ENGINEERING PORTFOLIO

MEENAKSHI

Aerospace & Mechanical Design Engineer

Designing what matters — structural components and mechanical systems taken from early-stage concept to manufacturable, analytically verified hardware.

OPEN FOR FREELANCE & CONTRACT WORK

Ecully, France

DESIGN

Concept to detailed engineered solutions

ANALYZE

FEA, CFD & analytical validation

DEVELOP

Manufacturable, optimized & tested

DELIVER

Real-world impact and performance

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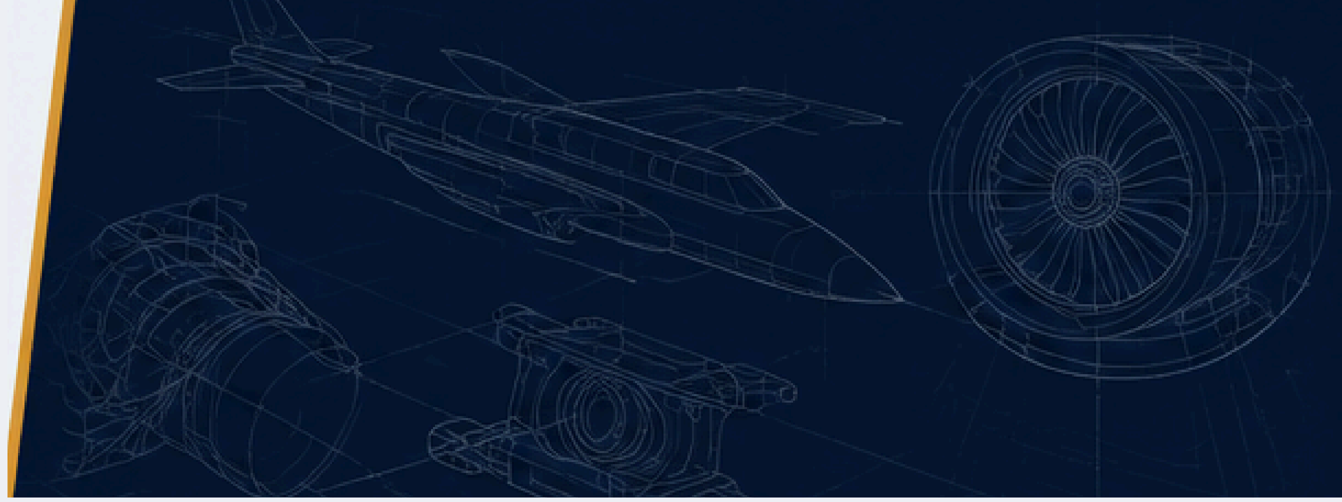
Portfolio reference: meenakshi.space



ABOUT

Aerospace & Mechanical Design Engineer

Specializing in CAD modelling, FEA, and simulation-driven design for aerospace and mechanical systems—from go-kart chassis and aircraft joints to composite UAV wings—using Creo, CATIA, Siemens NX, ANSYS, and NX Nastran.

Design Engineer with 4+ years of experience delivering structurally efficient, manufacturable designs through engineering analysis, optimization, and hands-on validation.

LANGUAGES

English	Professional
Hindi	Native
Punjabi	Native
French	A2

15+
PROJECTS SHOWCASED
End-to-end engineering projects from design to validation

10
CAD & SIMULATION TOOLS
Proficient in industry-standard design & analysis software

4 Yrs
DESIGN ENGINEERING EXPERIENCE
Hands-on experience in mechanical design & product development

3
AEROSPACE / MECH. DEGREES
Strong academic foundation in aerospace & mechanical engineering

SKILLS

Engineering toolkit

01 CAD & Product Design

Creo · Siemens NX · CATIA
SolidWorks · AutoCAD
Autodesk Inventor

02 Structural Analysis & FEA

Finite Element Analysis
Topology Optimization · NX Nastran
ANSYS

03 Aerospace & Fluid Systems

Aerodynamics · CFD
Aerospace Structures · UAV Design
Propulsion

04 Composite Engineering

Composite Laminate Modeling
ANSYS ACP · Vacuum Bagging
Carbon Fiber Mfg.

05 Computational Tools

Numerical Modelling
Engineering Calculations · Python
MATLAB

06 Manufacturing & Production

CAD/CAM · Mechanical Design
Sheet Metal Design · Mfg. Processes

07 Design Optimization

Topology Optimization · MCDM
Ashby Chart Screening

08 Technical Documentation

Engineering Reports · Design Reviews
Technical Documentation

09 Research Interests

Computational Mechanics · SHM
Fracture & Fatigue · FSI

END-TO-END MINDSET
From concept & analysis to manufacturing.

MULTI-DISCIPLINARY
Strong foundation across mechanical & aerospace domains.

DATA-DRIVEN
Simulation-led decisions with engineering rigor.

PROBLEM SOLVER
Focused on innovation, efficiency & real-world impact.

Four years of design engineering on an aerospace foundation

2025 — Present

Master's — Aeronautics & Space (Aerostructures)
École Centrale de Lyon, France

Advanced Design Project: Materials selection, structural analysis & fabrication of a UAV wing. Coursework: Advanced Materials, Manufacturing Processes, Structural Design, Computational Engineering, FEA, Aerospace Structures.

2021 — 2025

Design Engineer
Pearce Services Global Pvt. Ltd.

Performed FEA to evaluate structural integrity & design optimization; built simulation-driven workflows in Creo and AutoCAD; led structural evaluation of sheet-metal assemblies; mentored junior engineers.

2020 — 2022

M.Tech — CAD/CAM (Mechanical)
GNA University, India · GPA 7.8/10

Thesis: Design, Simulation & Topology Optimization of a Drone — FE modeling and topology optimization using ANSYS and NX Nastran. Ranked among top performers across multiple semesters.

2016 — 2020

B.Tech — Aerospace Engineering
GNA University, India · GPA 8.1/10

Major Project: Pulse Detonation Engine — conceptual propulsion system design and CAD modeling.

DESIGN FOCUSED

Strong foundation in CAD, analysis and optimization.

TECHNICAL DEPTH

Hands-on experience across design, simulation and fabrication.

LEADERSHIP

Led projects and mentored junior engineers.

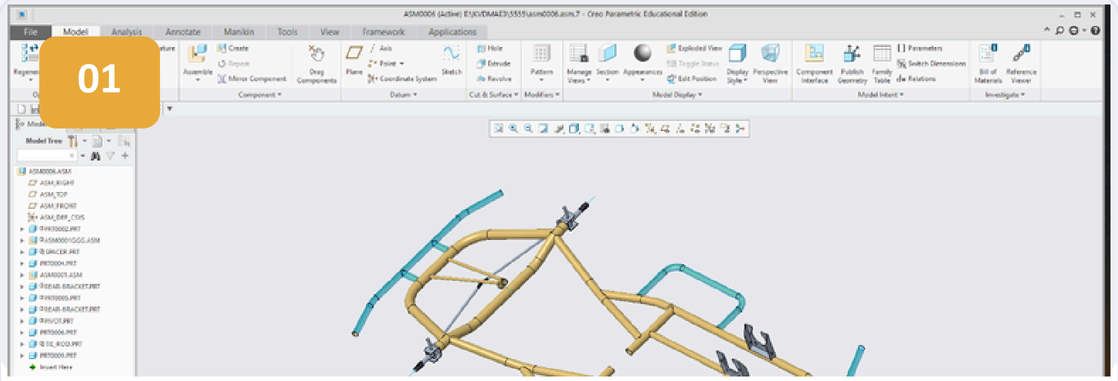
AEROSPACE MINDSET

Passionate about solving complex engineering challenges.

PROJECTS

Engineering Projects

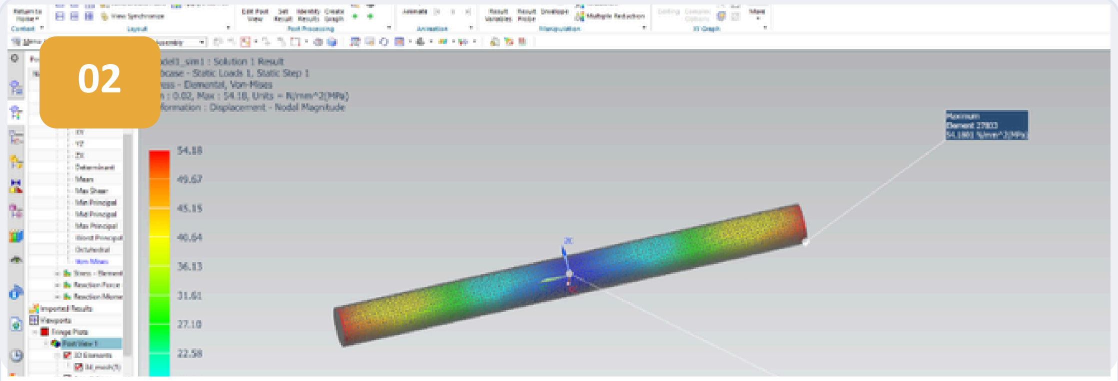
Six priority projects presented as full case studies across the portfolio, demonstrating design, simulation, and real-world engineering impact.



