

Owen May

Portfolio

BS Mechanical Engineering
California Polytechnic State University, SLO

Table of Contents

About Me	3
Test Fixture & Thermal System Redesign	4
Medical Device Redesign for Patient Care	5
ATV Powertrain and Gearbox Design	6
PVC Kart-Style Scooter	7
Material Characterization & Supplier Qualification	8
Regenerative Medicine Research	9
Land & Resource Analysis for Development	10
Regulatory Drawings & Approvals	11
Inclusive Product Design	12
Cal Poly Laboratory Work	13

About Me

Overview



Basics

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Academics

- California Polytechnic State University, SLO
- BS Mechanical Engineering, 2027
- CEA CAPA Education Abroad Barcelona, 2025

Introduction

Hi, I'm Owen, a 4th-year Mechanical Engineering student at Cal Poly, San Luis Obispo, originally from Denver, Colorado.

I'm drawn to solving complex, ambiguous problems — diagnosing the real issue, gathering the right data, and iterating toward solutions that hold up under real-world constraints. That approach has taken me across medical devices, land development, and consumer product design, each requiring me to learn a new domain quickly and work closely with clients, engineers, and end users to deliver results that matter.

The technical backbone stays consistent: CAD modeling, simulation (FEA/CFD), physical testing, and data-driven iteration. This portfolio walks through that process end-to-end — from problem framing to measurable outcomes — across each project.

Test Fixture and Thermal System Redesign

Apereo Health

Project Overview

Full ownership over redesign a test fixture and standard test method used during lot release testing to simulate a patient's airway for an implantable respiratory device, addressing various problems associated with the "Simulated Use Model"

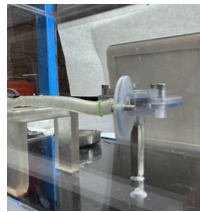
Problem Statement

The existing fixture struggled to reliably heat components to simulate internal body temperature, slowing throughput and complicating consistent test execution during this critical testing phase.

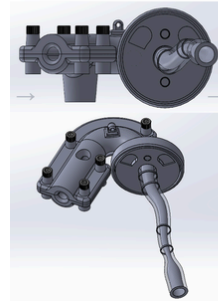
The Solution

1 - Airway Redesign

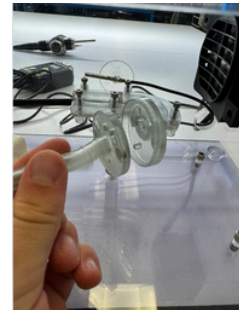
- Introduced a magnetic attachment system to simplify airway installation and removal between tests
- Iterated using Formlabs and Bambu resin printers across rigid and flexible materials to validate fit and function
- Applied DFM principles throughout to ensure the final print through Protolabs was manufacturable



Current Setup



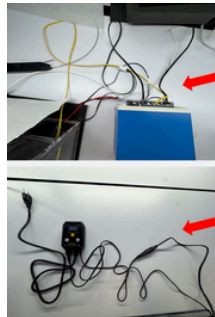
Solidworks Iterations



Final Design

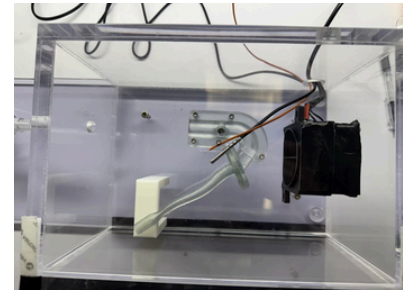
2 - Change in Heating Setup

- Identified a wattage limitation caused by the existing transformer and upgraded the heating setup for faster warm-up and improved temperature control
- Developed detailed electrical wiring diagrams for the new setup
- Ran a lab notebook study on the enclosure's heating behavior to characterize warm-up time and temperature uniformity
- Confirmed all components reach thermal soak before lot release testing



Old Temperature Controller, Heater Fan, and Thermocouple Setup

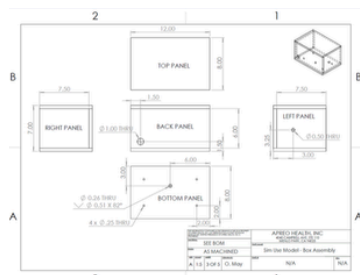
New Setup!



