ENGINEERING PORTFOLIO

Dana Martinez Gonzalez

Table of contents

Profile

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About this portfolio

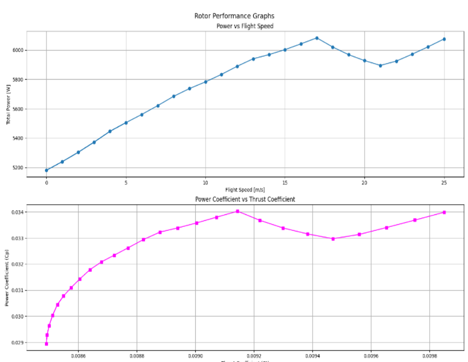
This portfolio complements my resume by highlighting selected projects I have completed during my undergraduate studies in Mechanical Engineering, with a minor in Aerospace Engineering. I strongly believe that hands-on, project-based experience is essential in engineering education. Throughout my studies, I have worked on a range of projects involving mechanical design, analysis, manufacturing, and aerospace applications, each contributing to my technical growth and problem-solving skills.

For each project, I include a brief description, relevant visuals, and, where applicable, code or analysis tools developed as part of the work. If you have any questions or would like to discuss any project in more detail, feel free to contact me.

Rotor Power Calculator (Python GUI)

Overview

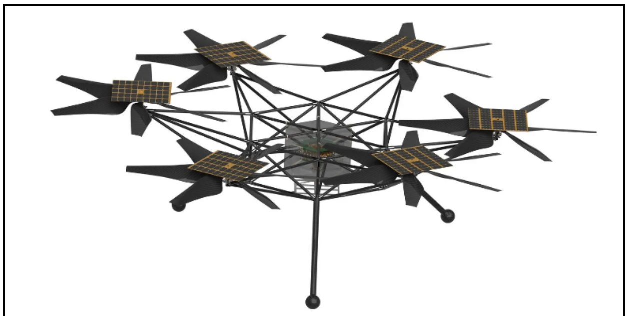
- A Python-based engineering tool developed during my internship at NASA Ames Research Center, within the Rotorcraft Aeromechanics group.
- The project focused on developing a rotorcraft power calculator to support preliminary performance analysis under varying flight conditions.
- The tool allows users to evaluate rotor power requirements as a function of parameters such as air density, rotor geometry, thrust, and forward flight conditions.



Default plots generated for CHOPPER mode: Total Power vs. Flight Speed and Power Coefficient vs. Thrust Coefficient.

Constants	Inputs
Gravity	Density
Gas constant	Temperature
Specific heat ratio	Mass
Rotor radius	RPM
Thrust-weighted blade solidity	Ground speed
Download factor	Wind speed (swept – initial to final, Δ)
Power error bias factor	Climb speed
	Turn rate
	Horizontal acceleration
	Vertical acceleration
	C_P tables

Calculated Values	
Speed of sound	Advance ratio
Vehicle weight	Ideal hover induced velocity
Power required for climb	v/vh
Rotor disk area	CW/s
Rotor blade area	CT/s total
Thrust	Power (interpolated)
Tip speed	Climb power factor (interpolated)
Tip Mach	Climb power increment
Flight Mach	Total power
Advancing tip Mach	