01

Racing Go-Kart Chassis

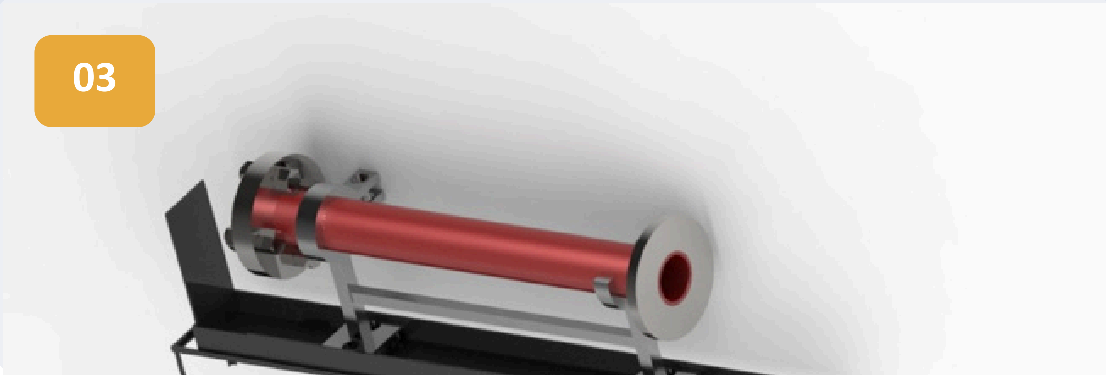
Creo • NX Nastran



02

Axle — Structural & FEA Evaluation

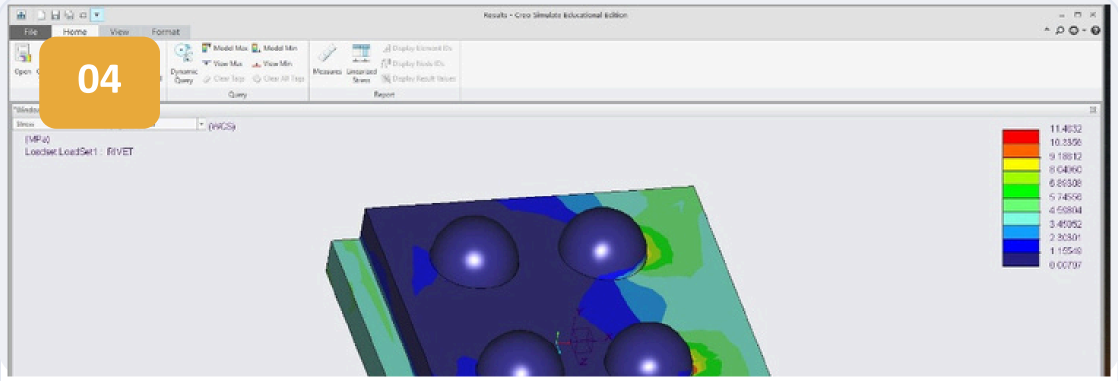
Siemens NX • Nastran



03

Pulse Detonation Engine

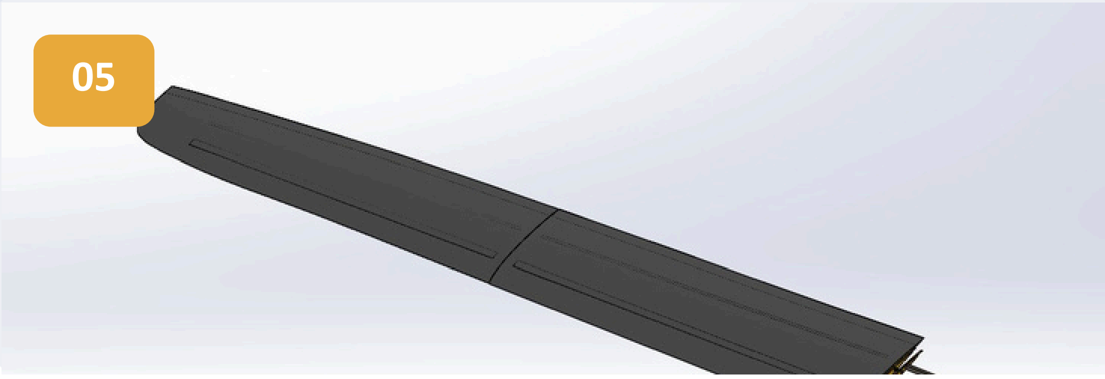
Creo • Built & Fired



04

Riveted Joint — Structural FEA

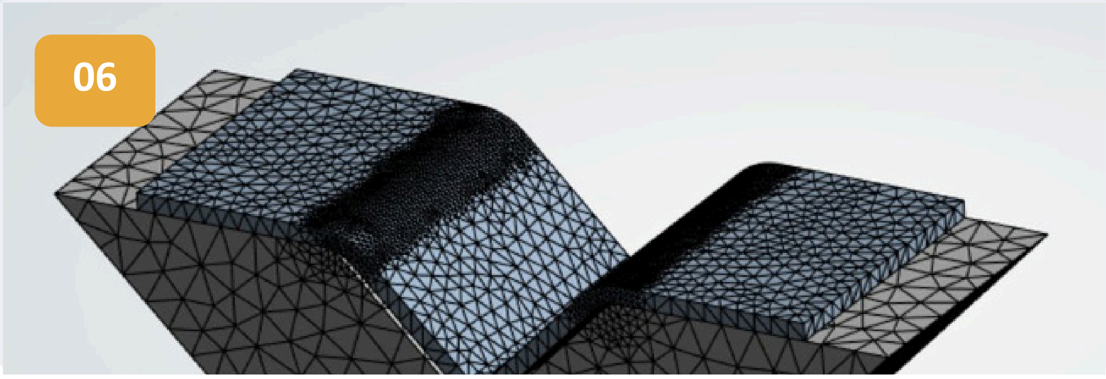
Creo • ANSYS



05

UAV Wing — Flagship

CATIA • ANSYS • CFRP



06

CFRP Springback — Flagship

ANSYS Workbench • ACP

Racing Go-Kart Chassis — Design, Analysis & Build

ROLE	SOFTWARE	INDUSTRY	OUTCOME
Design Engineer & Team Lead	Creo • NX Nastran	Automotive	Structurally validated, race-ready chassis

THE PROBLEM

A competition go-kart needed a chassis that was light enough to be competitive yet robust enough to carry the engine, driver, seat, and every vehicle subsystem, all while meeting the mechanical and safety specifications set by the competition.

OBJECTIVES

- Design a tubular space-frame chassis in Creo, optimized for stiffness, safety and weld access
- Verify strength and load-carrying capability through structural analysis
- Meet full competition compliance for mechanical performance and safety
- Lead the engineering team through design, fabrication and evaluation

KEY ACHIEVEMENTS

100% Competition Compliance
Achieved full compliance with competition specifications through iterative design and structural validation.

End-to-End Team Leadership
Led the project from concept to completion including CAD modeling, analysis, fabrication support and documentation.

Weld-Accessible Frame Geometry
Developed a frame design with excellent weld accessibility for ease of manufacturing without compromising performance.

Optimized Stiffness-to-Weight Ratio
Tubular space-frame optimized for stiffness and safe load paths.

Structurally Validated
Strength and load-carrying capability verified in NX Nastran under representative loading conditions.

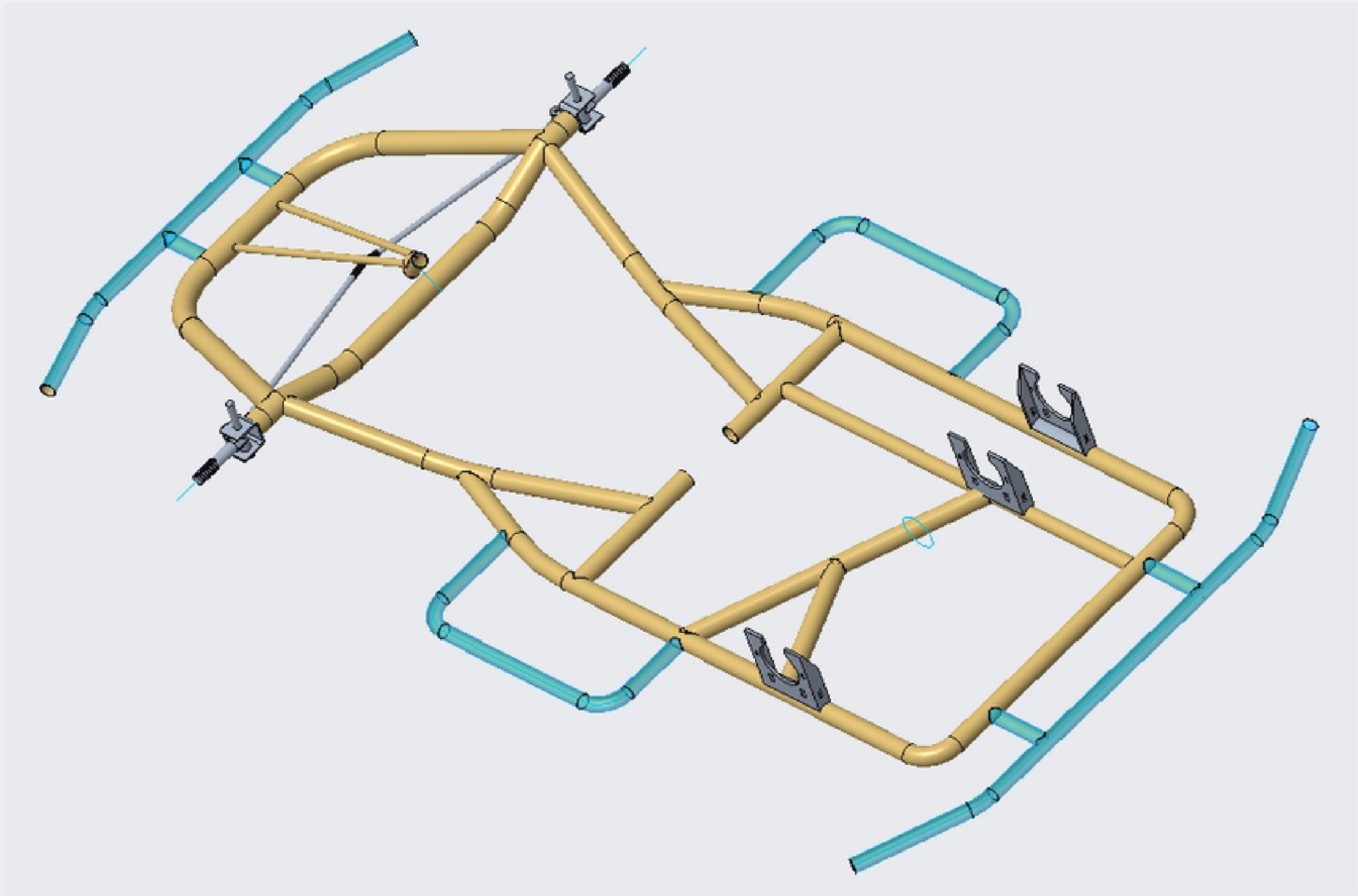


FIG - CHASSIS MODEL

PRJ-002 • STRUCTURAL ANALYSIS

Axle — Structural & FEA Evaluation

ROLE	SOFTWARE	INDUSTRY	OUTCOME
Simulation & Structural Engineer	Siemens NX • NX Nastran	Automotive / Structural	Deformation & stress fully mapped

THE PROBLEM

An axle needs to be assessed for how it deforms and where stress concentrates under load, so that the design can be confirmed safe before it is committed to service.

OBJECTIVES

- Build the axle solid model in Siemens NX to a level of detail suited for accurate meshing
- Apply realistic boundary conditions and representative static loads
- Mesh the geometry with local refinement at fillets and load regions
- Solve in NX Nastran and evaluate deformation and von Mises stress distribution

KEY ACHIEVEMENTS

Full Deformation & Stress Mapping

Mapped deformation and stress distribution across the axle's full geometry.

Peak Location Identified

Identified the location and magnitude of maximum deformation under the applied load.

Behaviour Confirmed

Confirmed the axle's structural behavior against the intended loading condition.

Refined Local Meshing

Refined mesh density around fillets and load-application regions to capture stress gradients accurately.

