint, then a lug held on every node, which clamped it and let it carry 513 N·m it physically can't.

The lug sits 119.28 mm from the pivot, not the 159 mm I assumed in the frame study, so the leverage is 4.26, not 3.2. The real link load is 33% higher. The frame was re-run with the corrected loads: it failed (550.5 MPa) and was fixed again (404.0 MPa, FoS 1.14)

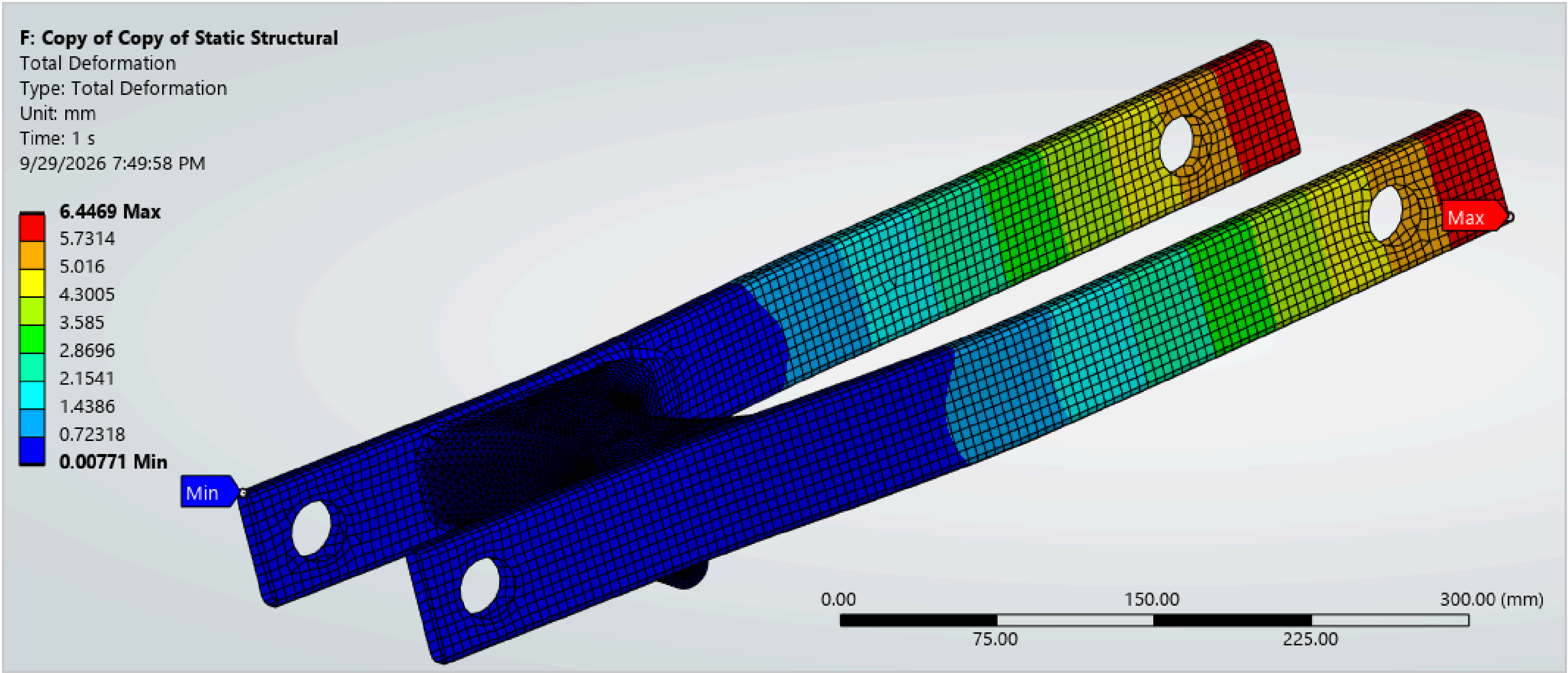
Four load cases



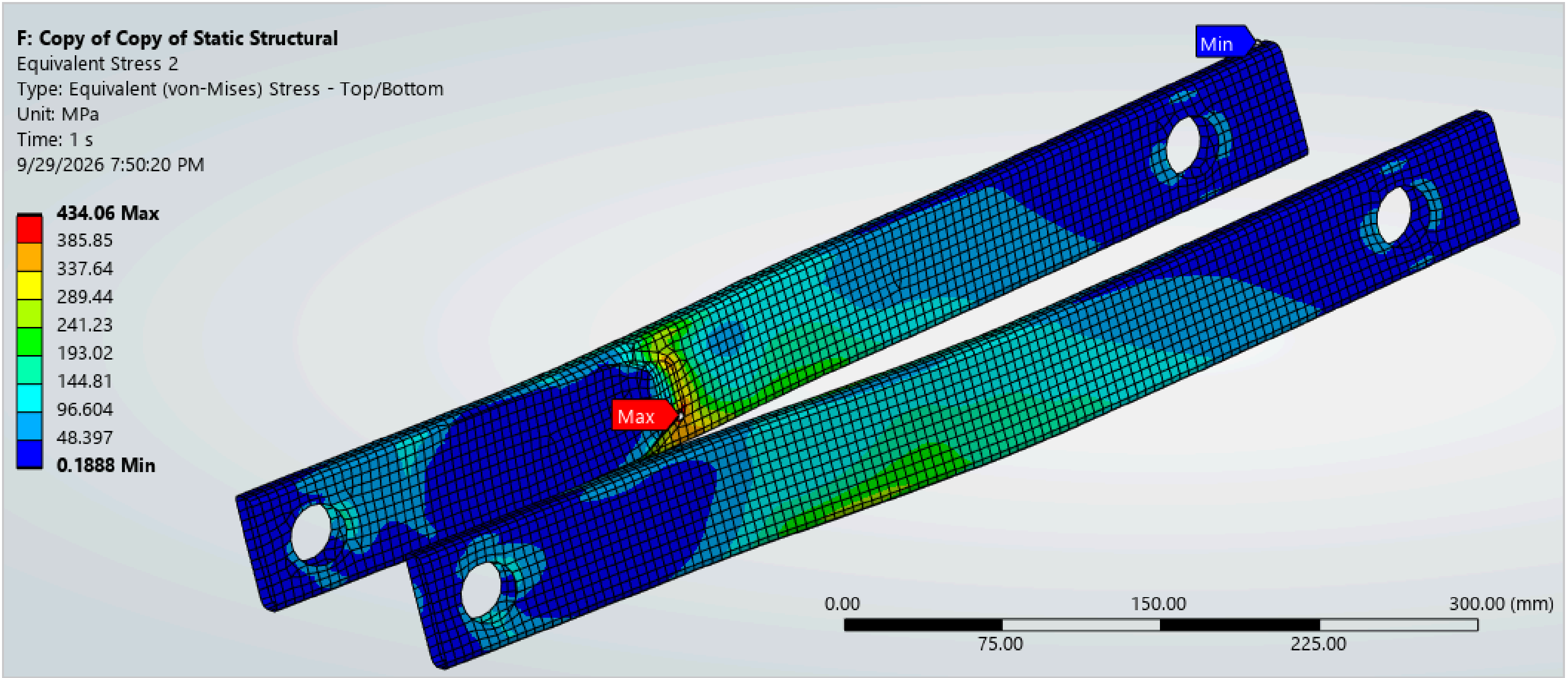
3 g bump: 295.6 MPa in the arm walls at the bend beside the block. Hand estimate 269 MPa (+10%).



Chain pull: 36.1 MPa at the chain-side pivot hole.



Lateral-envelope deformation: 6.45 mm at the axle, almost twice the bump case.



