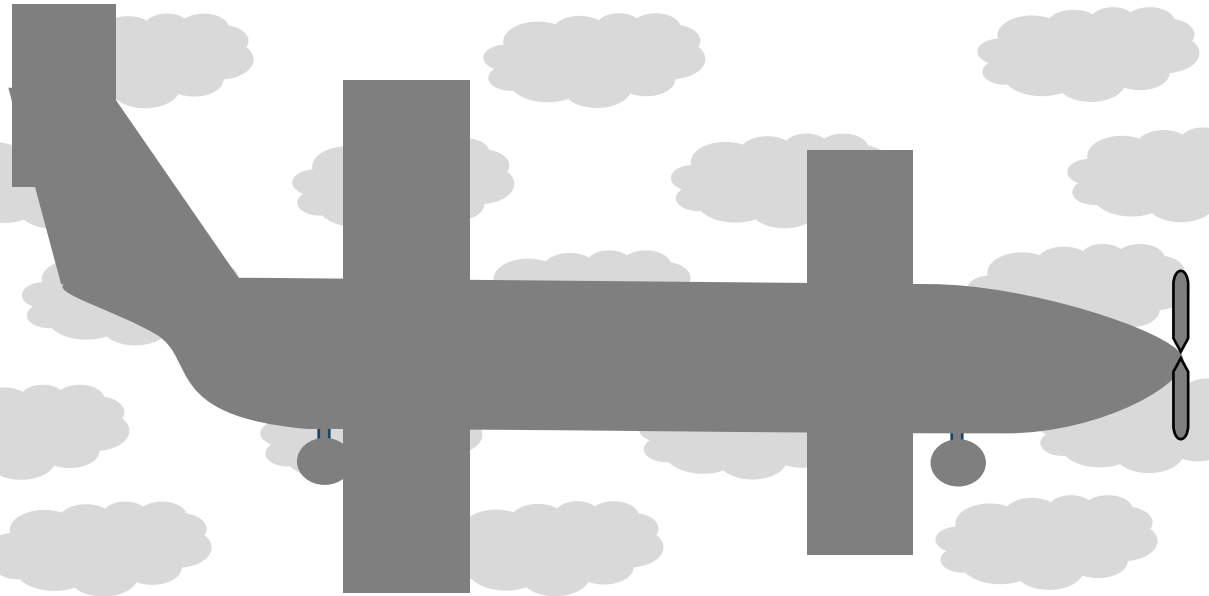
EML4551-2

Design Review 5



Team 507 - SAE Aero Design – Aero and Propulsion Team

Team Introductions

Sasindu Pinto:
Project /Aeronautics/Propulsion Engineer

Noah Wright:
Aerodynamics Engineer

Michenell Louis-Charles:
Thermal Fluids Engineer/Financial Chair

Cameron Riley:
Materials/Hardware Engineer

Adrian Moya:
Systems/Hardware Engineer

Sponsor and Advisors

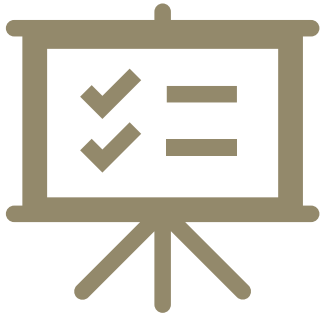
Florida Space Grant Consortium:
Funding Sponsor

