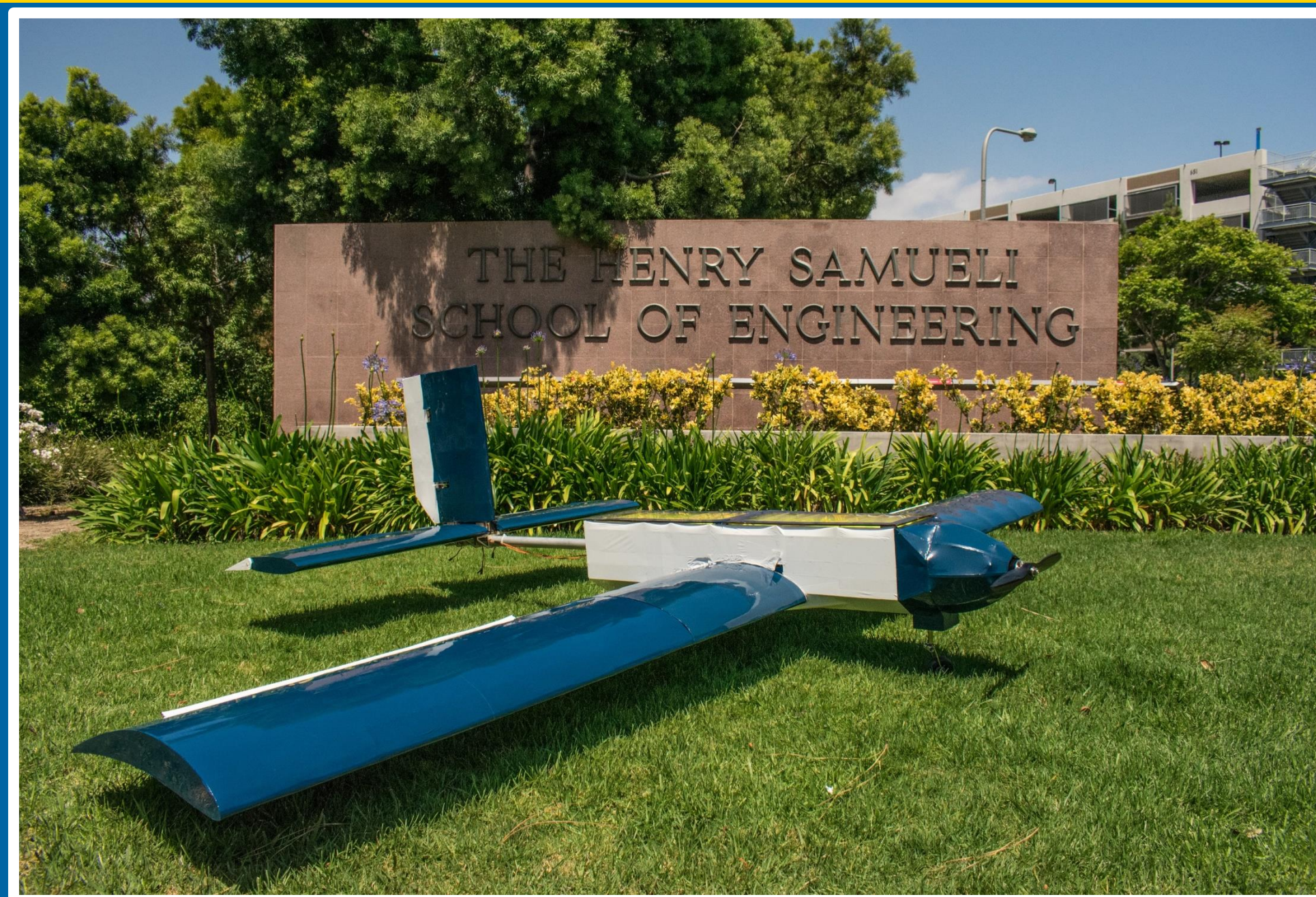
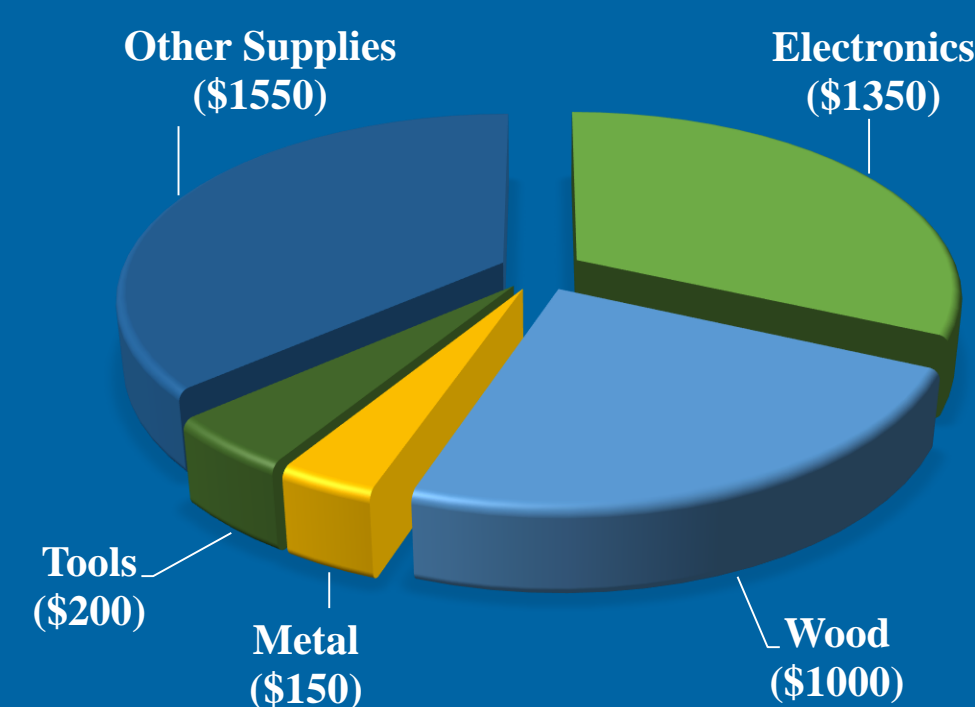