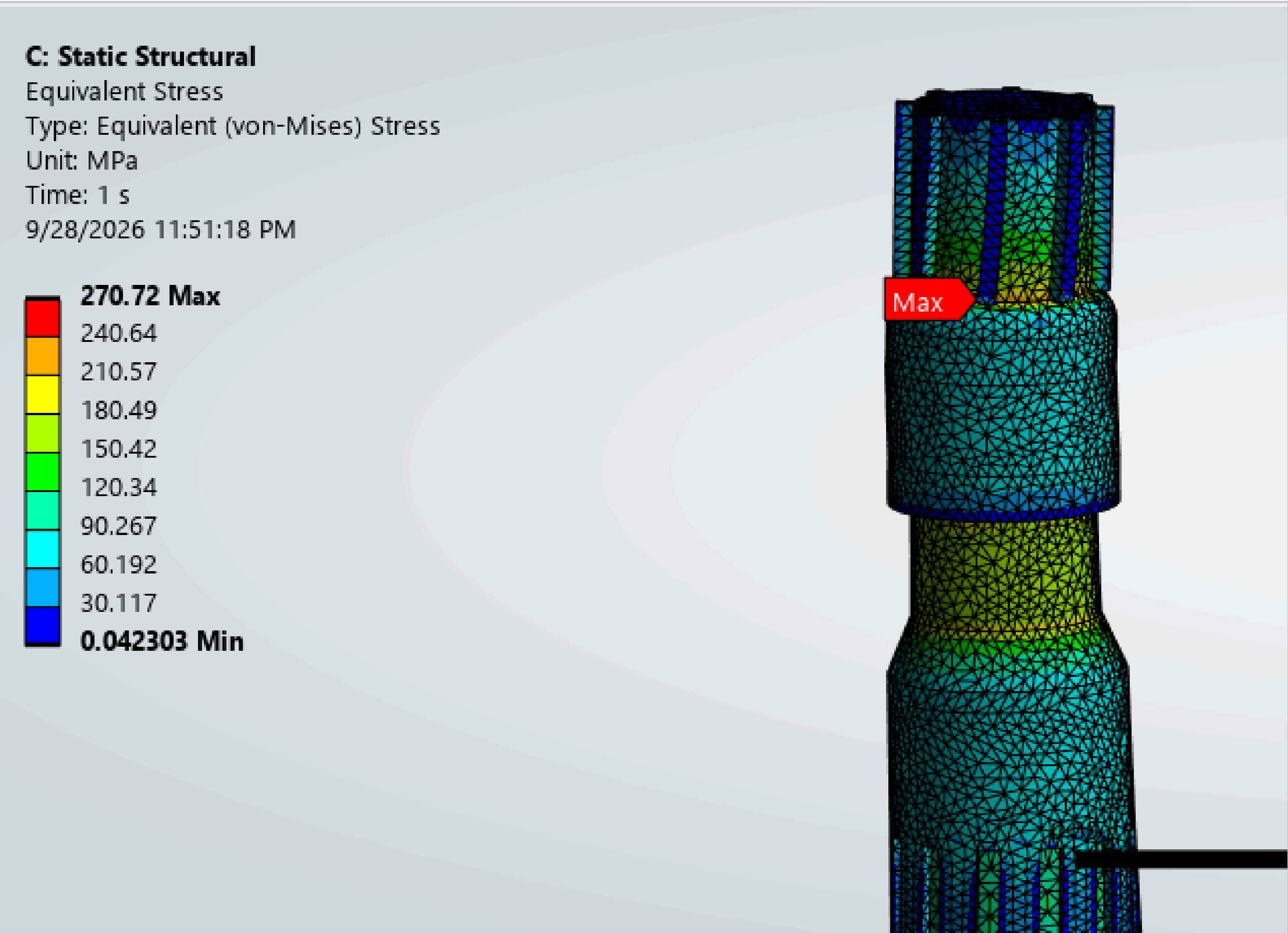
Lateral envelope: 434.1 MPa at the arm–block joint, FoS 1.06. The governing case.

READING IT

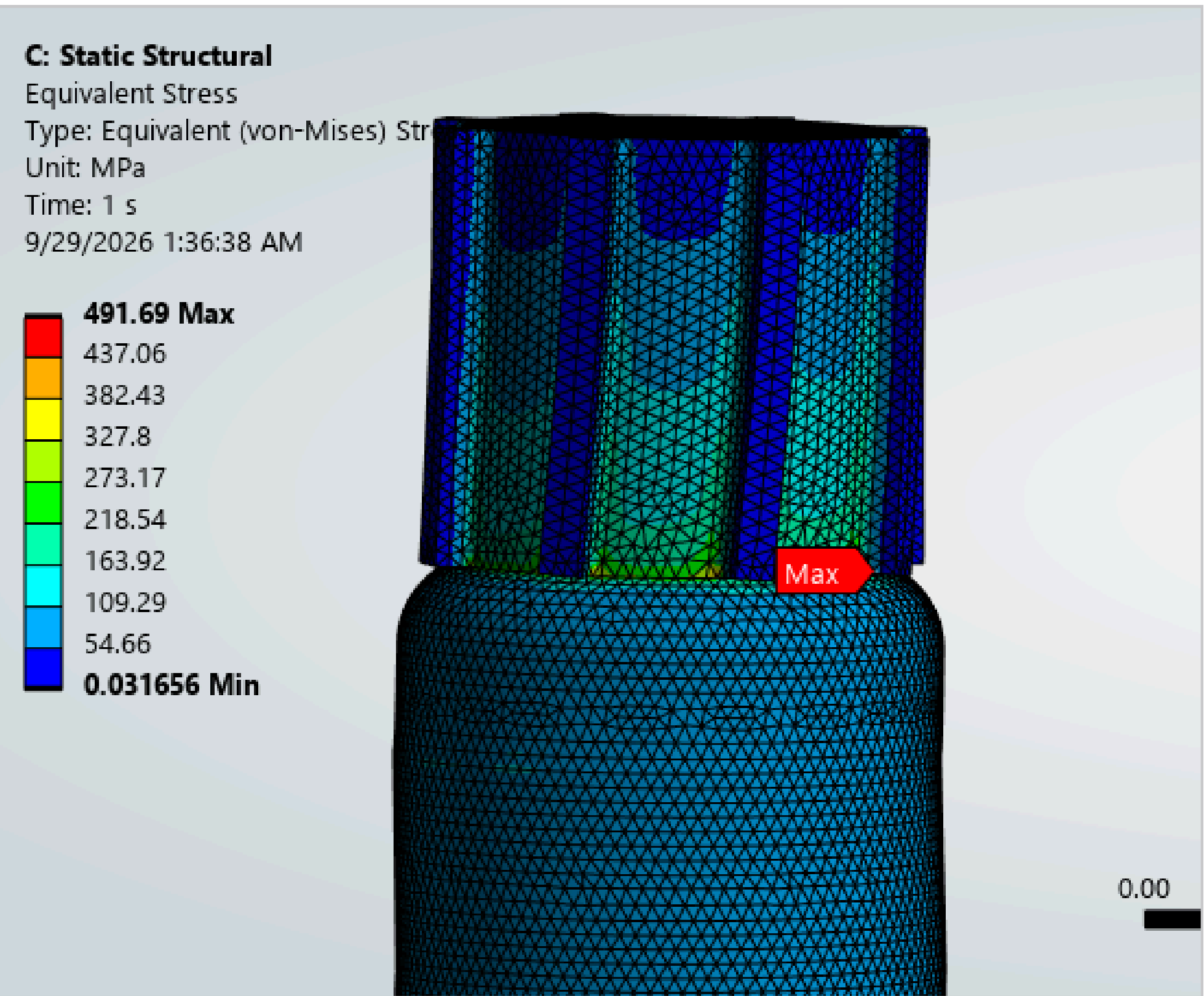
The arm is 60 mm tall but only 18 mm wide, so it is 7.3× stiffer (I 119115 vs 16355 mm⁴) and 2.2× stronger (Z 3970 vs 1817 mm³) up-and-down than sideways. A genuine sideways load (crossed-up landing, kerb strike, a sliding tyre suddenly gripping) finds that weak axis, and the crossmember joint adds a factor of about 1.6. I keep it as a conservative out-of-plane envelope; steady cornering itself is mild because the load stays in the bike's plane

LOAD CASE	PEAK STRESS	FOS	DEFLECTION
3 g vertical bump	295.6 MPa	1.56	3.59 mm
Chain pull 2218 N, one side	36.1 MPa	12.7	0.35 mm
Steady cornering, 45° lean: 1.41 g in the bike plane	139 MPa	3.3	1.7 mm
Lateral envelope: 1 g vertical + 1 g sideways	434.1 MPa	1.06	6.45 mm

The shaft passes; the teeth don't



Von Mises stress, 1st-gear case.



Rejected peak: spline-end corner rose 270.7 → 343.2 → 491.7 MPa with refinement. A singularity next to the loads, so it was checked by hand instead (FoS 3.4).



