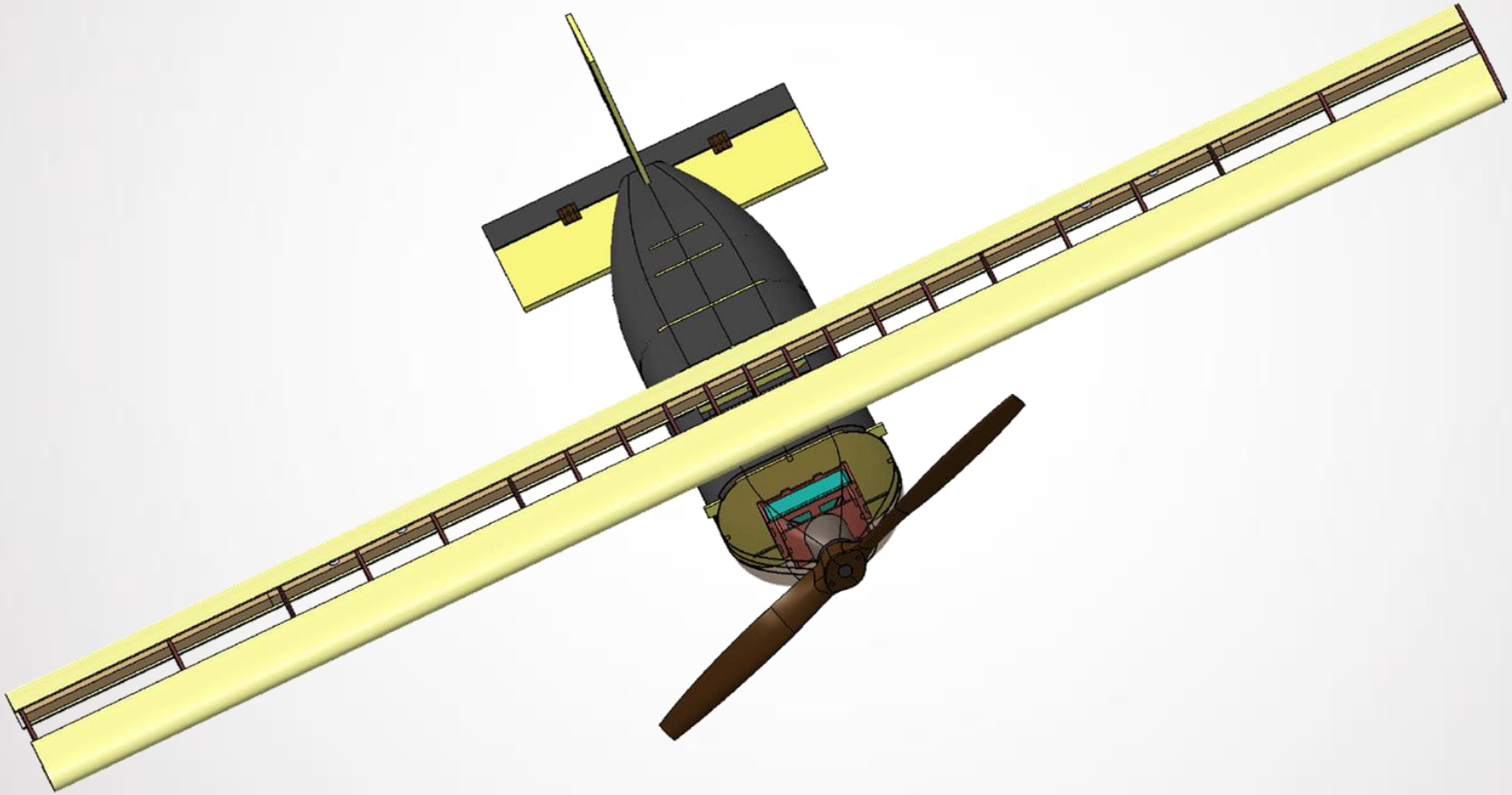
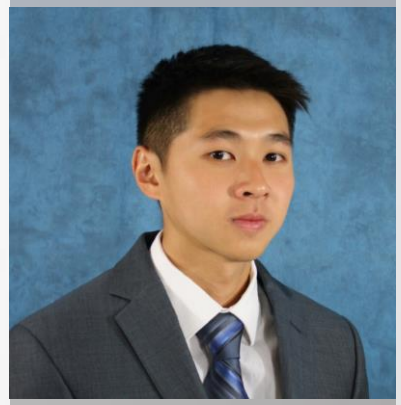
Wichita State University

TEAM #7: MAROSHELITE



Team Introduction

Tenzin Sherpa	Nick Livingston	Deepansh Arora	Robert Mabrey	Jun Chang Teoh
				
AERODYNAMICS LEAD DORJEETENZIN86@GMAIL.COM	PROPULSIONS LEAD NICKL555@COX.NET	STRUCTURES LEAD DPNSHARR@GMAIL.COM	STABILITIES AND CONTROLS LEAD ROBERT.MABREY55@GMAIL.COM	TEAM COORDINATOR/ OIA LEAD JEROMETEOH917@GMAIL.COM