Abstract

Cargo Plane is a senior competition project based on the SAE Aero Design West rules and regulations. The goal of the project was to design a lightweight airplane using wood and metal, allowing high lift generation with low velocities. The plane design parameters were to minimize weight, maximize passengers and cargo capacity while still following all the SAE competition rules. The airplane weight was optimized to be the smallest fraction possible of the 55lb takeoff limit to maximize payload. Therefore, the design team focused on analyzing multiple plane designs from previous years to pinpoint successful features for design incorporation. Plane dimensions were all calculated with equations found in accredited aerospace papers and test book. Through Finite Element Analysis (FEA) simulations, structural analysis, and material property tables, it determined balsa, poplar, birch ply, sitka spruce, and 6061-T6 aluminum were optimal building materials for construction due to the high specific strength properties. Cutouts and trusses allow for material reduction, particularly in non-load-bearing components. The main methods of manufacturing were laser cutting for wood parts and milling of aluminum components. The competition requires a limiter, used to restrict the motor power, which drove motor, battery, and propeller selection.



CARGO PLANE COSTS



Last Year's Design



Tail

Airfoil: NACA 0012
Horizontal Tail Volume Coefficient: 0.65
Horizontal Tail Span: 5.125ft
Horizontal Tail Chord: 1.5 ft
Horizontal Tail Planform Area: 7.69 ft²
Horizontal Tail Moment Arm: 4 ft
Vertical Tail Volume Coefficient: 0.65
Vertical Tail Span: 1.9 ft
Vertical Tail Chord: 1.5 ft
Vertical Tail Planform Area: 2.85 ft²
Horizontal Tail Moment Arm: 4 ft
Elevator Span: 4.96 ft
Elevator Chord: 7.2 ft
Rudder Span: 1.73 ft
Rudder Chord: 7.2 ft

Wing

Airfoil: Eppler 423
Chord: 1.9898 ft
Span: 12 ft
Planform Area: 23.8776 ft²
Aspect Ratio: 6.0307 ft
Aileron Span: 3 ft
Aileron Chord: 0.4974 ft

Fuselage

Length: 96.35 in
Width: 10 in
Height: 9.5 in
Total Passenger Capacity: 48
Passenger and Payload Weight: 30.24 lbs.