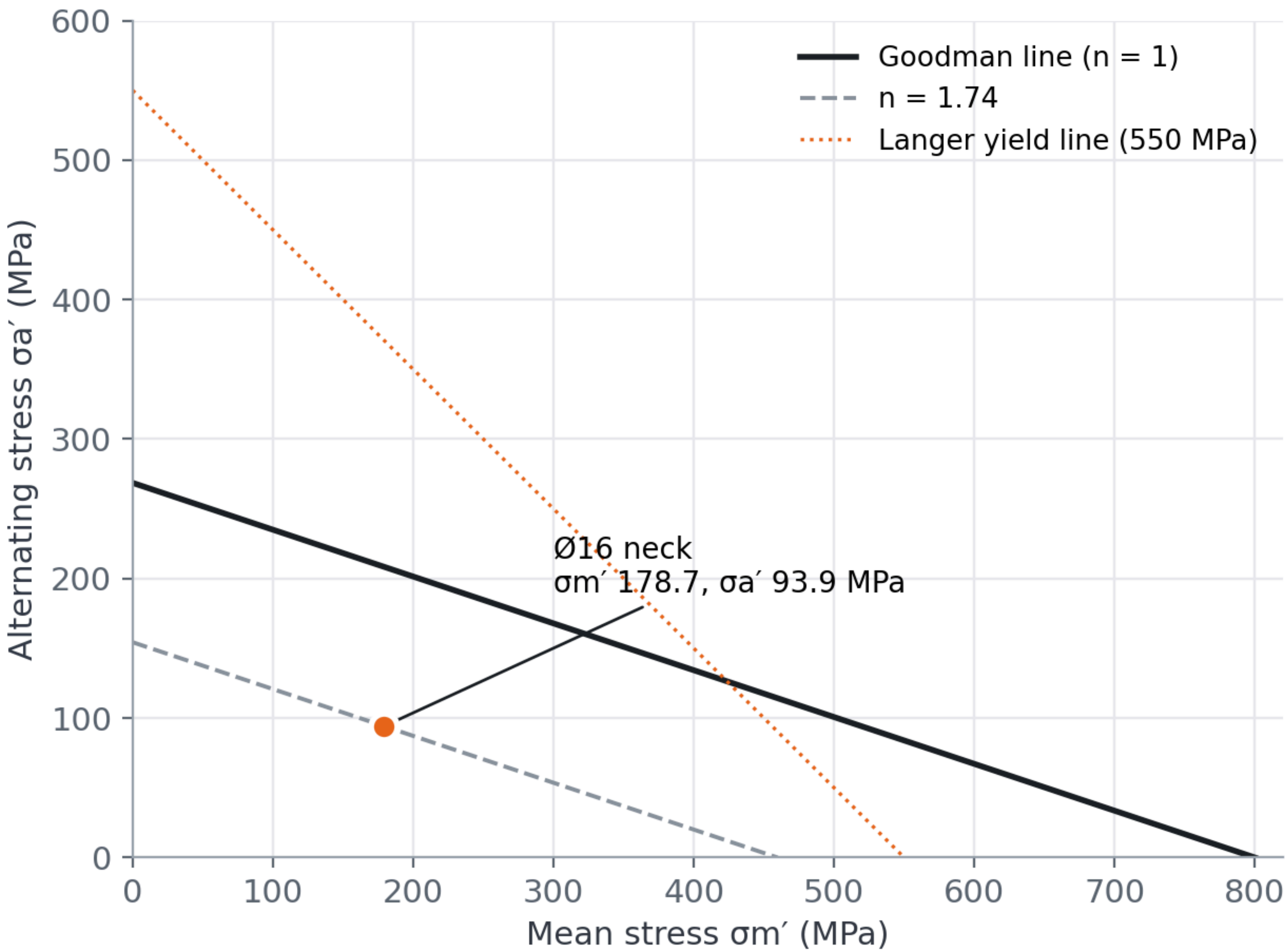
Neck probe: 206.1 MPa, 12% over nominal ($K_t \approx 1.12$). FoS 2.67; 1.33 at $\times 2$ shock

CHECK	HAND CALC	ANSYS	DIFF
Bearing A reaction	2224 N	2289.8 N	3.00%
Bearing B reaction	2782 N	2848.5 N	2.40%
Ø16 neck stress	183.5 MPa	206.1 MPa	12%

LESSON

The biggest number on the screen was the wrong one. It kept rising as the mesh got finer, which is the sign of a singularity, not a real stress. I checked the spline by hand instead and put the fix, an R0.5 run-out, on the drawing.

The shaft passes; the teeth don't



Goodman diagram, Ø16 neck. $S_e = 268.6$ MPa after Marin factors, $K_f 1.10 \rightarrow n = 1.74$ for infinite life.

PINION GOVERNS (LOWER LEWIS Y)	CURRENT: M 1.1, 26:52, 8 MM FACE	RESIZED: M 2.5, 18:36, 16 MM FACE
Bending, Lewis + Kv, pinion (vs 379 MPa)	1511 MPa · FoS 0.25	295 MPa · FoS 1.28
Bending, gear (for reference)	1269 MPa · FoS 0.30	241 MPa · FoS 1.57
Contact, Hertz/AGMA (vs 1240 MPa, carburized)	2616 MPa · FoS 0.47	1313 MPa · FoS 0.94
Centre distance	42.9 mm	67.5 mm

Contact FoS is on stress. On load it is $0.47^2 \approx 0.22$ (current) and $0.94^2 \approx 0.88$ (resized).

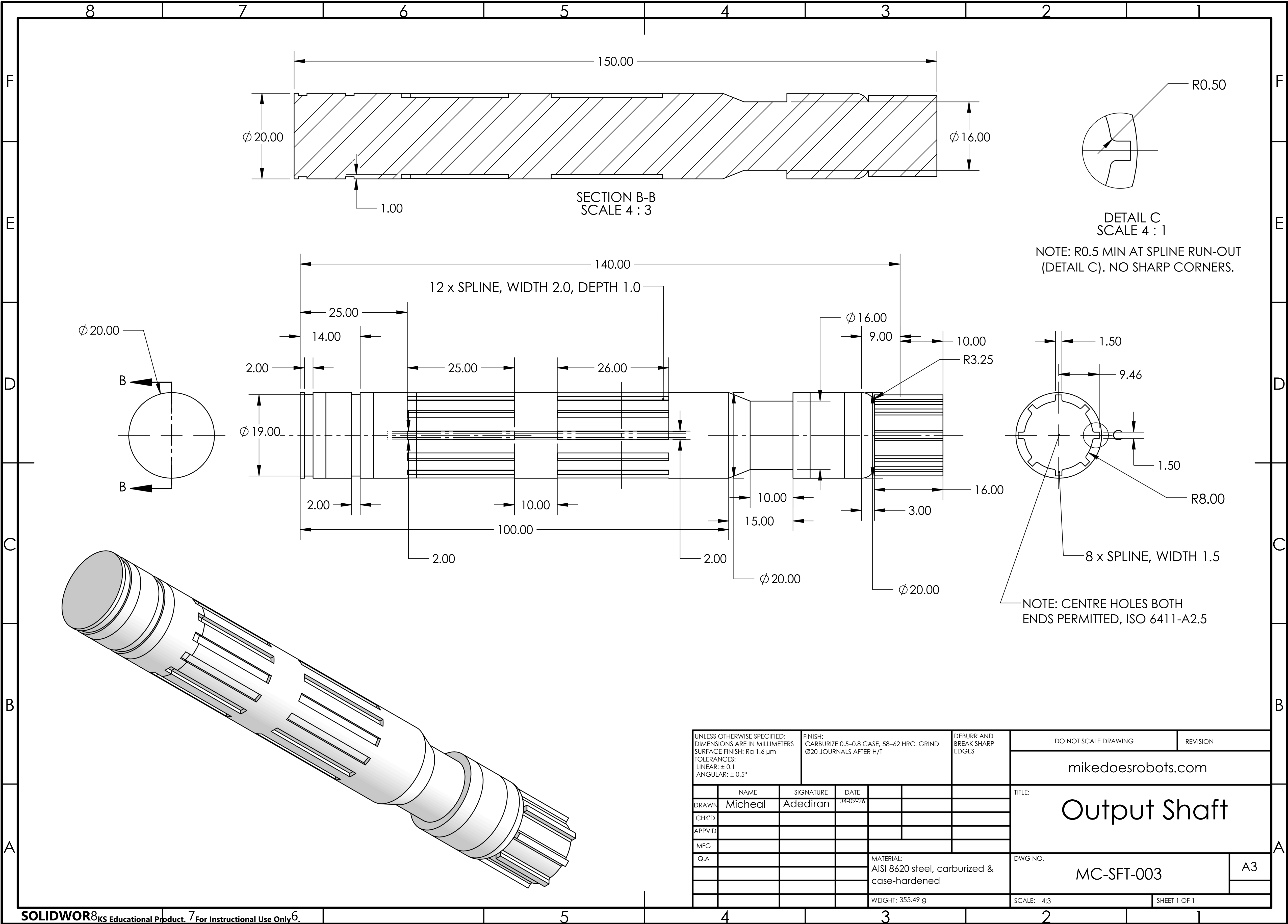
CONCLUSION

The shaft is fine; the teeth are the weak link. The pinion governs: it takes about 6 N·m of engine torque in bending and about 5 N·m in contact, so contact fails first.