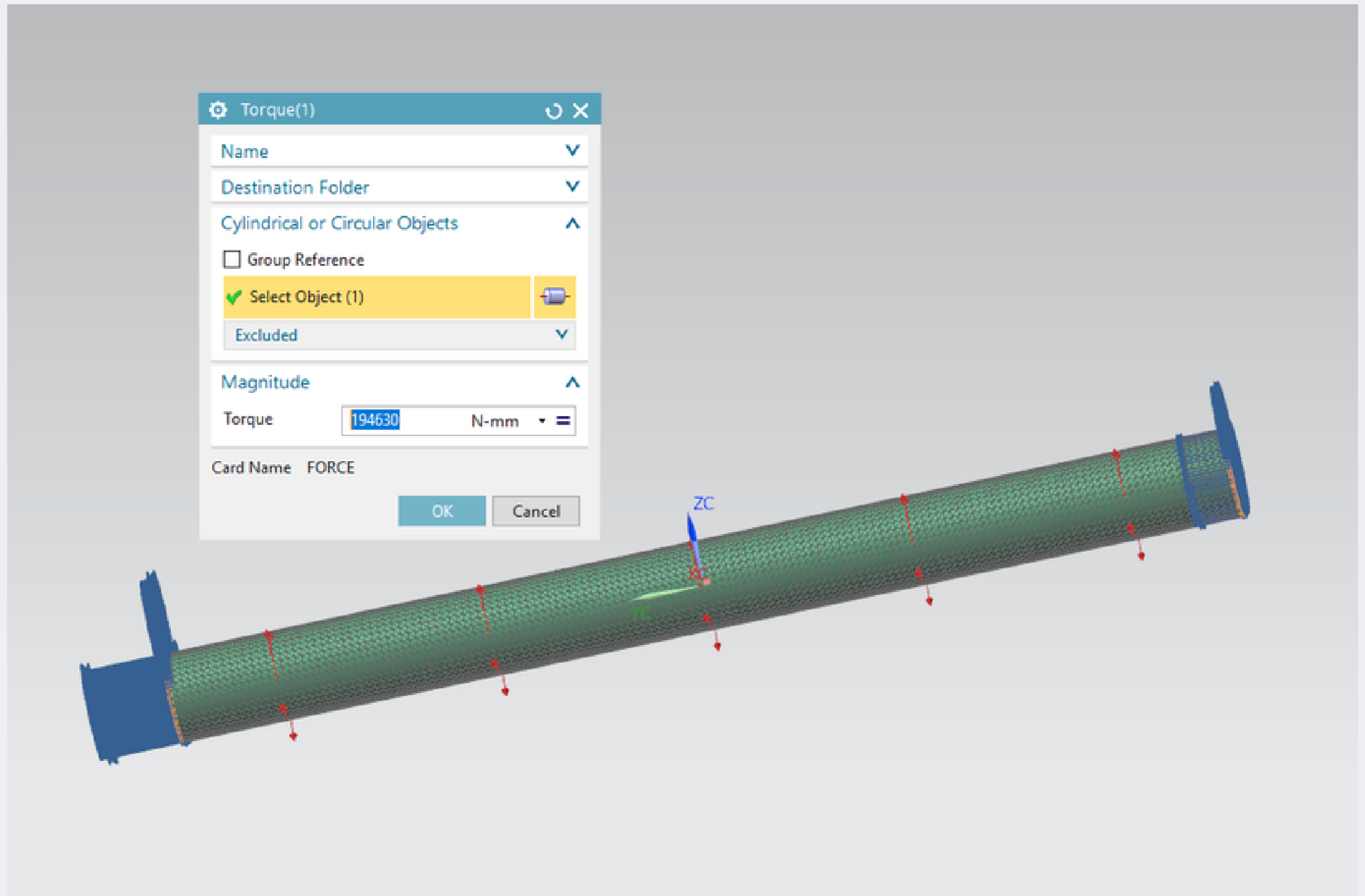


FIG- AXLE CAD MODEL • SIEMENS NX

Finite Element Validation Workflow — Siemens NX & NX Nastran

CAD Model
Siemens NX

›

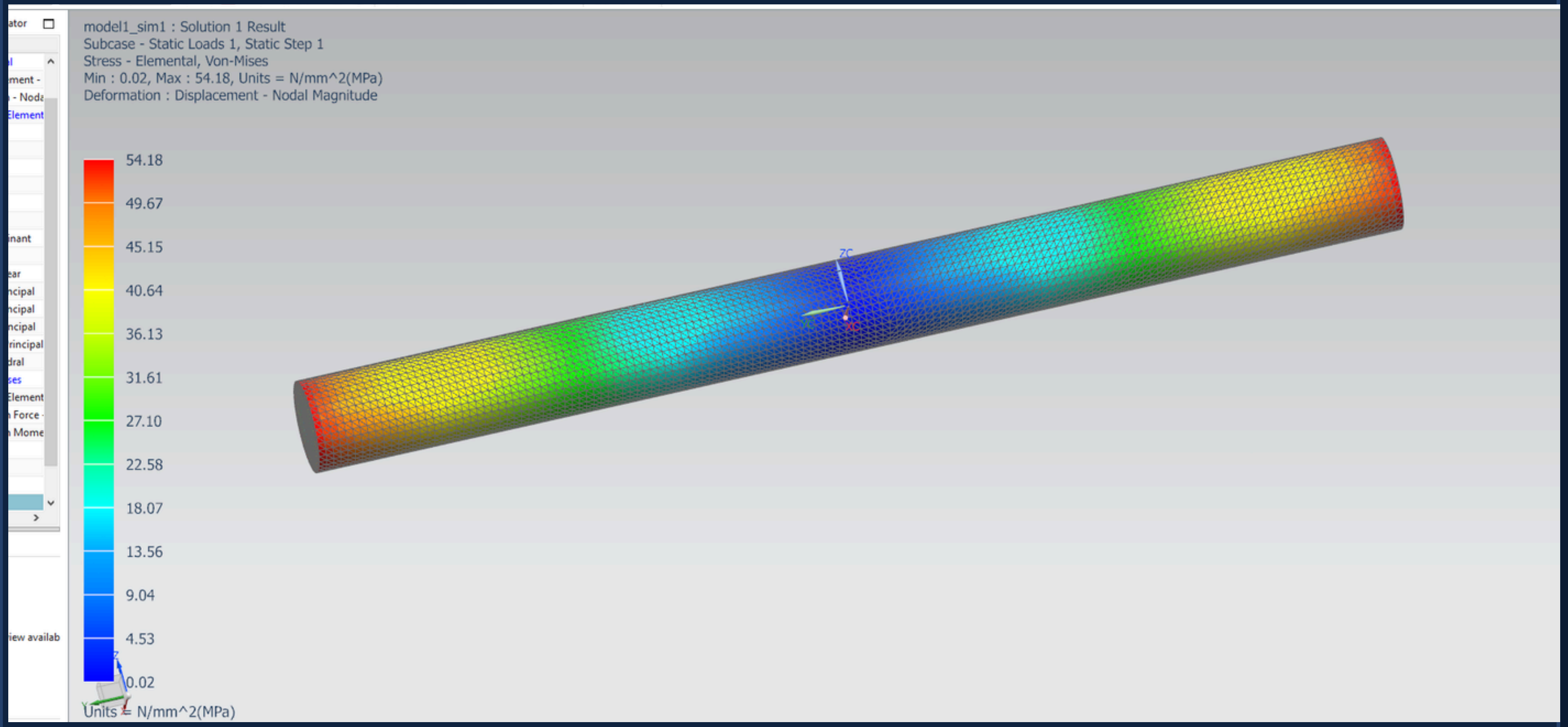
Mesh & Boundary Conditions
NX Pre/Post

›

Solve
NX Nastran

›

Results
Displacement & Stress

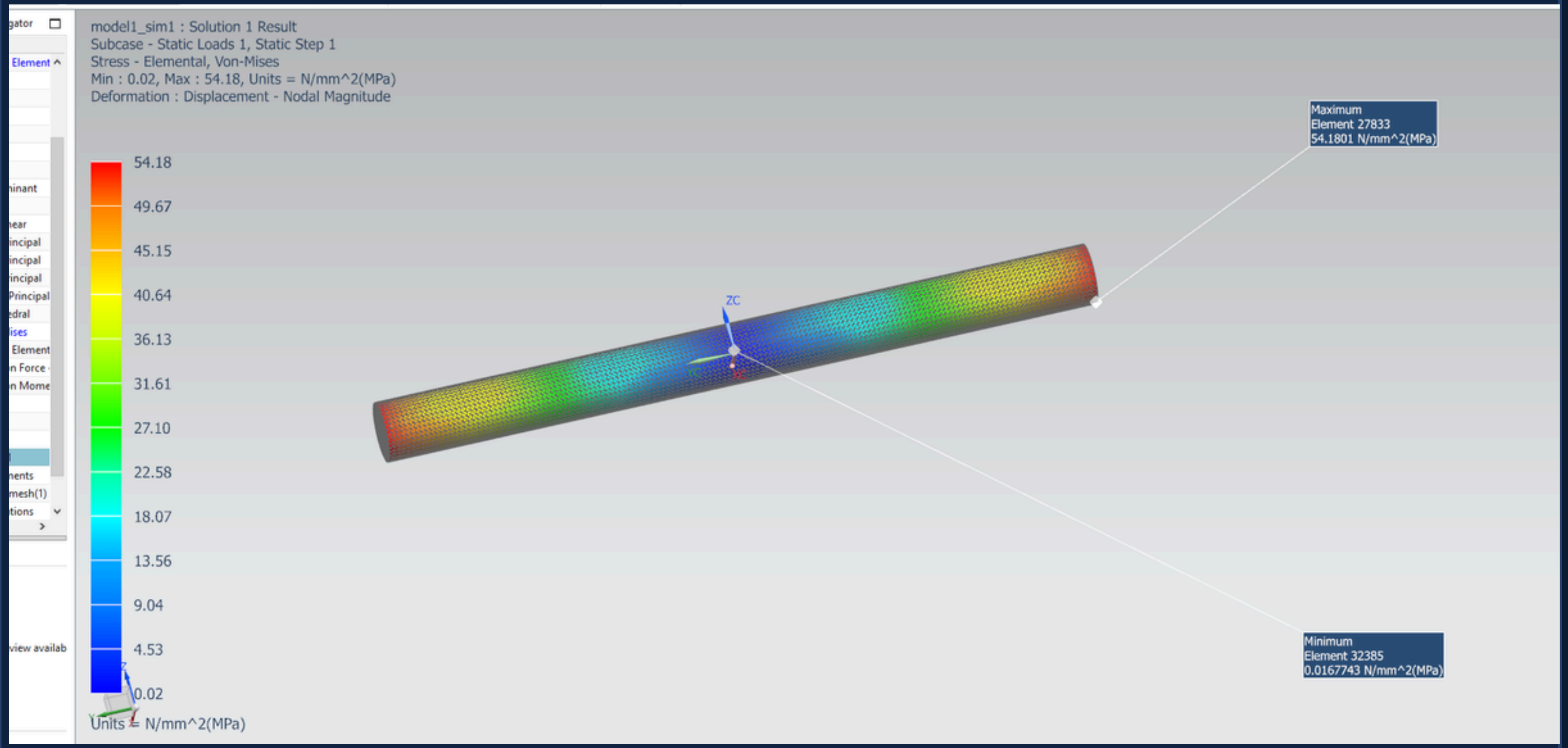


Mesh

Apply BC

Solve

Results



Max Displacement: 54.18 mm

High-Quality FE Mesh

Discretized model with local refinement at critical regions to ensure accuracy.

Representative Loading

Applied realistic boundary conditions and static loads to simulate real-world usage.

NX Nastran Solution

Solved static case in NX Nastran and evaluated displacement and stress distribution.

Critical Insights

Identified regions of maximum stress and displacement to inform design improvements.

End-to-End Workflow

Demonstrates a clean, repeatable CAD-to-validated-result workflow using Siemens NX.

Pulse Detonation Engine — Designed, Built & Fired

ROLE	SOFTWARE	INDUSTRY	OUTCOME
Mechanical Design Lead (5-member team)	Creo	Aerospace Propulsion	Prototype built & live-demonstrated

THE PROBLEM

A bachelor's capstone challenge: translate pulse-detonation propulsion theory into a real, working small-scale engine — one that could be fabricated with student-level resources and safely fired in front of reviewers.