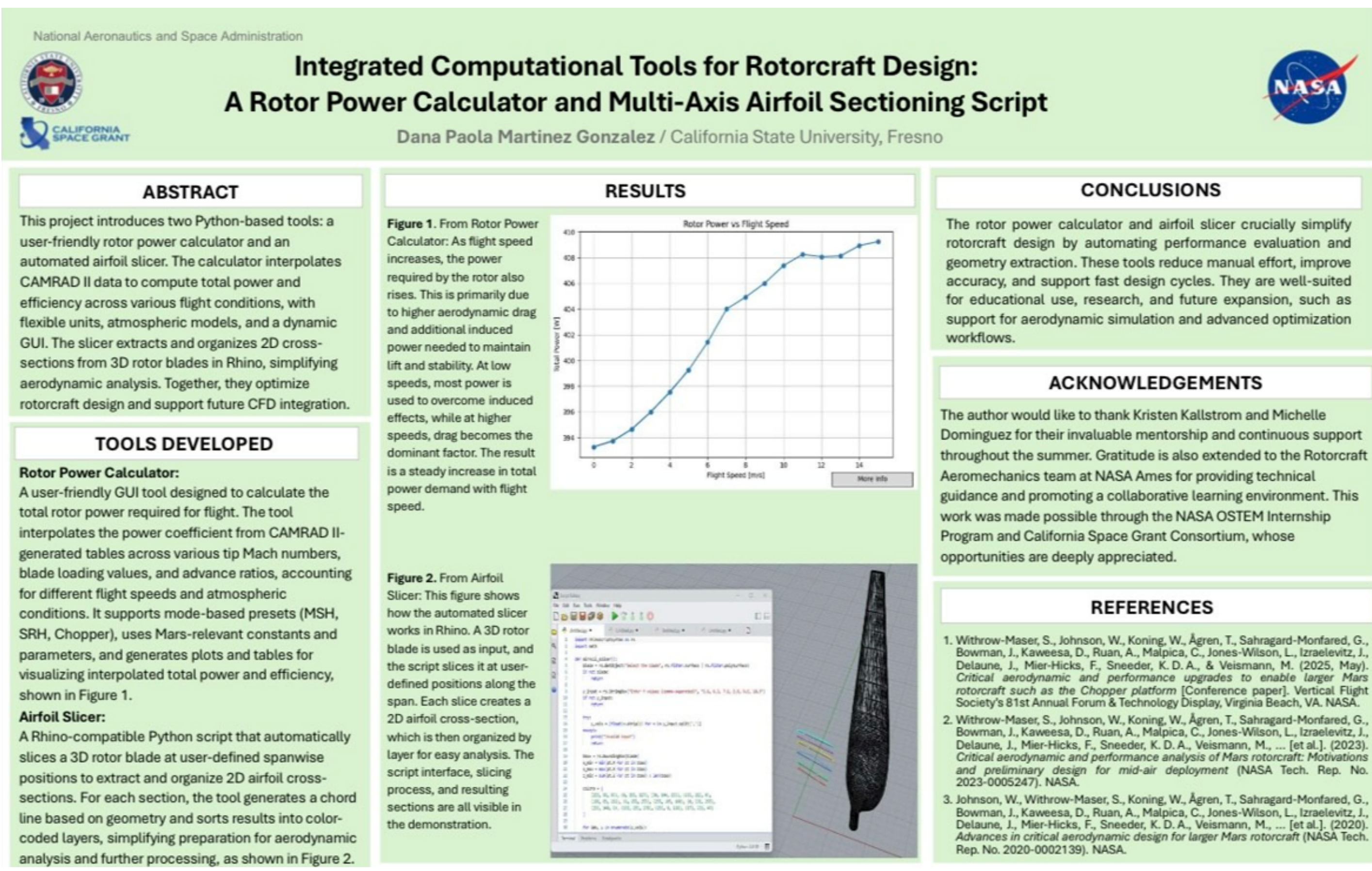


CHOPPER concept rendering. Credit: NASA/JPL-Caltech

- The figures above show the Python rotorcraft power calculator workflow and outputs, where flight inputs are converted into performance metrics and visualized through power and efficiency plots.
- The figure on the left shows the CHOPPER rotorcraft concept, a multi-rotor configuration used as a reference case for evaluating power consumption and performance trends in the Python rotorcraft power calculator.

Technical Implementation

- The application was fully developed in Python, using scientific and plotting libraries for numerical computation and data visualization.
- The GUI was designed to allow real-time parameter updates and automatic plot generation.
- The code structure was modular, separating input handling, aerodynamic calculations, and plotting logic.
- The tool supports multiple rotorcraft configurations, enabling comparison across different designs.
- Emphasis was placed on code clarity, scalability, and engineering-oriented usability.



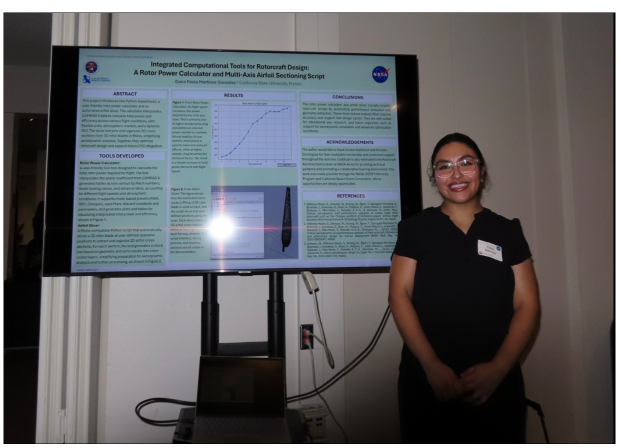
Poster Presentation

My contributions

- Designed and implemented the Python codebase for the rotorcraft power calculator.
- Developed the GUI interface to make the tool accessible to non-programmer users.
- Implemented aerodynamic and performance equations based on rotorcraft theory.
- Created plots and visual outputs to clearly communicate performance trends.
- Tested and validated the tool under multiple flight and density conditions.