The resized pair passes bending but is still marginal in pitting, so it needs about a 20 mm face ($\sigma_H \approx 1174$ MPa). Resizing moves both shafts and the cases, so it is logged as future work.

Bar to ground journal in seven steps

OP	PROCESS
10 -- 20	Cut 8620 bar Ø22 × 155; face, centre-drill
30	CNC turn between centres, seats +0.2 mm
40	Hob 12-spline; shape 8-spline
50	Carburize 0.5–0.8 mm, 58–62 HRC
60-70	Grind Ø20 k5, Ra 0.4; inspect



WHY CARBURIZE 8620?
It gives a glass-hard skin (58–62 HRC) for the splines and bearings over a tough core that won't snap under a shock load.

WHY THIS ORDER
Every operation holds the shaft between the same two centre holes, so all diameters stay concentric. Carburizing distorts the shaft slightly, so the bearing seats are left 0.2 mm big and ground to size afterwards.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: Ra 1.6 µm TOLERANCES: LINEAR: ± 0.1 ANGULAR: ± 0.5°				FINISH: CARBURIZE 0.5-0.8 CASE, 58-62 HRC. GRIND Ø20 JOURNALS AFTER H/T				DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING		REVISION	
										mikedoesrobots.com			
NAME		SIGNATURE		DATE						TITLE: Output Shaft			
DRAWN Micheal		Adediran		04-09-26									
CHK'D													
APPV'D													
MFG													
Q.A													
				MATERIAL: AISI 8620 steel, carburized & case-hardened				DWG NO. MC-SFT-003		A3			
				WEIGHT: 355.49 g				SCALE: 4:3		SHEET 1 OF 1			

Seven casting fixes

WHY PERMANENT MOULD

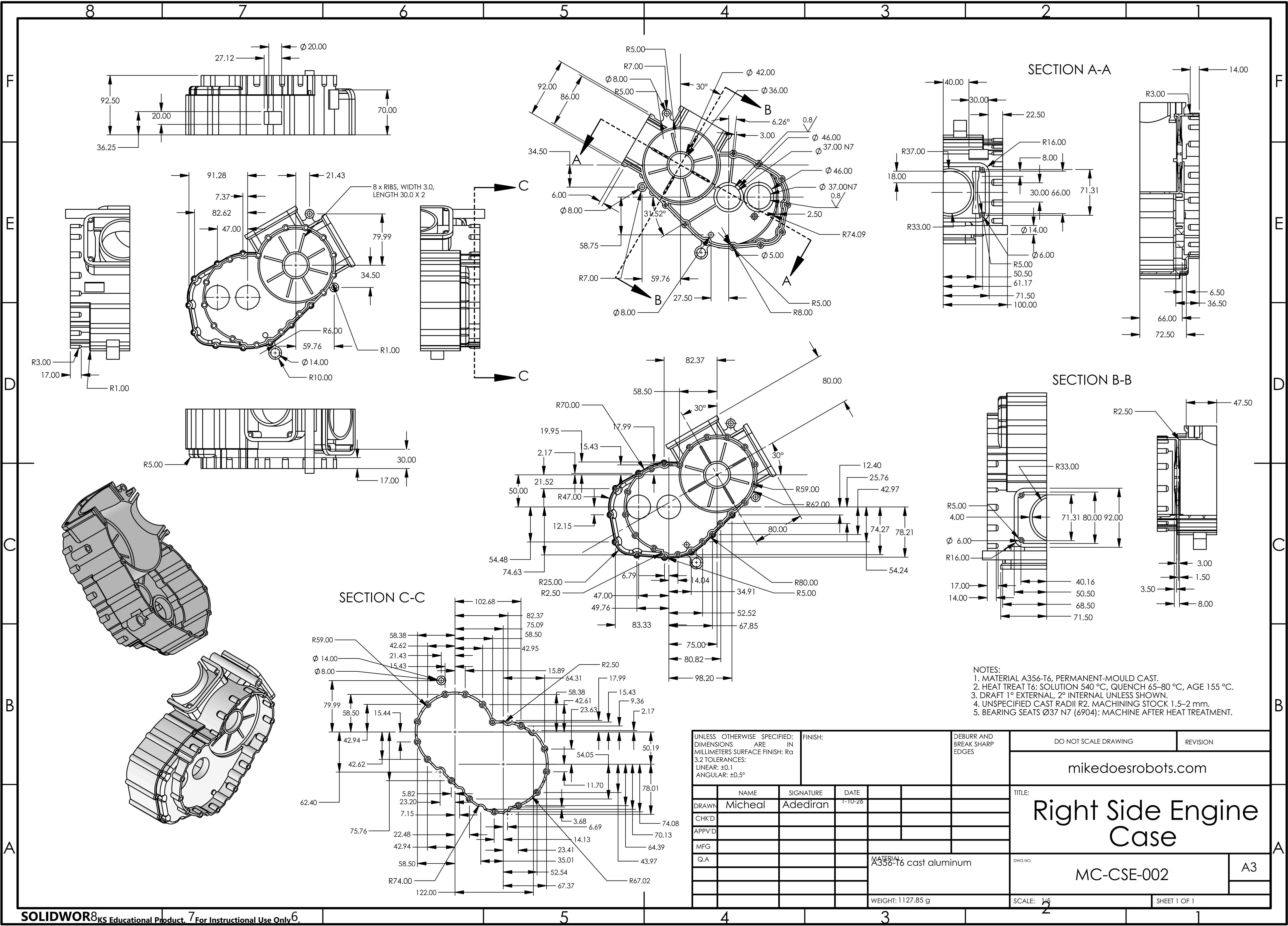
Machining from billet turns ≈90% of the block into chips. High pressure die casting traps gas that blisters during heat treatment, so it can't be T6. A gravity steel die gives thin walls, a good finish and full T6 strength for batches of 50–2,000.