OBJECTIVES

- Apply thermodynamics and fluid dynamics to size the combustion tube and flow path
- Design the complete engine in Creo — combustion section, valve arrangement, ignition, structural interfaces
- Detail every component for real fabrication and select materials for thermal and pressure duty
- Produce realistic renders to carry the design through team reviews

KEY ACHIEVEMENTS

Complete Engine Assembly
Modeled and detailed the entire engine in Creo, from combustion tube to ignition provision.

Built & Successfully Demonstrated
Design manufactured, assembled and successfully demonstrated in a live run by the five-member team.

Real-World Validation
Live demonstration confirmed both the mechanical design and the underlying functional concept.

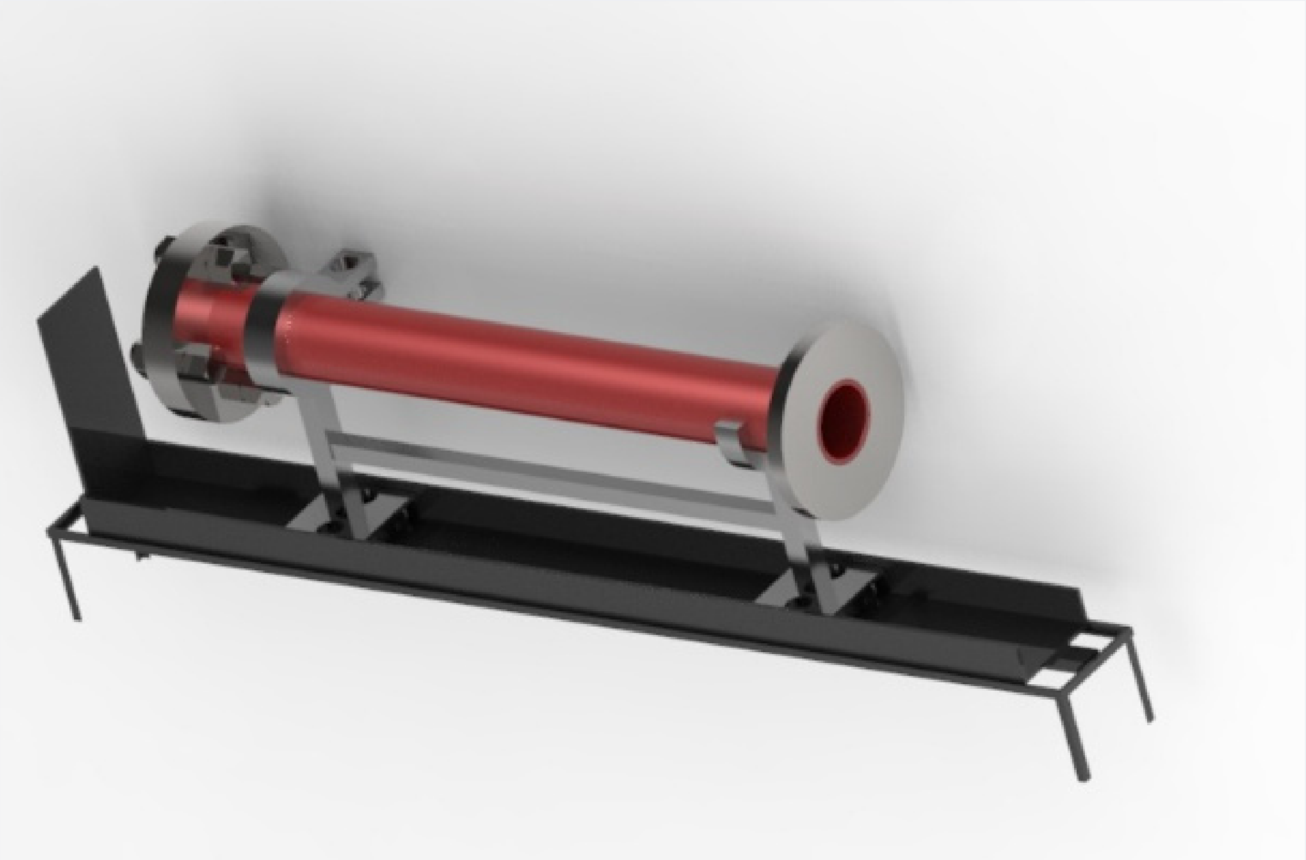


FIG — RENDERED ENGINE ASSEMBLY • CREO

Riveted Joint — Structural FEA

ROLE	SOFTWARE	INDUSTRY	OUTCOME
Structural Design Engineer	Creo • ANSYS	Aerospace Structures	Stress concentration identified

THE PROBLEM

Riveted joints concentrate stress around the fastener holes, and predicting where that concentration will be highest is essential to avoiding fatigue failure in service.

OBJECTIVES

- Build the riveted joint assembly in Creo, with sheet-metal plates and rivet fasteners
- Run a finite element analysis in ANSYS under representative tensile loading
- Refine mesh locally around rivet holes to capture stress concentration accurately
- Map how load transfers through a multi-rivet joint

KEY ACHIEVEMENTS

Stress & Deformation Quantified

Quantified VON-Mises stress and Shear Stress of the riveted joint under applied load.

Critical Fasteners Identified

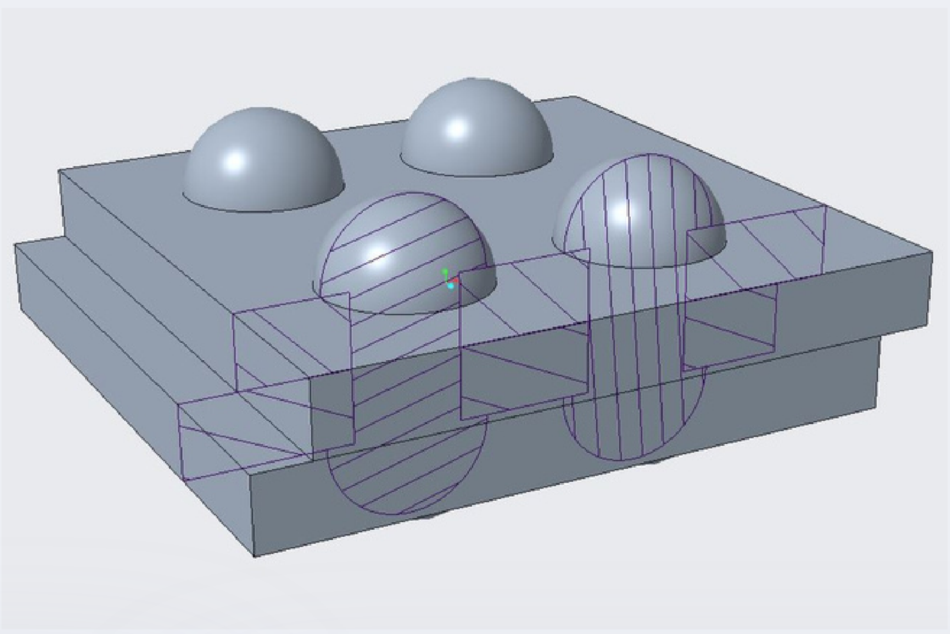
Identified the fastener locations with the highest stress concentration.

Load Transfer Understood

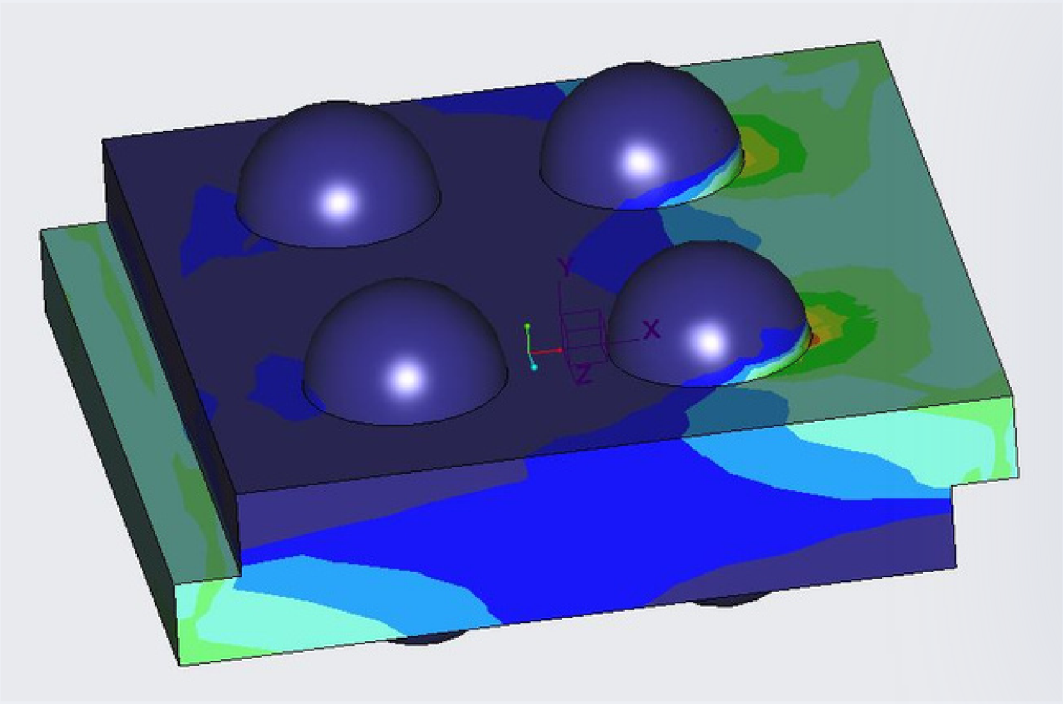
Built a clearer picture of how load transfers through a multi-rivet joint.

Localized Mesh Refinement

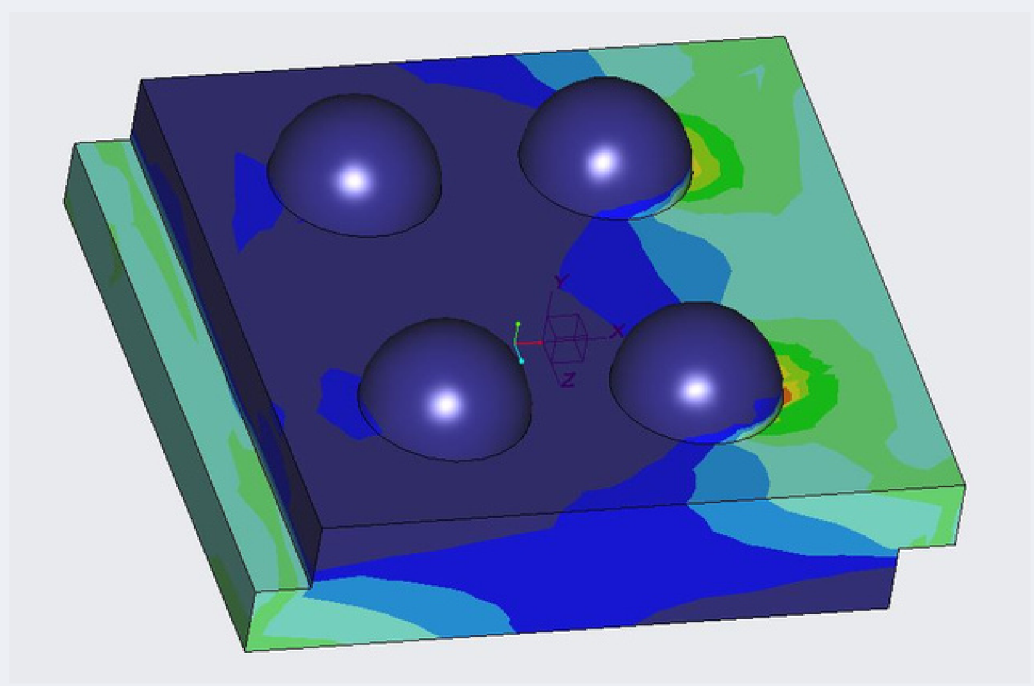
Focused mesh refinement around rivet holes without making the overall model too heavy to solve.