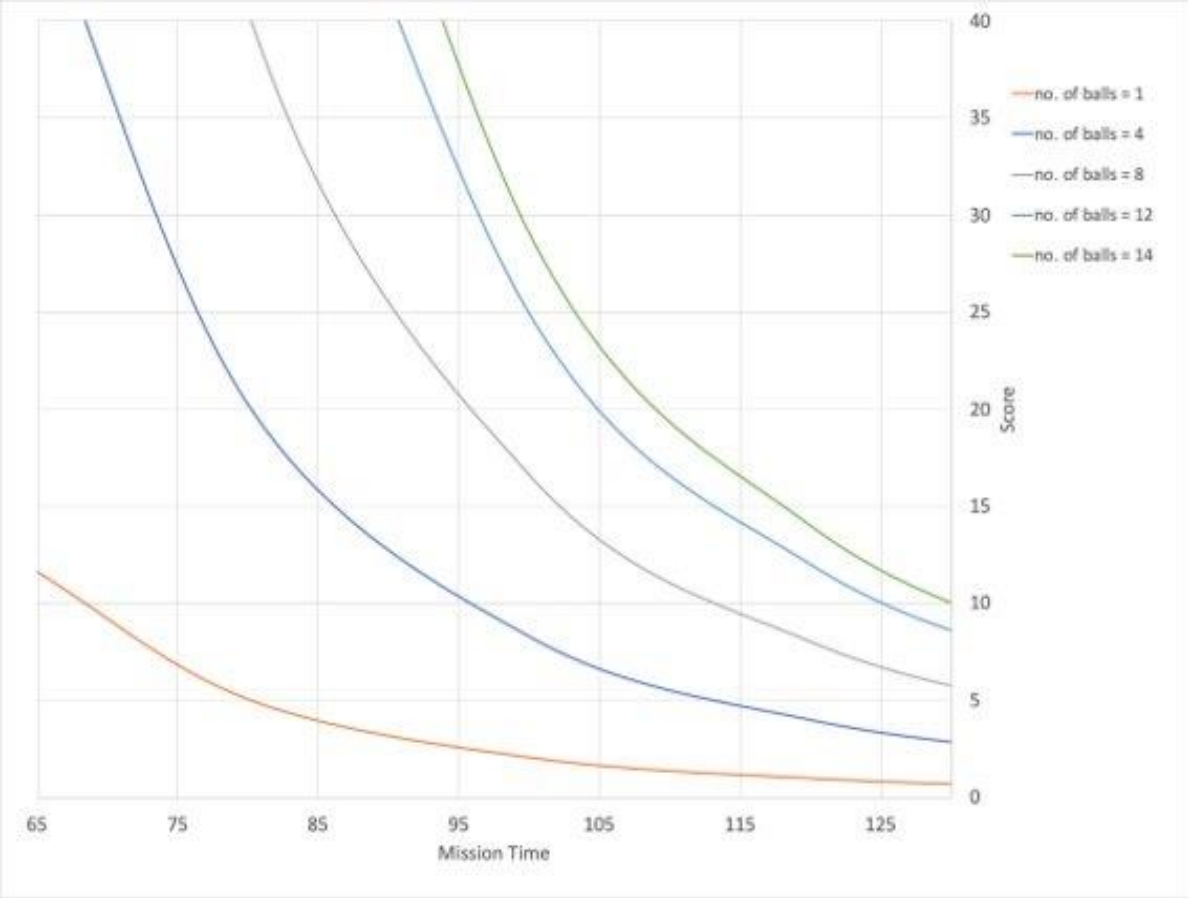
Mission Description

Mission: Bronze Propeller Competition

- Storable in a 11”x7”x36” box
- Have an autonomous payload release mechanism
- Be hand-launched
- Release payload after the second lap
- Fly a minimum of 5 laps
- Land successfully

Mission Analysis:

- Trade studies were done to determine the optimum number of balls and the speed for maximum score.



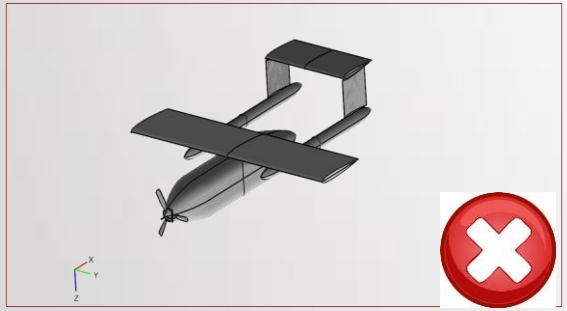
Requirements and Constraints:

- Stall speed greater than 30 ft/s.
- Load factor of 5g to -2g
- Static margin between 5% and 20%.
- Easy access to the battery and the payload.
- Cruise Speed greater than 50 ft/s.
- Propeller diameter less than 13 inches.

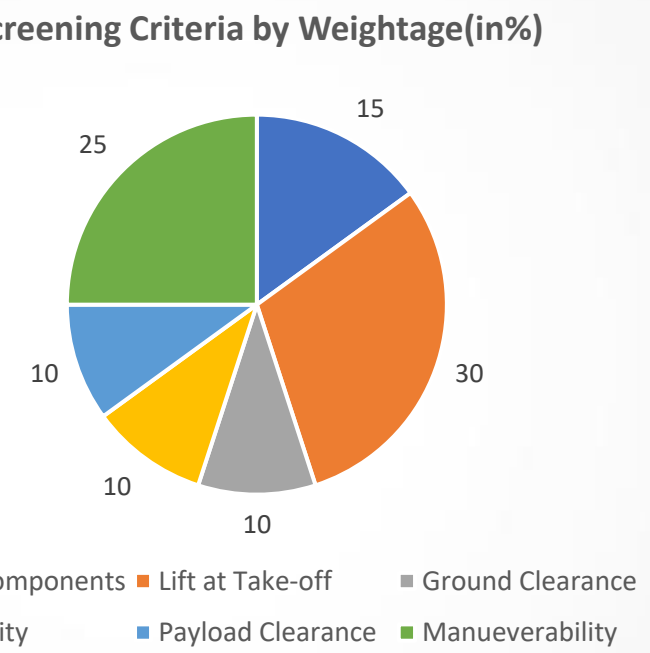
Concept Selection

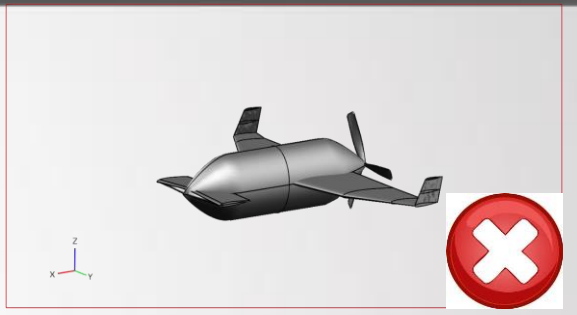
Conventional Twin-engine Plane with a T-tail

