Team 08: The Greater Frigates

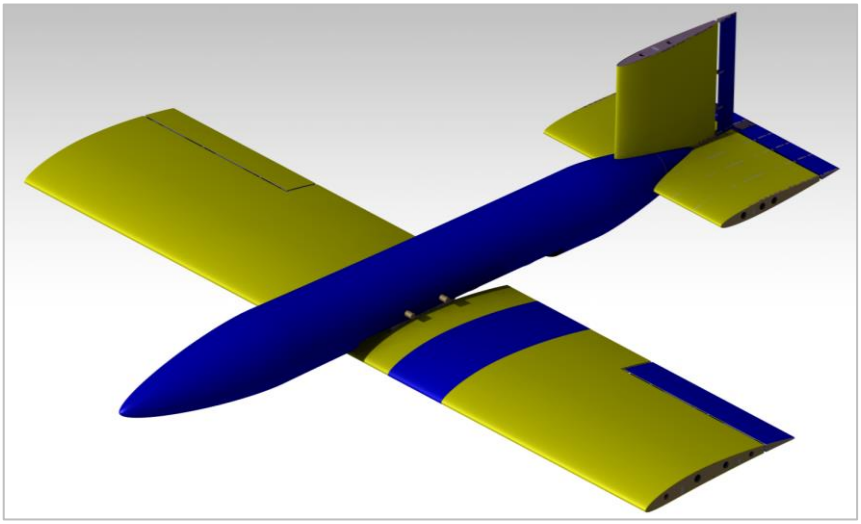
Bronze Propeller Competition

The Bronze Propeller website states, "This year's design competition is for '*A Storable Semi-Autonomous Emergency Supply Aircraft*.'" The mission consists of flying a specified number of laps while autonomously delivering a payload. The scoring for the competition places a heavy emphasis on the time taken to complete the mission.

Aircraft Description

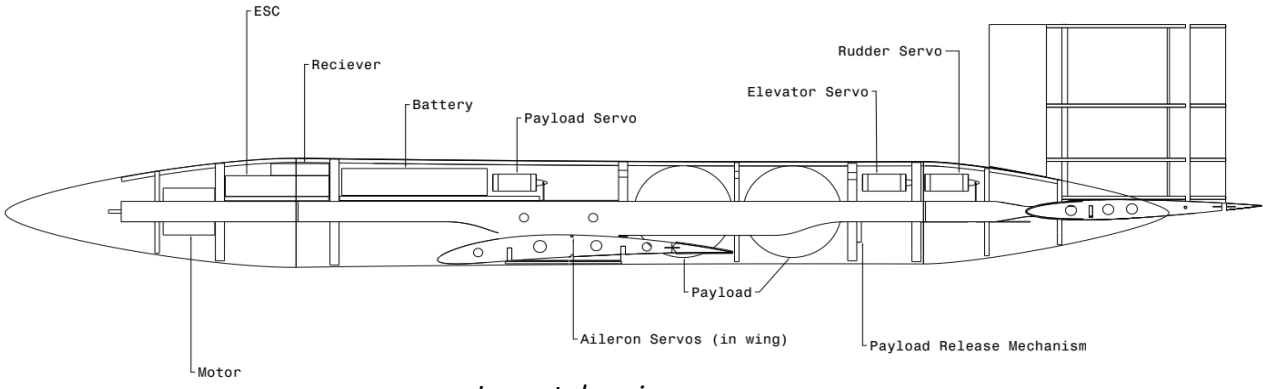
Utilizing a low-wing configuration, the aircraft emphasizes a low-drag, highly maneuverable design. The fuselage of the aircraft is designed to be as narrow as possible; the largest diameter of the fuselage, just above the payload bay, measures slightly less than 3 inches.

The Northern Screamer



Technical Specifications

Endurance: 180 sec
Length: 34.5 in
Wingspan: 35 in
Payload weight: 0.25 lbs
Takeoff weight: 2.3 lbs
Stall Speed: 32 feet/sec
Maximum Corner Speed: 100 feet/sec