(a)



(b)

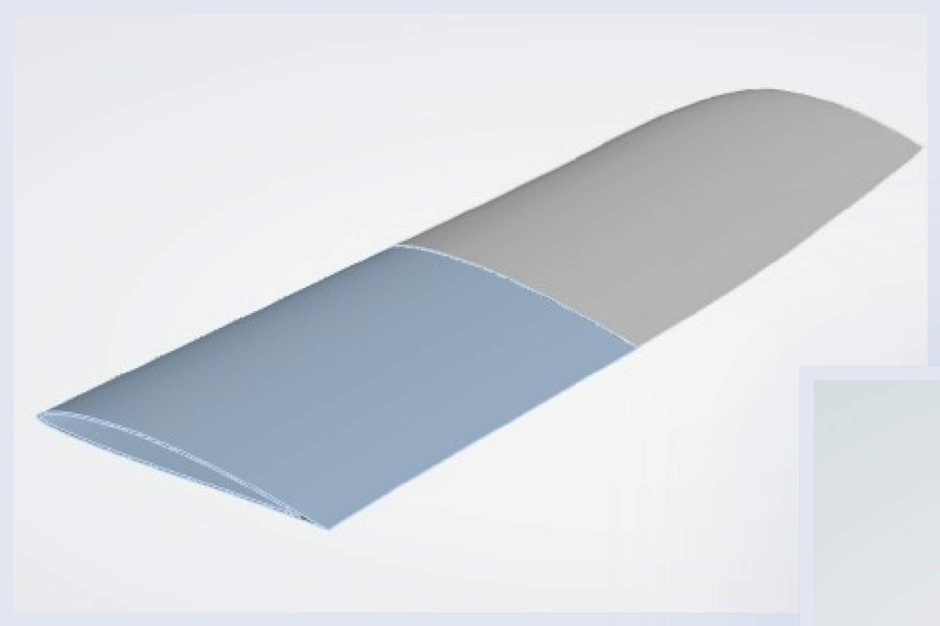


(c)

FIG — (a) CAD , ANSYS (b) Max Shear Stress & (c) Von Mises Stress Result

UAV Wing — Materials Selection, Structural Analysis & Fabrication

ROLE	SOFTWARE	INDUSTRY	OUTCOME
Structural Design Engineer	CATIA • ANSYS	Aerospace Structures	Optimized composite wing



(a)

(b)

FIG- (a) UAV WING CAD MODEL • CATIA, (b) Ansys Meshing

THE PROBLEM

High-aspect-ratio UAV wings are prone to bending and torsional deformation under aerodynamic loading. The wrong material adds weight, reduces stiffness, or causes excessive deflection — and the design must still be manufacturable.

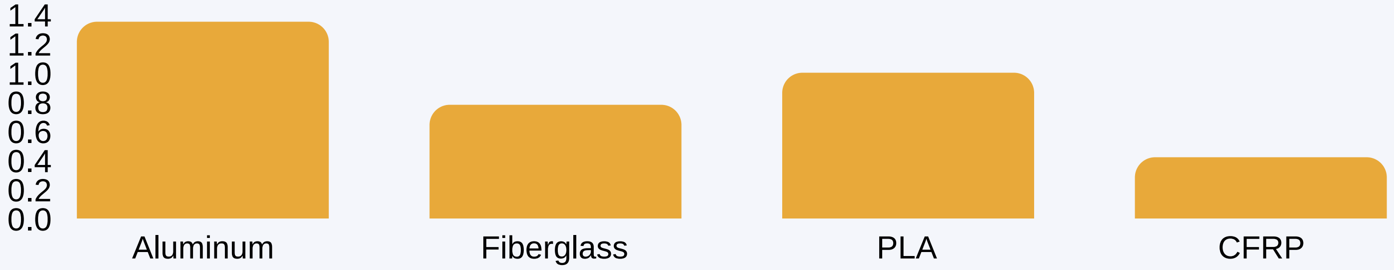
OBJECTIVES

- Design a high aspect-ratio UAV wing in CATIA
- Compare Aluminium, Fiberglass, CFRP & PLA
- Perform static and modal FEA in ANSYS
- Manufacture a composite prototype

MATERIAL COMPARISON

Material	ρ (kg/m³)	E (GPa)	σy (MPa)	Spec. E/ρ
Aluminum	2700	71	280	26.3
Fiberglass	1950	38	550	19.5
CFRP	**1600**	**135**	**800**	**84.4**
PLA	1250	3.5	60	2.8

WEIGHT COMPARISON (SAME STIFFNESS)



MATERIAL SELECTION MATRIX (WEIGHTED)

Material	Stiff	Strgth	Wt	Mfg	Total
Aluminum	3	3	2	4	12
Fiberglass	2	4	3	4	13
CFRP	**5**	**5**	**5**	**4**	**19**
PLA	1	1	5	5	12

KEY RESULT

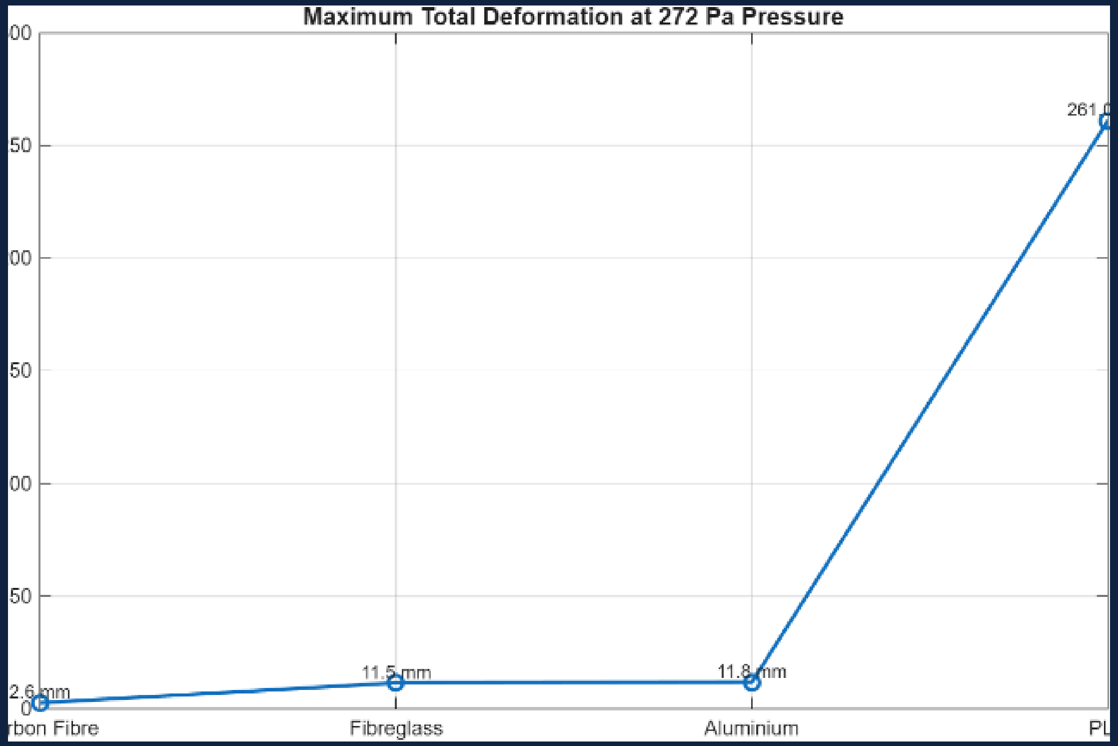
CFRP

selected across all three material-selection methods — Ashby screening, Performance Index, and MCDM — for the best stiffness-to-weight balance.

From material screening to an optimized composite wing

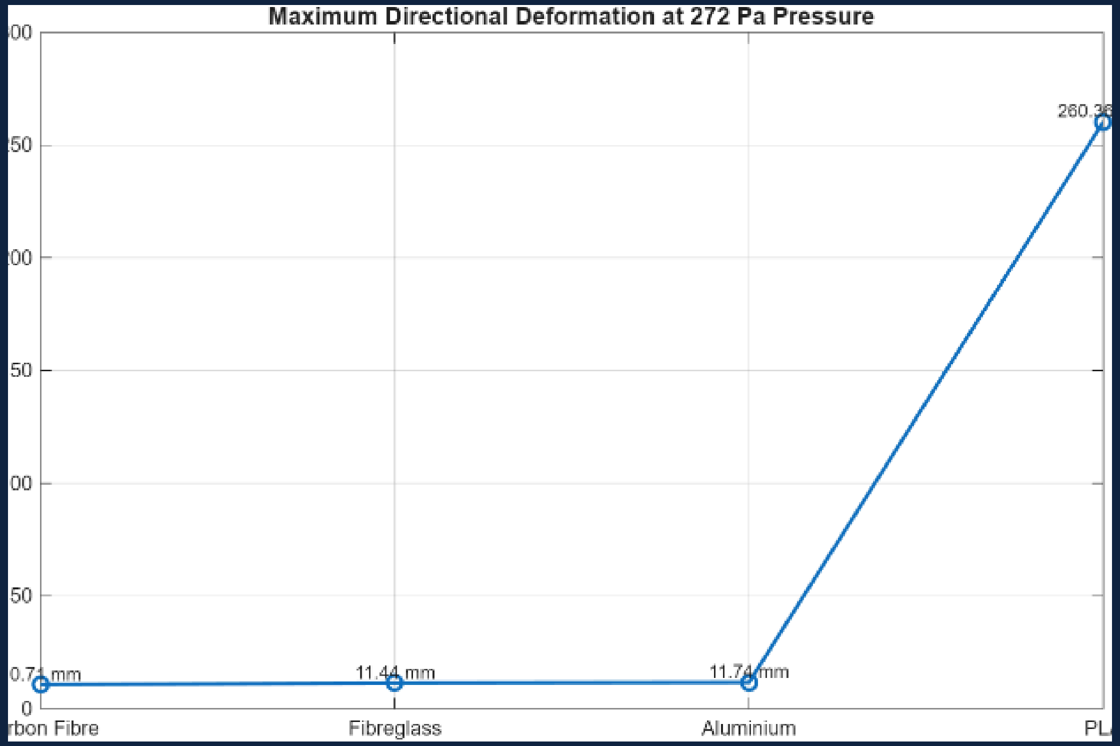
STATIC STRUCTURAL ANALYSIS — MATERIAL COMPARISON AT 272 Pa PRESSURE

TOTAL DEFORMATION (mm)