Results

- Delivered a functional and user-friendly engineering tool used for rotorcraft performance evaluation.
- Improved efficiency in exploring design trade-offs during early-stage analysis.
- The project contributed to ongoing research and analysis workflows within the group.
- The work was documented and summarized as part of my NASA internship technical report.



Internship Pictures

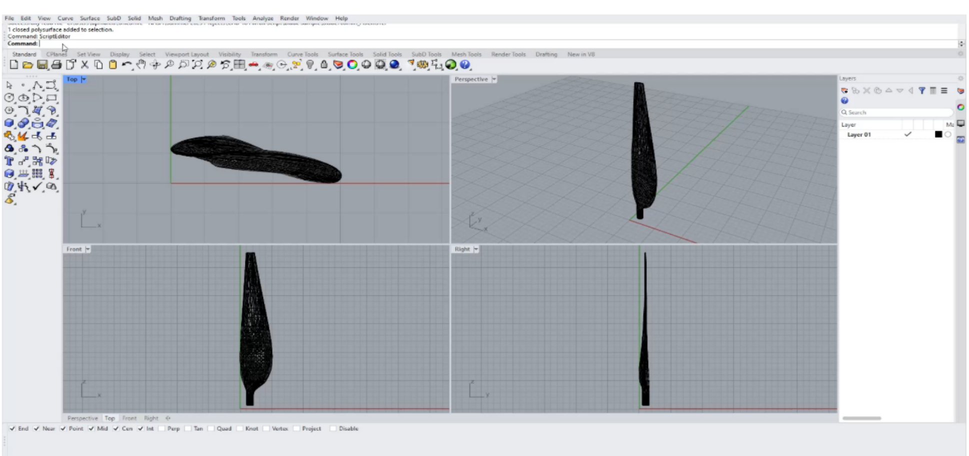
Airfoil Slicer

Overview

- A Rhino-based airfoil slicing tool developed during my internship at NASA Ames Research Center.
- The tool was created to extract 2D airfoil sections from complex 3D rotor blade geometries.
- It automates the slicing process along specified spanwise locations to support aerodynamic analysis and modeling.
- The figures above show the 3D blade geometry and the resulting airfoil cross-sections.

Technical Implementation

- Implemented a Rhino-based workflow to slice 3D rotor blade geometry into 2D airfoil sections.
- Defined spanwise slicing planes to extract airfoil profiles at user-specified locations.
- Automated geometry intersection and curve extraction for consistent airfoil output.
- Exported airfoil data for use in aerodynamic and performance analysis tools.

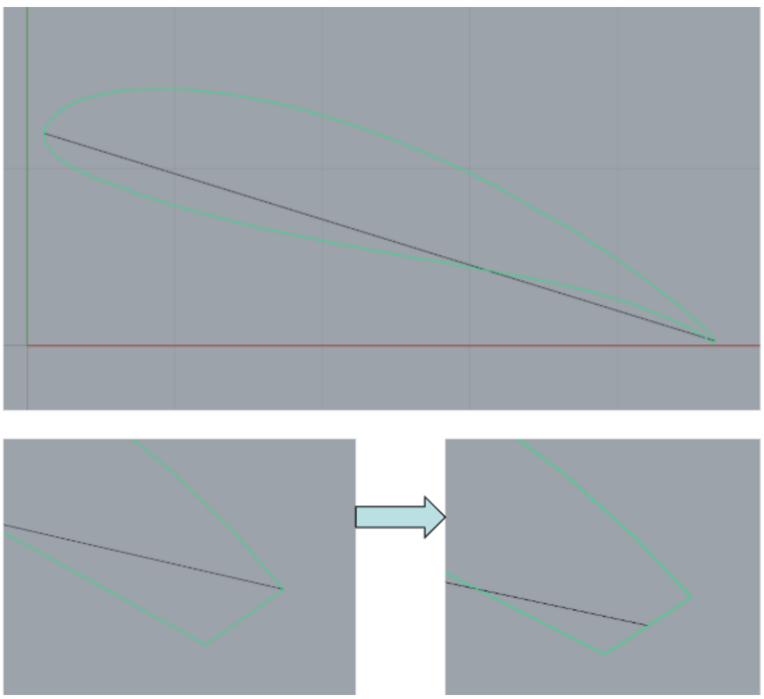


Results: Airfoil Slicer (Visualization)