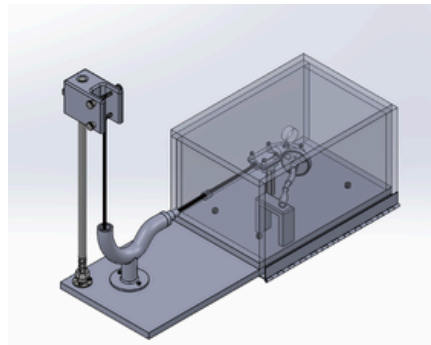
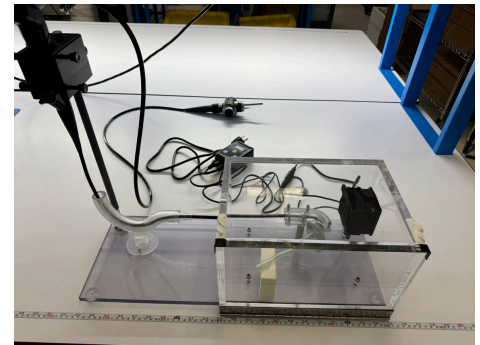
Temperature Measurement Setup Overview

3 - New Box Configuration

Worked directly with a plastics vendor to manufacture the enclosure, exchanging non-proprietary drawings and redlines throughout the process. Personally manufactured components on a manual mill prior to final assembly.



Example Page from Drawing Package



Deliverables & Outcome

Finalized two 10-15 page TOL (tooling) documents within the quality management system — one detailing the redesigned enclosure and one for the airway model — along with the drawings, dimensions, and manufacturing and sourcing instructions needed for fabrication and inspection. Authored an STM (standard test method) document supporting pre-design-validation testing, and delivered the completed box for use in DV testing as the product moves toward commercialization.

Skills Used

- Test Method Development - Authored the STM document supporting pre-design-validation testing
- Vendor Management - Coordinated directly with a plastics vendor, exchanging manufacturing drawings and redlines through production
- Design for Manufacturability (DFM) - Applied DFM principles to ensure successful, repeatable prints through Protolabs
- Project Ownership - Owned the redesign end-to-end, from concept through documentation and vendor handoff

Medical Device Redesign for Patient Care

EMPOWER Engineering Club / Edwards Lifesciences

Project Overview

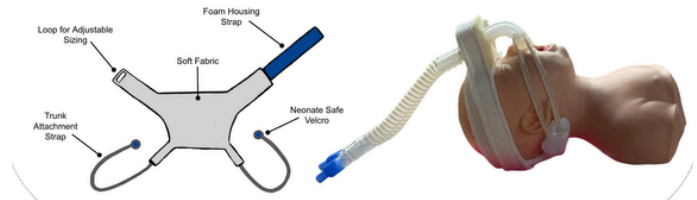
Redesigned a neonatal CPAP mask to improve airflow, comfort, and attachment reliability for preterm infants in the NICU. Collaborated with clinicians to develop a sleek, modular interface promoting consistent pressure delivery.

Problem Statement

The current NICU CPAP mask is bulky, unstable, and prone to turbulent flow, which reduces respiratory efficiency and causes skin breakdown in premature infants. Its poor fit and limited facial access hinder both patient comfort and clinical usability.

Design Goals

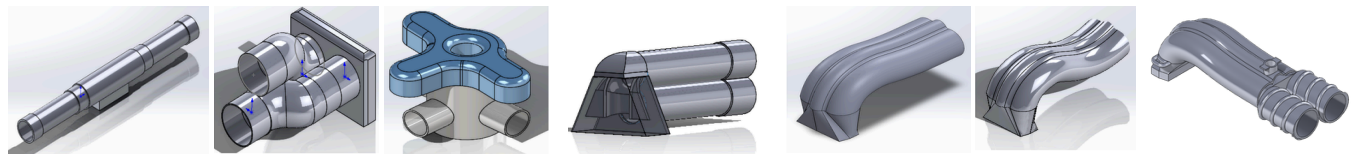
- Decrease flow disruption
- Increase access to patients head and face
- Decrease movement restriction in patients
- Ensure compatibility with current devices



My Role

As Design Lead, I led all CAD modeling and design iterations of the CPAP interface, incorporating clinical feedback and engineering constraints to improve flow dynamics and patient usability.

Attachment Piece Iterations



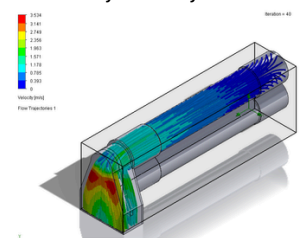
Initial Redesign

Final Redesign

Outcome / Where We Are

Reduced turbulent flow by 36.05% (FEA), promoting more consistent pressure delivery
Enhanced stability, with over 60% reduction in rotational inertia across all axes
Passed leakage testing, ensuring clinical reliability under NICU conditions
Improved aerosol delivery with less particle buildup at the proximal end
Project extended by the EMPOWER board, with increased funding for bench top validation, manufacturing and sterilization costs, as well as patent filing and IP protection

CFD of the original FlexiTrunk™, market standard by Fisher & Paykel Healthcare



Skills Used

- CAD Modeling - Multi-component assemblies designed in SolidWorks
- CFD - Airflow and pressure modeling SolidWorks Flow Simulation
- Material Selection - Selected biocompatible, FDA-cleared polymers for 3D printing in addition to sterilization compliance recognition
- Physical Testing - Designed and performed Mass Moment of Inertia, Range of Motion, Pulling Force, and Pressure Drop tests
- Human Factors - Improved usability and procedural access for NICU staff
- IP-Conscious Documentation - Created NDA-compliant visuals and patent-ready files
- Technical Communication - Presented at PDR and CDR reviews to multidisciplinary teams