Conventional Pusher plane with a conventional tail

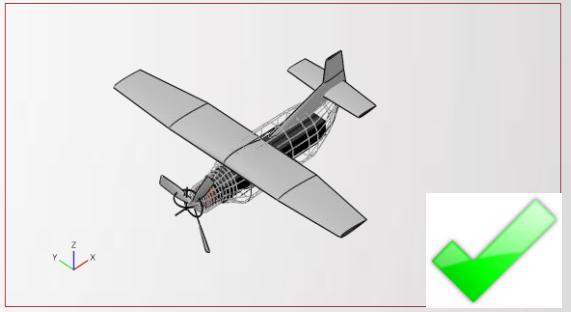


Conventional Wing with a Twin-boom tail





Mid-wing Airplane with a Canard



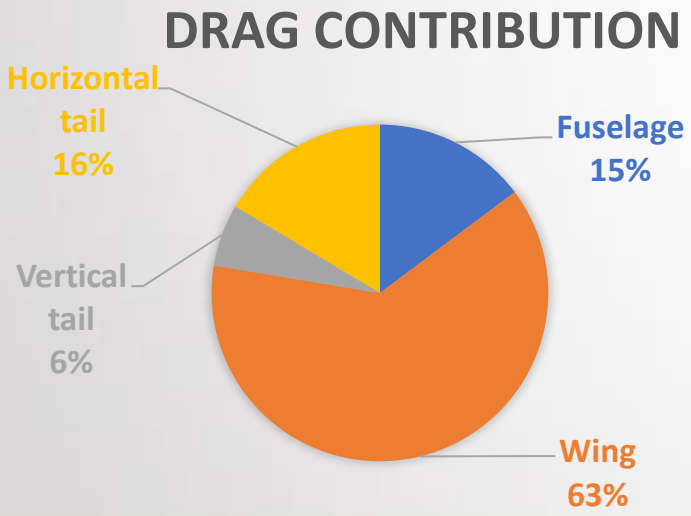
Conventional Mono-engine Plane with a Conventional tail

Aerodynamics

Airfoil Selection:

- Using UIUC Airfoil database, we selected airfoils that fit our mission based on their Lift/Drag for low speed (Reynolds number ~ 200,000).
- The selected airfoils were put under a selection process, and SD7062 was selected.

	Weight	NACA 4412	SD7062
L & D generated	35	3	4
Ease of manufacture	25	3	3
Stall behavior	25	3	4
Pitching Moment	15	3	4
Total Score		3	3.85

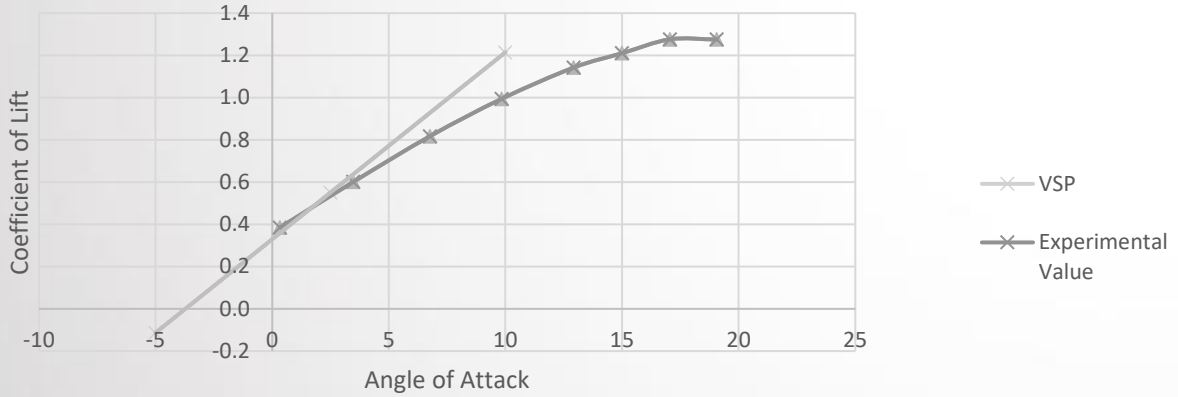


Drag Analysis:

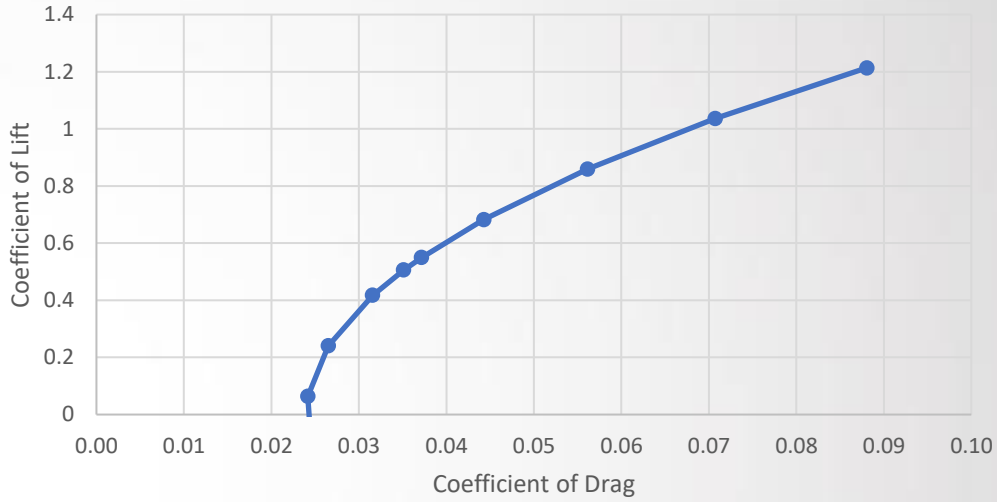
- Using tools like Nicolai Drag prediction, skin friction drags were estimated for major components.
- Using VSP, the induced drag was estimated, and the total drag was calculated.