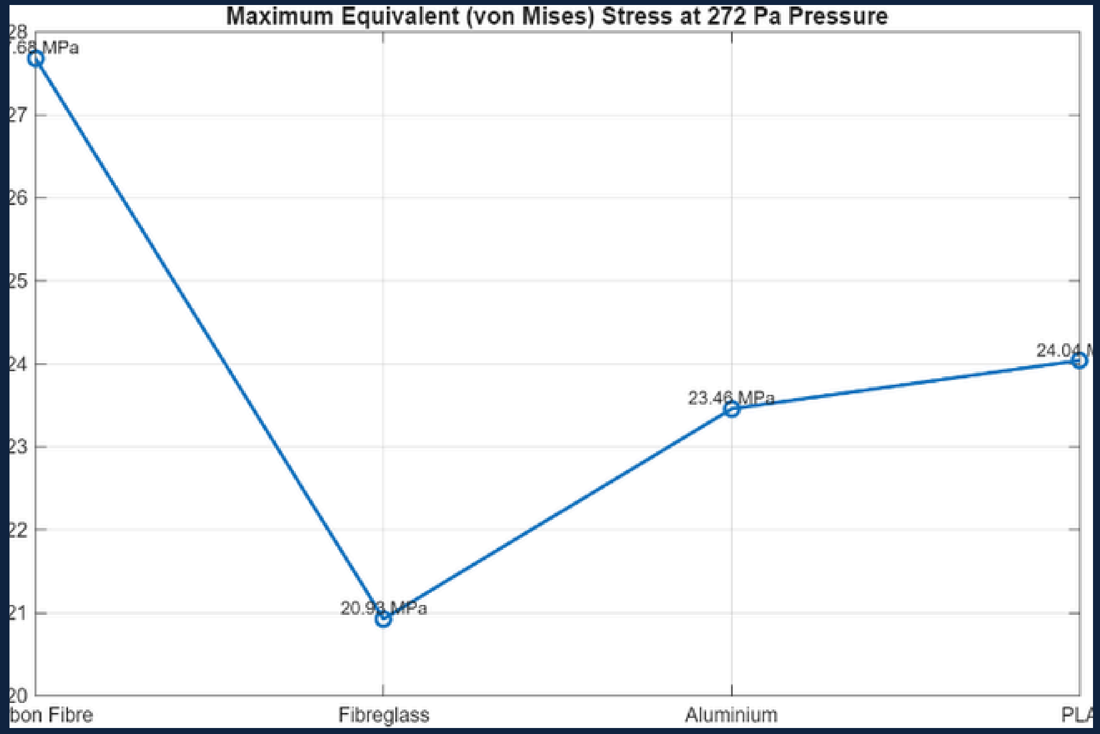
Carbon Fibre 2.6 mm → PLA 261.0 mm

DIRECTIONAL DEFORMATION (mm)



Carbon Fibre 10.7 mm → PLA 260.4 mm

VON MISES STRESS (MPa)



Carbon Fibre 27.7 MPa → Fiberglass 20.9 MPa

KEY OBSERVATIONS

1. Deformation stays under 12 mm for Carbon Fibre, Fiberglass and Aluminium, but rises to 261 mm for PLA — roughly 100× higher under the same load.
2. Directional deformation follows the same pattern: PLA deflects 260.4 mm versus 10.7 mm for Carbon Fibre, confirming PLA is unsuitable for a load-bearing wing.
3. Carbon Fibre carries the highest Von Mises stress (27.7 MPa) of the four, yet stays ~29× below its 800 MPa yield strength — the largest safety margin overall.

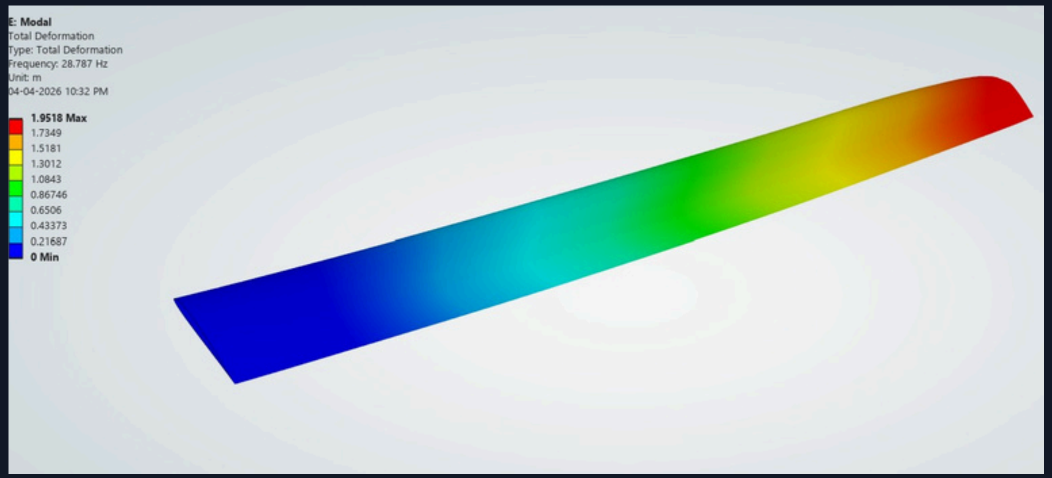
OUTCOME

CFRP selected for the final wing design — lowest deformation of all candidates and the widest structural safety margin, at 65% less weight than Aluminium.

2.238 mm	12.45 Hz	65%
Max Deflection	1st Natural Freq.	Weight vs. Aluminium

Modal Analysis

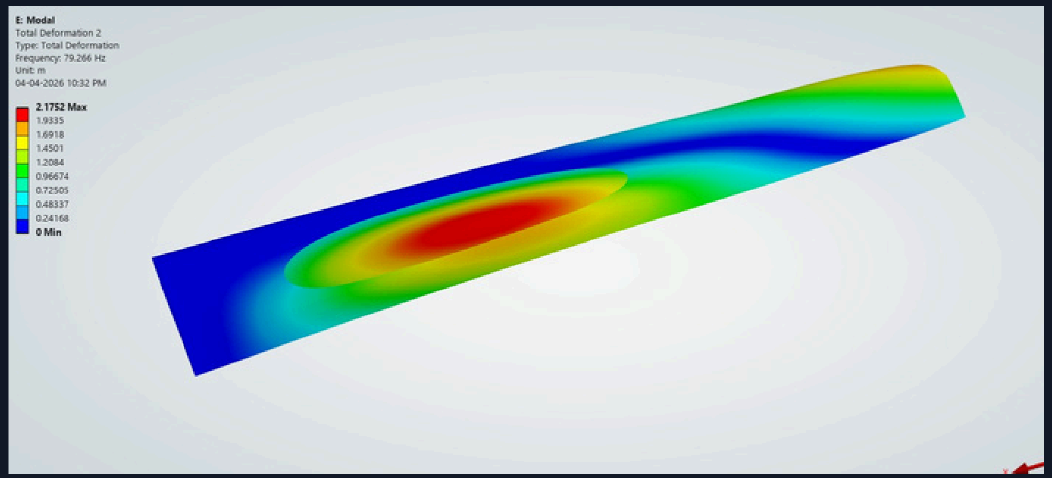
Free-vibration analysis of the optimized CFRP wing structure — natural frequencies and mode shapes from ANSYS Mechanical.



MODE 1 28.79 Hz

Bending

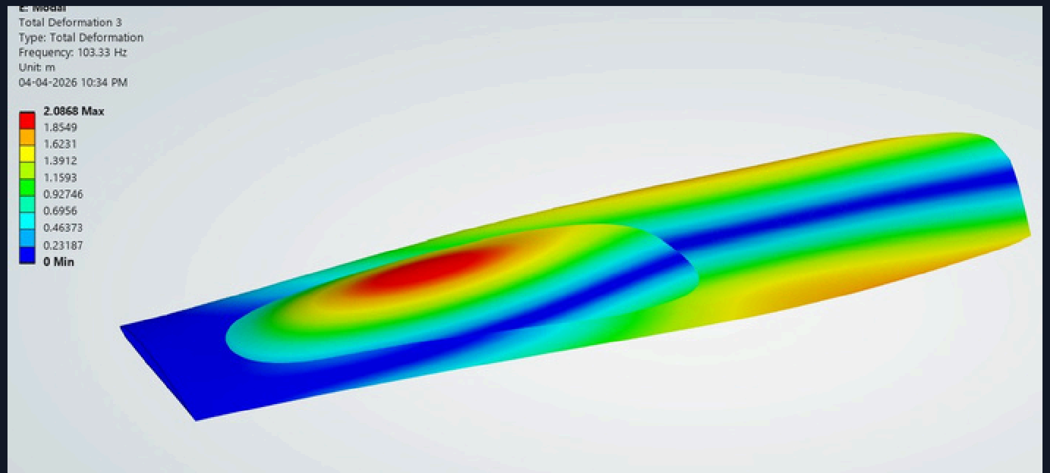
Vertical bending with maximum deflection at the tip — the primary, lowest-frequency structural response.



MODE 2 79.27 Hz

Torsion

Twisting about the longitudinal axis — governs lift distribution and flutter behavior.



MODE 3 103.33 Hz

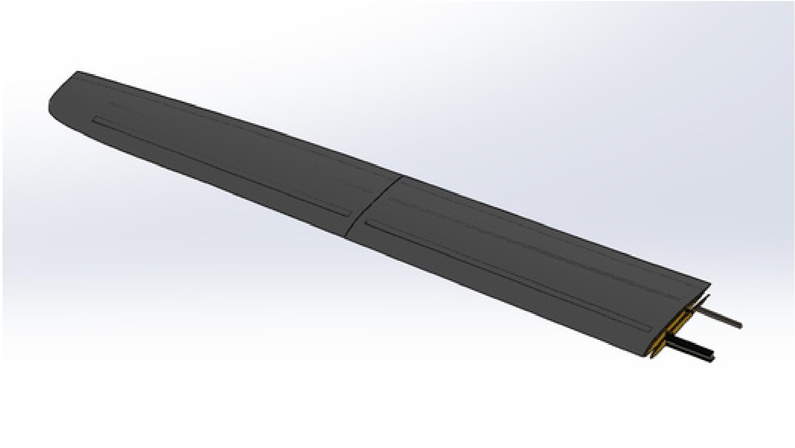
Coupled Bending–Torsion

Combined bending and twist — key indicator for aeroelastic stability and flutter onset.