Motor

Thrust: 12.08 lbs.
RPM/V: 330 kV
Model: Tomcat G90
Propeller: TCF Precision 20x8
ESC: 85A Mantis

Competition Requirements

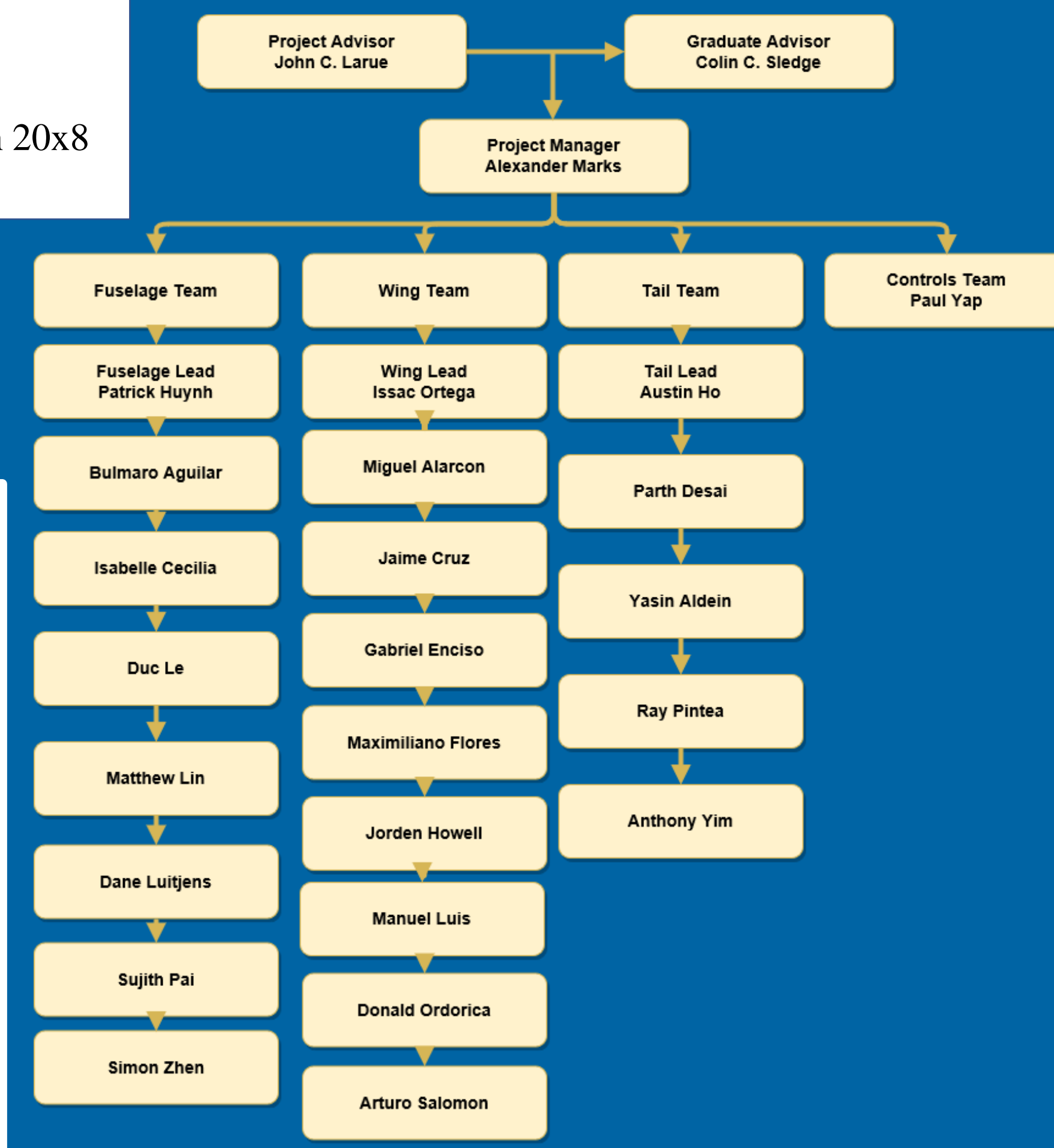
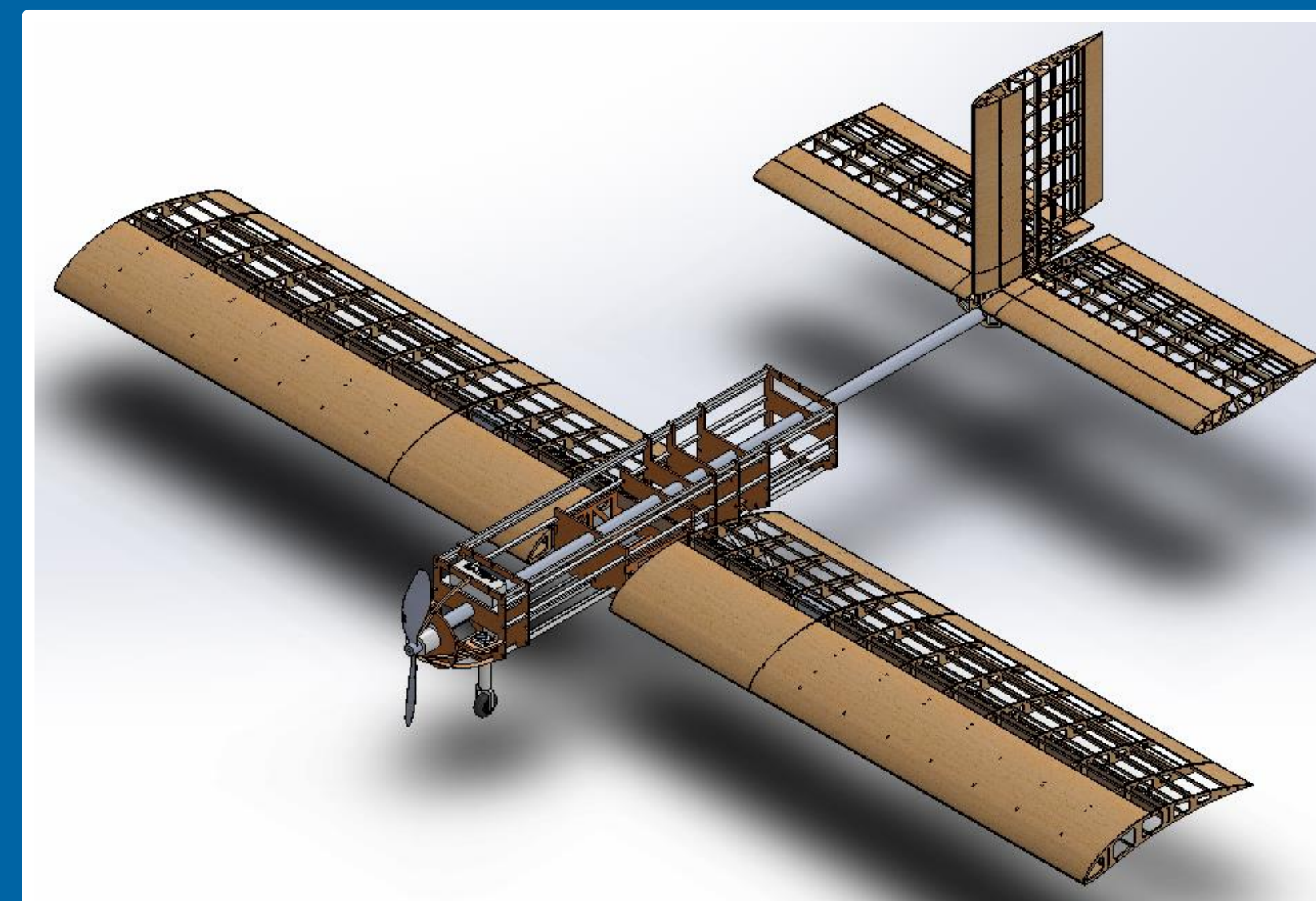
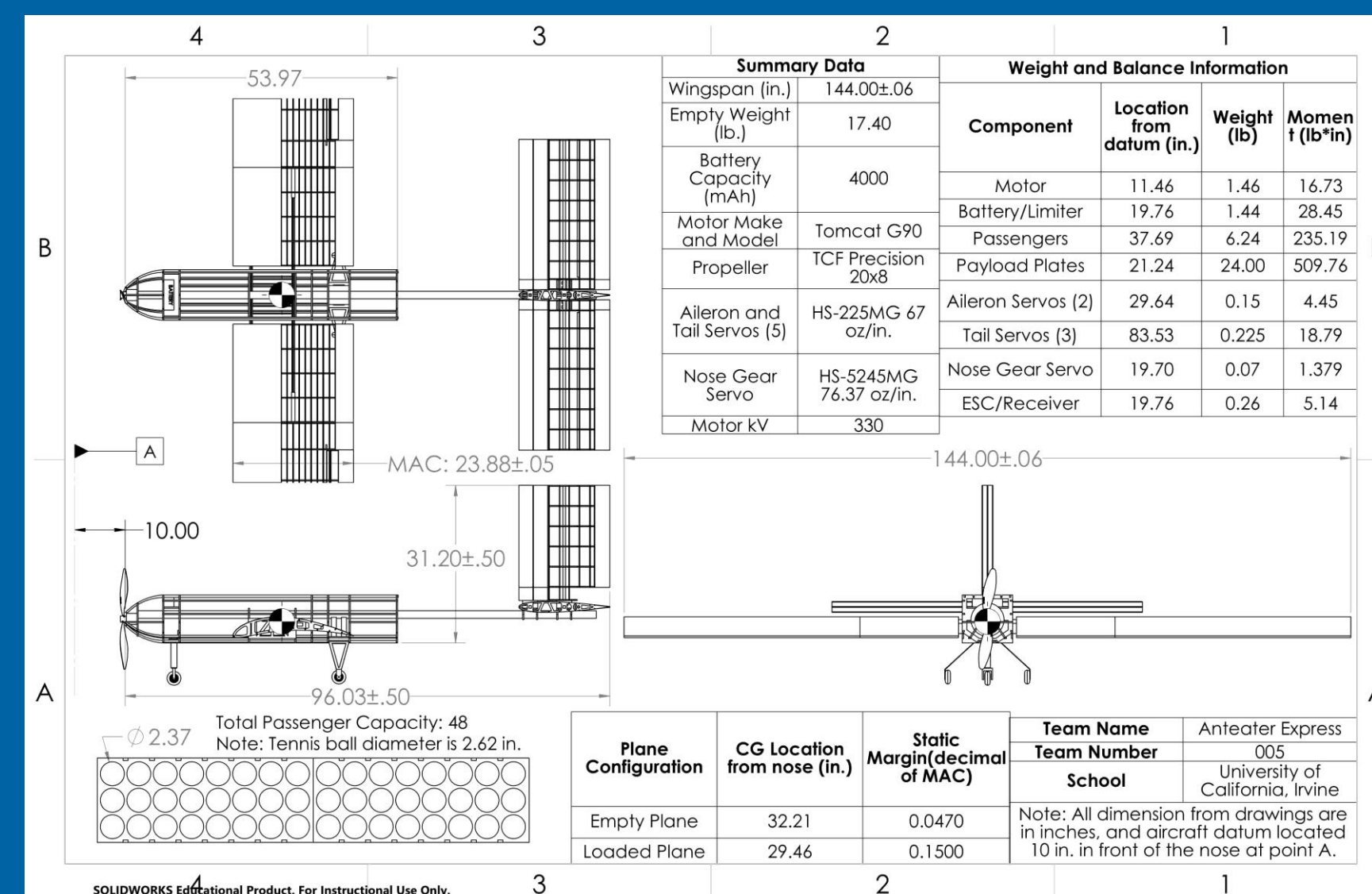
- Max wingspan:** 12 ft.
- Max loaded weight:** 55 lb.
- Max motor power:** 1000 W
- Passenger:** Tennis balls
- Luggage weight per passenger:** 0.50-0.75 lb.
- Mission:** Takeoff in less than 200 feet, maneuver, and land on a runway within 2 minutes
- CG Requirement:** Flyable in empty and loaded configuration

Innovation

- 1) **Weight reduction** by 1.5 lb. from last year
- 2) **Wooden wing spars**, and unique wing outboard and inboard sections
- 3) **Larger tail** with more control surface area
- 4) **Top-loaded** passenger and luggage
- 5) **Larger propeller** size (up to 24 in.)
- 6) **Function design** with more exposed area

Contact Information

Project Advisor | John C. LaRue | jclarue@uci.edu
Project Lead | Alexander Marks | awmarks@uci.edu
Future Lead | Maximiliano Flores | maximisf@uci.edu
Website: <https://tinyurl.com/UCI-Cargo>



Timeline

Fall:

- Research and Development
- Design
- Testing

Winter:

- Manufacturing
- Further Testing
- Competition Technical Report

Spring:

- Competition
- Final Report
- Preparing for next year