Aerodynamics (Contd.)

Airfoil	SD 7062
Wing Area	7”x54”
CL,max	1.29
CD	0.04
Lift/Drag	18.4

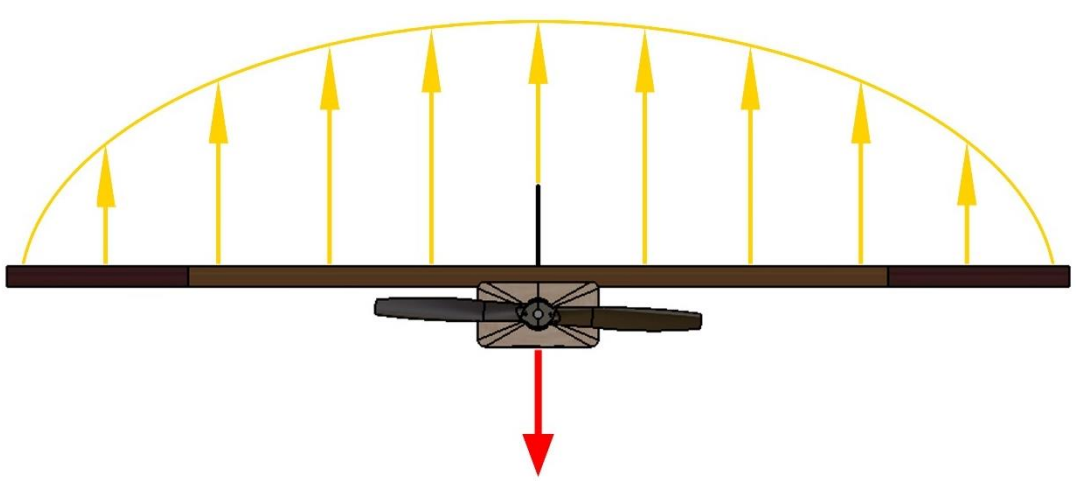


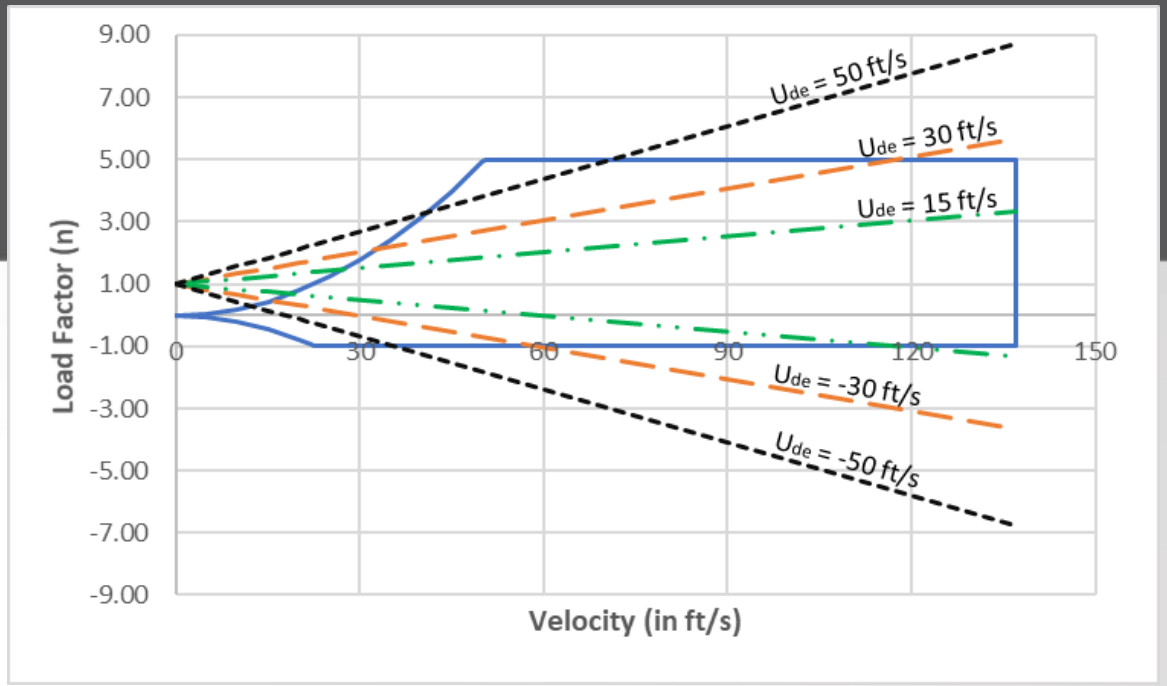
Experimental vs. VSP lift curves for airfoil