FIRST SIX NATURAL FREQUENCIES

Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6
28.79 Hz	79.27 Hz	103.33 Hz	124.05 Hz	141.45 Hz	160.81 Hz

From digital design to a manufactured composite prototype



1. CATIA Design

Final optimized CAD model of UAV wing

2. Composite Layup

Carbon-fiber wet layup with epoxy resin system

3. Vacuum Bagging

Vacuum bagging for consolidation and void removal

4. Ribs

Manufactured composite UAV wing prototype

PROCESS HIGHLIGHTS

- Selected optimized hybrid composite structure (CFRP)
- Fabricated using wet layup and vacuum bagging
- Used 3D printing for molds and jigs, and laser cutting for ribs

OUTCOME

- Manufacturing process successfully demonstrated
- Composite prototype validated the complete design workflow
- Lightweight, stiff and manufacturable UAV wing achieved

1.85e+08 Pa
MAX STRESS

2.238 mm
MAX DEFLECTION

12.45 Hz
1st NATURAL FREQUENCY

65% (vs. Al)
WEIGHT REDUCTION

Springback Prediction of CFRP Composite Laminates

ROLE	SOFTWARE	INDUSTRY	OUTCOME
Simulation Engineer	ANSYS Workbench • ACP • CATIA	Composites Manufacturing	Prototype-free springback prediction

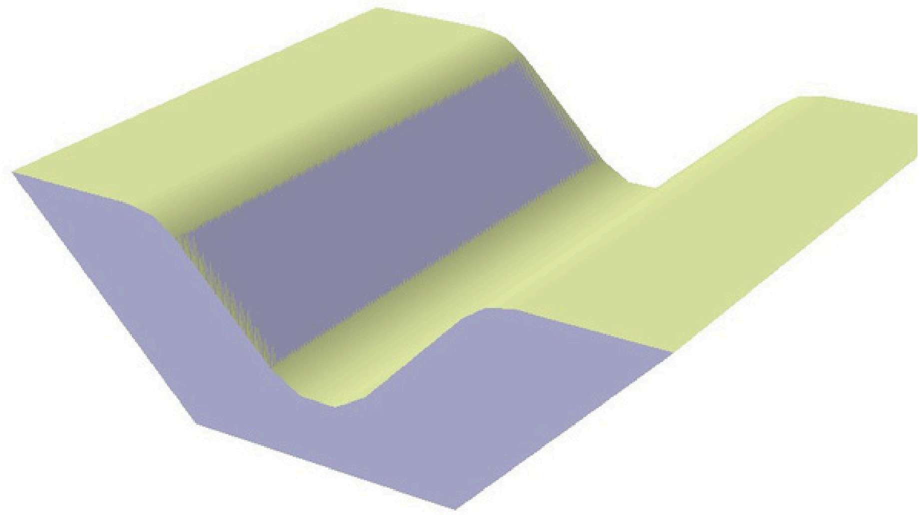


FIG — V-LAMINATE & MOULD GEOMETRY • CATIA

THE PROBLEM

Composite parts spring back after demoulding as cure- and cooling-induced residual stresses release, distorting geometry, driving rework, and raising production cost. Few existing studies compare mould material and cure state together in one deployable simulation workflow.

OBJECTIVES

- Predict post-demoulding springback of a V-shaped CFRP laminate purely by simulation
- Quantify the influence of mould material — steel vs. composite
- Quantify the influence of laminate cure state — cured vs. uncured
- Deliver a reusable workflow for tooling design and process optimization

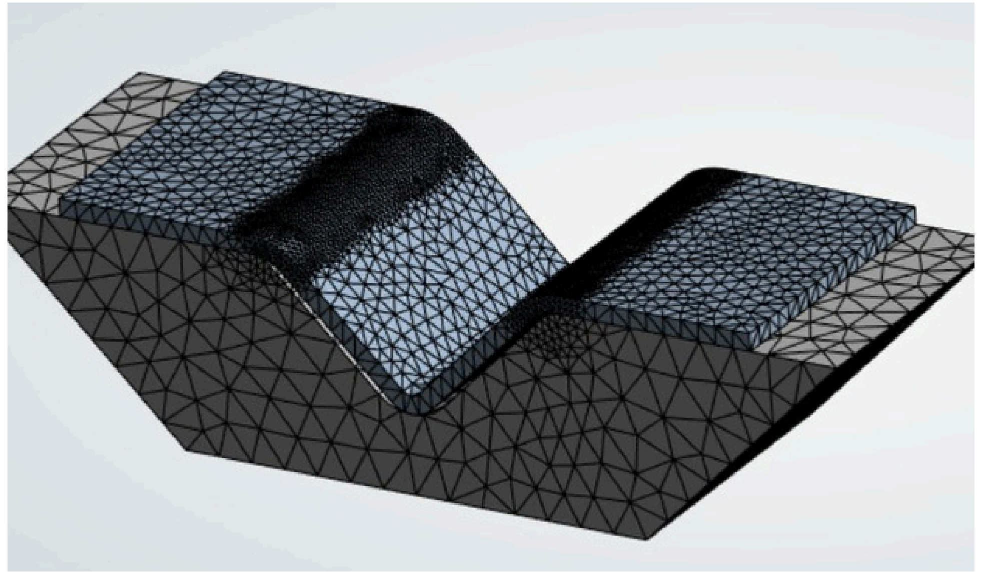


FIG — MESHED LAMINATE & MOULD

CFRP LAMINATE (AS4/8552 UD)

Density	1600 kg/m³
E_1 (Longitudinal)	140 GPa
$E_2 = E_3$ (Transverse)	10 GPa
Poisson's Ratio (ν_{12})	0.29
Stacking Sequence	[0/90/90/0]

STEEL MOULD

Density	7850 kg/m³
Young's Modulus	200 GPa
Poisson's Ratio	0.30
Thermal Conductivity	60.5 W/m·K
Coeff. Thermal Exp.	12×10^{-6} °C^{-1}

COMPOSITE MOULD

Density	1600 kg/m³
Young's Modulus	70 GPa
Poisson's Ratio	0.30

A coupled thermal-structural workflow, validated across four scenarios

01 — ACP (Pre) Layup
Orthotropic laminate model in ACP

›

02 — Transient Thermal
Full curing cycle to build residual stress

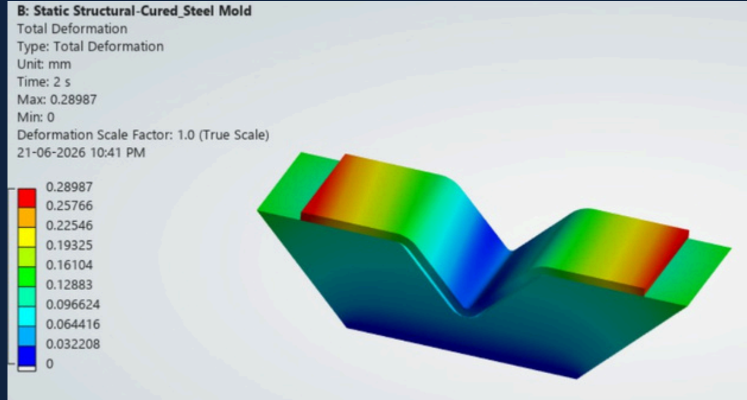
›

03 — Frictional Contact
Laminate-mould interaction that locks stresses in

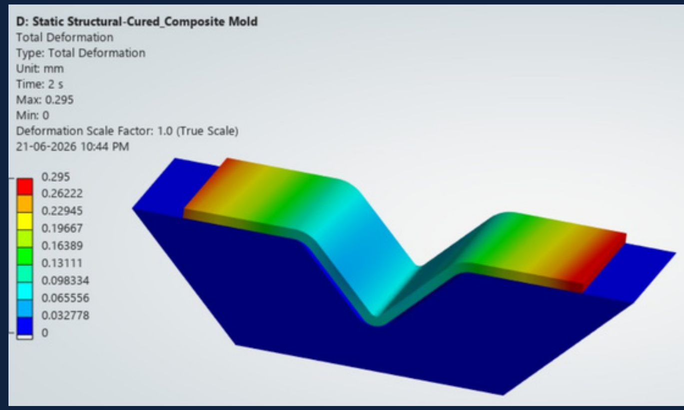
›

04 — Static Structural
Demoulding simulated — released deformation = springback

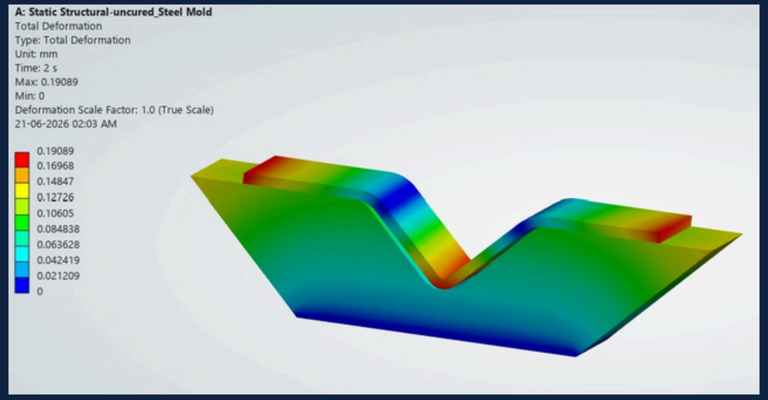
FOUR SCENARIOS ANALYSED — TOTAL DEFORMATION (mm)