ATV Powertrain and Gearbox Design

Cal Poly, San Luis Obispo - ME329: Mechanical Systems Design

Project Overview

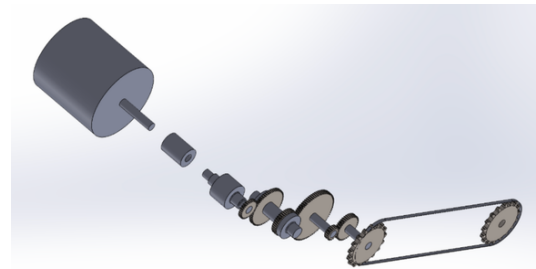
Designed a complete ATV powertrain — from motor selection through final drive — capable of transmitting power from an electric motor to the drive wheels while meeting specified speed, torque, reliability, and manufacturability requirements, with no existing baseline system to design from.

Problem Statement

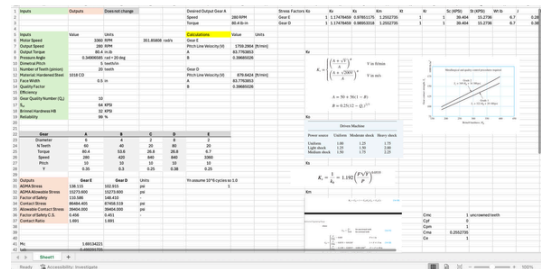
The motor's 4,500 RPM output was far higher than the target wheel speed and torque required to propel a 500 lb vehicle up to 15° grades at 20 mph. Every downstream component — gear train, shafts, bearings, and final drive — had to be sized from scratch to convert that high-speed, low-torque input into a lower-speed, higher-torque output, while meeting a 5-year service life.

The Process

- **Motor Selection** — Used vehicle dynamics calculations (weight, rolling resistance, wheel diameter, target grade) to determine required tractive effort, torque, and horsepower; selected an ME1616 PMAC water-cooled motor (26.8 HP, 4,500 RPM)
- **Gear Train Design** — Iteratively developed gear ratios across three stages to achieve the required 8:1 overall reduction while keeping gear diameters and tooth counts practical
- **Gear Stress Analysis** — Verified the first two gear meshes against AGMA bending and contact stress limits using Grade 2 through-hardened steel gears
- **Shaft Design** — Built free-body diagrams for both shafts, combined bending and torsional loading, and applied fatigue design methods incorporating stress concentration and reliability factors to determine minimum diameters
- **Bearing Selection** — Calculated required dynamic load ratings (C10) based on a 5-year service life at 4 hours/day, 250 days/year, then selected bearings exceeding those ratings
- **Chain Drive Design** — Calculated required design horsepower (incorporating service and design factors) and selected chain pitch and sprocket sizing for the final drive



Gearbox Isometric (SolidWorks)



All work done was tracked in a comprehensive Excel sheet, which was used to create iterative designs and repetitive analysis throughout each step of the process

The Outcome

- Achieved the required 8:1 gear reduction with AGMA safety factors of 2.4–3.5 (bending) and 1.02–1.2 (contact)
- Sized two custom shafts (1.25 in and 1.75 in) via fatigue analysis
- Selected bearings and a chain drive exceeding required load and horsepower ratings at every location
- Delivered a complete SolidWorks assembly and shaft detail drawings ready for fabrication

Skills Used

- AGMA Gear Design - Verified gear stress and contact ratios across a multi-stage 8:1 reduction train
- Shaft & Bearing Design - Sized custom shafts via fatigue analysis and selected bearings against calculated load ratings
- Chain Drive Design - Specified sprocket and chain sizing for the final drive against required design horsepower
- SolidWorks Assembly Modeling - Developed the complete powertrain assembly and detail drawings for fabrication