Layout drawing

Aerodynamics

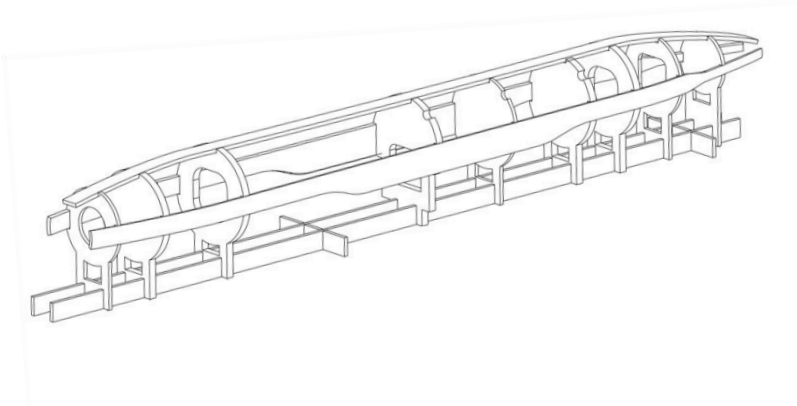
The aerodynamic design of the vehicle was focused primarily on the reduction of drag across major surfaces. In support of this goal the wing is designed using a NACA 4409 airfoil. The fuselage was designed to allow for smooth flow, giving the fuselage a Reynolds Number of 1.3 million at cruise on a standard Wichita day.

Stability and Controls

The stability and controls of the aircraft were designed around a small static margin and maintaining a high level of control during the mission flight. The elevator control surface was sized to keep a reasonable level of control accuracy for our servo selection, while maximizing our trim potential. Because of this, we can trim up to a C_L of 1.2 within a 12-degree deflection.

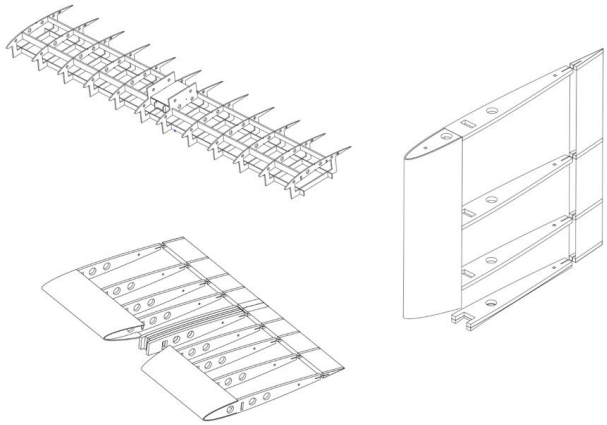
Structures

The aircraft was designed to have a semi-monocoque structure. Three spruce longerons are included in the design. Bulkheads are placed along the length of the fuselage to transfer loads and maintain the cylindrical shape of the fuselage. A 1/32” balsa skin covers the structure to give it a sleek aerodynamic shape.



Fuselage load path diagram, including tooling

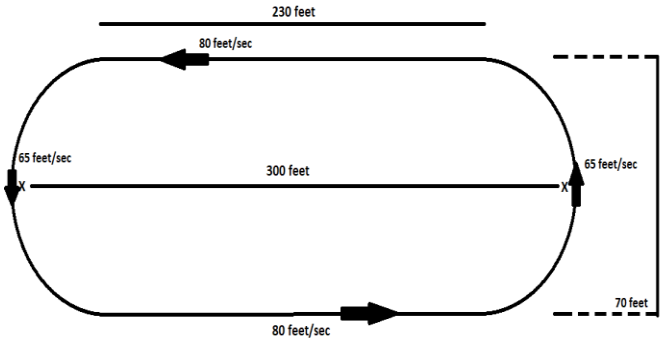
The wing consists of two spars, 12 ribs, and 1/32” balsa skin covering. The two center ribs connect the wing to the fuselage. The horizontal and vertical tails both have a single spar and use both balsa and MonoKote for skin.



Clockwise, from top left: wing buildup, vertical tail buildup, horizontal tail buildup

Propulsion

By selecting a smaller 3S battery, the team was able to limit the weight of the battery while providing just enough power to be able to fly the aircraft for up to three minutes, more than enough time to complete the required five laps. The team was also able to find a motor that provided the required thrust during maneuvers and was able to propel the aircraft to speeds of about 80 feet per second when paired with an 11x7 propeller, which would be made to be detachable on landing so as to not damage the nose of the aircraft.



Course layout and anticipated flight speeds

Payload Release

The payload release system consisted of two components: hardware and software. The hardware consisted of two retractable cords in tension that held up the payload during flight. These cords were released by an Arduino Uno, based on kinematic calculations run using positional information fed from a GPS module. This information, along with a lap counter and assumed roll distance, allowed for a reliable payload drop into the target area.

Scoring Summary

By having the aircraft fly at 80 feet per second in the straightaways and 65 feet per second around the corners, the team predicts a final time of approximately 46 seconds, resulting in a maximum score per flight of about 191 points. Along with accommodations made allowing the aircraft to fly more than once, such as a landing skid added to the final design, this value results in an expected final score of well over 300 total points.

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