CAUGHT IN REVIEW

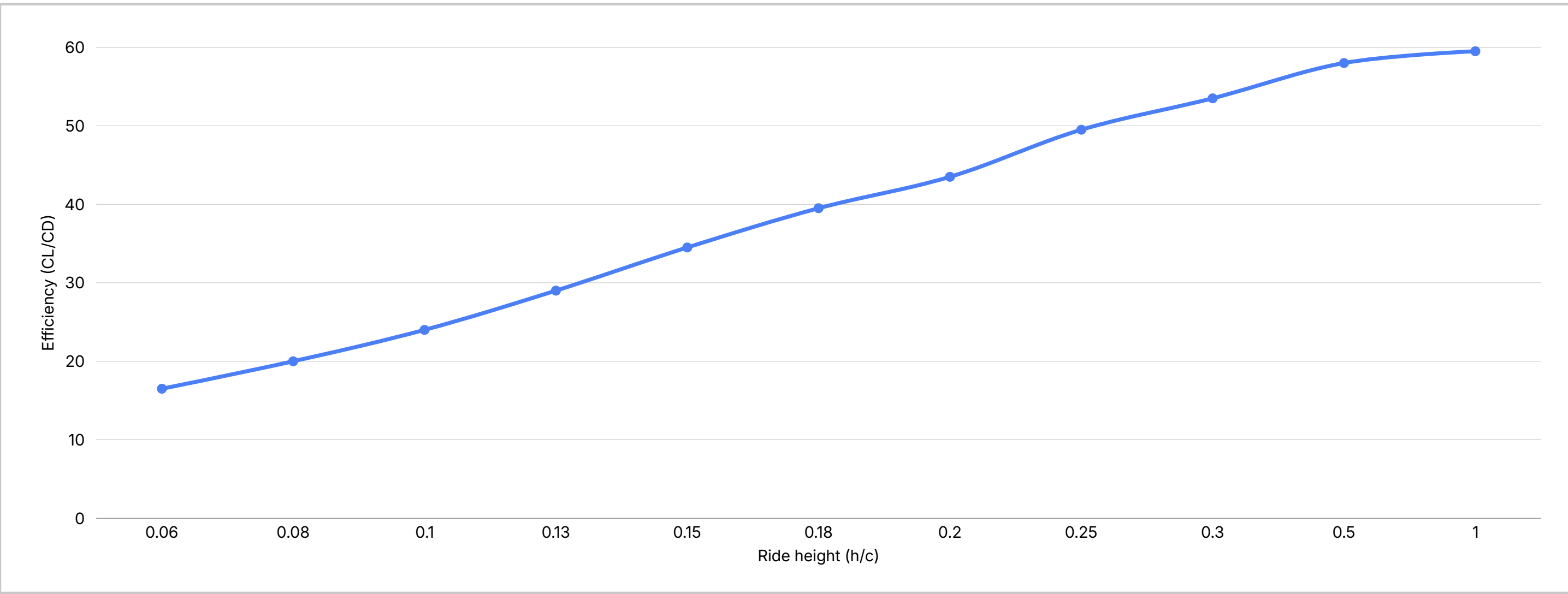
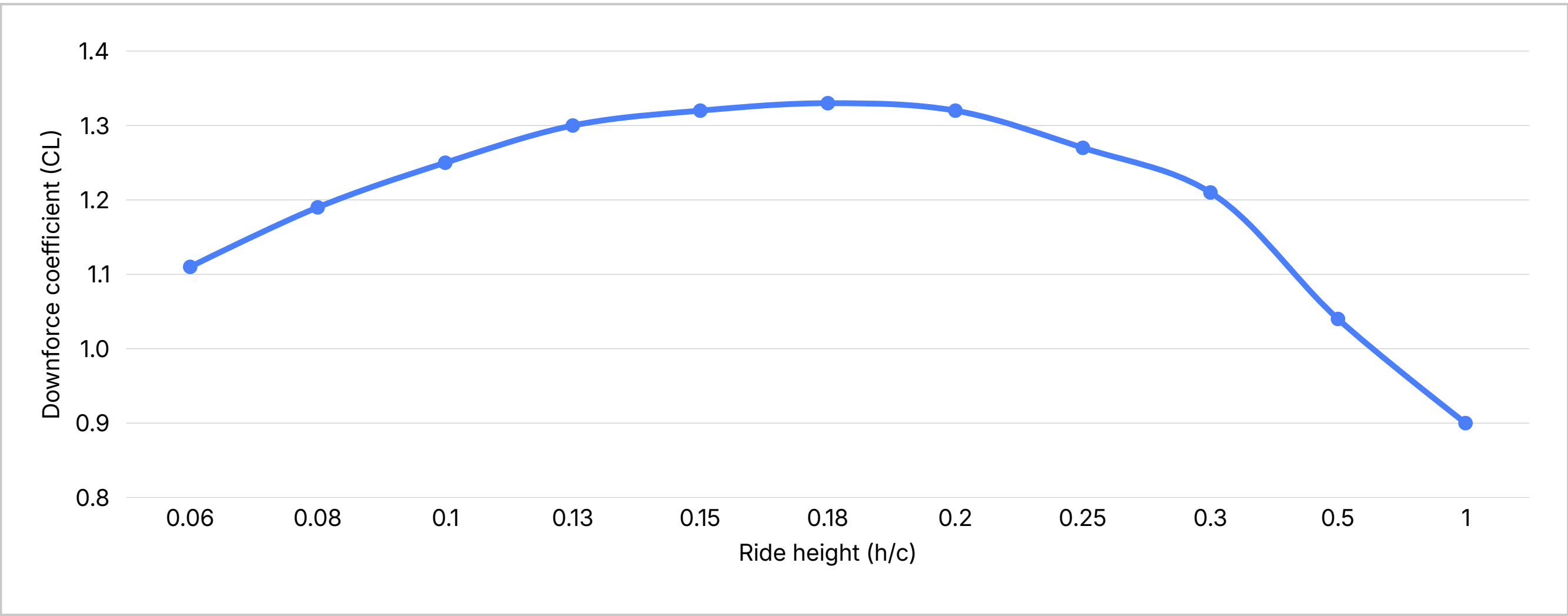
The gearbox bearing seats were drawn at Ø36 to suit a 36 mm bearing, but no catalogue bearing for a Ø20 shaft is 36 mm outside. The nearest real part is a 6904 (20 × 37 × 9), so the seats became Ø37 N7

FIXES - 7

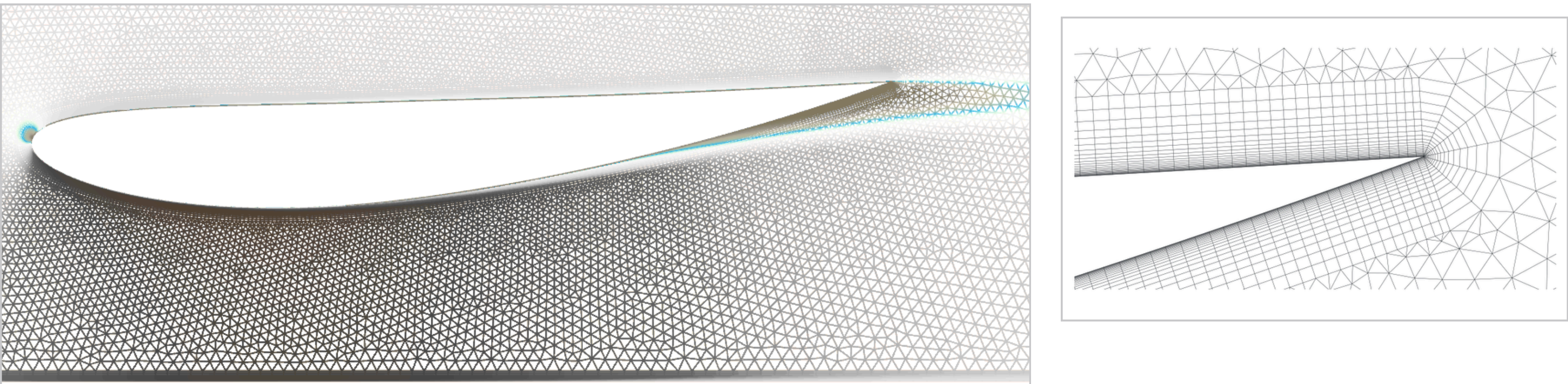
- Draft 1°/2°
- 4 mm wall, cored bosses
- R3 fillets
- drafted ribs
- side slide for the saddle
- Ø37 N7 seats (6904)
- as-cast model with stock



Front wing in ground effect: +47% downforce, then a stall



11 ride heights, one wing, 180 km/h. Downforce rises 47% as the gap closes to 44 mm, plateaus, then falls 16% by 15 mm while drag climbs 4.5×.



Mesh at h/c 0.20: quad boundary layer wrapped around the wing and along the road, fanned at the sharp trailing edge (right).

AIM

An F1 front wing runs centimetres off the road, where ground effect can add downforce or suddenly take it away.