- The figure shows the 3D rotor blade geometry displayed in Rhino, viewed from multiple orthographic and perspective angles, which was used as the input model for the airfoil slicing and section extraction process.

My contributions

- Developed the slicing logic and workflow within Rhino.
- Defined spanwise section locations and ensured consistent airfoil extraction.
- Processed and organized airfoil outputs for use in analysis tools.
- Verified geometric accuracy of extracted sections.



- The figure shows automated airfoil extraction in Rhino, where blade cross-sections are generated at user-defined spanwise locations, chord lines are computed, airfoils are aligned for normalization, and chord length data is prepared for export.

Results

- Enabled faster and more reliable extraction of airfoil data from rotor models.
- Reduced manual geometry processing time.
- Supported downstream aerodynamic and performance analyses during the internship.

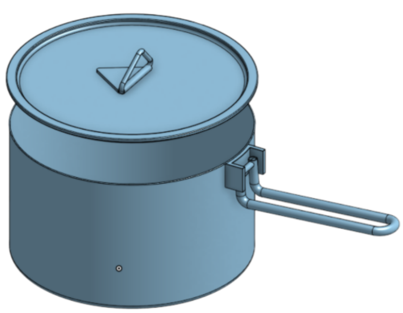
OptiCook Camping Pot

Overview

- OptiCook Camping Pot is a compact cookware design project focused on functionality, durability, and manufacturability.
- The project explored material selection, forming processes, joining methods, and surface treatments for a lightweight camping pot system.
- The design emphasizes heat efficiency, corrosion resistance, and cost effective mass production.
- The project was completed as part of an engineering design and manufacturing course.

Technical Implementation

- Selected titanium for the pot body due to its high strength to weight ratio, corrosion resistance, and thermal performance.
- Applied deep drawing, punch blanking, cold rolling, and rotary punching for pot and lid fabrication.
- Designed the handle using injection molded Bakelite for thermal insulation and user safety.
- Integrated laser beam welding, milling, drilling, and bending for precise assembly and structural integrity.



- The figure shows the compact campfire pot design, highlighting material selection, shaping and forming processes, and joining and finishing details. The design emphasizes functionality, cost efficiency, and suitability for a streamlined production line.

