R/C Cargo Aircraft for SAE Aero Design Competition: Regular Class

Spring 2026

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Abstract

Efficient cargo transport through aircraft methods is a necessary endeavor made difficult due to space, fuel, and flight limitations & requirements. SAE has challenged us with designing a **large-scale R/C aircraft to carry 2L commercial soda bottles as cargo**, while utilizing a **multi-motor setup** with **limited battery capacity**. The aircraft must maintain a wingspan between 6 and 10 feet, and weigh under 55 pounds. Propeller size is limited based on the number of motors that we chose; For the **two-motor configuration**, we were limited to **12-inch diameter propellers**. Additionally, SAE limited the battery to a commercially available 4S 2200 mAh battery to power both motors. The team approached the problem as an **optimization problem**. The team utilized commercial software such as **MATLAB, ANSYS Fluent & Mechanical, XLFR5, OpenVSP**, and others, to create theoretical ideal geometric configurations that remained within the constraints of the competition requirements. For critical equipment selection such as motors, propellers, and servos, the team **analyzed load cases** for expected flight stage loadings and selected equipment of best performance from specification charts. Thorough **testing** and **experimentation** have led to iterations that have reduced aircraft weight and wingspan, **reduced throttle input** to **maintain stable power & flight**, and increased durability of landing gear. With the current configuration, the team **expects** to be able to **carry** a total of **two 4-pound soda bottles in the competition**.

Methods

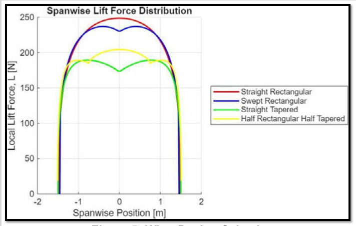


Figure 5: Wing Design Selection

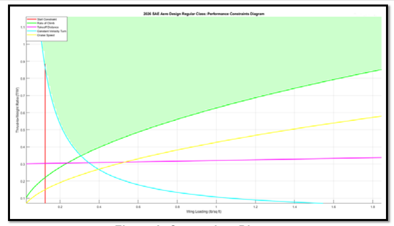


Figure 6: Constraints Diagram

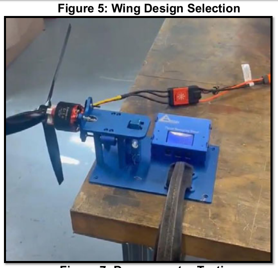


Figure 7: Dynamometer Testing

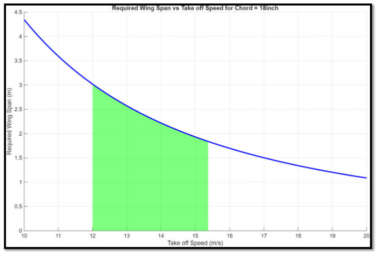


Figure 8: Wingspan Design

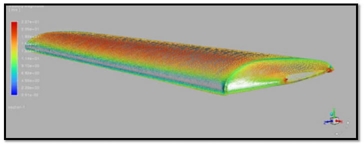


Figure 9: ANSYS Fluent Study

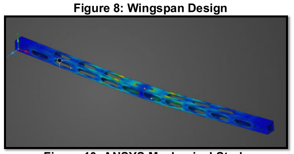


Figure 10: ANSYS Mechanical Study

Competition Requirements

Table 2:Customer Requirements Table

Customer Requirements
Requirement
(1) Wingspan Restriction
(2) Aircraft Length
(3) Weight Restriction
(4) Airfoil Chord Length Restriction
(5) Propeller Sizing Restriction
(6) Motor Count (2 or 4)
(7) Receiver/Control System Restriction
(8) Safety Requirements
(9) Team Identification Vehicle Badges
(10) Empty Weight Center of Gravity Markings
(11) Steerable Landing Gear
(12) Take-Off Distance
(13) Flight Attempt Time Limit
(14) Landing Distance
(15) Cargo Requirements (2L bottles)
(16) Propulsion System Battery Restriction