Seminole RC Club:
Equipment/Personnel Sponsor

Dr. Chiang Shih:
Professor & AME Center Director Advisor

Michenell Louis-Charles

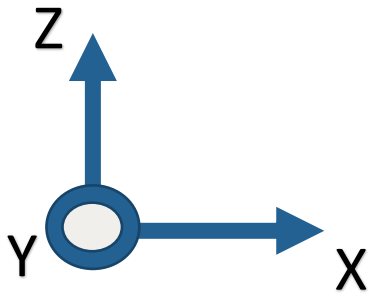
Team Objective



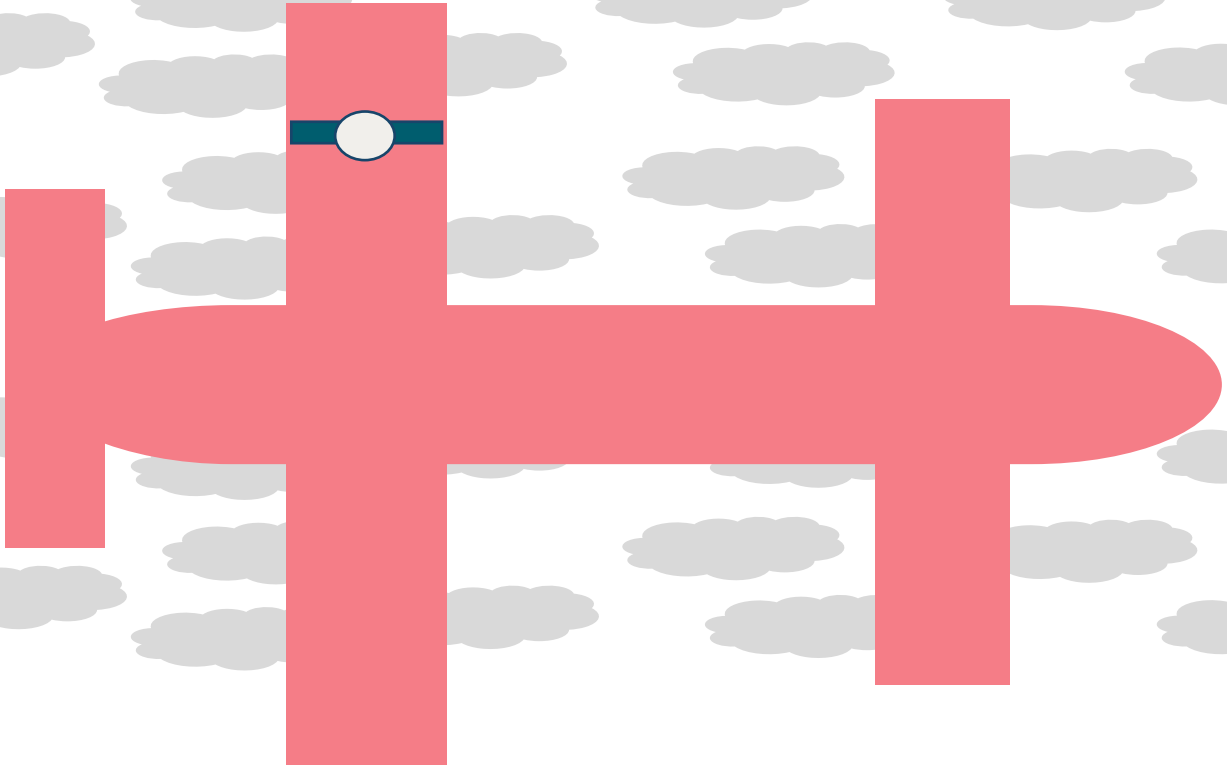
The objective of the aero-propulsion team is to ensure that the plane takes off, completes the flight path, and lands safely while carrying a payload.