PVC Kart-Style Scooter

Cal Poly, San Luis Obispo - ME328: Design for Strength and Stiffness

Project Overview

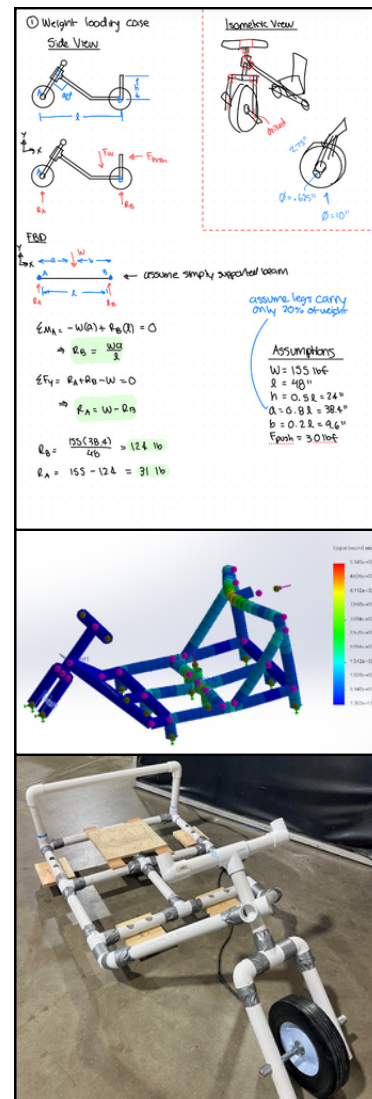
Designed and built a lightweight, PVC-based kart-style scooter with a three-person team, intended for a self-driven or push-assisted rider, prioritizing simplicity, affordability, and manufacturability from readily available materials.

Problem Statement

The scooter had to support rider loads while remaining stiff, steerable by hands or feet without added mechanical complexity, compact enough to pass through a standard door, and durable enough to survive repeated testing and demonstration. No 3-D printed components allowed

The Process

- **Load Case Definition** — established a 220 lb design load (155 lb rider $\times$ 1.5 factor of safety) across three cases: seated/standing rider weight, combined push force and rider weight on the steering column, and a curb-impact abuse case
- **Hand Calculations** — used simplified beam theory to estimate bending moments, axial forces, and deflections, sizing members prior to detailed modeling
- **FEA Verification** — modeled the full assembly in SolidWorks Simulation, applying boundary conditions at wheel contacts and loads at the seat and push bar, identifying the four-way steering joint as the governing stress location
- **Fabrication** — machined the steering cross joint for free rotation, mounted swivel wheels to reinforced wood blocks, and bonded the frame with PVC solvent cement, working back-to-front to maintain alignment
- **Physical Testing** — applied known seated and push loads, measuring deflection at each critical joint with a ruler to validate the FEA predictions
- **Iteration** — diagnosed an unanticipated joint failure at the seating connection (a location the FEA hadn't flagged as critical), traced it to an assumption that didn't hold in the built prototype, and reinforced the joint for reliable operation under both push and pull loading



Skills Used

- Finite Element Analysis (FEA) - Modeled three load cases in SolidWorks Simulation to identify peak stress and deflection locations
- Hand Calculations & Beam Theory - Sized structural members and predicted deflections prior to detailed FEA modeling
- Physical Testing & Validation - Measured deflection at critical joints under applied load to validate simulation results
- Root-Cause Analysis - Diagnosed an unanticipated joint failure and iterated the design to resolve it

Material Characterization & Supplier Qualification

Apreo Health

Project Overview

Characterized an alternate wire source to determine whether it could be qualified as equivalent to the current single supplier for a critical implant component.

Problem Statement

With only one qualified wire supplier, the device carried single-source supply chain risk. My focus was verifying comparable Af temperature behavior and identifying any required process adjustments.

01 What is Af?

Af (austenitic finish) is the **temperature where a material transforms** into its austenite phase, once above the Af the material fully **returns to its "set" shape** and superplastic behavior

02 Why is Nitinol Unique?

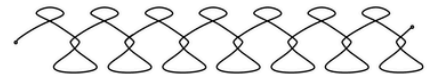
Nitinol can be **shape set, deformed through cooling**, and then **recover its original geometry** when heated. In addition, it has a very **high tolerance to fatigue**

03 Why do we Characterize?

Changing wire sources can shift Af temperature and affect device behavior. The goal was to compare the new wire source with our desired Af range!

Implant Creation Process

1. **Wire wrapping** - Form the wire around a fixture to create the implant geometry.
2. **Shape setting** - Heat treat the formed wire to establish its intended shape.
3. **Af tuning** - Evaluate and tune the austenitic finish (Af) temperature.
4. **Trimming** - Remove excess wire and finish the implant geometry
5. **Ballizing** - Form rounded ends at the wire tips to create smooth, finished terminations.



The Testing Process & Results

Af Testing

To characterize thermal shape recovery and evaluate an alternate wire source, I performed bend-free recovery testing on each implant sample. I deformed each sample below its Af (austenitic finish) temperature, then gradually heated it in a water bath while tracking temperature. I recorded the temperature at which the implant recovered its original shape and compared the recovery behavior of the new wire source with the qualified baseline across tuning conditions. This let me assess source-to-source consistency and how tuning time affected the measured Af response.

Radial Force Testing

I measured Chronic Outward Force (COF) and Radial Resistive Force (RRF) across old and new wire lots. Comparing force-diameter curves helped assess how well Af temperature predicted radial force behavior across sources.