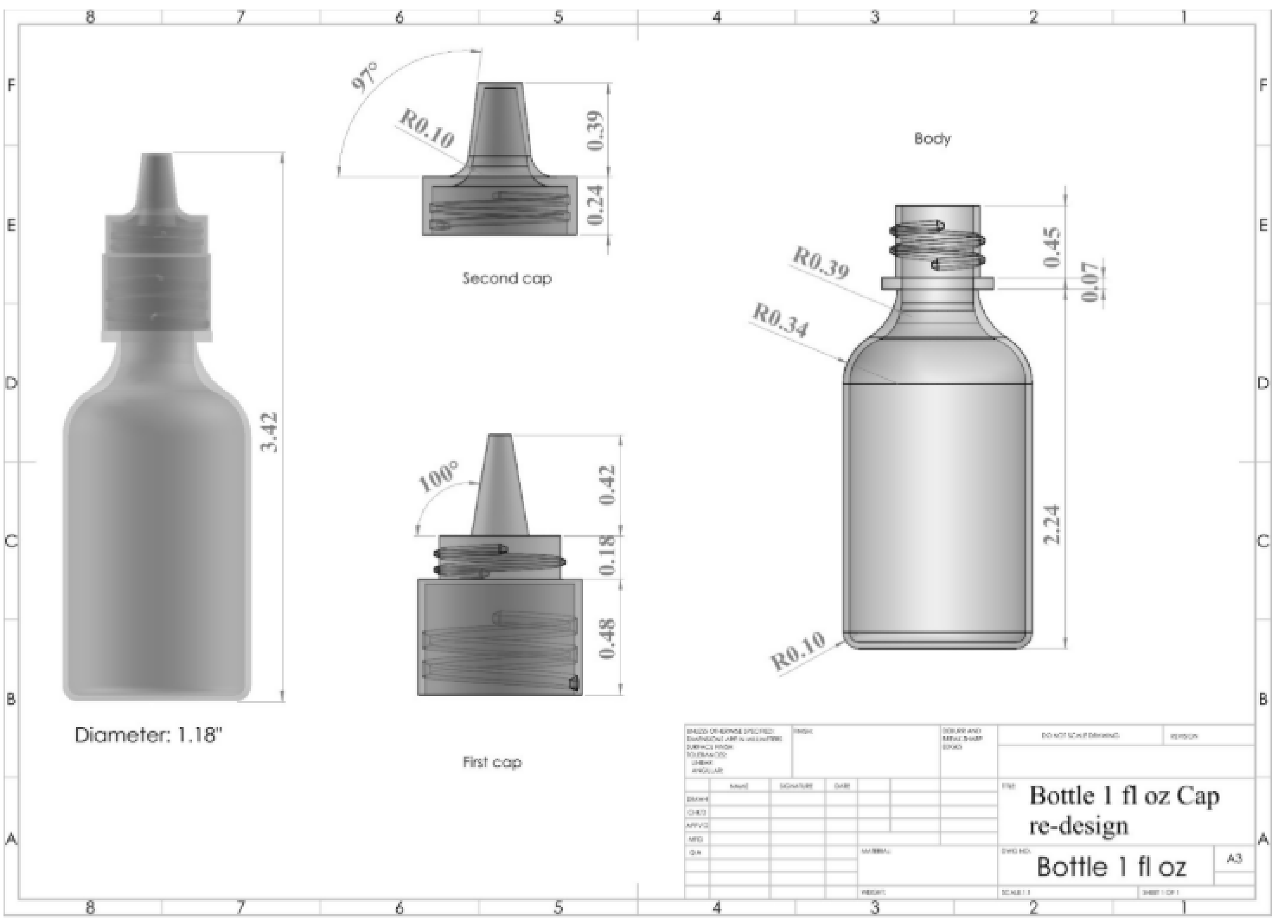
Results

- Delivered a complete, manufacturable camping pot concept optimized for weight, durability, and cost.
- Demonstrated a realistic production line workflow from raw material to finished product.
- The final design balanced performance, manufacturability, and user safety, meeting project goals successfully.

Packaging Component Redesign

Overview

- Engineering internship project focused on product packaging design and process improvement at iLoveToCreate.
- Worked on redesigning packaging components to improve manufacturability and production efficiency.
- Projects supported both design engineering and operations and quality teams.
- The figures above show a CAD-based packaging component redesign.



SolidWorks Model of 1fl oz Bottle

Technical Implementation

- Redesigned the 1 fl oz bottle and cap assembly in SolidWorks with fully defined, parametric features.
- Created detailed dimensioned drawings for the bottle body and cap components to meet manufacturing requirements.
- Refined thread geometry, fillets, and tolerances to improve fit, functionality, and manufacturability.
- Ensured design consistency across components to support quality control and production documentation.

My contributions

- Created packaging specifications and engineering drawings for new product lines using SolidWorks and ArtiosCAD.
- Led the SolidWorks redesign of the 1 fl oz bottle and cap assembly, including detailed dimensions and tolerances.
- Conducted time studies and data analysis to support production improvements and efficiency reporting.
- Wrote standardized packaging instructions and collaborated closely with the Vice President of Operations and Quality Engineering Manager.

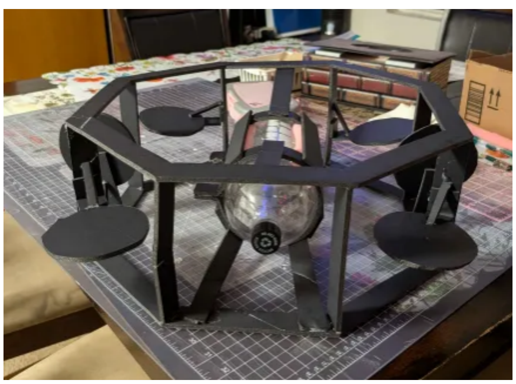
Results

- Delivered a finalized SolidWorks bottle and cap redesign ready for manufacturing and quality review.
- Improved clarity and consistency of packaging specifications and engineering drawings.
- Supported process efficiency improvements through documented time studies and analysis.
- Strengthened coordination between design, production, and quality teams.