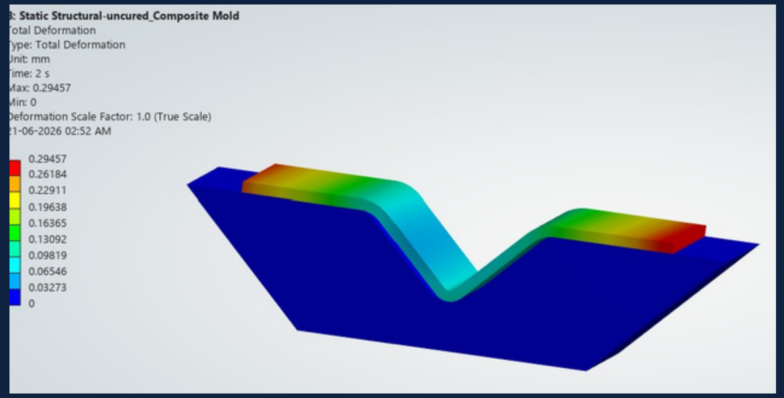
A — Steel Mould, Cured



B — Composite Mould, Cured

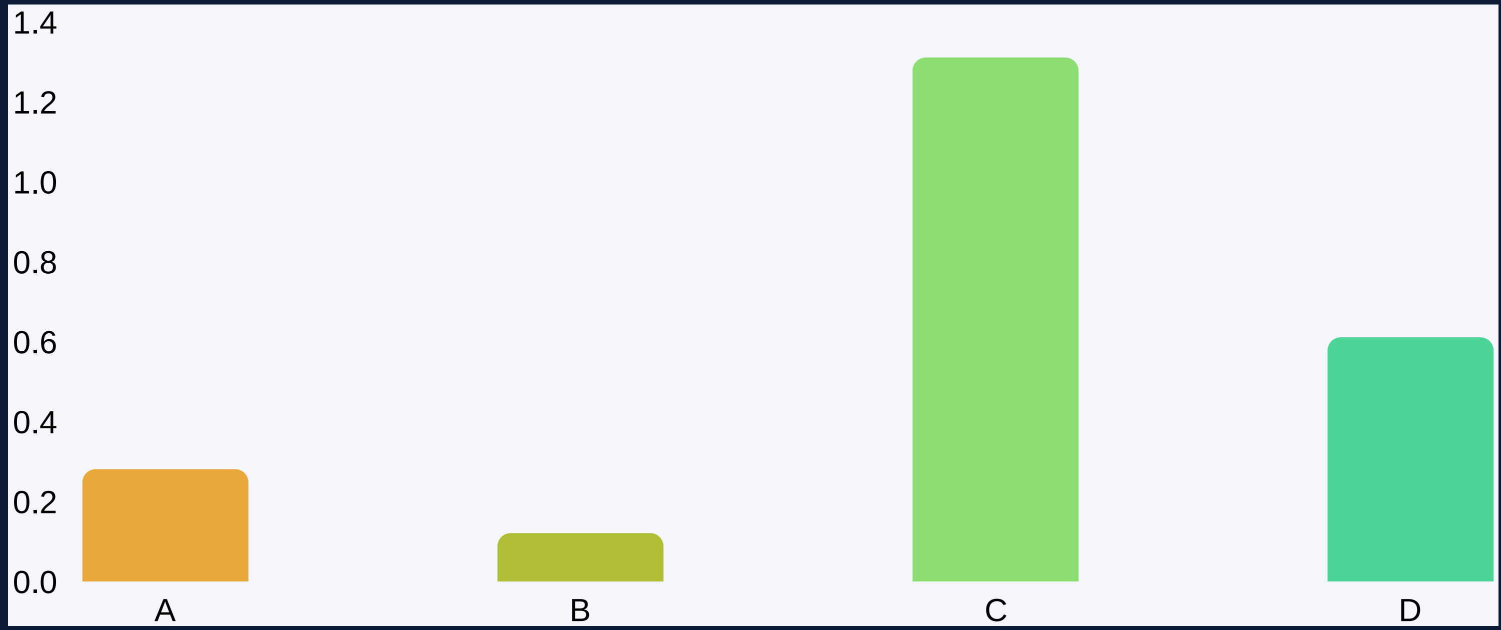


C — Steel Mould, Uncured



D — Composite Mould, Uncured

SPRINGBACK COMPARISON (mm)



RESULT HIGHLIGHTS

Scenario	Max (mm)
A — Steel, Cured	**0.28**
B — Composite, Cured	**0.12**
C — Steel, Uncured	**1.31**
D — Composite, Uncured	**0.61**

TAKEAWAY

Composite mould + cured laminate minimizes springback by up to ~96% vs. steel mould + uncured case. FEA proven as a driver for tooling design, cutting trial-and-error in composite production.

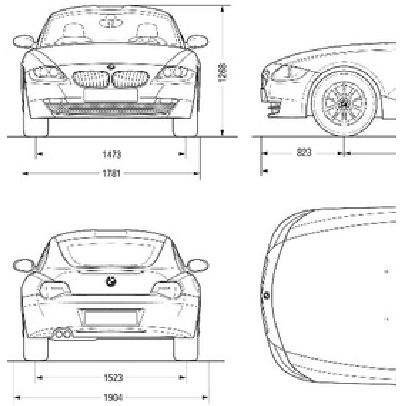
PRJ-007 • CAD MASTERY

CAD Modelling & Visualisation Portfolio

Nine precision modelling studies — Class-A surfacing, assemblies, materials, decals, and photorealistic rendering across CAD platforms.

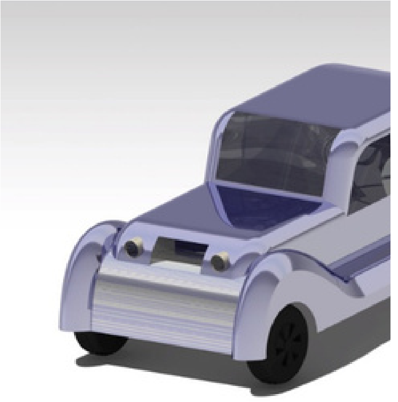
01 Dassault Falcon

- Image tracing & freestyle
- Generative Shape Design
- Part design & surfacing



02 BMW Surface Study

- Class-A surface modelling
- Applied materials
- Photorealistic rendering



03 Concept Car

- Part design & surfacing
- Materials & rendering
- Concept visualization

04 Quadcopter

- Part & assembly modelling
- Component positioning
- Photorealistic rendering

05 Smartphone

- Accurate part features
- Materials assigned
- Realistic product model

06 Chess Set

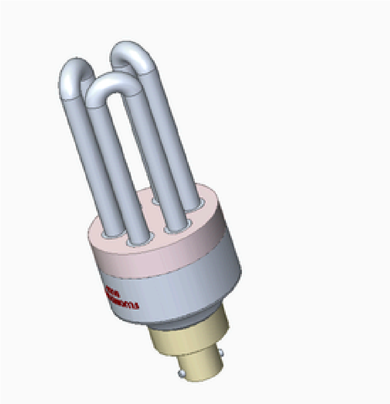
- Part design & assembly
- Materials & textures
- Decals for board

07 Beverage Can

- Part & surface design
- Custom label (sticker)
- Photorealistic rendering

08 Hair Dryer

- Smooth surfacing
- Materials applied
- Photorealistic rendering



09 CFL Bulb

- Complex geometry
- Accurate modelling
- Product visualization

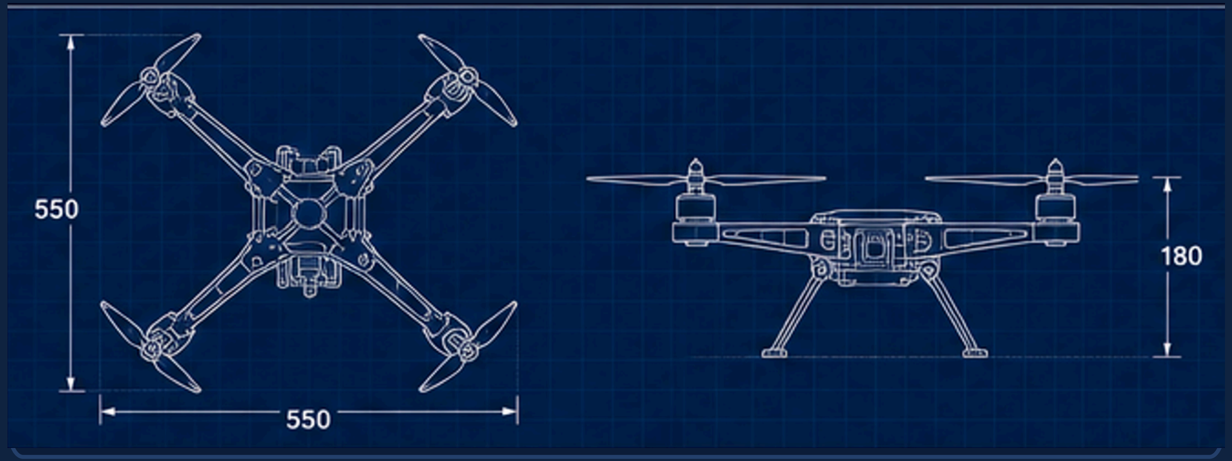
ADDITIONAL EXPOSURE

Hands-on workshops beyond the core project list

Practical workshops that strengthened my hands-on skills in design, fabrication, assembly and systems understanding.

01 QUADROTOR WORKSHOP

Hands-on workshop on quadrotor design and construction — practical exposure to UAV systems, fabrication, and flight mechanics, plus assembly and operational understanding of multirotor platforms.

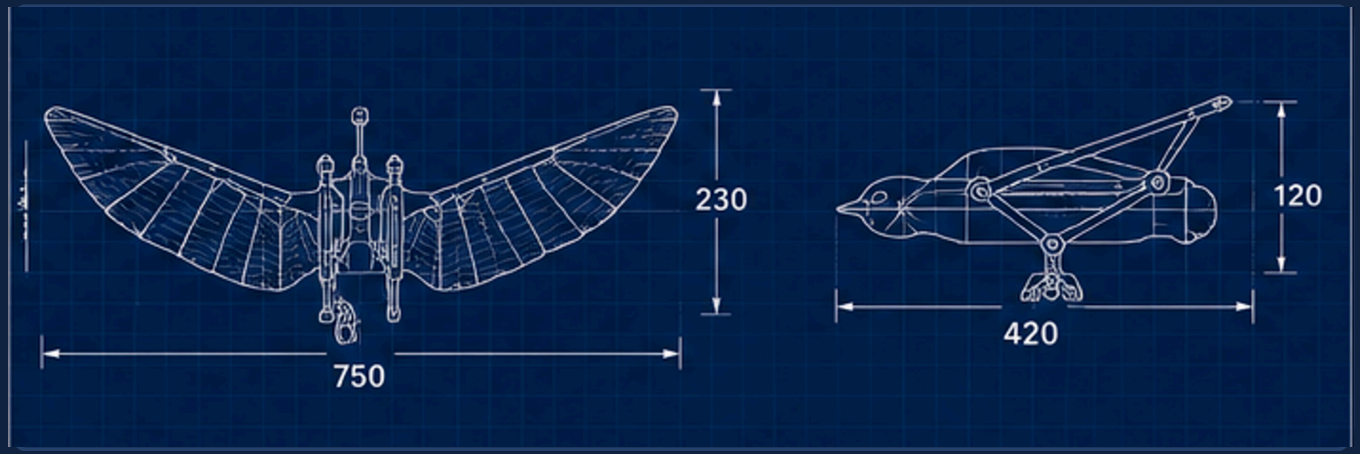


WORKSHOP HIGHLIGHTS

- Designed and modelled quadrotor frame in CAD for strength and weight optimization
- PID tuning and flight calibration
- Propulsion system setup and thrust balancing
- Integrated electronics: ESC, flight controller, motors, wiring
- Fabricated frame using CNC/laser cut parts and hardware assembly
- Test flights and performance evaluation

02 ORNITHOPTER WORKSHOP

Workshop on the design and fabrication of ornithopter systems — lightweight aerospace structures and bio-inspired flapping-wing mechanisms, with hands-on mechanical assembly and fabrication.



WORKSHOP HIGHLIGHTS

- Designed bio-inspired flapping-wing mechanism in CAD
- Tuning of stroke, frequency and amplitude
- Integrated drive system with motors and transmission
- Developed wing mechanism with optimized linkage and motion
- Fabricated lightweight structure using CNC cut parts and 3D printed components
- Performance testing and iterative design improvements

SERVICES

How I can help on your next engineering project

End-to-end engineering support combining design, analysis, optimization, and documentation to turn ideas into high-performance solutions.

01

CAD Modeling & Product Design

Part, surface & assembly modeling across Creo, CATIA, Siemens NX, SolidWorks, and Autodesk Inventor. Clean, parametric models built for manufacturability and performance.

02

Structural Analysis & FEA

Static, modal, and thermal-structural finite element analysis using ANSYS and NX Nastran to validate performance, safety, and reliability.

03

Composite Design & Simulation

Laminate layup design, cure simulation, and springback/residual-stress prediction using ANSYS ACP for advanced composite structures.

04

Design Optimization

Topology optimization and material selection using Ashby charts, Performance Index, and MCDM methods to deliver lightweight, efficient, and cost-effective designs.

05

Prototype & Fabrication Support

Design-for-manufacture guidance, mould and tooling geometry, and hands-on support for CNC, 3D printing, composites, and prototype development.

06

Technical Documentation

Clear engineering reports, design reviews, and calculation packages for cross-functional teams and certification-ready deliverables.

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