Skills Used

- Supplier qualification - Applied test results to assess an alternate wire source against the qualified baseline.
- Comparative testing - Evaluated behavior across wire sources and tuning conditions.
- Thermal-mechanical characterization - Used bend-free recovery testing and Af temperature to evaluate wire shape-recovery behavior.
- Radial force testing - Measured Chronic Outward Force (COF) and Radial Resistive Force (RRF) across implant diameters.

Regenerative Medicine Research

CU Anschutz Medical Campus / UC Health

Project Overview

Supported wet lab development of a mechanical stretch assay to study platelet-rich-plasma (PRP) effects on tendon progenitor cells (TPCs) from chronic tendinopathy patients. The assay modeled tendon loading in vitro and contributed to a larger effort to standardize PRP and develop IRB-ready clinical protocols.

Problem Statement

Chronic tendinopathy remains difficult to treat due to poor healing and limited regenerative options. While PRP is a promising biologic therapy, clinical outcomes are inconsistent due to variability in preparation and a lack of standardized testing platforms.

The Stretch Assay

A lab method used to mimic tendon strain and study how cells respond to PRP treatment.

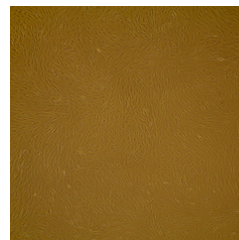
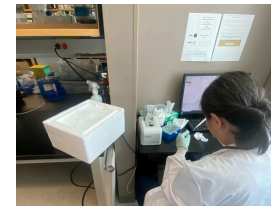


Image captured using the Zeiss LSM microscope. Tendon Progenitor Cells (TPCs) are visible across the field. Thousands of similar images were collected to analyze cell alignment and viability across varying PRP levels—providing foundational data for the abstract report and contributing to the published study.

Pub Med - <https://pubmed.ncbi.nlm.nih.gov/articles/PMC9596906/>

Aims of the Study

- Create a stretch assay to model physiologic tendon loading in vitro
- Evaluate the effects of PRP on chronic TPC morphology and alignment
- Support validation of TPC viability under repeated strain
- Assist in standardizing chamber prep, seeding, and stretching protocols
- Contribute to IRB-ready workflow and future clinical application of PRP



Senior Scientist, Quianbin He, demonstrating the careful addition of PRP to a well

My Role

Supported all stages of the project, beginning with the organization and digitization of the human tendon tissue biobank to enable consistent sourcing of chronic tendinopathy samples. Contributed to the writing of the project proposal, which was submitted for IRB approval and used as the foundation for experimental planning. Participated in biweekly research meetings, where I presented updates and collaborated with the team to refine study design. Aided in the development of cell testing methods, including PRP preparation tracking, stretch exposure protocol, and cell viability assessment. Performed tendon progenitor cell (TPC) plating, microscopy-based morphology analysis, and data logging to evaluate regenerative effects of PRP formulations. Helped draft and finalize the research abstract, which was presented at the 6th Annual Orthopedic Research Symposium.

Outcome / Where We Are

Established a working in vitro platform to evaluate PRP effects on chronic tendon cells under mechanical load. Findings supported an IRB submission and were presented at the 6th Annual Orthopedic Research Symposium. Ongoing work includes extended PRP testing and gene expression analysis.

Skills Used

- Proposal & Abstract Writing - Contributed to IRB submission materials and symposium abstract
- Scientific Communication - Presented findings in biweekly meetings and research symposium
- Microscopy & Imaging - Captured and analyzed cell morphology using phase-contrast microscopy
- Cell Culture Techniques - Assisted with TPC isolation, plating, and maintenance under sterile conditions
- Biobank Management - Organized and digitized tendon tissue inventory for research use
- Assay Development - Helped create protocols to assess PRP effects under mechanical strain
- Data Documentation - Logged and tracked cell responses, PRP characteristics, and timepoints

Land & Resource Analysis for Development

J&T Consulting

Project Overview

Performed detailed land analysis for Mangess Land Holdings, beginning with survey point data collection of surface elevations. Then drilling for clay, and bedrock layers. Using the data, developed 3D terrain models using AutoCAD, with alignments, profiles, and grading plans to guide site planning. Completed volume calculations, stage-storage modeling, and reservoir capacity estimates.

Problem Statement

Existing site models relied on outdated data, limiting accuracy for resource planning. The client needed a full redesign to maximize profitability while meeting regulatory compliance.

Outcome

Discovered over 4 million square yards of additional minable surface beyond initial estimates. All tracts are now scheduled to become long term water reservoir sites after completion.

Process Step-by-Step

1 - Survey Points & Data Collection

Gathered hundreds of survey points across multiple tracts, capturing elevation and location data needed for surface modeling. These points provided the raw dataset used in all subsequent analysis.

2 - Borings & Depth Logs

Analyzed boring logs and depth charts to distinguish surface, clay, and bedrock layers at each point. This testing was essential for mapping subsurface conditions and separating material types for accurate modeling.