Michenell Louis-Charles

Key Definitions

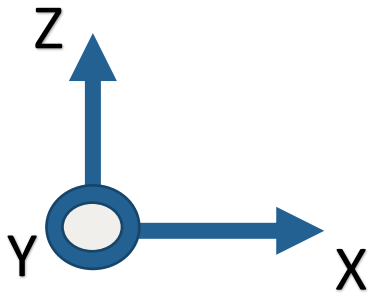


Coefficient of Lift

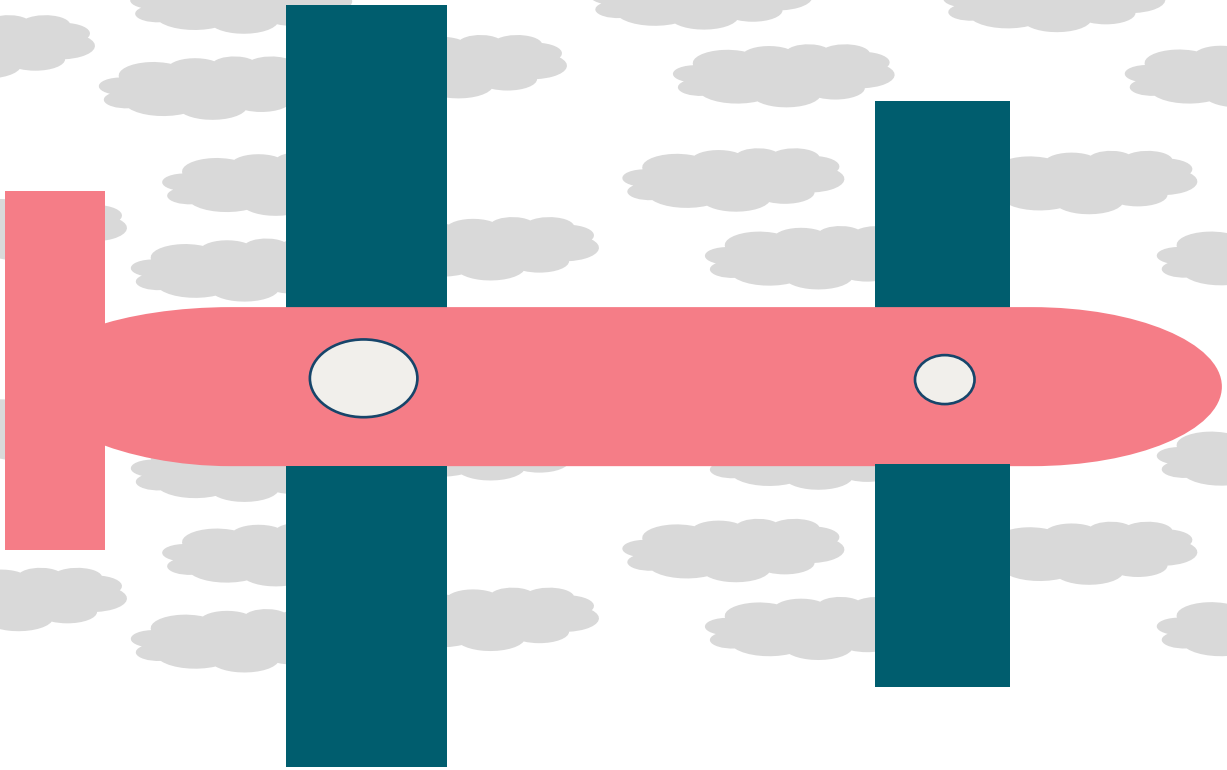


Michenell Louis-Charles

Key Definitions

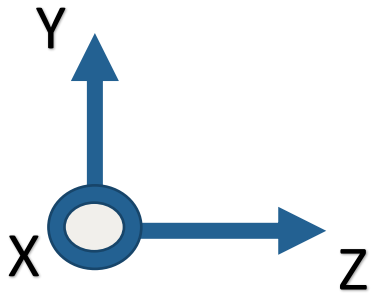


Lift

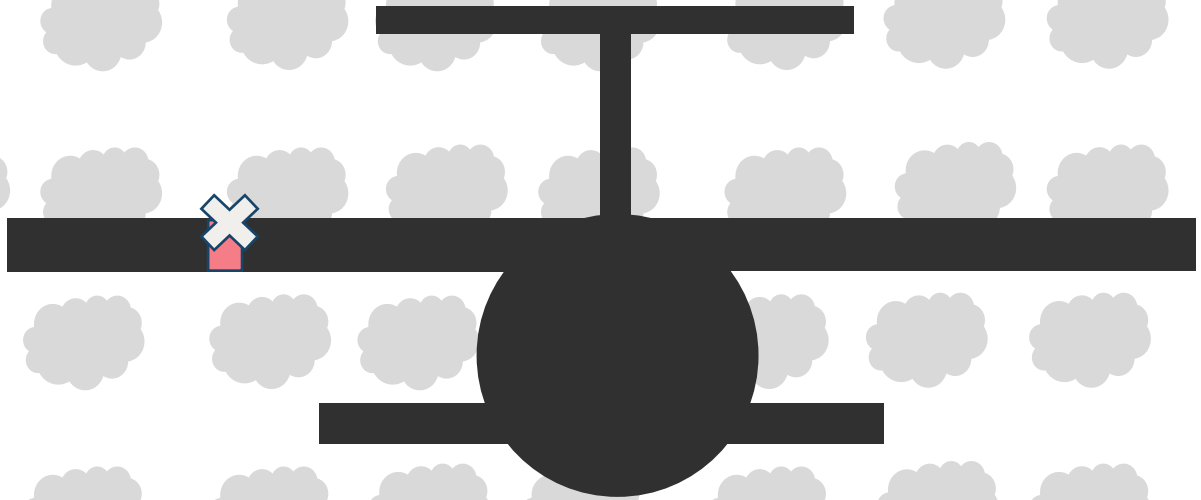


Michenell Louis-Charles