This study set out to map how downforce, drag and the flow change with ride height for a single front-wing element, find where downforce peaks and why it falls after, and turn that into a ride-height recommendation, using a mesh and solver set-up validated against reference data first

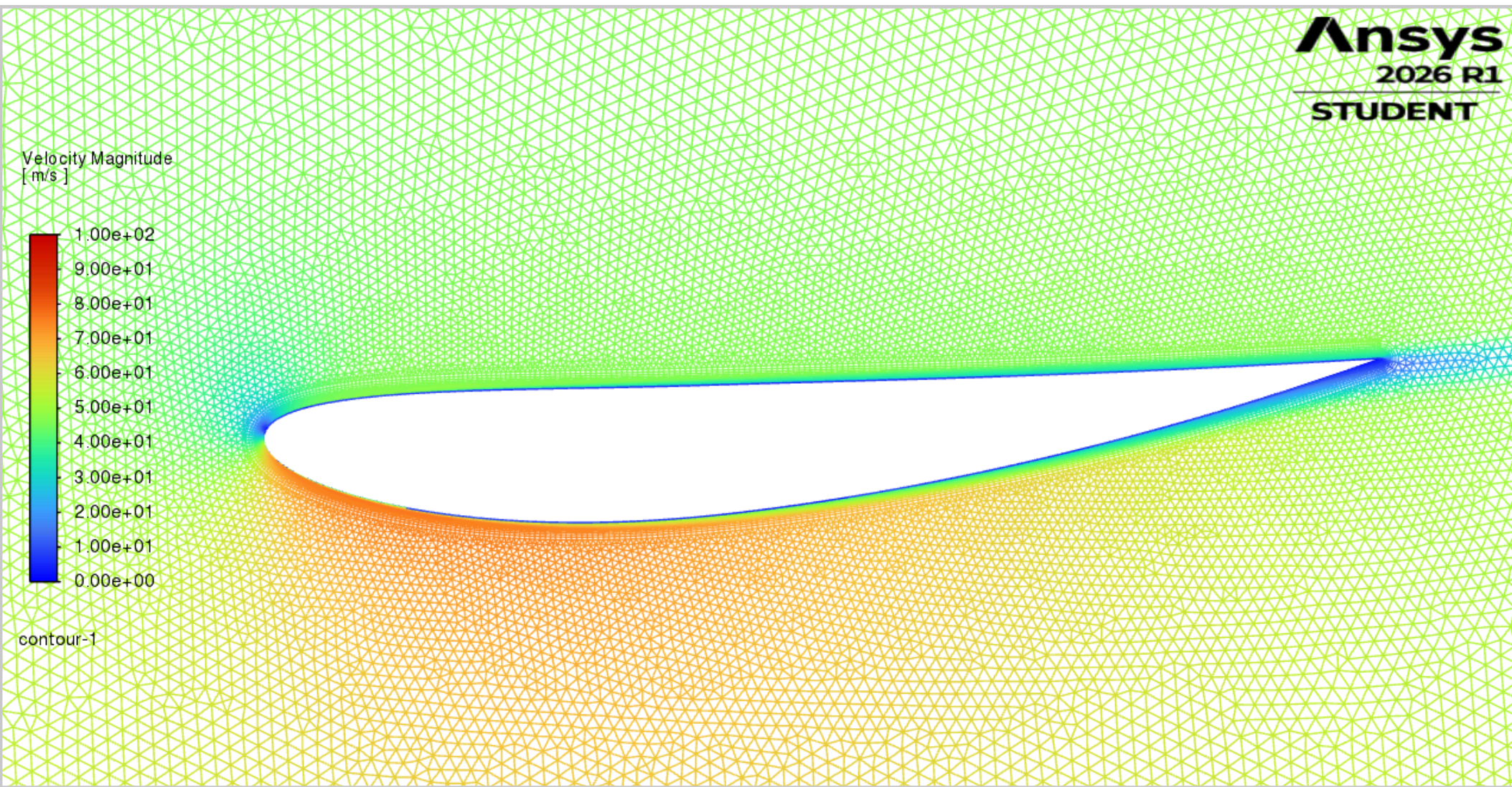
SET-UP	
Wing	NACA 4412, inverted, chord 250 mm, 4° incidence
Flow	50 m/s (180 km/h), $Re = 8.6 \times 10^5$, moving ground at 50 m/s
Model	2D steady RANS, k- ω SST, coupled solver, 2nd order
Mesh	107000–148000 cells, 25 prism layers, first cell 0.01 mm
Sweep	$h/c = 1.0 \rightarrow 0.06$ (250 $\rightarrow$ 15 mm), 11 cases, residuals 1e-5

CHECK	CFD	REFERENCE
Downforce CL	0.902	0.875–0.915
Drag CD	0.0152	0.0135 (turbulent)
Wall y+ on wing	≤ 1.8	≈ 1 for SST

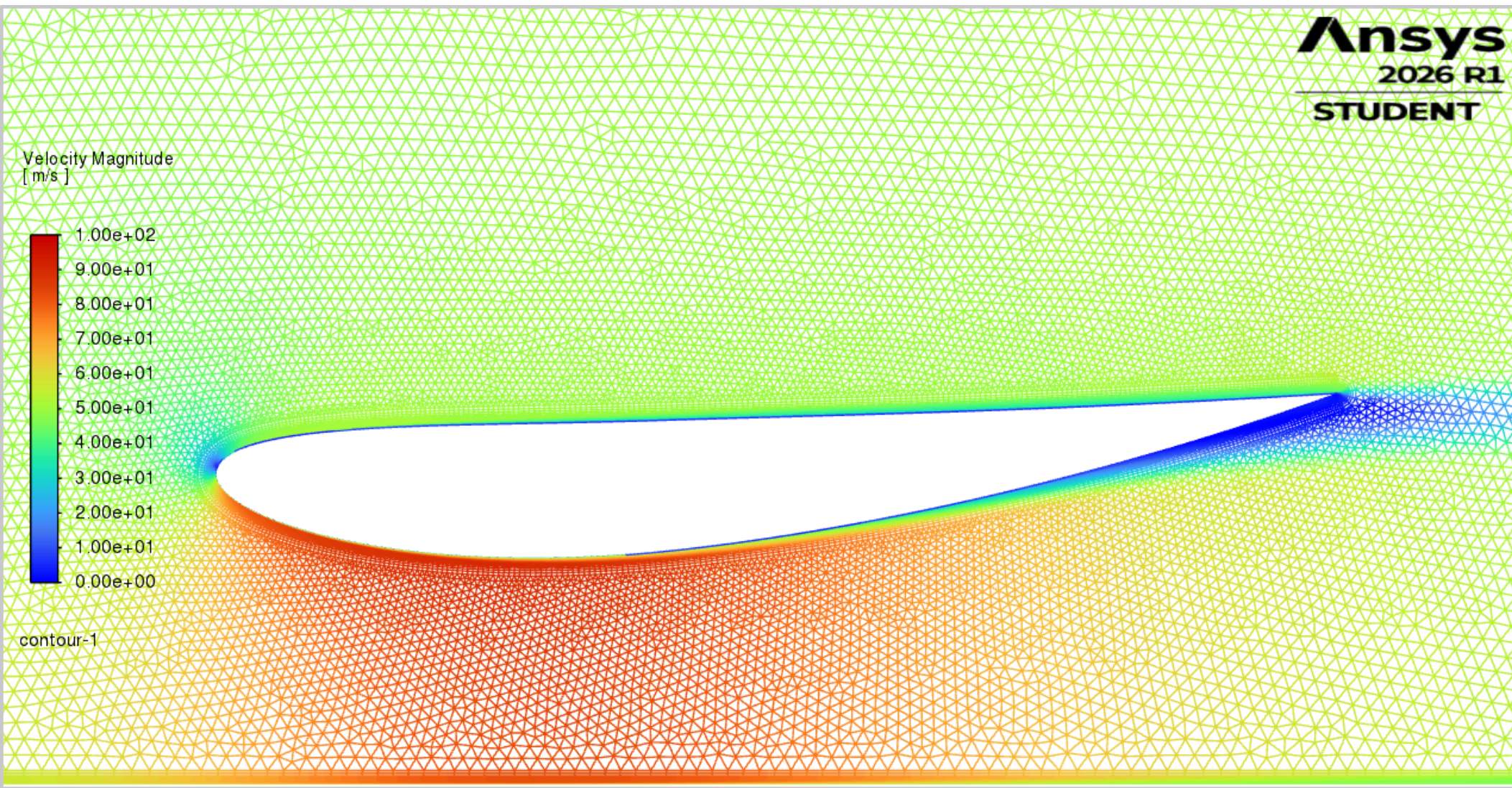
Reference: NeuralFoil (XFOIL-trained) at the same Re and incidence, free and forced transition.

WHY DRAG READS HIGH:
SST treats the whole boundary layer as turbulent, so skin friction is overstated compared to a real wing that stays laminar near the nose. Against the fully turbulent reference, it's +12%. The trends are what the study relies on.