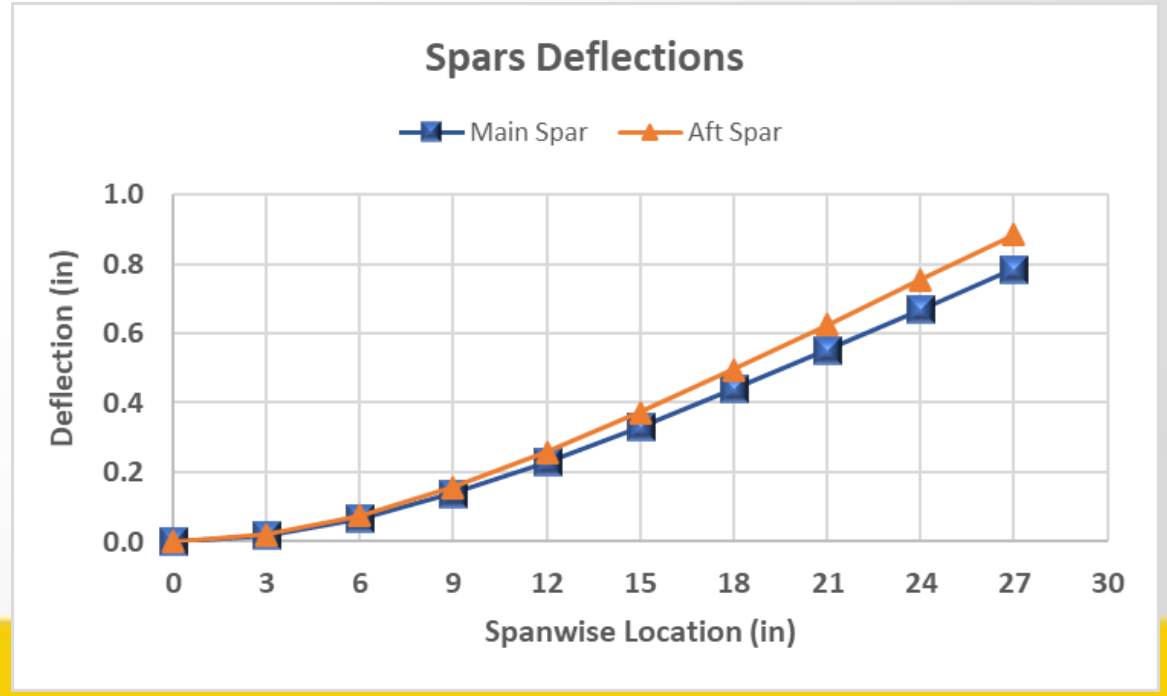
Drag Polar of the SD7062 airfoil

Structures





- Semi-monocoque structure
- Spars construction using basswood
- Aerodynamic Surfacing - Monokote
- Aircraft weight (without payload) – 2.47 lb
- Aircraft weight (with payload) – 3.51 lb
- Aircraft's cruise velocity – 90ft/s
- Aircraft's corner speed – 50 ft/s



PROPULSION

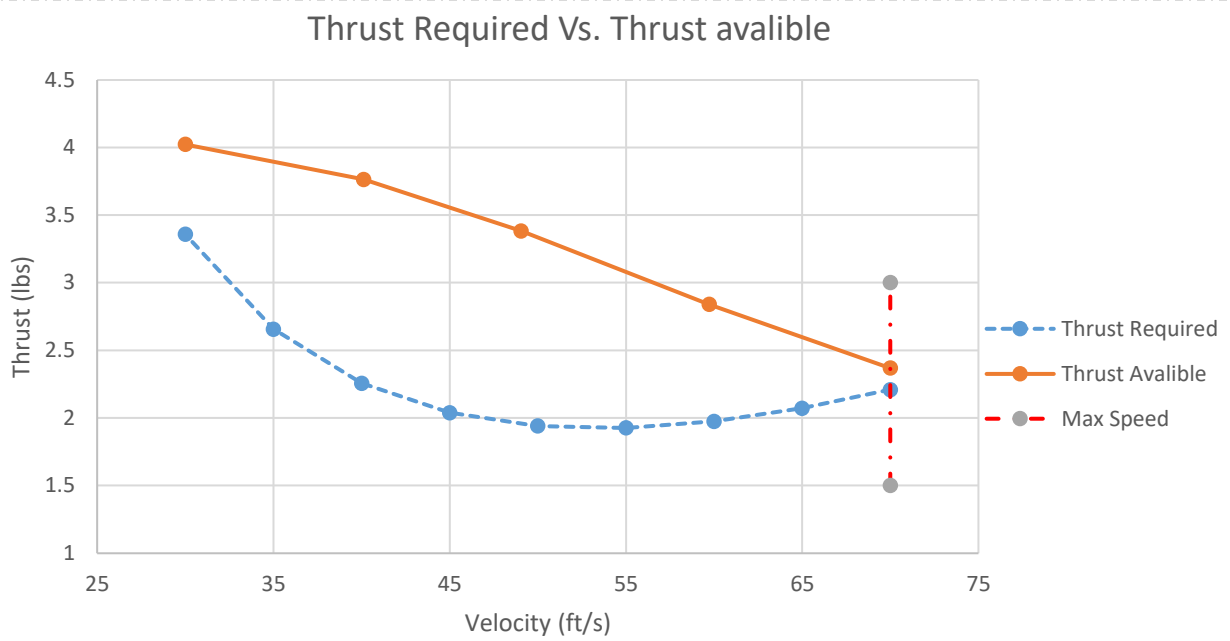
Battery: Venom LiPo 1500 mAh 4S 75C

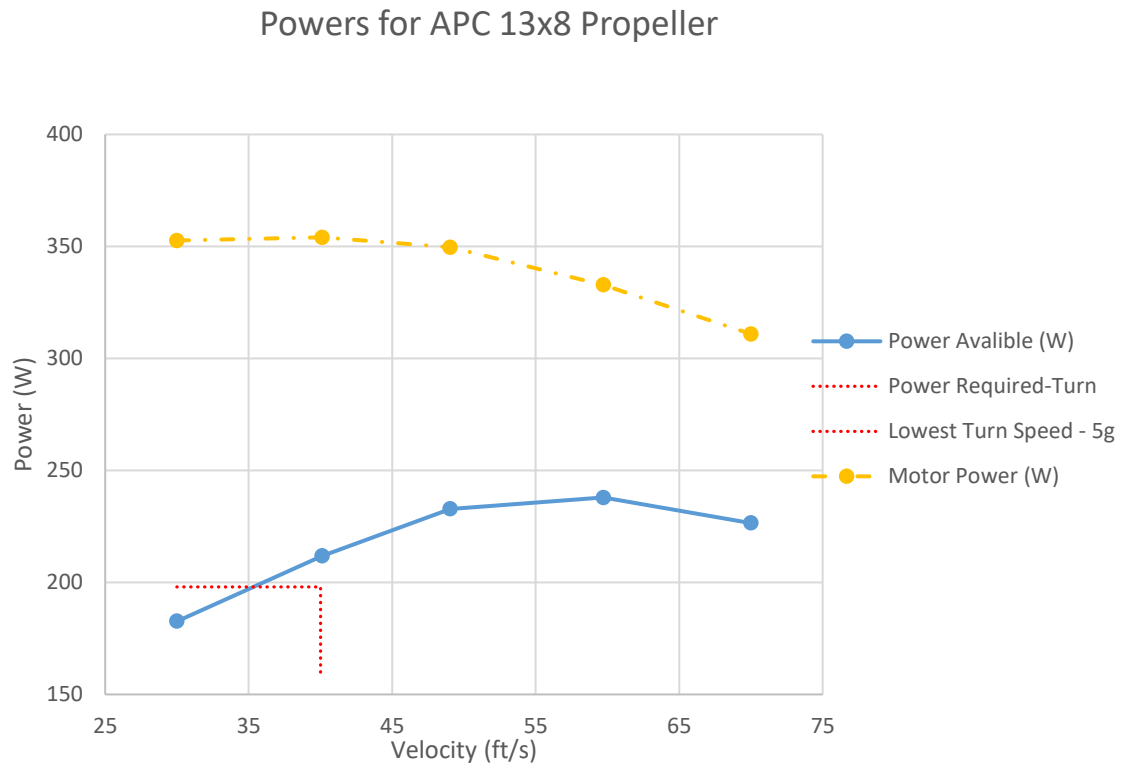
- 4 cell battery
- Weight: 169 g
- Capacity: 1500 mAh

