AAE 451: Group 4

Design, Build, Fly

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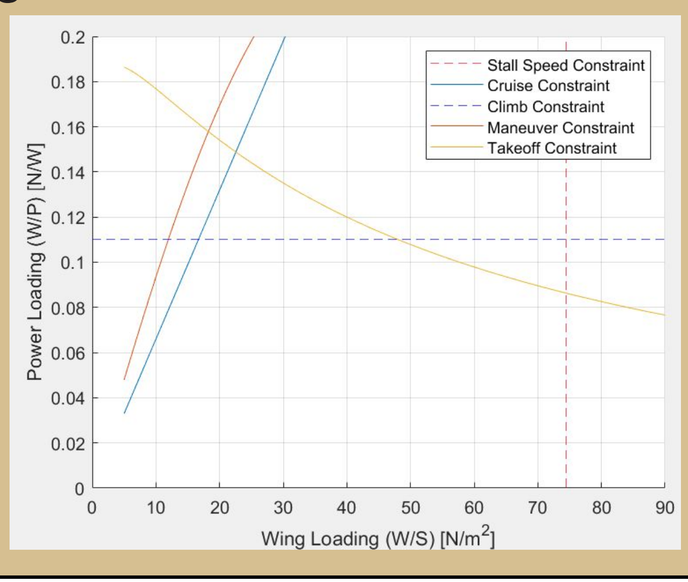
Design & Analysis

Requirements

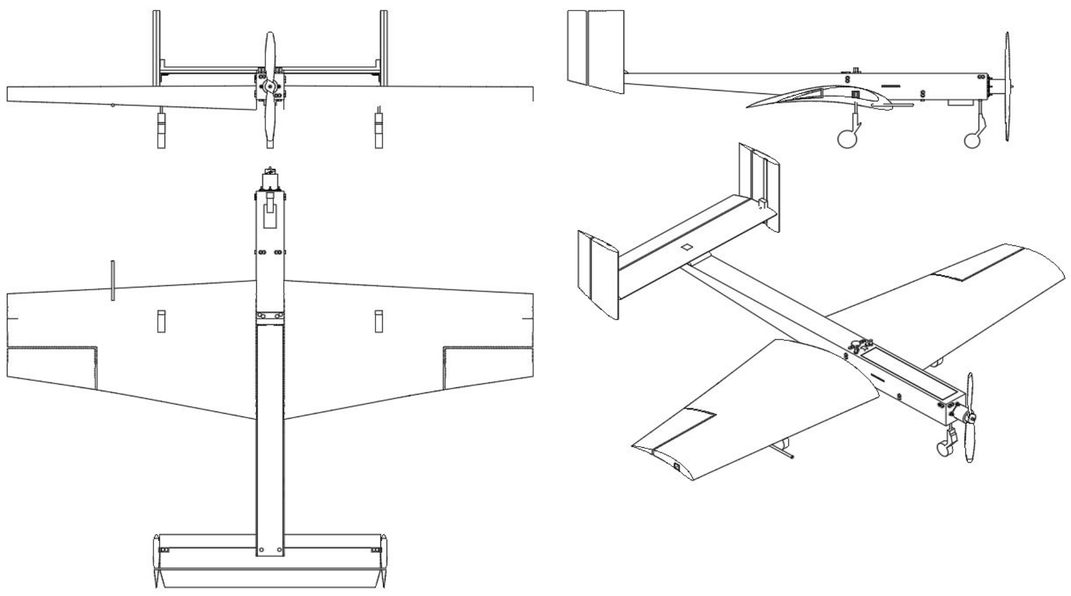
Size & Weight: Fits within a 75x75x150cm storage volume, max 150cm wingspan, and MTOW ≤ 6kg.
Performance & Handling: Takeoff within 25m, soft-field landing, stable and controllable with or without payload, and easy for an external pilot to fly.
Payload Requirements: Must carry at least one 518g steel bar with dimensions 2.75×0.25×6in.
Setup & Operations: Transition from storage to flight in under 5 min, payload and battery installed in under 2 min, and battery connects without removing components.
Power and Budget: Propulsion system limited to 1000W max electrical power, total budget is $400.

Design Parameters

Wing Airfoil: Eppler E423
Wing Area: 0.5m^2
Aspect Ratio: 4.5
MAC: 0.34m
Taper Ratio: 0.6
Root Chord: 0.42m
Tip Chord: 0.25m
Wing Sweep: 0°
C_D Trimmed: 0.03
C_D Untrimmed: 0.024
Tail Airfoil: NACA 0012
H-Tail Configuration