3 - Surface Creation

Built digital terrain models from survey and boring data, generating separate surfaces for each material layer. These models established the foundation for grading and resource calculations.

4- Profiles & Alignments

Created profiles and alignments across the project site to evaluate elevation changes, identify constraints, and plan development pathways. This step allowed for clear visualization of terrain transitions.

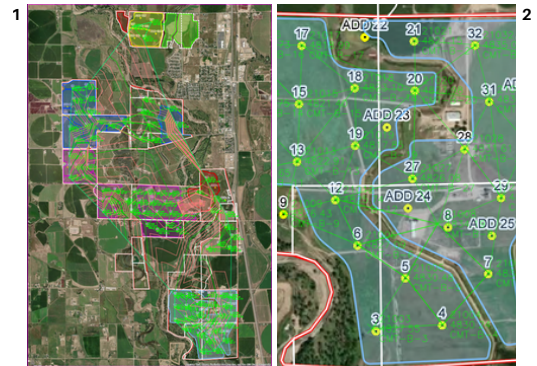
5 - Grading & Volume Calculations

Performed grading analysis to simulate cut-and-fill operations, ensuring efficient land use. Calculated material volumes across tracts to quantify earthwork requirements and resource potential.

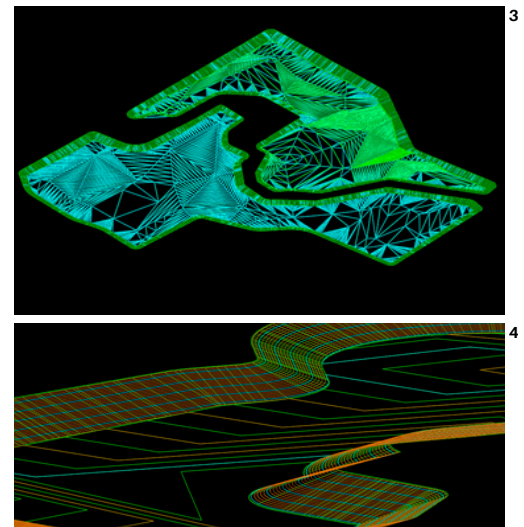
6 - Stage-Storage & Reservoir Estimates

Developed stage-storage curves and water capacity models to assess potential reservoir sites. These results provided critical insight into long-term water resource management and project feasibility.

BASEMAP (1) is comprehensive overview of the 13 different tracts of land. Zoomed in view (2) shows ground points from survey data that aid surface creation (3)



An example of a gradation to the bedrock surface. From LIDAR data (3), and a zoomed in view of the Northern tract (4)



Skills Used

- AutoCAD Civil 3D - Learned over the course of 5 weeks, modeled terrain surfaces, profiles, and alignments for large-scale land development
- Geospatial Data Analysis - Processed survey points, boring logs, and depth charts to build accurate subsurface models
- Earthwork & Hydrology Calculations - Performed grading, volume analysis, and stage-storage modeling to estimate reservoir capacity
- Technical Communication - Delivered findings through clear visualizations, maps, and design reports for client decision-making

Regulatory Drawings and Approvals

J&T Consulting

Project Overview

Conducted on-site material testing for active construction projects, coordinating with crews to obtain representative samples. Monitored field testing procedures and documented conditions, times, and results. Prepared formal reports with test data to support geotechnical evaluation, quality control, and verification of soil suitability for construction.

The Tests

- Porosity (Lab Collaboration) – Analyzed void ratio and permeability characteristics of soil and concrete
- Filtrate – Measured fluid loss with sealed pressure chamber and an attached air compressor
- Viscosity – Assessed flow characteristics of fluids, ensuring the same starting head pressure and volume
- Sand Content – Determined percentage of solids in slurry
- Unit Weight – Recorded density of fluids and backfill to ensure compliance with design specs
- Gradations - Determined particle size distribution of soil to identify proportions of gravel, sand, silt, and clay
- Slump Test – Evaluated workability and consistency of fresh concrete

Skills Used

- Quality Control - Ensured accuracy and reliability of field and lab soil test results
- Technical Reporting - Generated clear, detailed reports to support engineering evaluation and decision-making

Obtaining a gradation sample



Unit weight test



Regulatory Drawings & Approvals

J&T Consulting

Project Overview

Completed three different drawing groups for the state engineering organization, each 12 pages long.

Problem Statement

All construction drawings and CAD plans required formal approval before implementation.