Motor: Great Planes Rimfire .15

- Constant Current: 45 amps
- Constant Power: 500 Watts
- Max Current Needed: 43 amps
- Max Sustained Current Limit: 45 amps

Propeller : APC thin electric 13x8

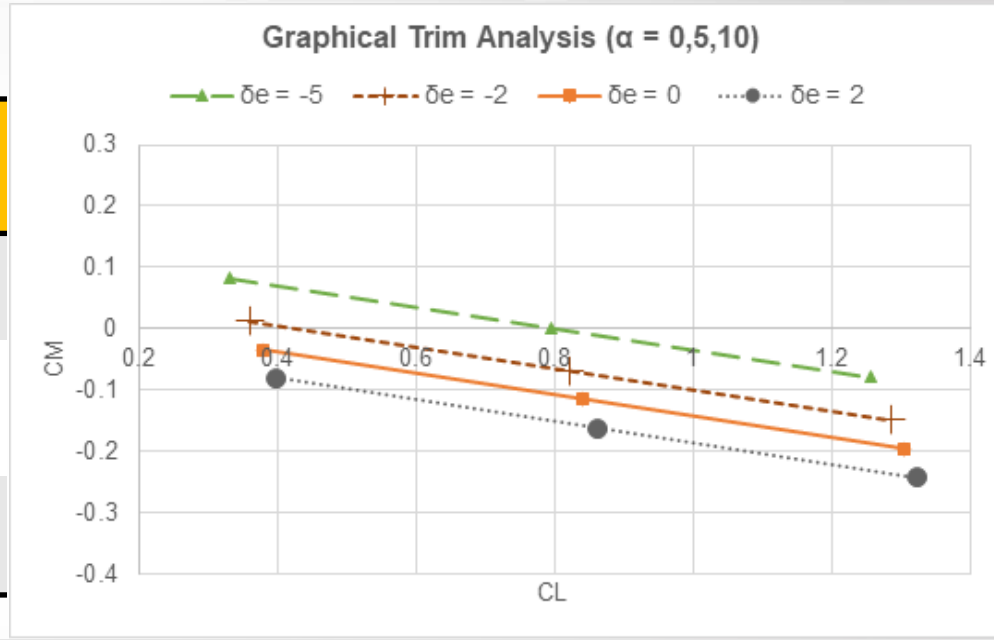




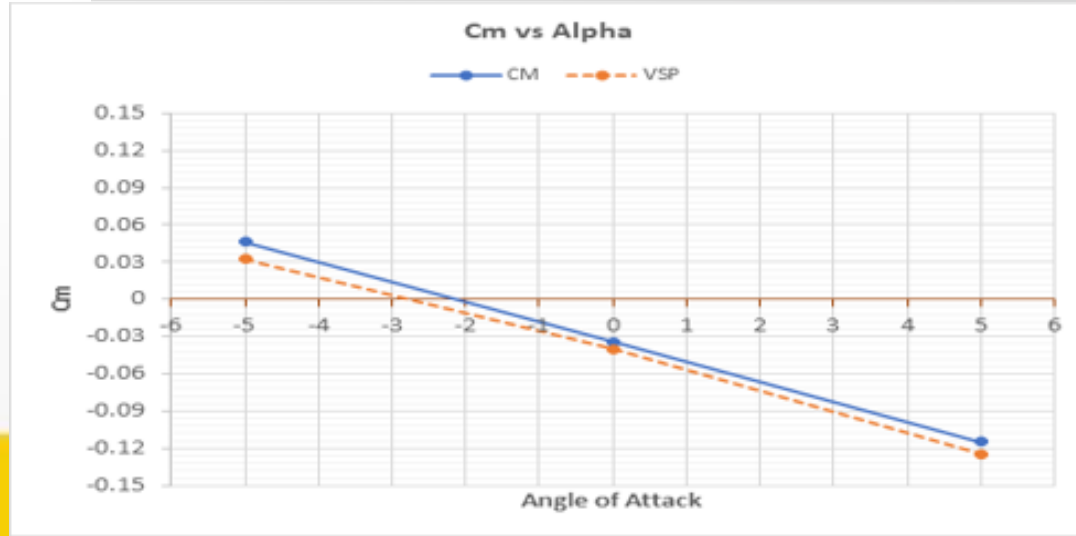
Stability & Control

Horizontal Stabilizer

Section	Dimensions	Lift Characteristics	Moment Characteristics	Trim
H-Stab:	4.25x11.25in	3.38 per radian	-0.92 per radian	0 deg
Elevator:	1.75x11.25in	0.546 per radian	-1.34 per radian	0.20 deg (cruise)
Together:	6x11.25in			



