Engineering Design Portfolio | Tristan Brasov

A selected portfolio of mechanical and aerospace design projects completed during undergraduate studies at the University of Missouri Columbia and graduate studies at the University of Colorado Boulder. Each section highlights an academic or industry-aligned project emphasizing analytical precision, design, and applied problem-solving.

Table of Contents

Drifters in a Tornado Vortex

Problem and Constraints

Reconstructed the Baker and Sterling single cell tornado model to predict how a pseudo Lagrangian drifter behaves in a realistic vortex. Required accurate nondimensional velocity, pressure, and buoyancy fields with full trajectory simulation.

Contribution

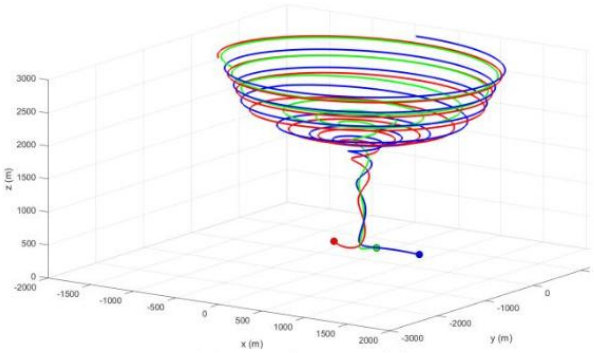
Built a MATLAB framework handling all coordinate transforms, nondimensional scaling, and vortex reconstruction. Added a superpressure balloon model and ran sensitivity studies across release conditions.

Impact

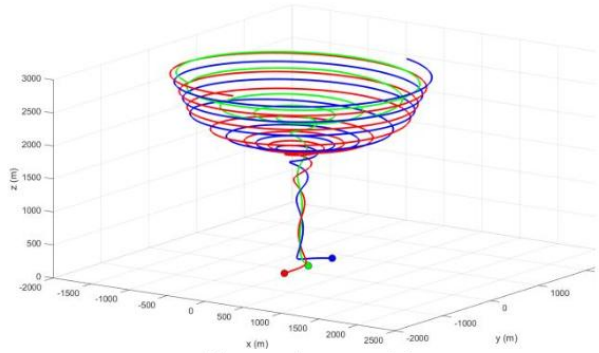
Showed that altitude, not horizontal offset, governs drifter capture and core interaction. Demonstrated a validated end to end pipeline for coupled flow field and drifter dynamics.

Tools and Methods

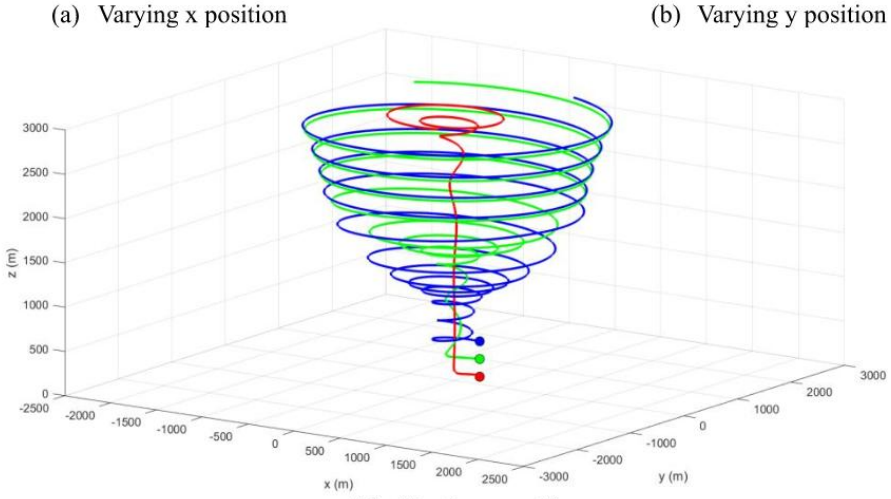
MATLAB, ODE45, and coordinate transformations.



(a) Varying x position



(b) Varying y position



(c) Varying z position

NACA 23012 CFD

Problem and Constraints

Modeled the NACA 23012 airfoil at Re ≈ 3e6 and matched wind tunnel conditions, requiring a high-quality mesh with y+ below 1 and a low Mach turbulence model.