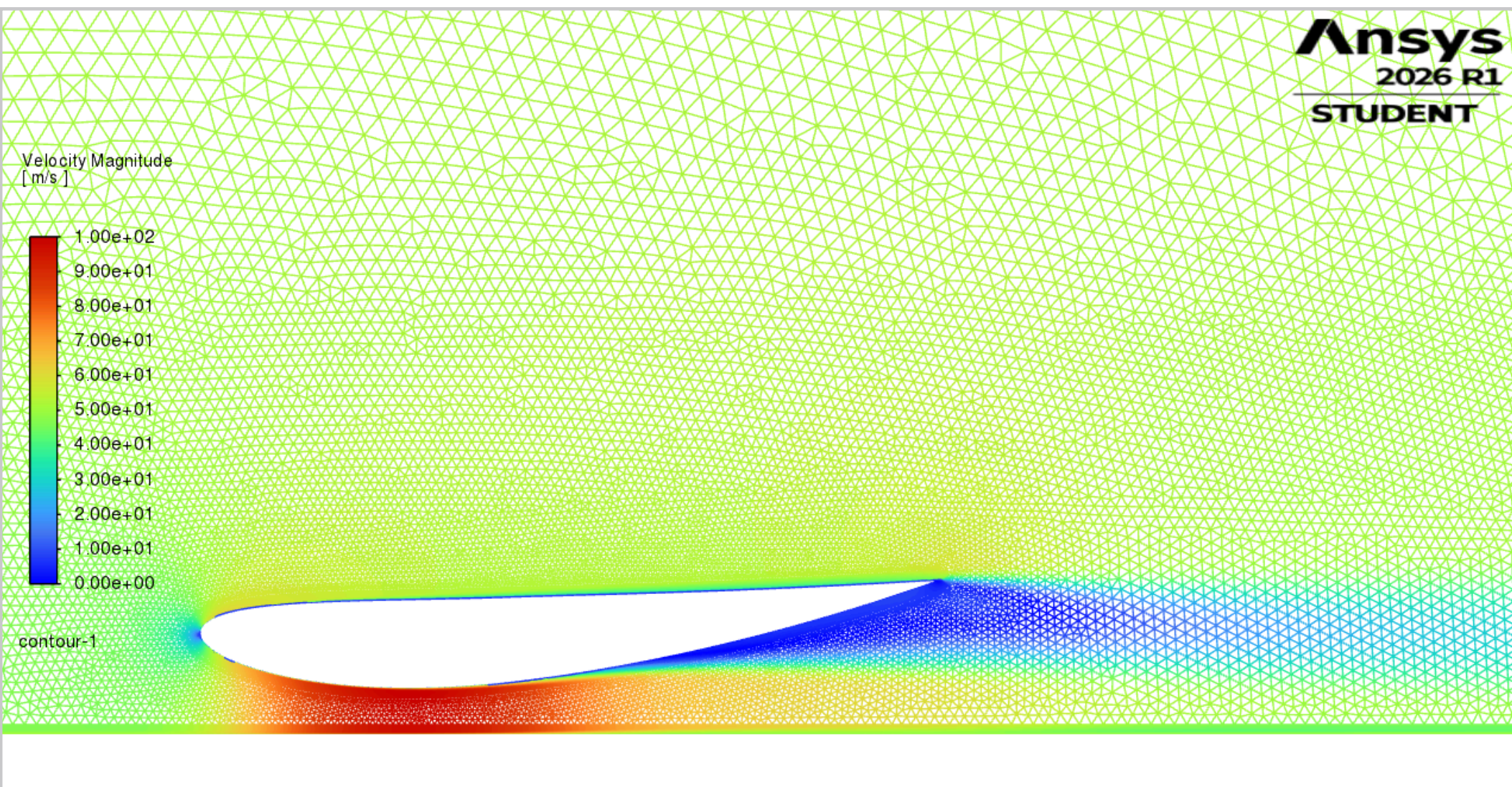
Why it stalls: separation creeps forward as the gap closes



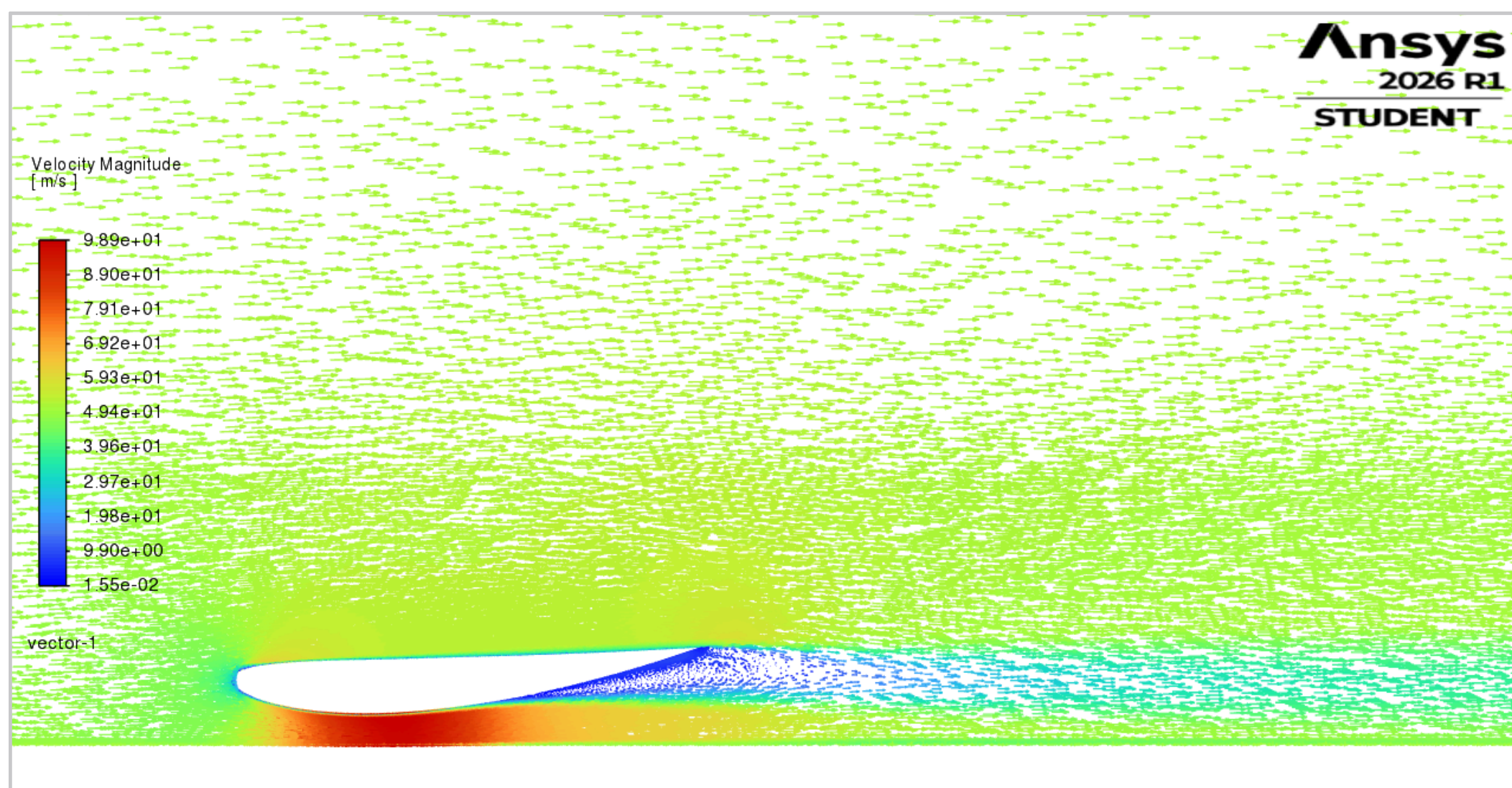
h/c 1.0 (250 mm): attached flow, thin wake. CL 0.902.