AVI Robotics MATE ROV Chassis and Propulsion Design

Overview

- Chassis and Propulsion Team project for AVI Robotics competing in the MATE ROV Competition at California State University, Fresno.
- Focused on designing a six thruster propulsion layout to enable full 6 DOF control and station keeping in flowing water.
- The project emphasizes stability, maneuverability, and structural reliability in underwater environments.
- Project expected to be finalized by May 2026.



- The figure shows an early physical prototype of the ROV chassis, constructed primarily from cardboard and other lightweight materials. This prototype was built by my teammate Dottie to evaluate overall geometry, component spacing, and layout before moving to a final structural design.

Technical Implementation

- Designed and evaluated six thruster configurations to achieve balanced forces and moments for 6 DOF motion.
- Contributed to chassis layout and thruster shroud considerations to improve flow interaction and safety.
- Developed tether routing and strain relief concepts to transfer loads into the chassis and protect electronics.
- Conducted design research on competitor chassis joints to guide structural decisions and reduce failure risk.

My Contributions

- Designed and evaluated thruster placement for full 6 DOF control and station keeping.
- Contributed to chassis geometry and structural layout with a focus on stiffness and load paths.
- Developed tether routing and strain relief concepts to reduce mechanical and electrical risk.
- Performed independent research on UWROV chassis joint design to inform joint thickness, fastener selection, and modularity.

Results (In Progress)

- Established a validated six thruster propulsion concept for full maneuverability.
- Defined structural design guidelines for chassis joints and modular assembly.
- Improved system reliability through informed tether load management and joint design decisions.
- Final system integration and testing scheduled to conclude by May 2026.

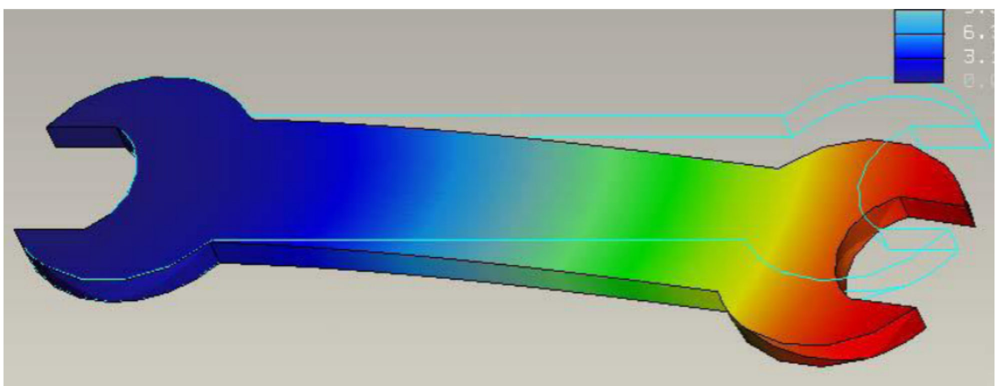
Finite Element Analysis and Mechanical Design Laboratory

Overview

- ME 154 (Mechanical Design Laboratory) focused on integrating CAD, finite element analysis (FEA), and manufacturing in a paperless design workflow.

- The course emphasized applying mechanical design theory through hands-on SolidWorks modeling and simulation.

- Labs were structured around real engineering components, such as a double-ended wrench, to connect theory with practice.



Double-Ended Wrench — CAD Model and FEA Analysis (ME 154)

Technical Implementation

- Modeled fully dimensioned mechanical components in SolidWorks, using parametric sketches and features.

- Performed static FEA using SolidWorks Simulation, including material assignment, boundary conditions, loads, and meshing.

- Analyzed stress, strain, displacement, and factor of safety under applied loads.

- Compared simulation results to hand calculations based on beam bending and statics.

Results

- Developed a strong foundation in FEA methodology and mechanical design principles.
- Gained experience validating simulations with first-principles calculations.
- Built confidence using SolidWorks Simulation as a design and analysis tool.
- Applied these skills to later projects involving structural design and performance evaluation.