- Neutral Point – 11.5in from the front of the aircraft
- 0.15-0.16 Static Margin
- Placement of internal components minimizes C.G shift, even with max payload
- Validated results through VSPAero show close similarities in Cm vs Alpha

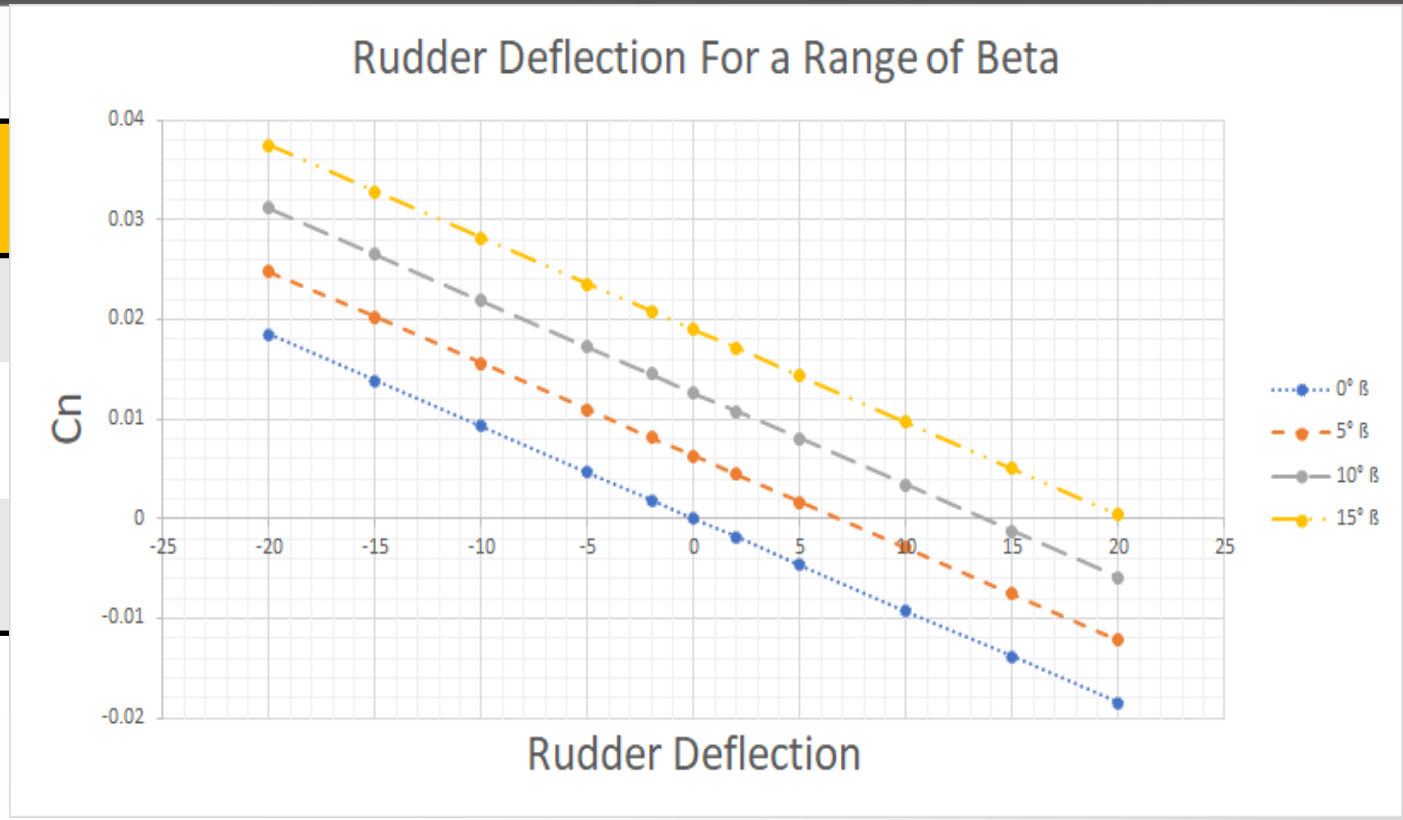


Stability & Control Cont.

Vertical Stabilizer

	Dimensions	Yaw Characteristics	Trim
V-Stab:	3.5x6in	0.0723 per radian	0 deg
Rudder:	1.75x4.64in	-0.053 per radian	3.4 deg (cruise)
Together:	3.5x6in		

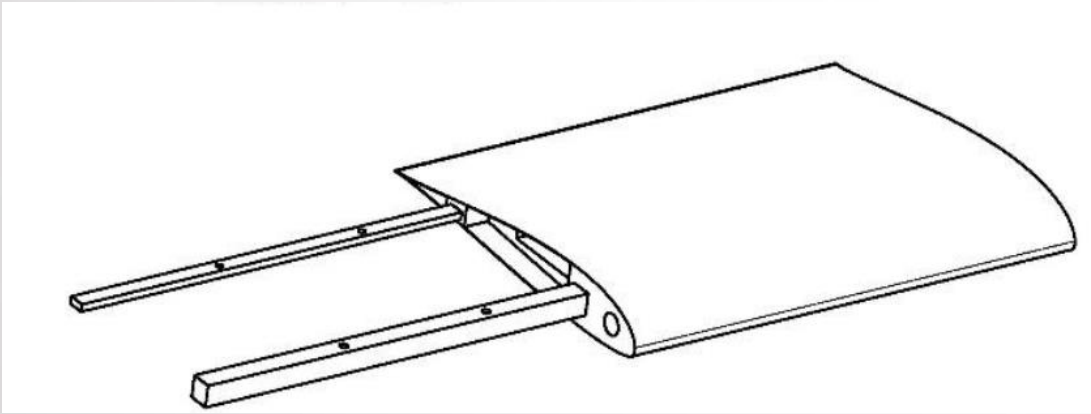
- Vertical stabilizer was calculated to account for up to 20deg beta
- Able to recover from spins due to rudder sizing
- Ailerons are installed to maximize roll rates to increase maneuverability