Contribution

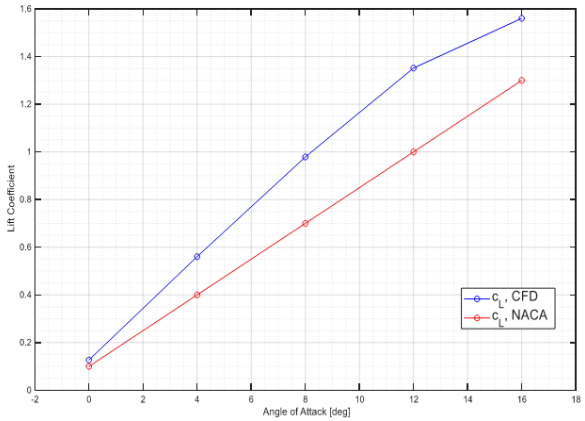
Built a structured mesh with refined boundary layer spacing and implemented the Spalart-Allmaras model. Computed lift and drag trends and compared them to NACA data.

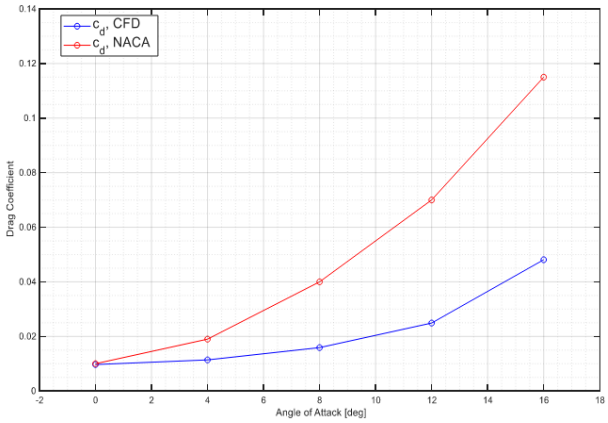
Impact

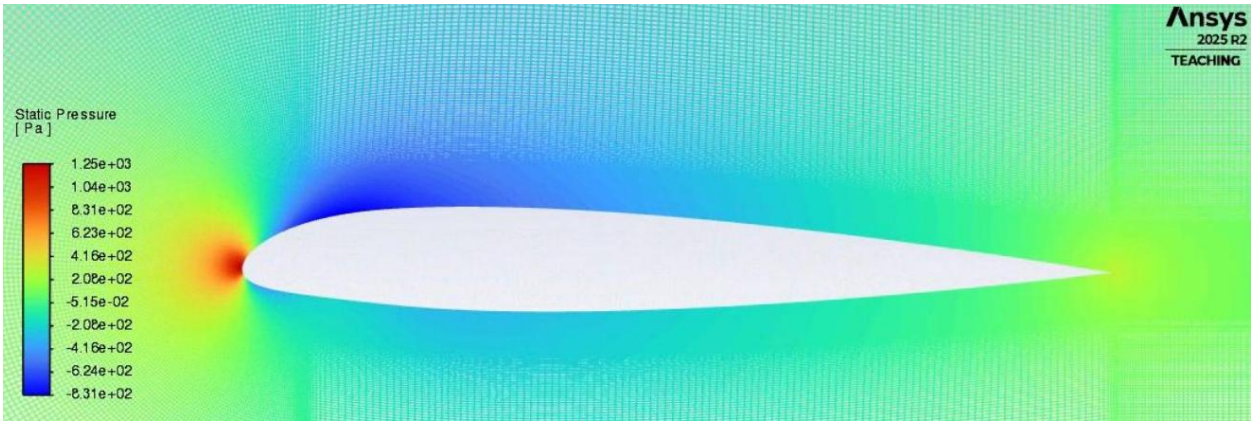
Matched experimental behavior at low angles and identified model limits near separation. Validated ability to generate clean CFD setups and interpret results.

Tools and Methods

ANSYS Fluent, structured meshing, and SA turbulence modeling.







Senior Capstone Project

Problem and Constraints

Existing skid steer ramps were overweight and impractical. Needed major weight reduction while increasing factor of safety and keeping fabrication simple.

Contribution

Redesigned the ramps using SolidWorks and finite element analysis, optimizing rib layout and thickness. Guided fabrication and load testing to verify analytical predictions.

Impact

Reduced weight by 60% and increased factor of safety from 1.5 to 2.1, validated through full scale loading.

Tools and Methods

SolidWorks, finite element analysis, TIG welding, and load testing (see next page).