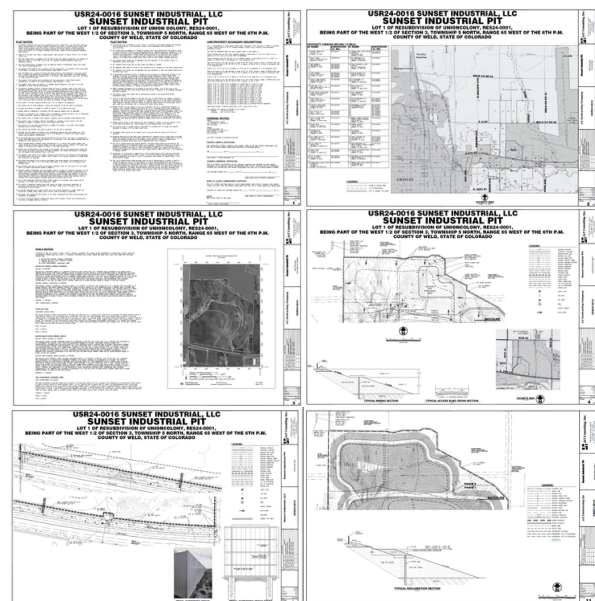
To achieve approval, each drawing had to be properly formatted, revised through multiple redline review cycles, and updated in response to engineer and client comments.

In addition, the drawings needed to comply with applicable codes, standards, and project specifications to ensure accuracy, constructibility, and regulatory approval.

Skills Used

- Guidelines Compliance - Reviewed and applied engineering codes, standards, and requirements to ensure drawings met approval criteria.

A few example pages, showing compliance standards, drawings, etc.



Inclusive Product Design

Empower Engineering Club / Callaway Golf

Project Overview

Designed an adaptive golf glove for individuals with limited grip strength, in collaboration with Callaway. The glove improves swing control through ergonomic support, assistive strapping, and targeted reinforcement—enabling more accessible and consistent play. The final design earned second place in a campus-wide engineering competition.

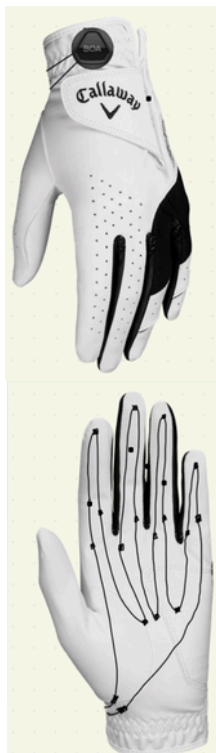
Market Analysis + Cost Breakdown

With over 25 million golfers in the US, many over age 50, grip strength issues are common, especially among those with arthritis. Current solutions like athletic tape, oversized grips, and personal training are often costly, temporary, or inaccessible.

The adaptive glove offers a targeted, lower-cost alternative. After sourcing components and prototyping, we found the total manufacturing cost to fall between \$30–40 per unit, including:

- Callaway Glove Base – \$15.99–21.99
- BOA Dial (IP1/Li2) – \$12.99–17.00
- Routing Materials – \$0.15 per part
- 3D-Printed Attachment – \$1.05 per part

This positions the glove as a scalable and affordable option in the adaptive golf equipment market.



Problem Statement

Traditional golf gloves offer minimal support for players with hand weakness or impaired grip. Without a secure connection to the club, adaptive athletes struggle to maintain control, resulting in inconsistent shots and increased injury risk. A redesigned glove was needed to restore grip function without interfering with swing mechanics.

BOA System Integration

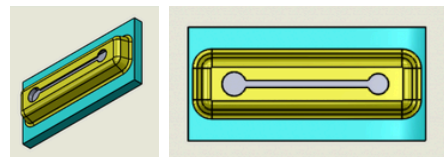
To create a glove that could support one-handed operation and adaptive grip assistance, we embedded a BOA cable system. A BOA is a mechanical dial-and-cable closure used in performance footwear and medical braces. Drawing inspiration from snowboard boots, hiking shoes, and wrist supports, we conducted market research on multiple BOA dial models. We selected the Li2 and IP1 dials for their compact form, smooth adjustability, and proven reliability in high-stress applications.

The Prototype - Initial Designs

- BOA Cable System – Guided lining along fingers to assist grip formation
- Bag Attachment Module – Custom-designed track and twist-lock mechanism for securing glove post-use
- Reversible Dial Mount – Symmetrical locking design for use by both left- and right-handed golfers

Attachment Unit

To accommodate users with limited or no hand function on one side, a custom bag-mounted attachment was designed unit that allows the BOA dial to be tightened using only one hand. The dial inserts into a 3D-printed locking track, where it can be secured and rotated using a twisting mechanism—similar to buckling a seatbelt. This feature ensures the glove remains fully operable for golfers with unilateral limb difference or weakness, expanding its usability across a wider range of adaptive athletes.