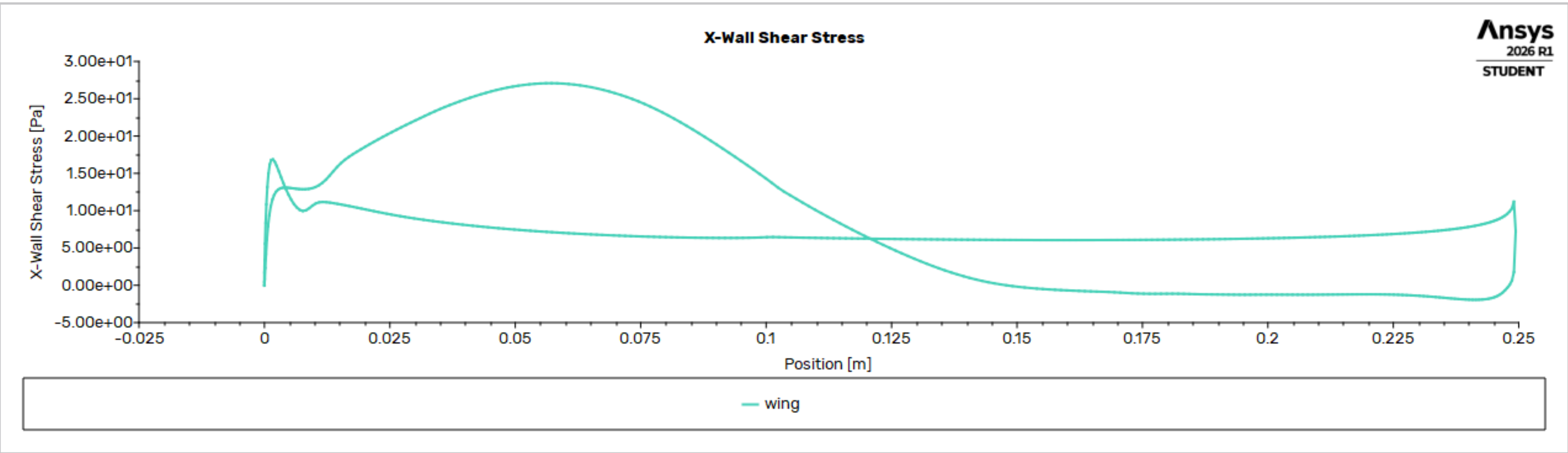
h/c 0.20 (50 mm): gap flow accelerates; a small separated zone forms at the tail. CL 1.319



h/c 0.06 (15 mm): gap air reaches 99 m/s, but the rear 43% of the underside separates. CL 1.113.



Velocity vectors, h/c 0.06: the slow, reversed region behind mid-chord feeds a wide wake.



X-wall shear, h/c 0.06: the ground-facing side crosses zero at 57% chord and stays negative, which is reversed flow.

h/c	SEPARATES AT	CL	CL/CD
1.00	none	0.902	59.4
0.2	82% chord	1.319	43.7
0.06	57% chord	1.113	16.4

Closing the gap speeds up the air under the wing, which adds suction. But the air then has to slow back down before the trailing edge, and the tighter the gap, the harder that recovery. Below about 44 mm the separated zone grows faster than the gap suction, so downforce falls and drag climbs

RECOMMENDATION

Run at h/c 0.20–0.25 (50–62 mm). CL is 1–5% below the 1.33 peak (1.319 at h/c 0.20, ≈ 1.27 at 0.25), but efficiency is higher (CL/CD 43.7 at 0.20, ≈ 49 at 0.25). The wing also sits 6–18 mm above the 44 mm peak, so pitch and heave of a few millimetres don't push it onto the falling side. Avoid h/c below 0.10 (25 mm), where CL is more than 6% below peak, and CL/CD has dropped to ≈ 24 .

OTHER WORK

NAVI: collapsible navigation cane for blind users

AAKRUTI Innovation Competition 2026 (Dassault Systèmes) ·
Team of 4 · My role: structural simulation, rendering, part of
the CAD



Problem. Blind users need to know where they are and how to reach a destination without relying on another person.

Solution. Navi combines GPS positioning with destination coordinates, voice control, and feedback cues. It alerts the user when they drift off course, and it folds down for carrying.

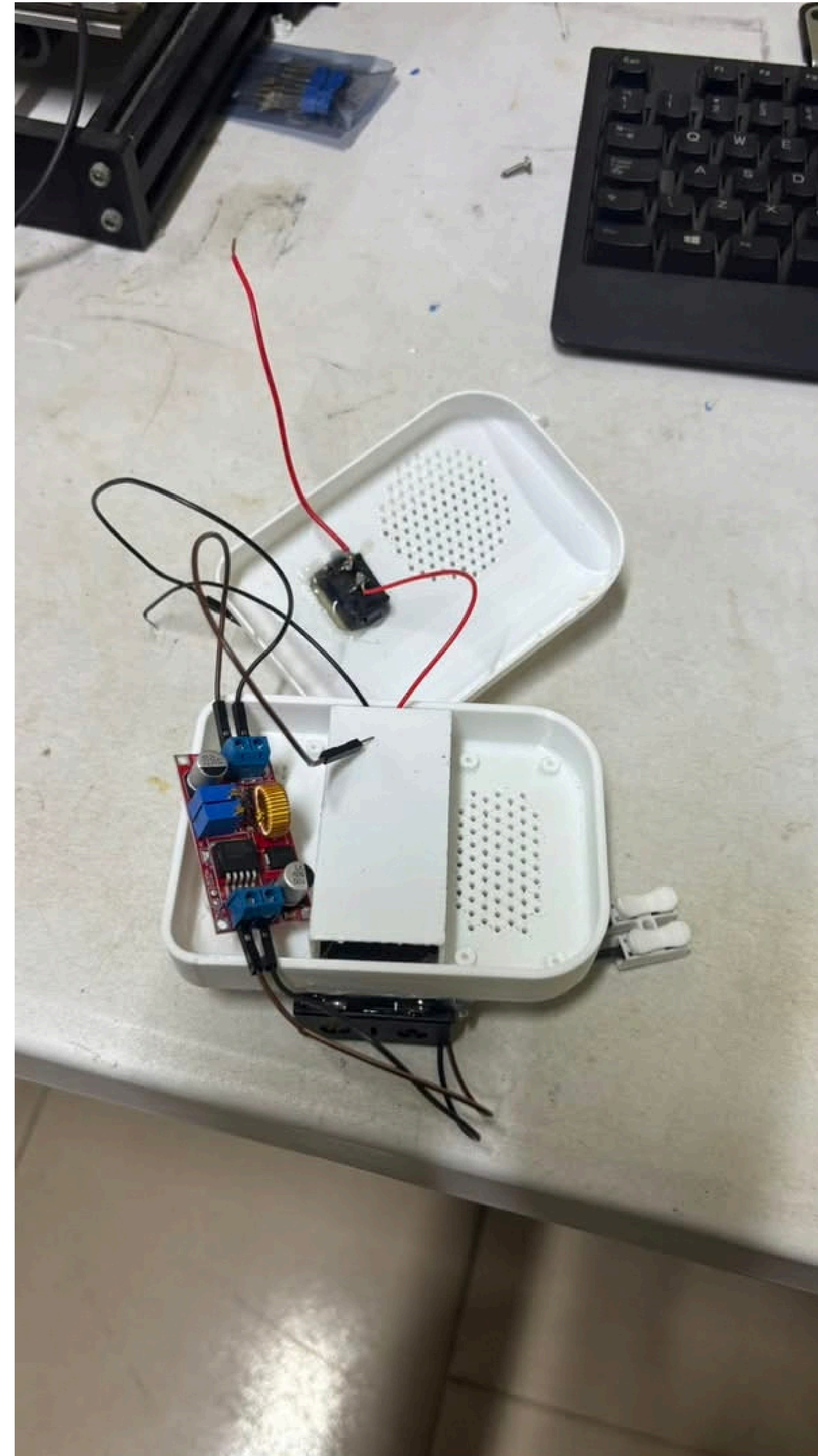
My contribution. All four of us shared the design. I set up the structural simulations of the telescoping shaft assembly in SolidWorks Simulation (6061-T6, angled worst-case grip load) and produced the renders. I also contributed to the CAD.

Status. Through to the regional stage; result pending.

Shows: structural simulation and rendering within a team submission.

TRANSIDIME: plug-in translation hub

Team project · 3rd place, Innovate Local (first edition) · ₦250,000 grant · My role: casing design



Problem. Travellers can't follow the people around them in another language.

Solution. The user plugs their earphones into the hub and hears the people around them in their own language. The electronics work, and the team is now finalising the enclosure.

My contribution. I designed the 3D-printed housing around the electronics.

Result. Third place, and a ₦250,000 grant to build the product.

Shows: enclosure design for a working electronics product, built under a funded brief.

AN ISSUE DURING ASSEMBLY

At the time, the main focus was on ergonomics, but that led to a huge oversight: we didn't add enough thickness (1 mm) to the cover after adding fillets and some surface curves, which caused the 3D print to feel like single-line threads on some portions and even break when a force was applied to it. Similarly, the casing didn't have enough tolerance for the cover.

The fix was to redo the model in SolidWorks and allocate a thickness of 2.5 mm and a tolerance of 0.5mm