Improved Skid Steer Loading Ramps

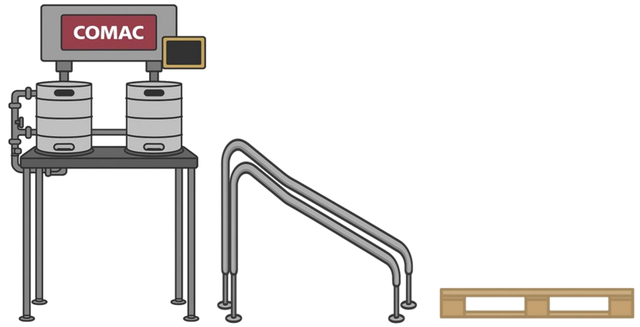
Aaron Jewett , Jack Neidt , Joseph Rollinson , Sean Yates , TJ Minear , Tristan Brasov, Professor Poehlman

College of Engineering
University of Missouri

HAPPY RAMPS™

Assisted Keg Ramp

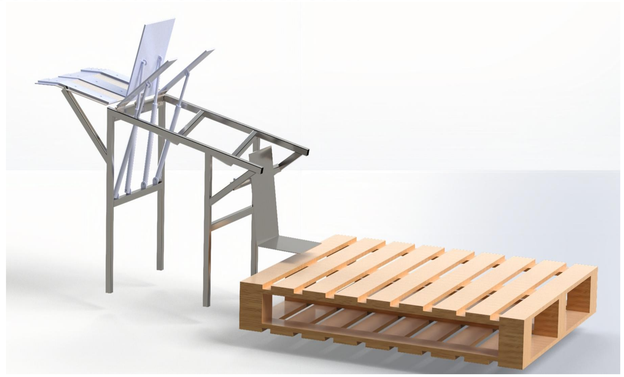
For the first 10 weeks of the semester, we worked with Logboat Brewing Company to design and fabricate an improvement to their Keg-filling process. With their current ramp (see below), the operator must “walk” each full keg, weighing 170 lbs, down an unstable ramp to the pallet.



Through site visits and discussions with operators, we decided to create a hands-off assisted ramp that would gently place the keg on the pallet.

Requirements of the assisted Keg ramp:

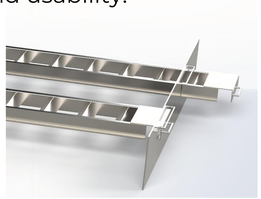
- Flip the keg 180° to right-side-up
- Span the distance from the filler to the pallet
- Minimal change to operation time
- Be constructed of stainless steel



Continued review of our material requirements and budget revealed that stainless-steel stock and components drove costs well above our cap, far more than non-corrosive alternatives. When we contacted Logboat to explore cost-saving options, they could not offer any further assistance. Thus, we had to find a new project at week 10 of the semester.

Improved Trailer Ramps

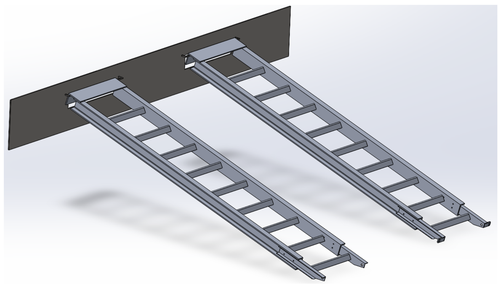
Each steel ramp weighs 85.89 lbs. and requires a 180-degree rotation to latch, placing considerable strain on the operator. The combination of weight and motion raises safety concerns, highlighting the need for a redesigned system to improve both safety and usability.



Design

Requirements of the Improved Loading Ramp:

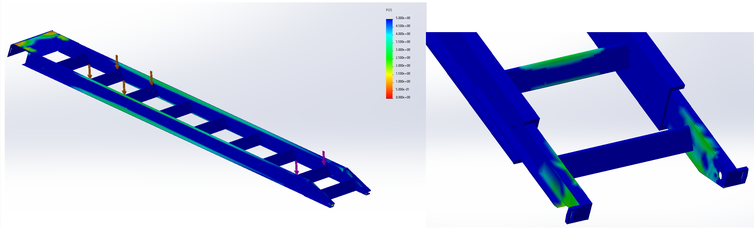
- Must be lightweight and operate without rotation
- Needs to withstand an 8,000 lbs. static load
- Equal or greater factor of safety
- Exert minimal deflection



Key Design Improvements

- Utilized 6061 Aluminum to reduce weight
- Steel cable handle pull-out
- Increased U-channel thickness for strength
- Shortened ramp to lower maximum bending moment
- Implemented U-channel extensions to optimize budget
- Angled bottom piece for ground support

FEA

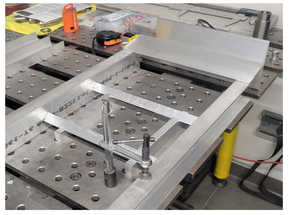


Performance Metric	Old Ramp	New Ramp
Weight (lbs)	85.89	30.85
Adjusted FOS*	1.5	2.11
Maximum Deflection (in)	0.094	0.393

* While the simulated factor of safety for both designs falls below 1.0, the original design withstood the full load with no signs of failure or fatigue. A conservative FEA model likely underestimates true performance, validation tests have confirmed the reliability of the new design.