Skills Used

- Human-Centered Engineering – Designed for one-handed use and accessibility across varying grip strengths
- Product Design – Created adaptive grip system integrating BOA hardware with commercial glove base
- Rapid Prototyping – Developed glove modifications and 3D-printed attachment unit for functional testing
- Team Collaboration – Delivered a refined final product that placed 2nd overall in Cal Poly's campus-wide design competition

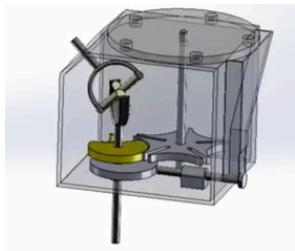
Cal Poly Laboratory Work

Cal Poly, San Luis Obispo

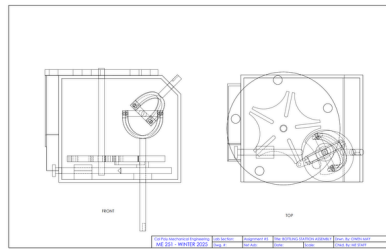
Bottle Wheel Assembly, Geneva Wheel Mechanism - ME 251: Intro to Detailed Design

SolidWorks

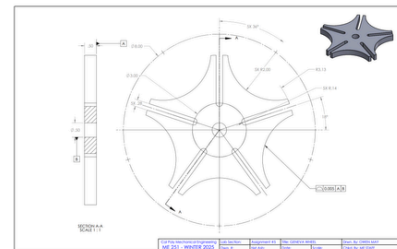
Constrained components using advanced SolidWorks mates, and applied a Motion Study to simulate intermittent indexing. Utilized advanced modeling features and a motion analysis tools to verify smooth operation and timing of the mechanism.



Motion study freeze frame



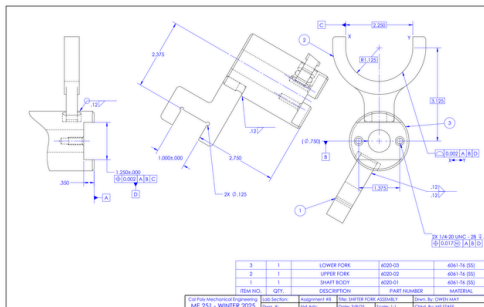
Assembly drawing



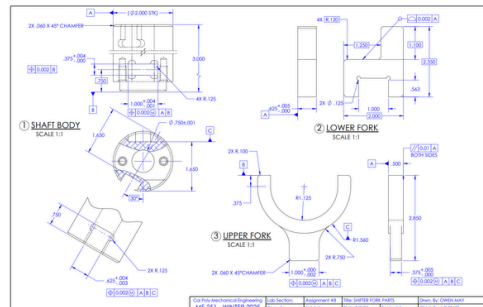
Geneva wheel drawing

Shifter Fork - ME 251: Intro to Detailed Design

SolidWorks



Bill of materials and assembly drawing



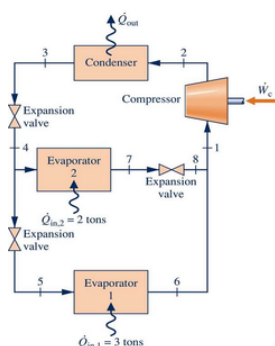
Individual parts drawing

Incorporated full dimensioning and geometric tolerancing, bill of materials, and callouts to industry standards. Ensured clarity and manufacturability by applying proper drawing conventions, annotations, and revision control.

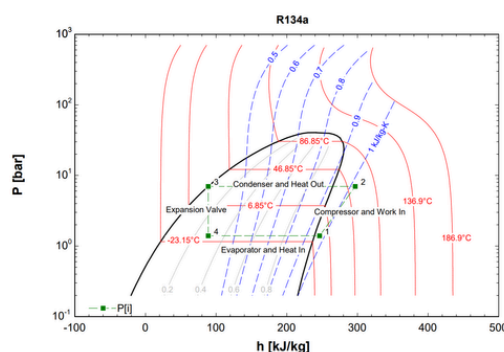
Refrigeration System Analysis - ME 303: Thermodynamics II

Engineering Equation Solver (EES)

- Cycle Modeling - Programmed refrigeration cycles in EES to analyze thermodynamic performance.
- Refrigerant Selection - Chose working fluids and calculated state properties, heat transfer rates, and efficiencies.
- Performance Evaluation - Determined coefficient of performance (COP) under varying operating conditions.
- Visualization - Generated P-h and T-s diagrams to illustrate cycle behavior and system performance.



An example system



A labeled p-h diagram from a refrigerant selection case study

SOLUTION
Unit Settings: SI C bar kJ mass deg
Capacity = 6.077 [tons]
h_{2s} = 281.2 [kJ/kg]
Q_{in,boil} = 4.6 [tons]
COP_h = 3.115
Q_{in} = 16.18 [kJ/s]
W_{in} = 5.194 [kJ/s]

No unit problems were detected.

Arrays Table: Main				
	P _i	T _i	h _i	s _i
	[bar]	[C]	[kJ/kg]	[kJ/kg-K]
1	1.398	-10	246.4	0.9725
2	7	58.5	296.9	1.021
3	7	26.69	68.82	0.3323
4	1.398	-18.8	68.82	0.3536

A solution window from the same case study