Correlation

Table 3: Engineering Requirements Table

Engineering Requirements	
Requirement	**Value**
(1) Wingspan	6' < L < 10'
(2) Vehicle Length	< 10'
(3) Gross Weight	≤ 55lbs
(4) Wing Chord	> 4"
(5) Propeller Diameter	9" or 12"
(6) Propulsion Battery 4 Cell LiPo 14.8V	≤ 2200 mAh
(7) Receiver Battery LiPo or LiFE	≥ 1000 mAh
(8) Arming Plug	≥ 9" from any Propeller
(9) Landing Distance	≤ 400'
(10) Take-Off Distance	≤ 100'
(11) Flight Attempt Time Limit	≤ 60s
(12) Radio Control System	2.4 GHz
(13) Cargo Volume	2 Liter Bottles

References

[1] L. M. Nicolai, "Estimating R/C Model Aerodynamics and Performance," Lockheed Martin Aeronautical Company, June 2009.
[2] A. K. Mitra, Aircraft Performance and Design, 2nd ed. Library of Congress, 2020.
[3] "Aircraft Design Optimization with the Fixed-Wing Object," The MathWorks, 2026. [Online]. Available: https://www.mathworks.com/help/aerotbx/ug/aircraft-design-optimization-with-the-fixed-wing-object.html
[4] C. Reyes, RC Advisor's Model Airplane Design Made Easy, 1st ed. Albuquerque, N.M.: Rcadvisor.com, 2009.
[5] SAE International, 2026 Collegiate Design Series SAE Aero Design Rules, 2026.

Results

Table 1: Final Aircraft Design Summary

Aircraft Summary	
Description	**Result**
Max Cargo Volume	4 Liters (2 Bottles)
Planform Wingspan	80 Inches
Wing Chord & Dihedral Angle	19 Inches | 3°
Horizontal Stabilizer Span	39 Inches
Horizontal Stabilizer Chord	8 Inches
Aircraft Length	59 Inches
Aircraft Height	26 Inches
Wing Airfoil Standard	SELIG1223
Tail Airfoils Standard	NACA0012
DC Motors	Spektrum 4250-800kV
Propeller Specifications	Master AirScrew 12" x 6" 3 Blade
Empty + Loaded Weights	12 lbf EMPTY | 20 lbf LOADED

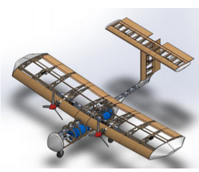


Figure 1: Final CAD

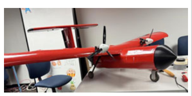


Figure 2: Final Build

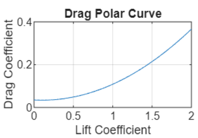


Figure 3: Aircraft Drag Polar Characteristics

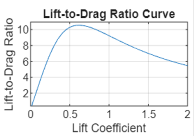


Figure 4: Aircraft Lift/Drag Characteristics

Conclusion

For the 2026 SAE Regular class AERO competition, our team was tasked with designing a flight ready cargo aircraft to carry 2L soda bottles. Being constrained by battery size, propeller size, and motor count, our team optimized for an aircraft that could carry two bottles. This design challenge simulates what industry aerospace engineers must overcome to maximize cargo delivery while managing fuel consumption. For future design teams, we would like to emphasize the importance of the process shown with the methods section. Preliminary design of an aircraft requires the section of a geometry that performs best under the assumed conditions of the competition. For figure 4 this shows which wing geometry has the best lift characteristics and in cargo aircrafts high lift is priority. All design efforts should push towards characterizing the aircraft in lift, drag, roll, pitch, and yaw. We also recommend having less emphasis on frame design until a full geometry and load cases have been created for takeoff, cruise, bank, and landing.

Acknowledgements

Special thanks to the Flagstaff Flyers, Professor David Willy, Dr. Peter Vedasz, Jose Ben, and Tesla Ventsam for being vital mentors to this project. Guiding the overall design of the aircraft, providing insight into calculations and the planes electrical system. Thanks, are also given to Salt River Project for providing significant funding for this project, Society of Automotive Engineers for hosting the competition, and Northern Arizona University for hosting the capstone project.

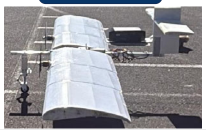
Design Iterations

Oct. 2025

Nov. 2025

Dec. 2025

Feb. 2026



Mar. 2026

Apr. 2026