Fabrication

Raw bar stock was cut with a bandsaw, and bolt holes were drilled. Jigs were machined on a vertical mill to efficiently weld and ensure accuracy. The ramps were TIG welded and subsequently tested on the trailer. The testing focused on strength and stability under the weight of a skid steer.



Lessons Learned

Regular and frequent budget reviews are essential to staying on track and adapting to changes. It's important to recognize when it's time to pivot and adjust plans accordingly. Successful collaborations depend on mutual commitment from all parties involved, and maintaining transparent communication is crucial throughout the process.

Gulfstream G550 Analysis

Problem and Constraints

Evaluated climb envelope and rate of climb by modeling thrust decay, aerodynamic limits, and energy height across operating weights.

Contribution

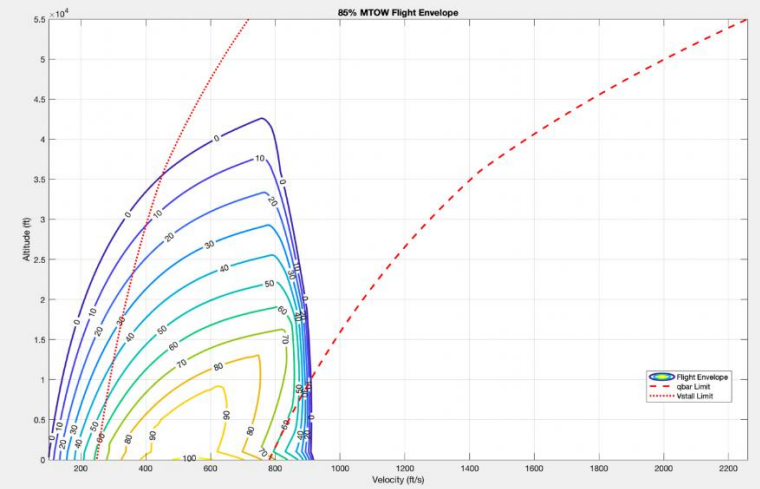
Developed MATLAB flight performance models and generated envelopes at two critical weight conditions using excess power relations.

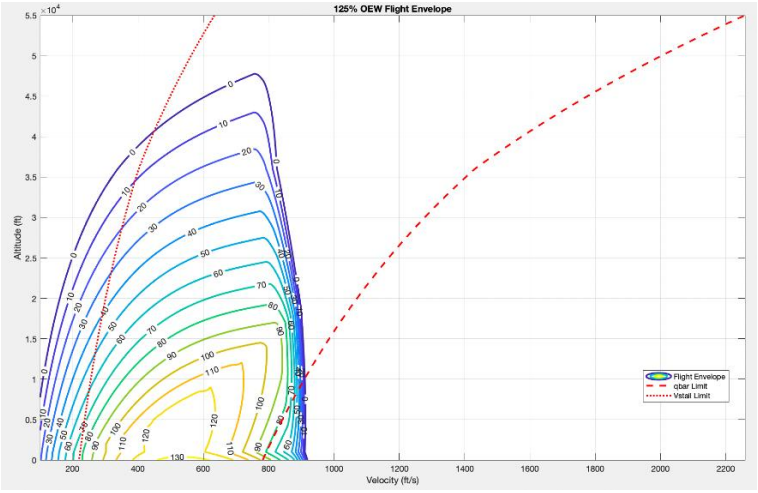
Impact

Clarified how weight and thrust shape climb capability and service ceiling, demonstrating understanding of aircraft performance methods.

Tools and Methods

MATLAB, performance modeling, excess power analysis.





Compact Gearbox Design

Problem and Constraints

Designed a compact 2 stage gearbox achieving 5x torque multiplication while meeting life, reliability, and manufacturability constraints.

Contribution

Performed gear stress, fatigue, and shaft deflection calculations and built a SolidWorks assembly sized for stiffness and alignment.

Impact

Delivered a small, robust gearbox with factors of safety above 2, validated through analytical checks.

Tools and Methods

SolidWorks, gear calculations, shaft and bearing analysis.