Aircraft & Manufacturing

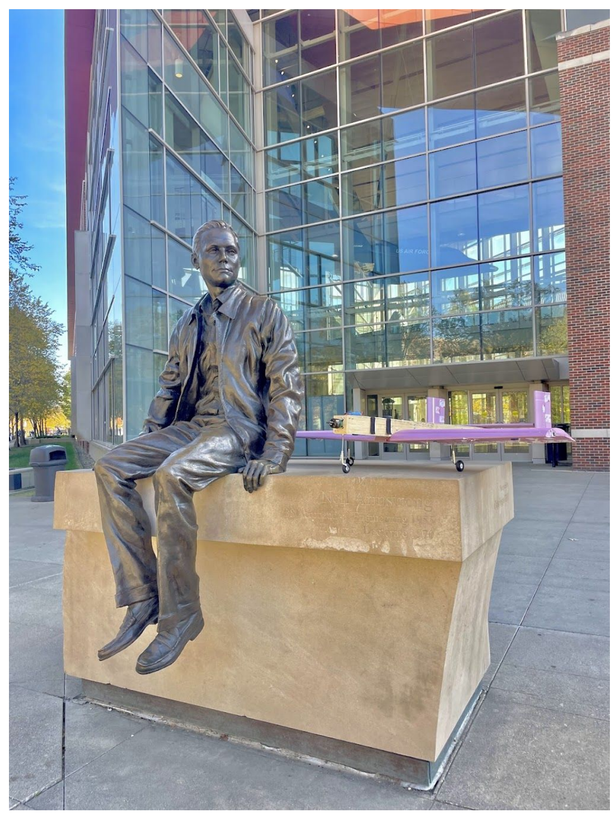


Propulsion System

Motor: Cobra C-3520/14 Brushless Motor
ESC: RC Electric Parts Brushless ESC Classic 4S 60A
Battery: Turnigy 4000mAh 4S 30C LiPo Pack
Propeller: APC 13x6.5E

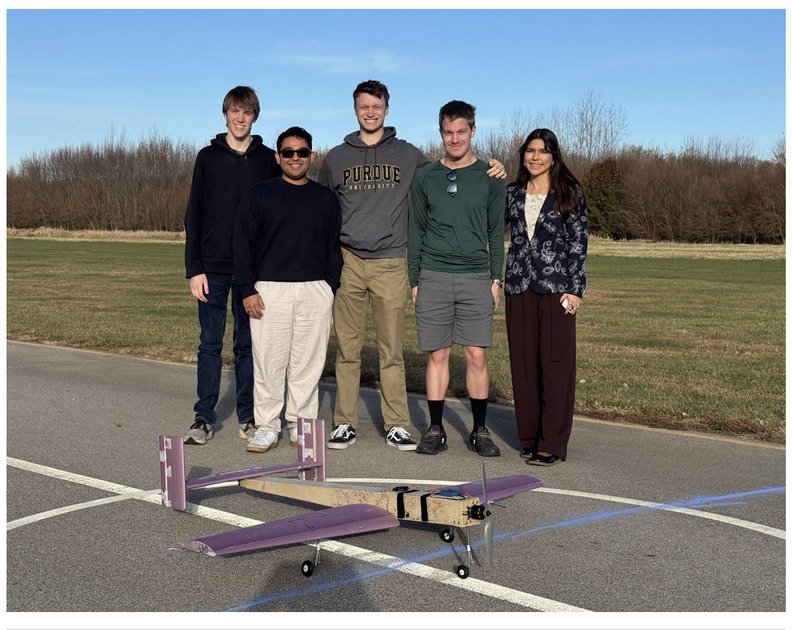
Manufacturing Changes

- Smaller nuts & bolts
- Full box structure for tail boom
- Tail servos in the center back of tail boom
- ESC moved to the top of the fuselage



Weight Table

Parameter	Predicted (kg)	Actual (kg)
Empty Weight	2.875	2.483
Battery Weight	.452	.399
Total Weight	3.845	3.4



Lessons Learned

Avoid Sharp Internal Corners in notched components, as they create major stress concentrations and weaken the structure.
Wing-spar was over-engineered; reducing its cross-section would significantly cut weight and improve its fit within the thin wing-tip profile.

Flight Performance & Results

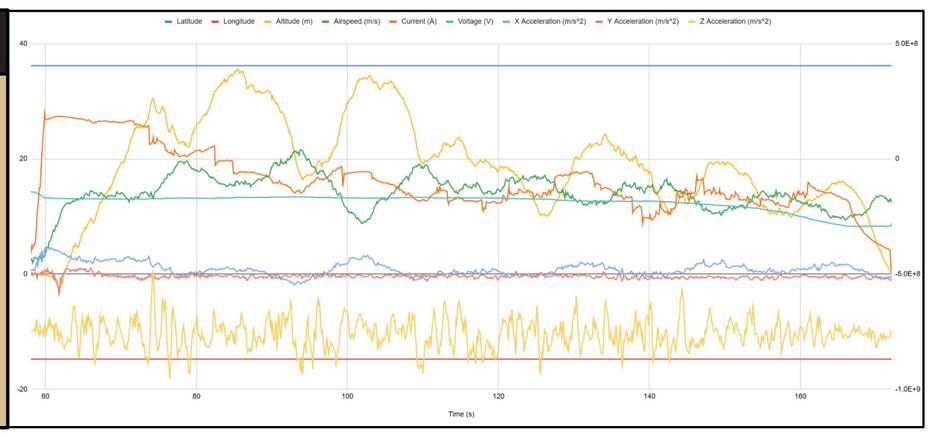
Flight Test Issues

Tail Flutter:

At high power settings the horizontal & vertical stabilizers would flutter due to insufficiently ridgid attachment to fuselage

Crash Landing:

An insufficiently charged battery caused a loss of power, resulting in an uncontrolled descent and crash landing



RFP Requirements Verification

Parameter	PASS or FAIL
Can be stored within 1.5 x 0.75 x 0.75 m box	FAIL
Wingspan under 1.5 m	FAIL (1.51 m)
MTOW under 6 kg	PASS (3.4 kg)
Takeoff in under 25 m	PASS (15.95 m)
Climb to 30 m	PASS (35.6 m)
Successful Soft Field Landing	FAIL (Structural Failure)
Avoid Property Damage	PASS
Under 1000 W of Power Draw	PASS (368.6 W)
Connect Battery in Safe Manner	PASS
Assemble Without Battery / Payload in 5 Minutes	PASS
Install Battery / Payload in Under 2 Minutes	PASS
Stable / Controllable with & without Payload	PASS
Easy to Fly by External Pilot	PASS
Part Cost Under $400	PASS