Key Features

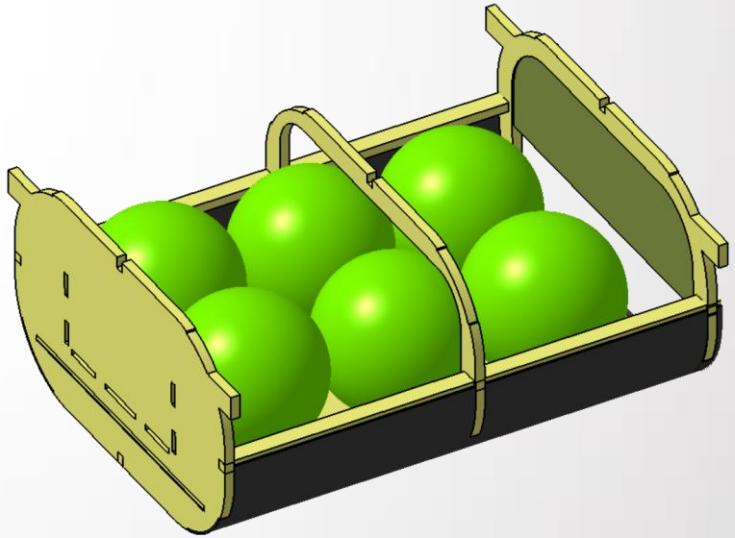
1. Interconnectable Wings

- Box sizing restricts a single wing size to 36”
- A larger wing creates a larger lift carry more payload.
- Three connectable wing segments were used to increase wingspan

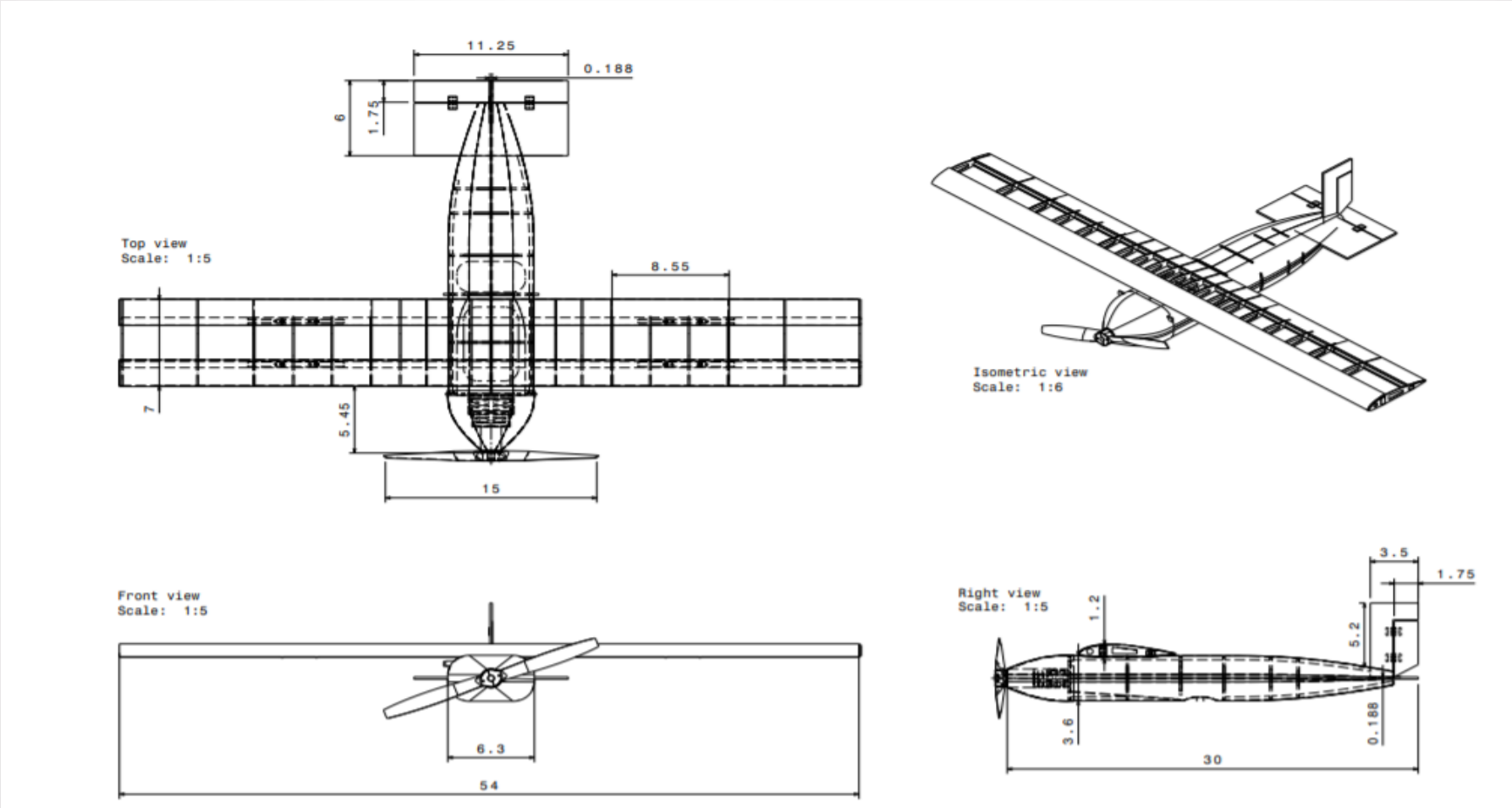


2. Payload Release Mechanism

- GPS integrated Arduino for an autonomous circuit.
- An 8˚ ramp to ease payload drop.
- Servo controlled hinge that opens the ramp.



Aircraft Configuration



Performance Specification

Performance Characteristics:

Cruise Speed	70 ft/s
Stall Speed	31 ft/s
Endurance	118 seconds
Turning Speed	50 ft/s
Payload Weight	1.04 lbs
Empty Weight	2.70 lbs
Rate of Climb	25 ft/s

Flight Path: