

Conceptual
Design Review

StratoShield

Introduction

Mission and
Requirements

Market Survey

Initial Design

Trade Studies

Flight Performance

Airfoil Selection

Wing Sizing and
Placement

Fuselage Design

Propulsion

Structures

Current
Concept

Conclusion

Conceptual Design Review Presentation

The Banshee

StratoShield

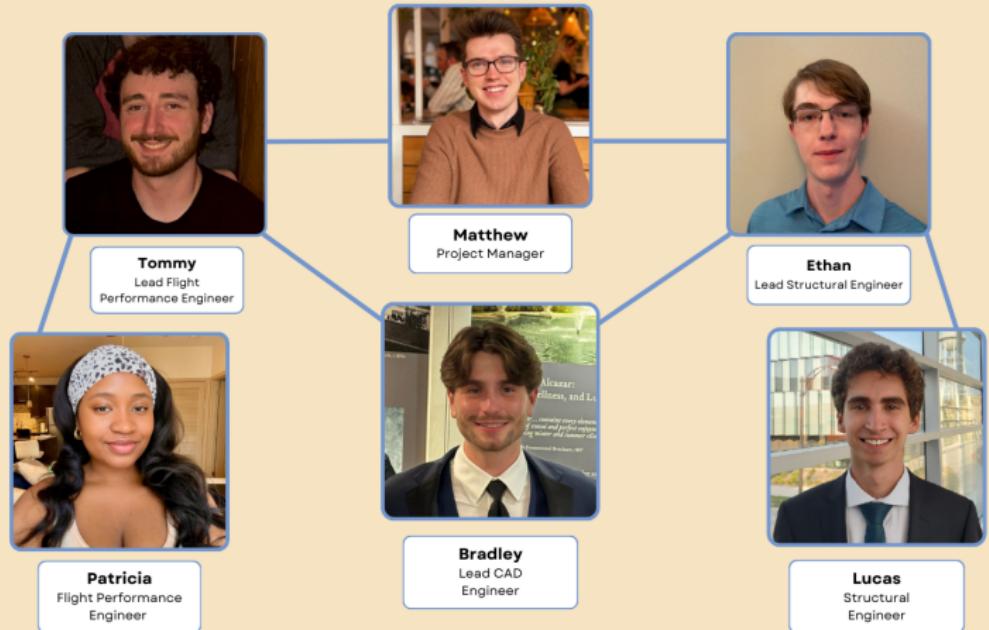
Iowa State University

Tuesday, November 5th, 2024

STRATOSHIELD



Organization Chart



Executive Summary

- 1 Introduction
- 2 Mission and Requirements
- 3 Market Survey
- 4 Initial Design
- 5 Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
- 6 Current Concept
- 7 Conclusion

Conceptual
Design Review

StratoShield

Introduction

Mission and
Requirements

Market Survey

Initial Design

Trade Studies

Flight Performance

Airfoil Selection

Wing Sizing and
Placement

Fuselage Design

Propulsion

Structures

Current
Concept

Conclusion

Mission

- Customer: Department of Homeland Security
- Mission: Protect U.S. citizens from hostile sUAS

Threats Posed by sUAS

- Conceptual Design Review
- StratoShield
- Introduction
- Mission and Requirements
- Market Survey
- Initial Design
- Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
 - Propulsion
 - Structures
- Current Concept
- Conclusion

- Surveillance and espionage

Threats Posed by sUAS

- Surveillance and espionage
- Smuggling payloads

Threats Posed by sUAS

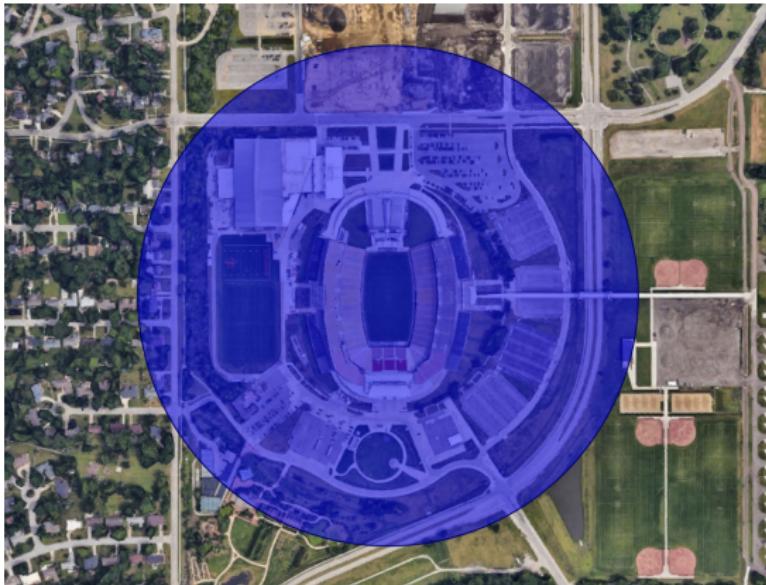
- Surveillance and espionage
- Smuggling payloads
- GPS spoofing and jamming

Threats Posed by sUAS

- Surveillance and espionage
- Smuggling payloads
- GPS spoofing and jamming
- Weaponization

Key Requirements

- ① The UAV shall prevent a hostile airborne sUAS from reaching a key area in an AOI where the key area is at most a circular area of ≈ 100 acres.



Key Requirements

Conceptual Design Review
StratoShield
Introduction
Mission and Requirements
Market Survey
Initial Design
Trade Studies
Flight Performance
Airfoil Selection
Wing Sizing and Placement
Fuselage Design
Propulsion
Structures
Current Concept
Conclusion

- ① The UAV shall prevent a hostile airborne sUAS from reaching a key area in an AOI where the key area is at most a circular area of ≈ 100 acres.
- ② The UAV shall be capable of detecting an airborne sUAS.

Key Requirements

Conceptual Design Review
StratoShield
Introduction
Mission and Requirements
Market Survey
Initial Design
Trade Studies
Flight Performance
Airfoil Selection
Wing Sizing and Placement
Fuselage Design
Propulsion
Structures
Current Concept
Conclusion

- ① The UAV shall prevent a hostile airborne sUAS from reaching a key area in an AOI where the key area is at most a circular area of ≈ 100 acres.
- ② The UAV shall be capable of detecting an airborne sUAS.
- ③ The UAV shall be capable of fixed-wing flight.

Key Requirements

Conceptual Design Review
StratoShield
Introduction
Mission and Requirements
Market Survey
Initial Design
Trade Studies
Flight Performance
Airfoil Selection
Wing Sizing and Placement
Fuselage Design
Propulsion
Structures
Current Concept
Conclusion

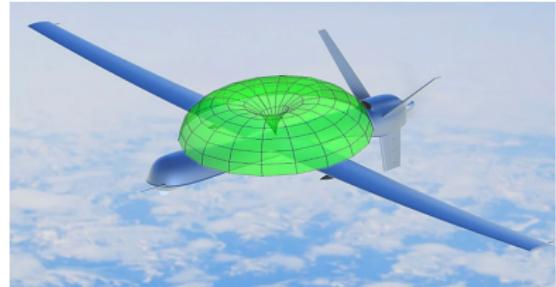
- ① The UAV shall prevent a hostile airborne sUAS from reaching a key area in an AOI where the key area is at most a circular area of ≈ 100 acres.
- ② The UAV shall be capable of detecting an airborne sUAS.
- ③ The UAV shall be capable of fixed-wing flight.
- ④ The UAV shall support autonomous flight.

Solutions

Kinetic Impact

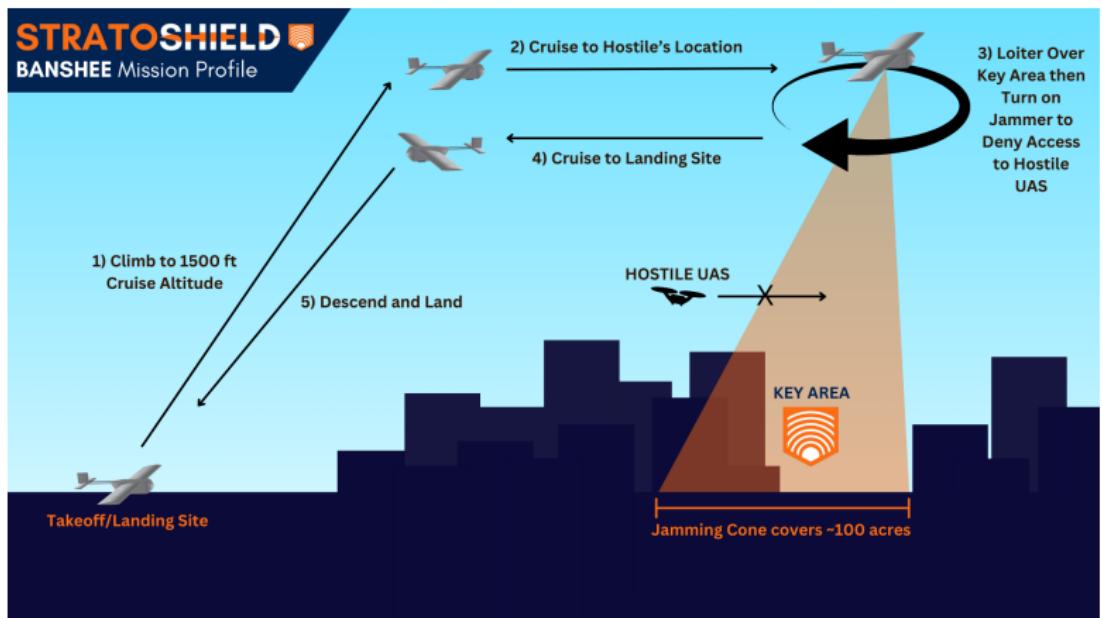


Jamming



- Conceptual Design Review
- StratoShield
- Introduction
- Mission and Requirements
- Market Survey
- Initial Design
- Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
 - Propulsion
 - Structures
- Current Concept
- Conclusion

Mission Profile



Comparable sUAV



Hunter 2-S



MyFlyDream Nimbus



AeroVironment RQ-11 Raven

Conceptual Design Review

StratoShield

Introduction

Mission and Requirements

Market Survey

Initial Design

Trade Studies

Flight Performance

Airfoil Selection

Wing Sizing and Placement

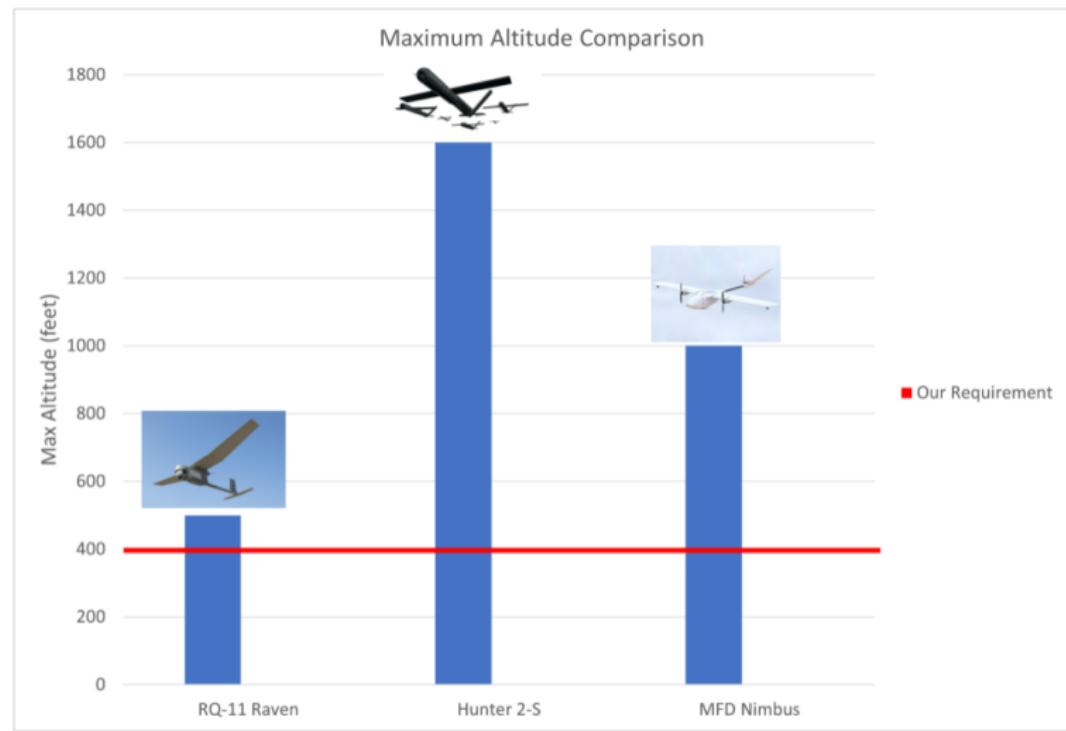
Fuselage Design

Propulsion

Structures

Current Concept

Conclusion



Conceptual Design Review

StratoShield

Introduction

Mission and Requirements

Market Survey

Initial Design

Trade Studies

Flight Performance

Airfoil Selection

Wing Sizing and Placement

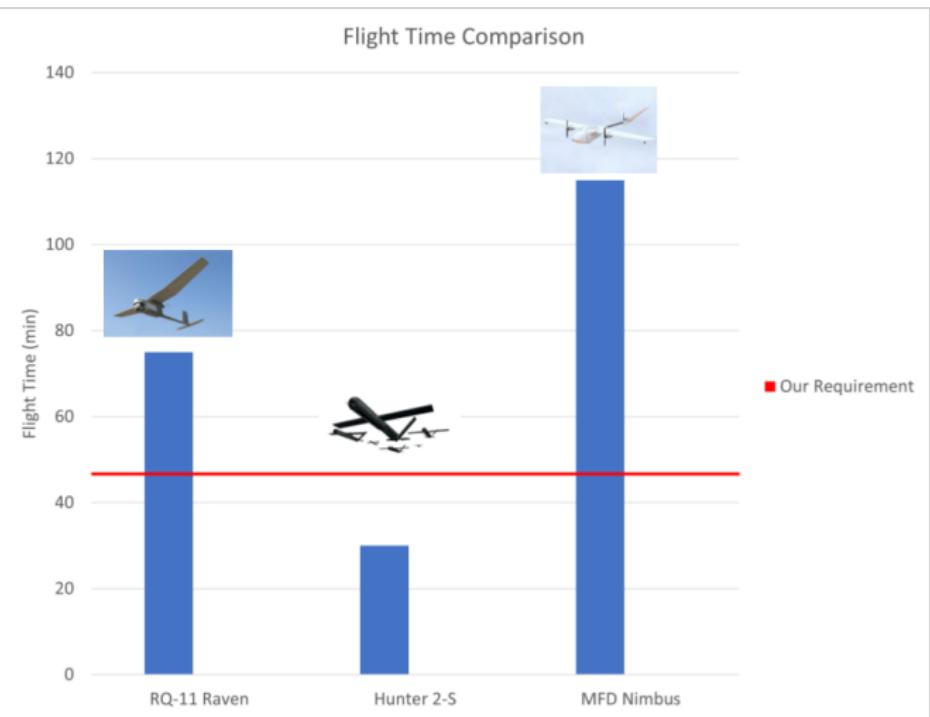
Fuselage Design

Propulsion

Structures

Current Concept

Conclusion



Conceptual Design Review

StratoShield

Introduction

Mission and Requirements

Market Survey

Initial Design

Trade Studies

Flight Performance

Airfoil Selection

Wing Sizing and Placement

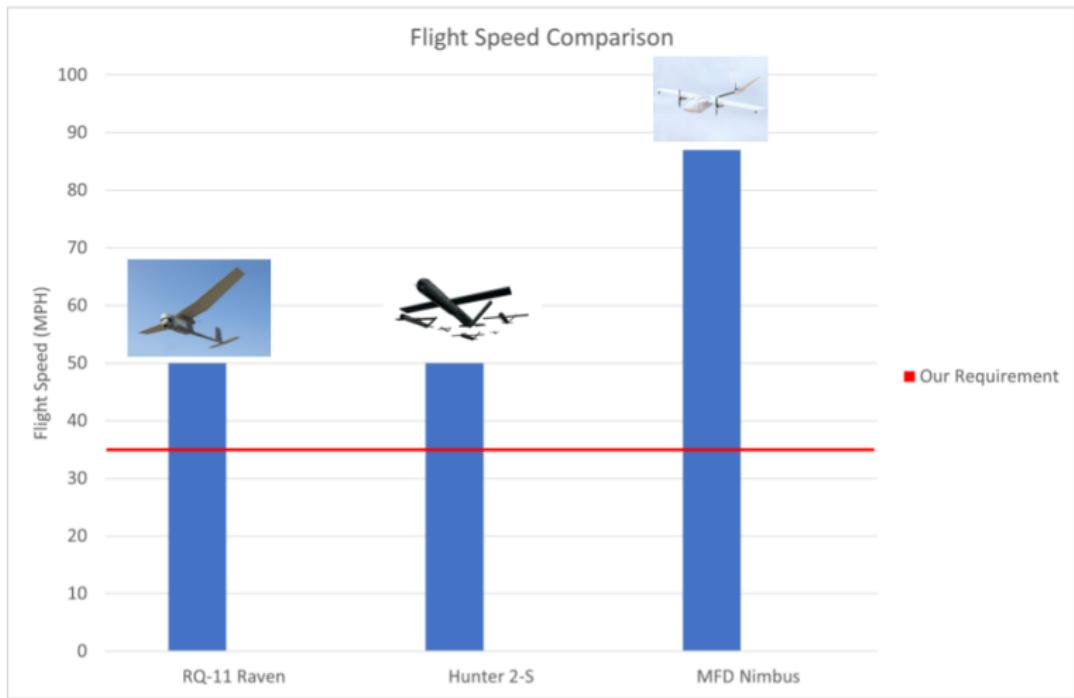
Fuselage Design

Propulsion

Structures

Current Concept

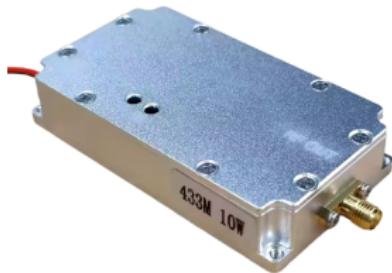
Conclusion



Technologies I



Jamming Antenna



Jamming Module

Total Weight = 0.50 lbs

Technologies II

- Conceptual Design Review
- StratoShield
- Introduction
- Mission and Requirements
- Market Survey
- Initial Design
- Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
 - Propulsion
 - Structures
- Current Concept
- Conclusion



Drone Detector SDR

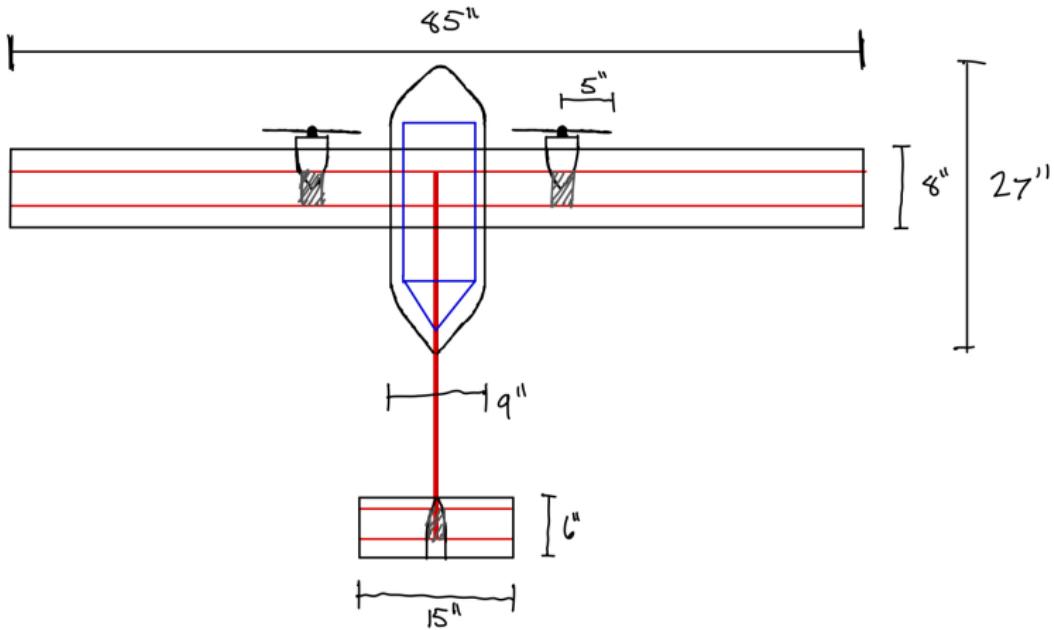


Detector Antenna

Total Weight = 0.23 lbs

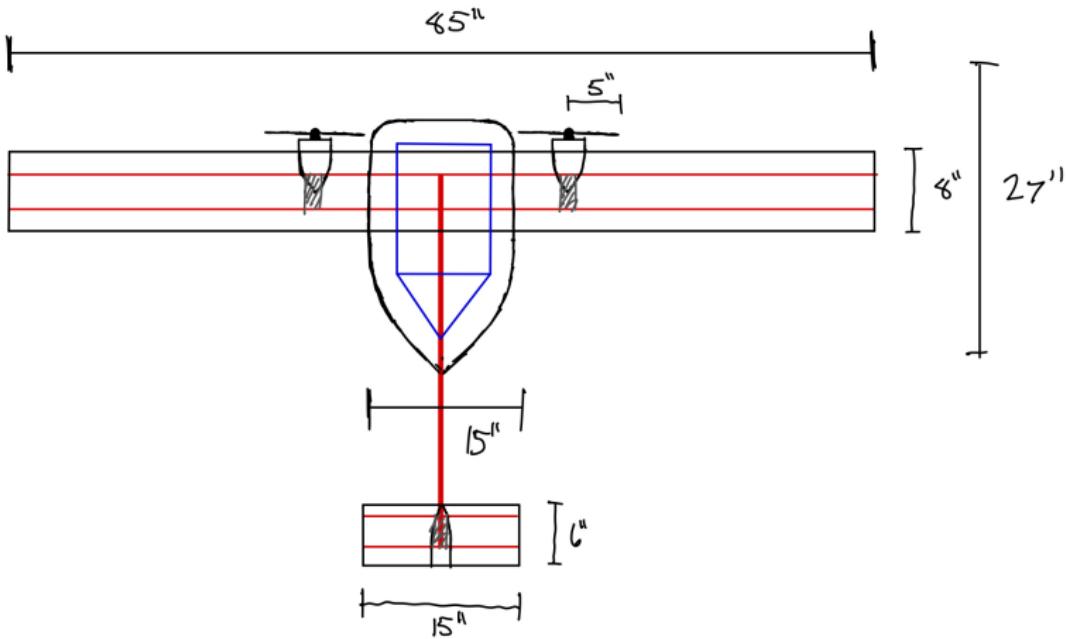
Initial Design I

- Conceptual Design Review
- StratoShield
- Introduction
- Mission and Requirements
- Market Survey
- Initial Design**
 - Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
 - Propulsion
 - Structures
 - Current Concept
 - Conclusion



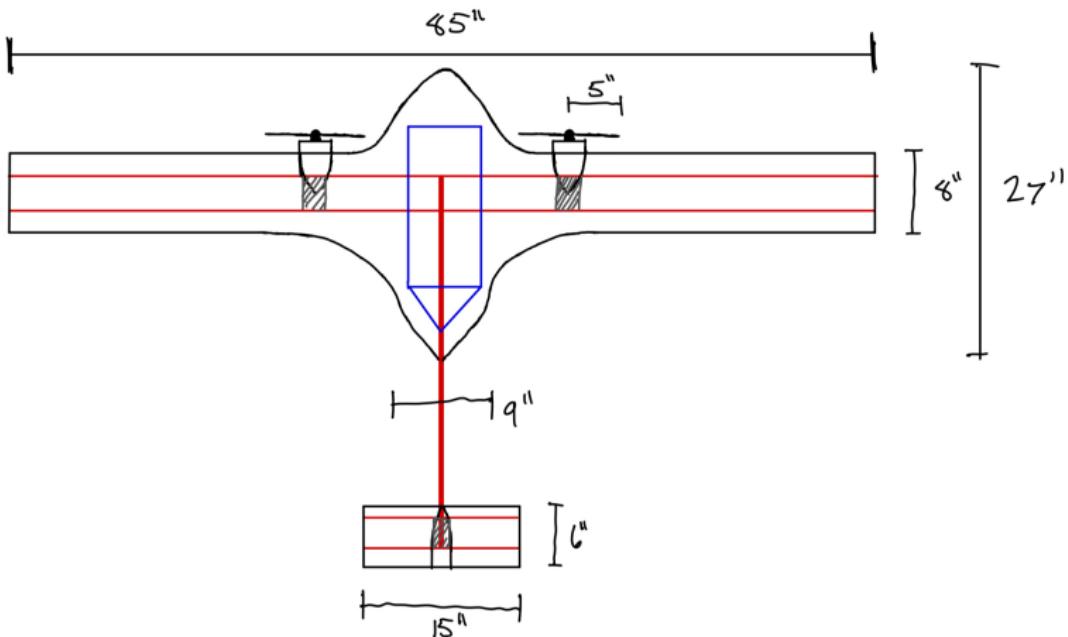
Initial Design II

- Conceptual Design Review
- StratoShield
- Introduction
- Mission and Requirements
- Market Survey
- Initial Design**
 - Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
 - Propulsion
 - Structures
- Current Concept
- Conclusion

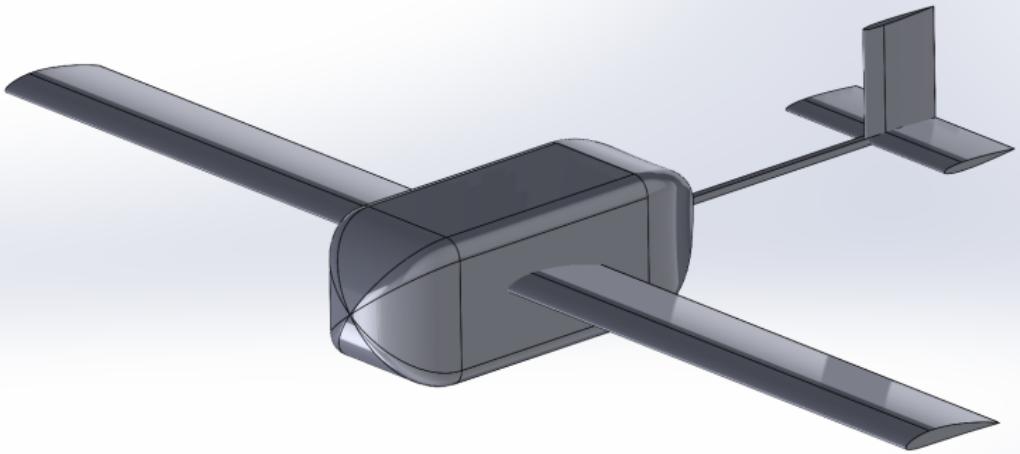


Initial Design III

- Conceptual Design Review
- StratoShield
- Introduction
- Mission and Requirements
- Market Survey
- Initial Design**
 - Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
 - Propulsion
 - Structures
- Current Concept
- Conclusion



Initial Design



- Conceptual Design Review
- StratoShield
- Introduction
- Mission and Requirements
- Market Survey
- Initial Design**
 - Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
 - Propulsion
 - Structures
- Current Concept
- Conclusion

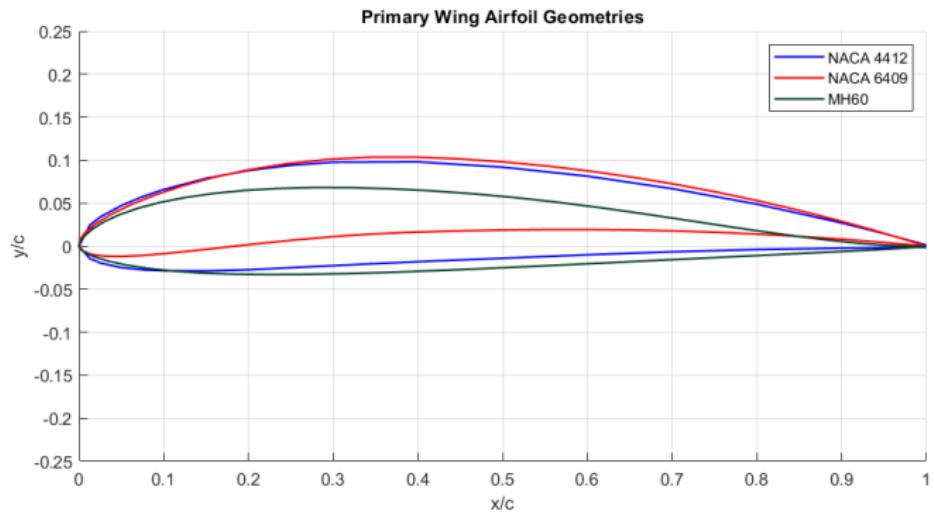
Primary Wing Airfoil Selection I

Conceptual Design Review
StratoShield

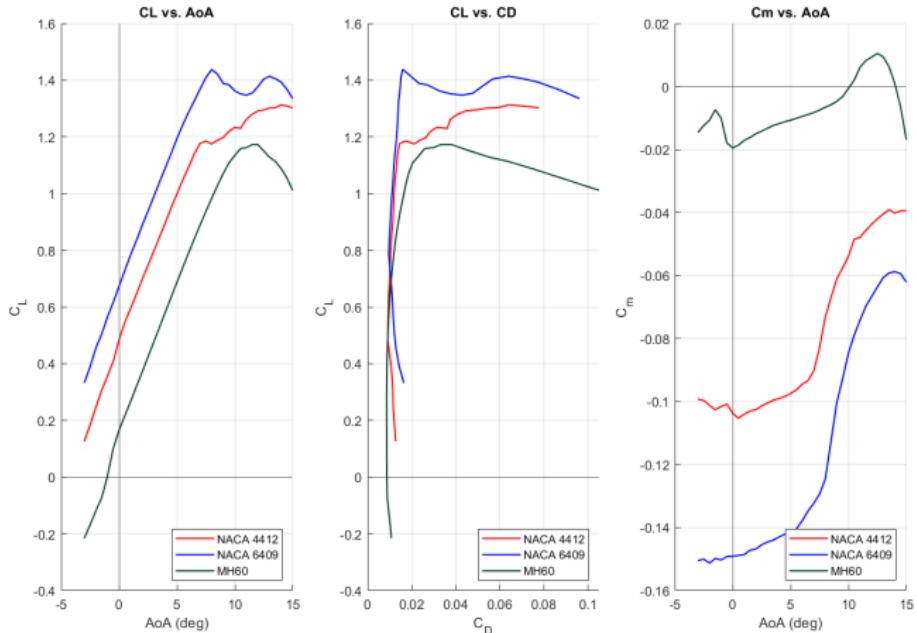
Introduction
Mission and Requirements
Market Survey
Initial Design
Trade Studies
Flight Performance
Airfoil Selection
Wing Sizing and Placement
Fuselage Design
Propulsion
Structures

Current Concept

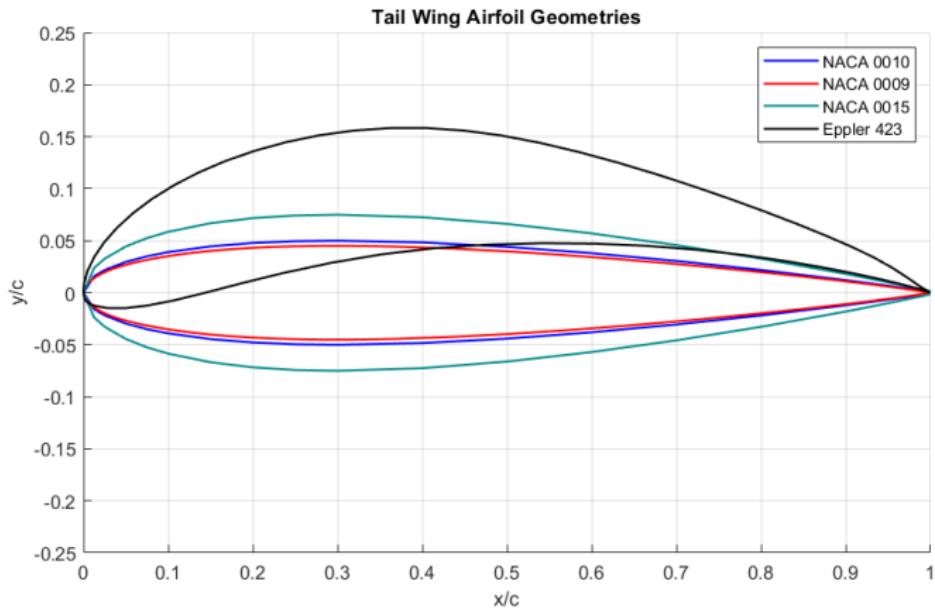
Conclusion



Primary Wing Airfoil Selection II



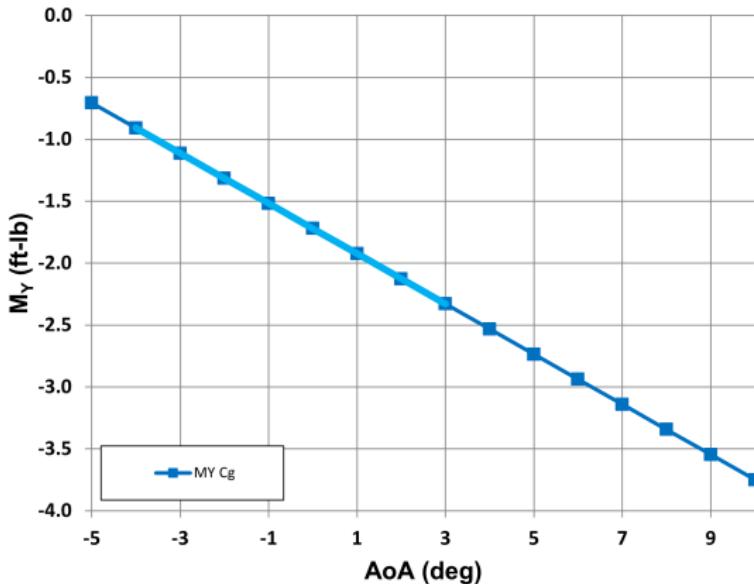
Tail Wing Airfoil Selection I



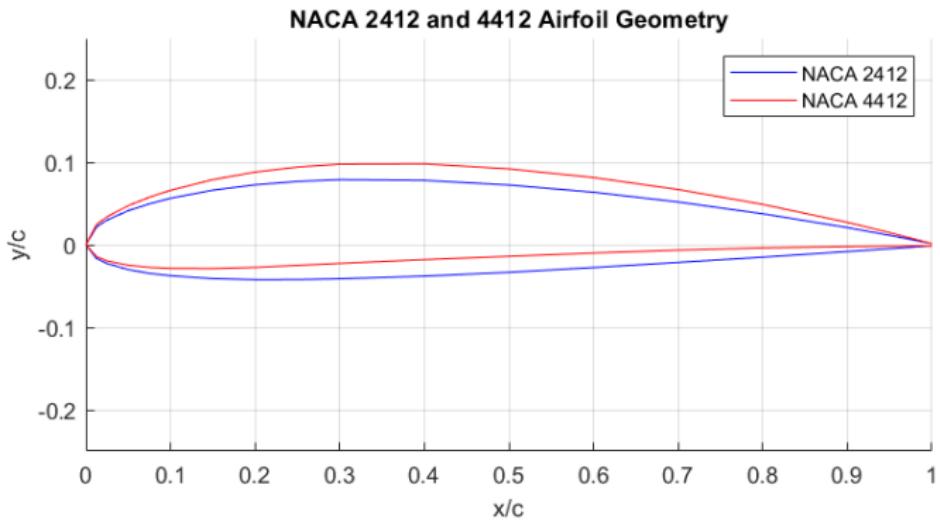
Initial Airfoil Selection Summary

- Initial choice:

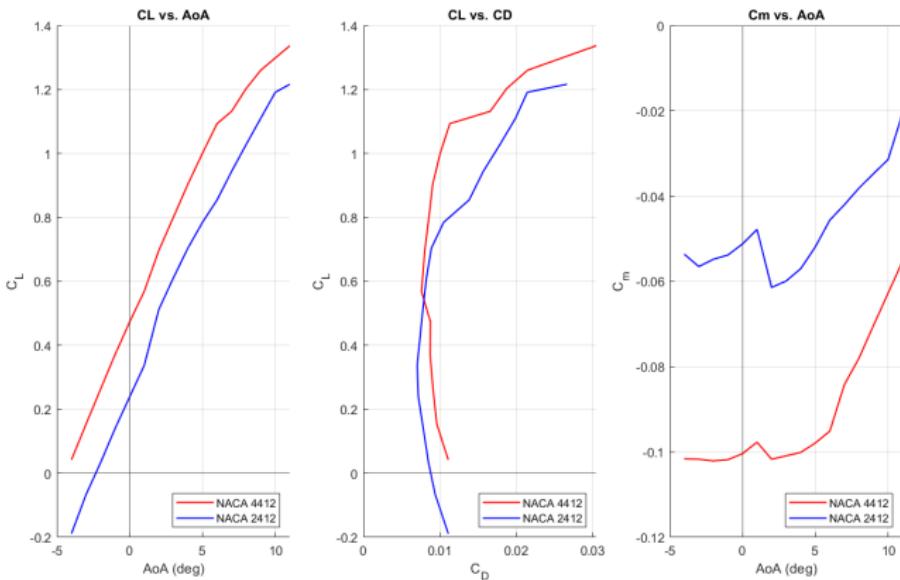
- Primary wing: NACA 4412
- Tail: NACA 0015



NACA 2412 vs. NACA 4412 |

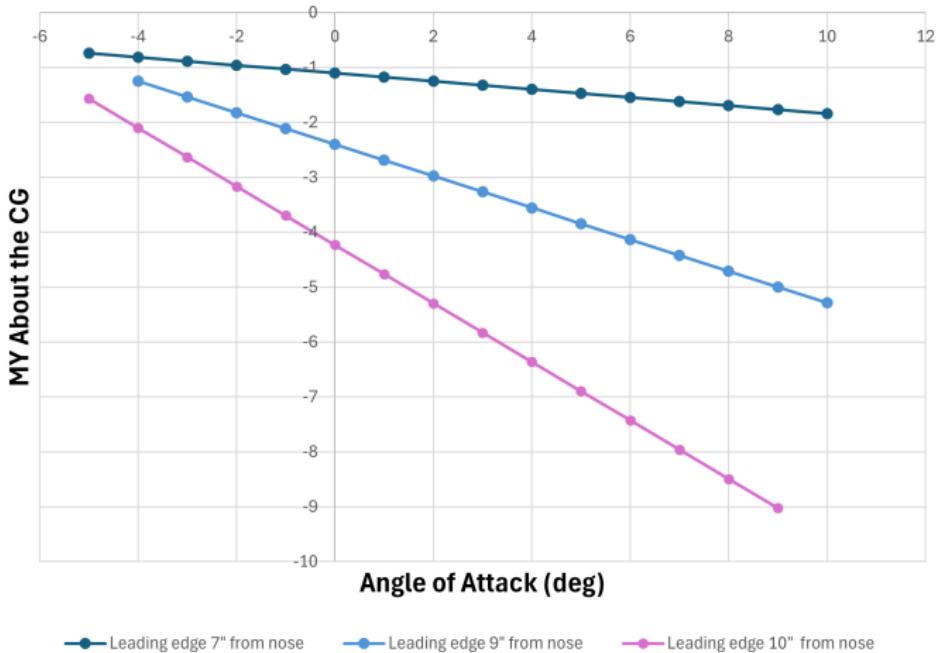


NACA 2412 vs. NACA 4412 II

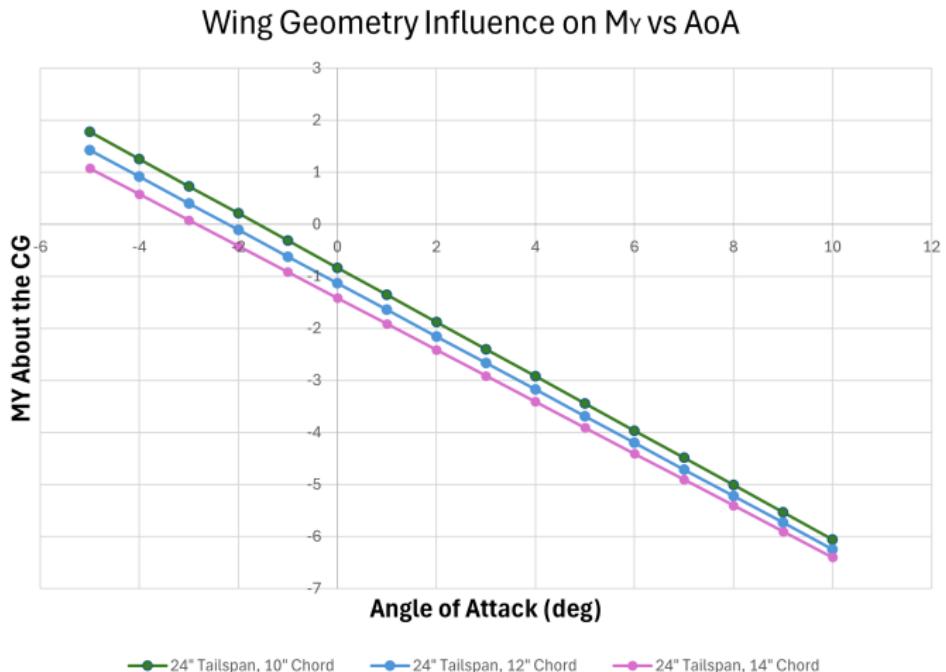


Wing Placement Analysis

Primary Wing Influence on MY vs AoA



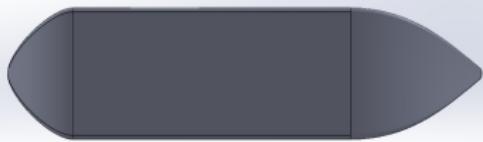
Wing Sizing Analysis



Fuselage Designs



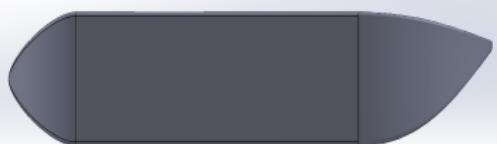
Initial Design Model



Model A

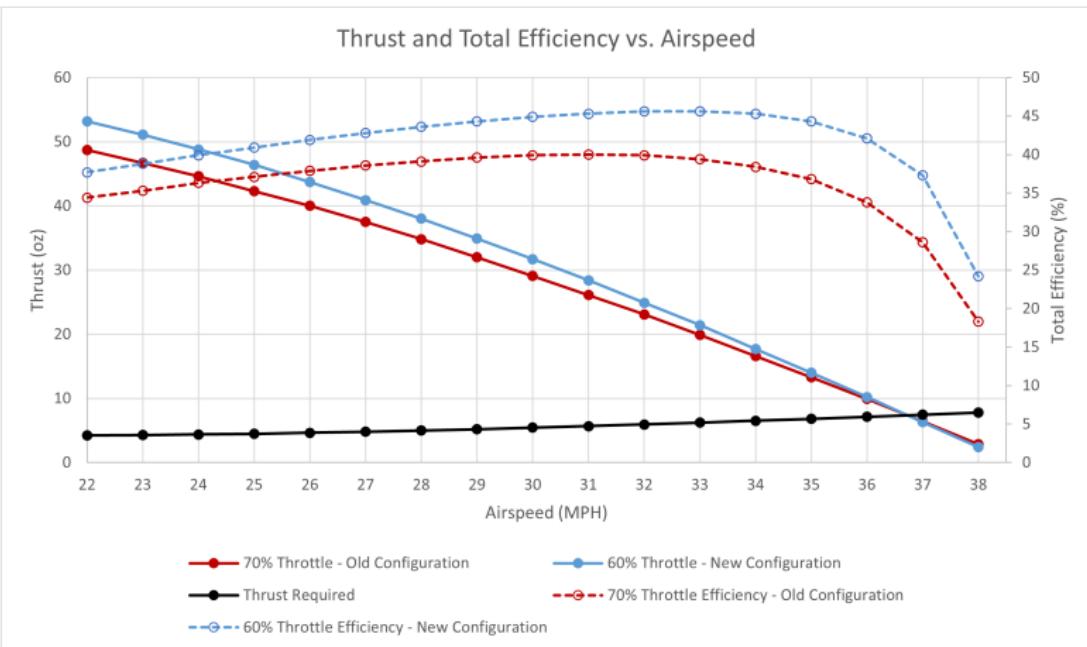


Model B



Model C

Propulsion Analysis I

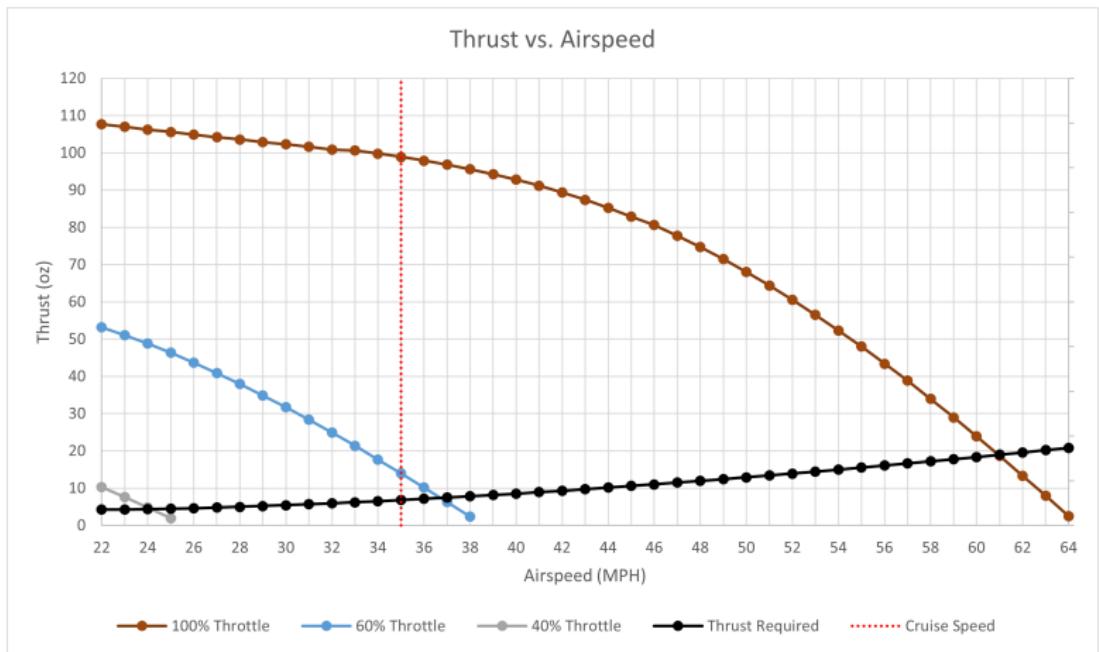


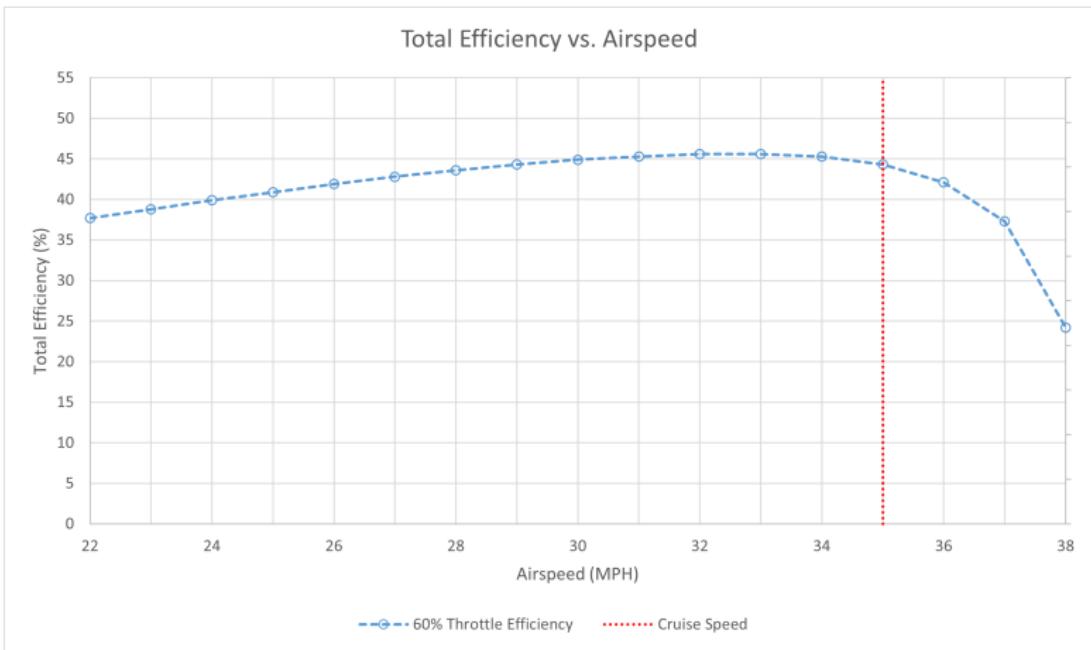
Current Propulsion System I

- Motor: E-Flite Power 32 (770 Kv)
- Propeller: APC 13x6.5E
- Battery: Thunder Power 5S 5000 mAh
- Flight time at cruise speed: 40min 24s

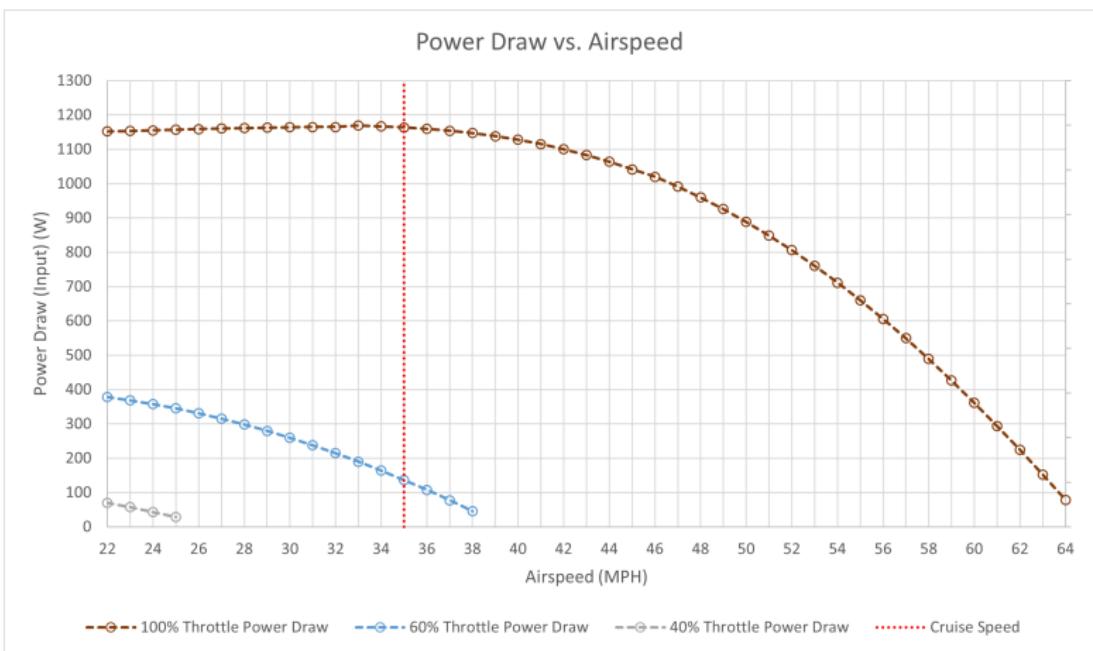


Current Propulsion System II





Current Propulsion System IV



Conceptual Design Review

StratoShield

Introduction

Mission and Requirements

Market Survey

Initial Design

Trade Studies

Flight Performance

Airfoil Selection

Wing Sizing and Placement

Fuselage Design

Propulsion

Structures

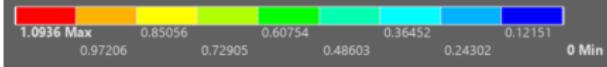
Current Concept

Conclusion

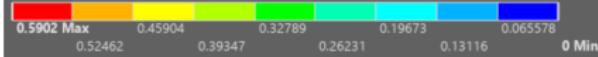
Structures I



3/8" Spar: 2.39" at tip



1/2" Spar: 1.09" at tip

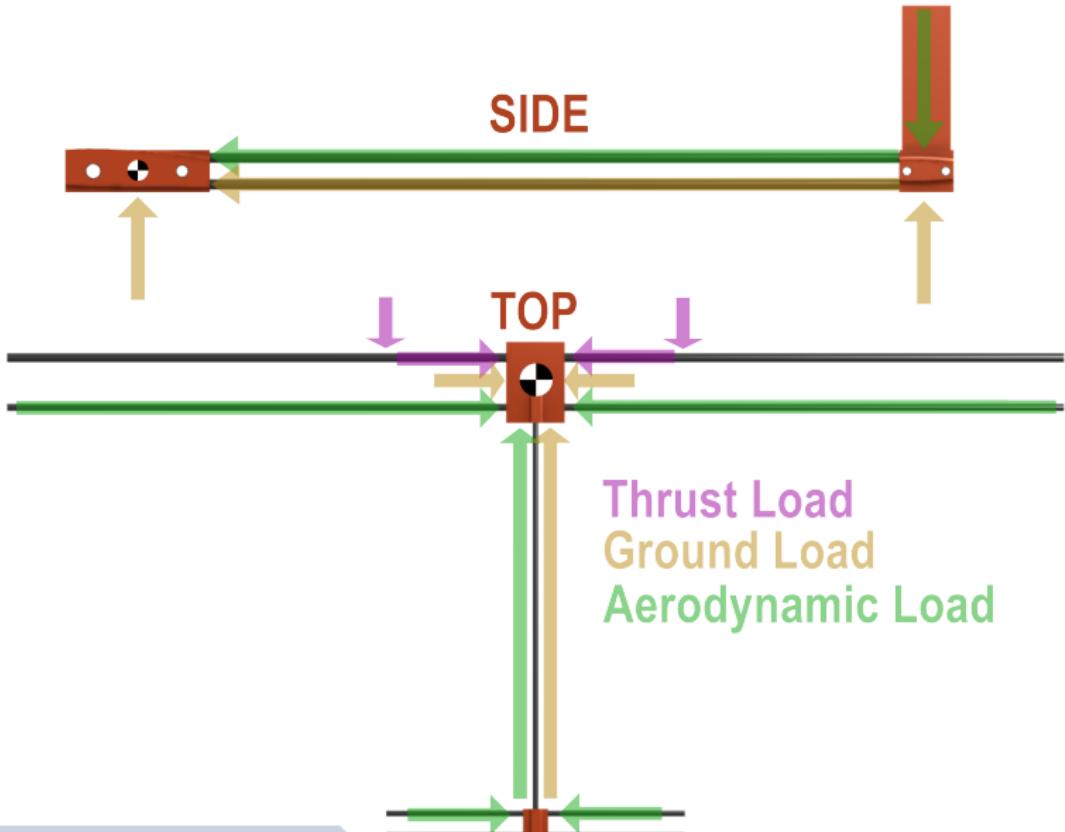


5/8" Spar: 0.59" at tip

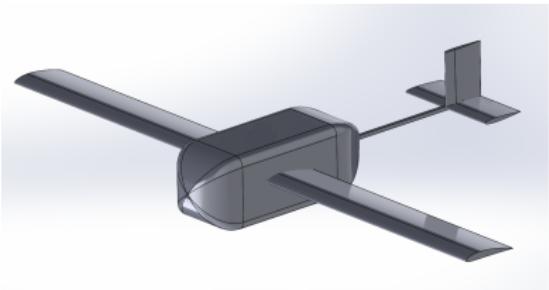
Structures II



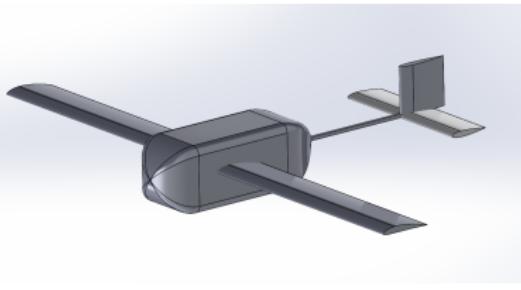
Structures III



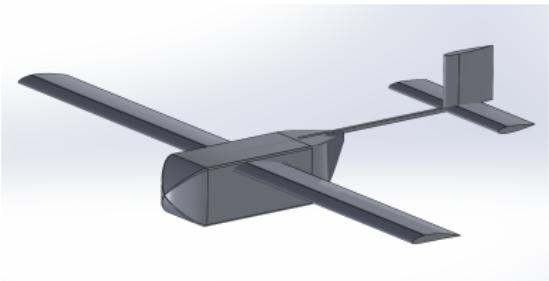
Aircraft Progression



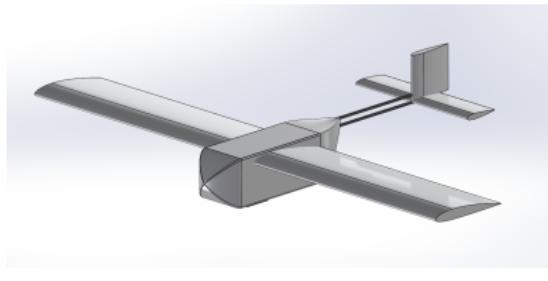
Initial Design



Iteration 1

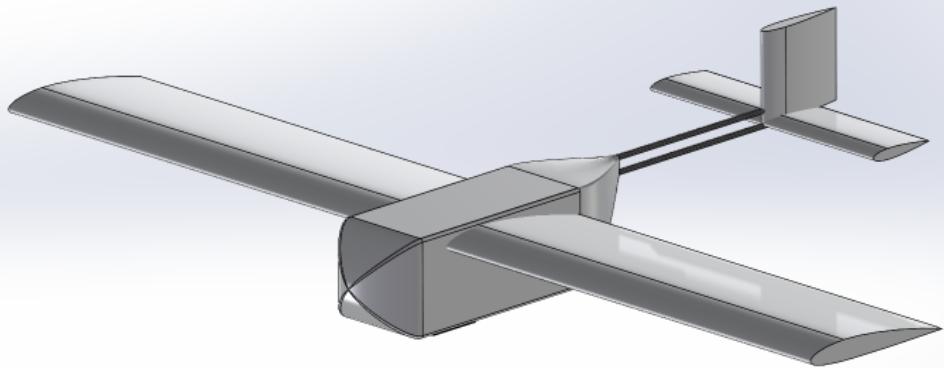


Iteration 2



Iteration 3

Current Aircraft I



Conceptual Design Review
StratoShield

Introduction
Mission and Requirements
Market Survey
Initial Design
Trade Studies

- Flight Performance
- Airfoil Selection
- Wing Sizing and Placement
- Fuselage Design
- Propulsion
- Structures

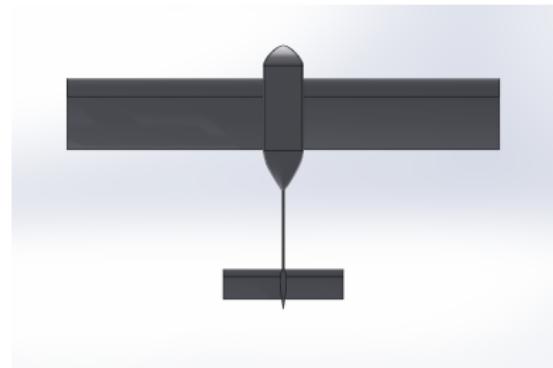
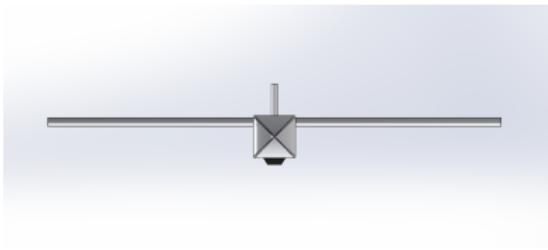
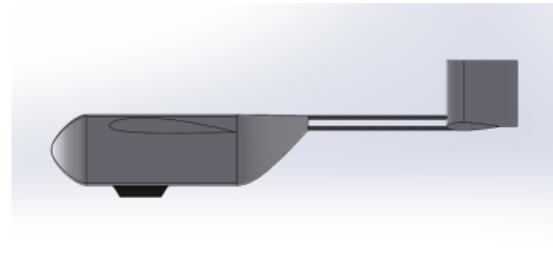
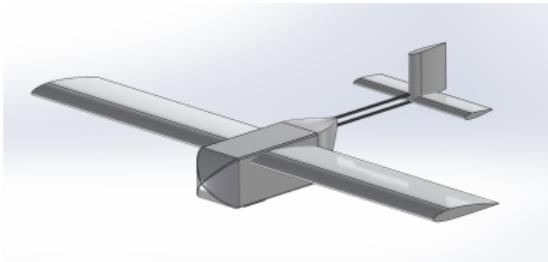
Current Concept

Conclusion

Current Aircraft II

Conceptual Design Review
StratoShield

Introduction
Mission and Requirements
Market Survey
Initial Design
Trade Studies
Flight Performance
Airfoil Selection
Wing Sizing and Placement
Fuselage Design
Propulsion
Structures
Current Concept
Conclusion



Conceptual
Design Review

StratoShield

Introduction

Mission and
Requirements

Market Survey

Initial Design

Trade Studies

Flight Performance

Airfoil Selection

Wing Sizing and
Placement

Fuselage Design

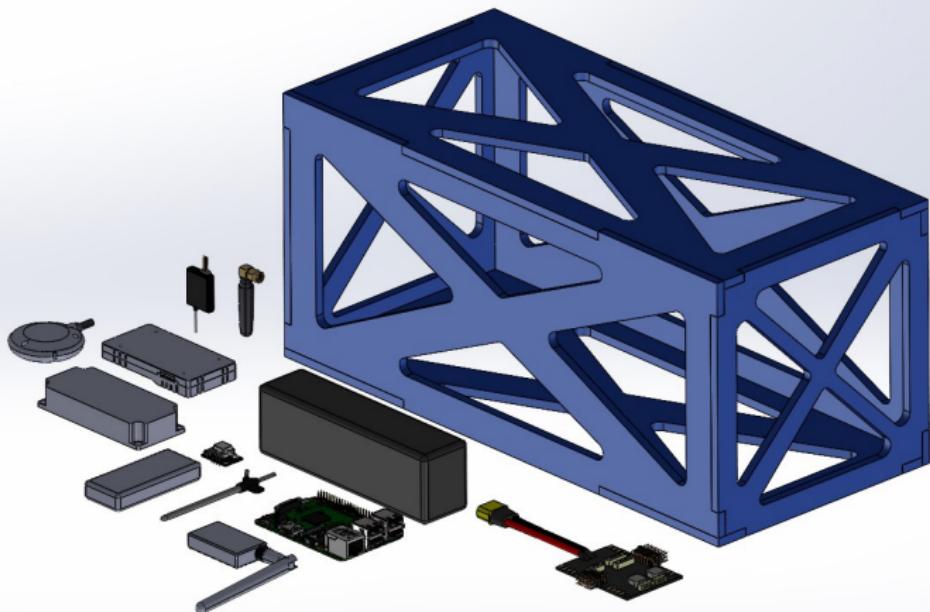
Propulsion

Structures

Current
Concept

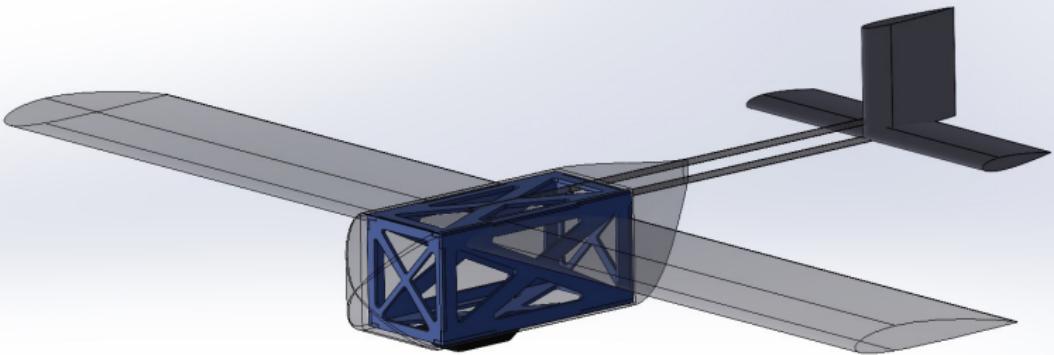
Conclusion

Internal Components

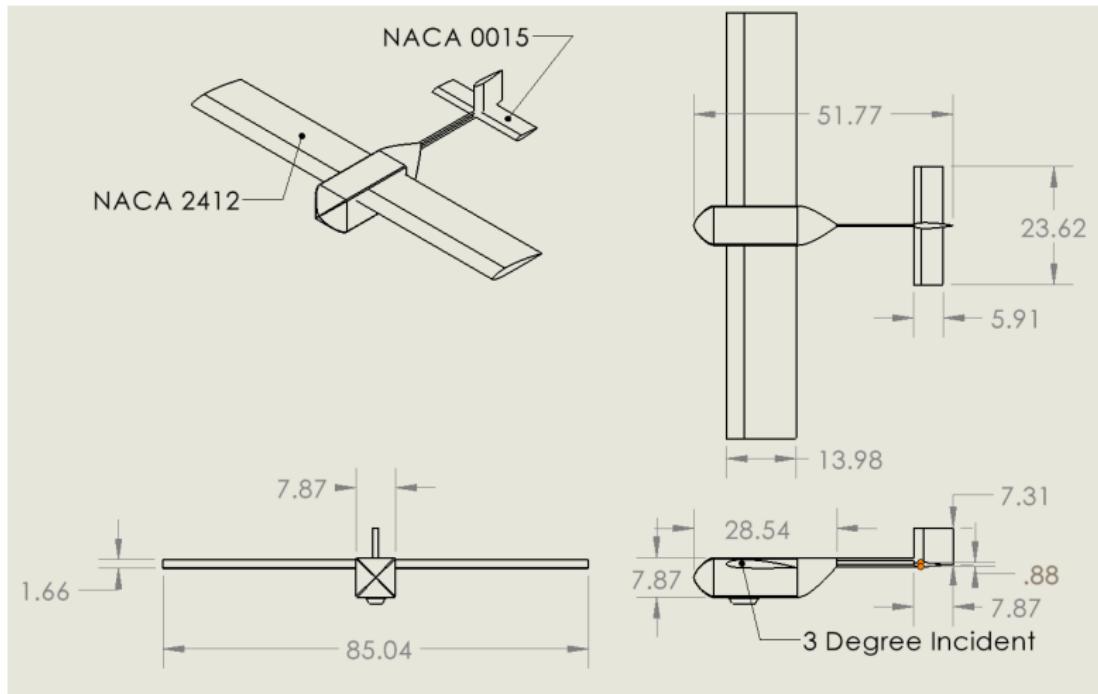


Internal Concept

- Conceptual Design Review
- StratoShield
- Introduction
- Mission and Requirements
- Market Survey
- Initial Design
- Trade Studies
 - Flight Performance
 - Airfoil Selection
 - Wing Sizing and Placement
 - Fuselage Design
 - Propulsion
 - Structures
- Current Concept**
- Conclusion



Dimensions



Estimated Weight: 6.38 lbs

Next Steps

- ① Finalize requirements and system scorecard
- ② Design control surfaces
- ③ Design landing gear
- ④ Refine CAD design
- ⑤ Create a BOM
- ⑥ Create manufacturing plan

Closing Summary

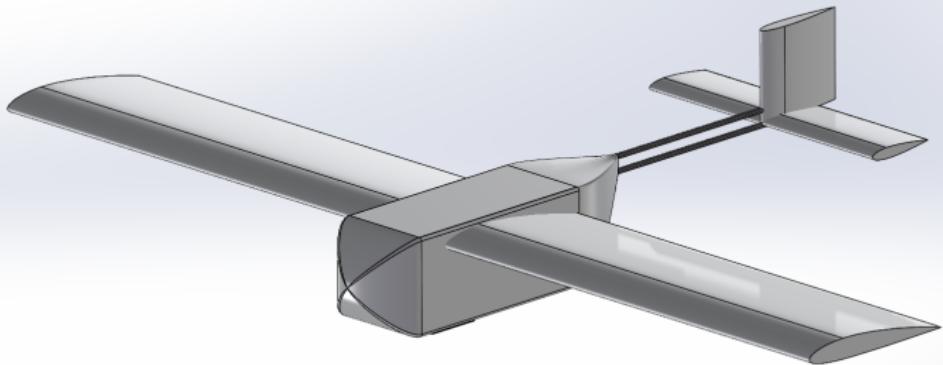
Conceptual Design Review
StratoShield

Introduction
Mission and Requirements
Market Survey
Initial Design

Trade Studies
Flight Performance
Airfoil Selection
Wing Sizing and Placement
Fuselage Design
Propulsion
Structures

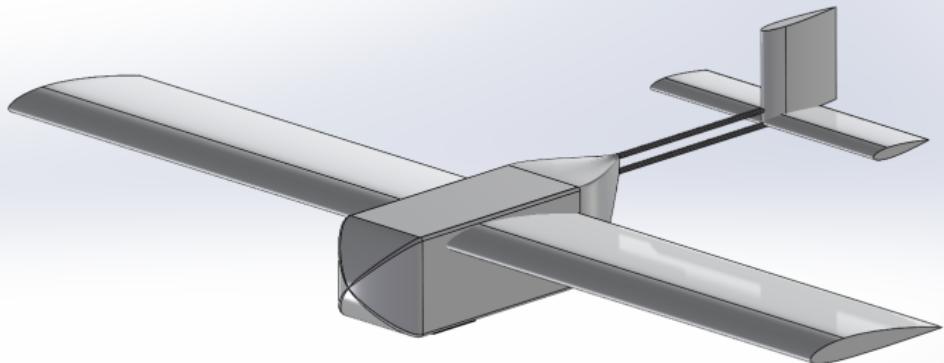
Current Concept

Conclusion



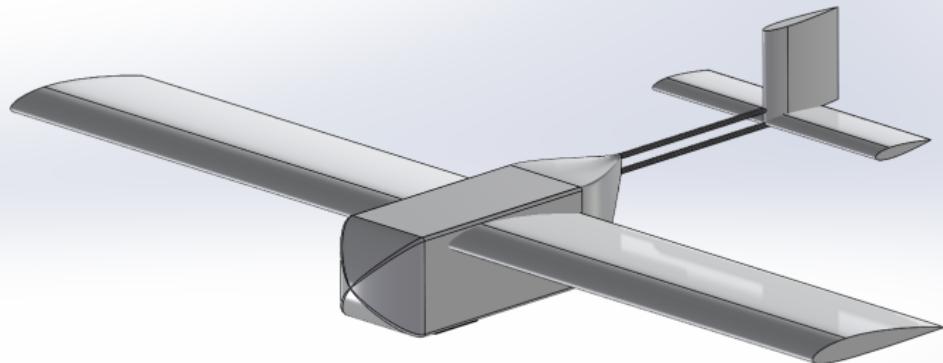
Closing Summary

- ① Unique versatility not found in the market



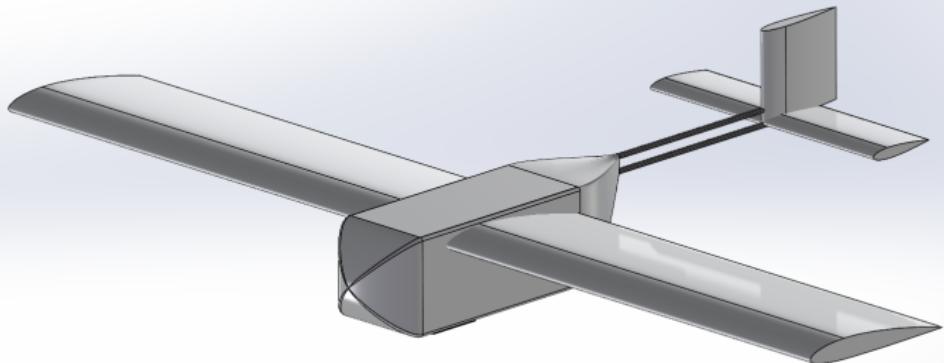
Closing Summary

- ① Unique versatility not found in the market
- ② Cost effective



Closing Summary

- ① Unique versatility not found in the market
- ② Cost effective
- ③ Design headroom



Conceptual
Design Review

StratoShield

Appendix
Contents

Longitudinal
Stability

Appendix Contents

⑧ Longitudinal Stability

Longitudinal Stability

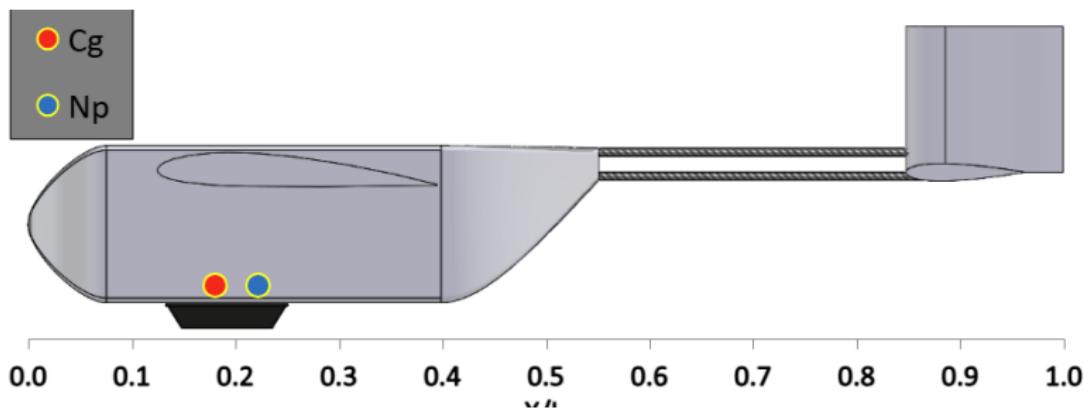


Figure: CG and NP on current design iteration.