Key Definitions

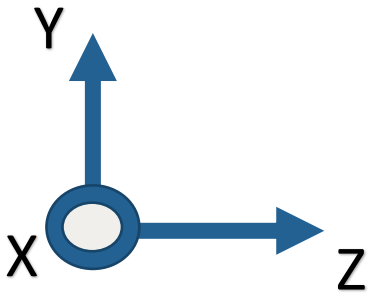


Coefficient of Drag

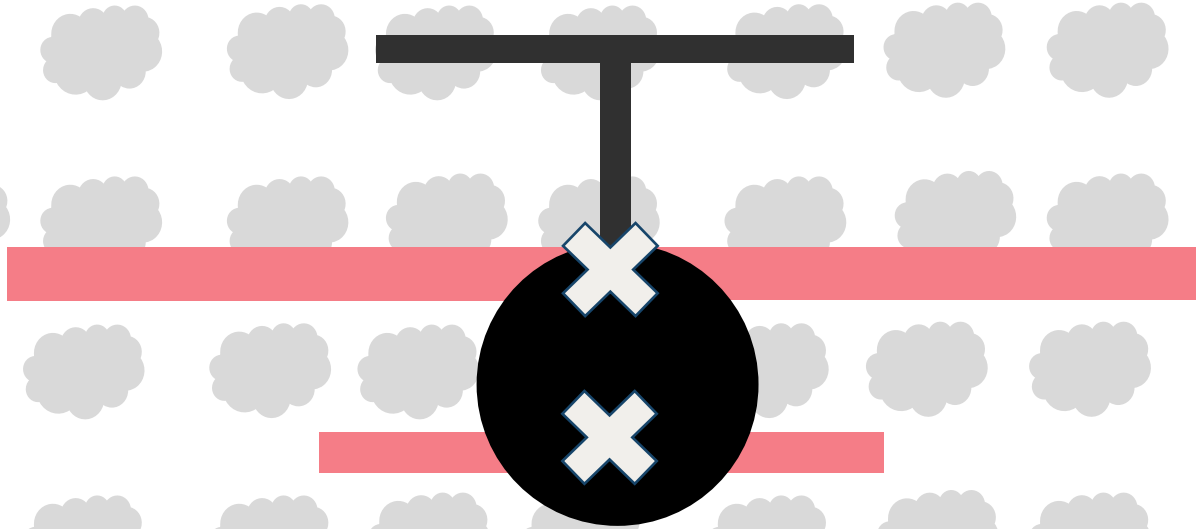


Michenell Louis-Charles

Key Definitions

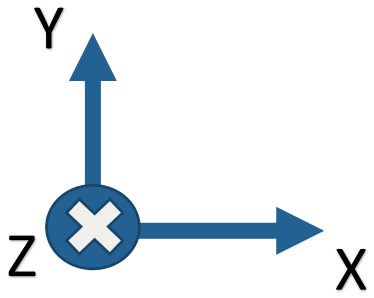


Drag

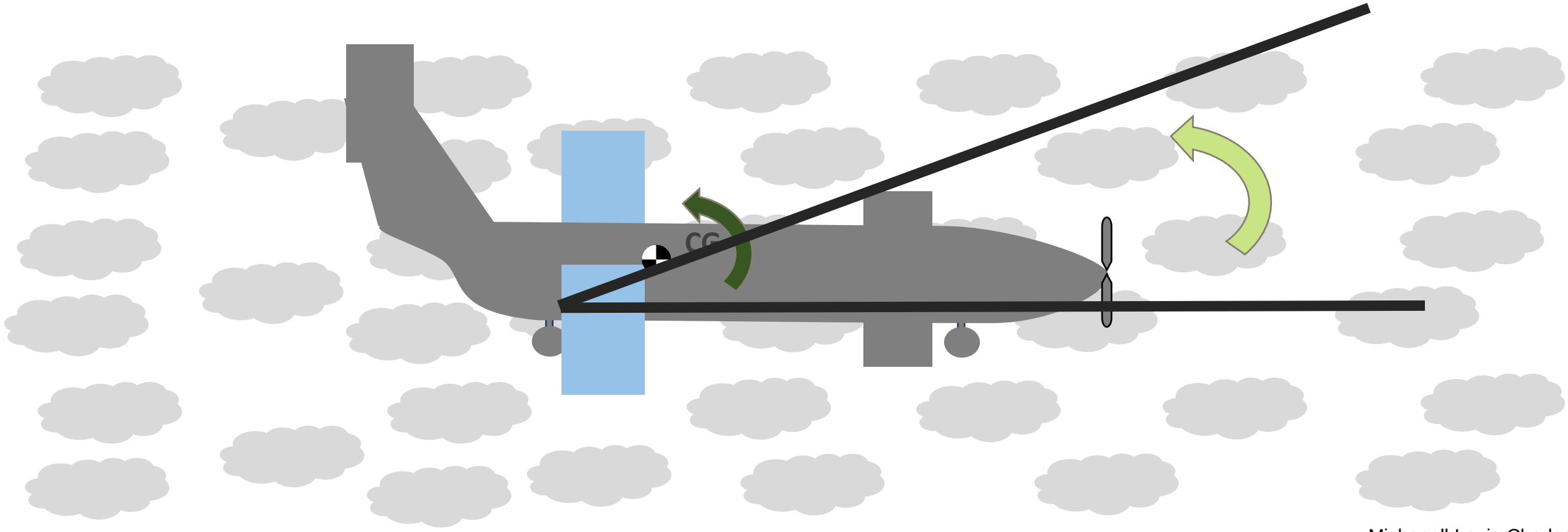


Michenell Louis-Charles

Key Definitions



Angle of Attack (AoA / Alpha)

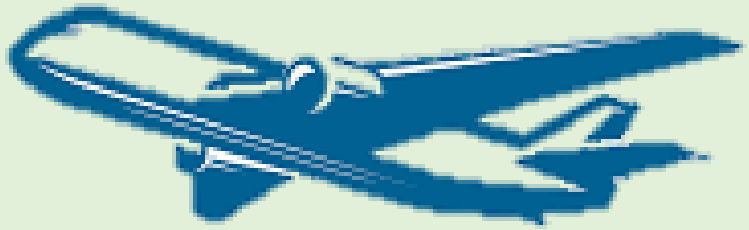


Michenell Louis-Charles

Review

Presenter – Michenell Louis-Charles

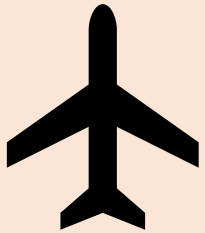
Project Background



- Plane designed to be entered in SAE Aero Design Competition East
  - Only participating in the Design Knowledge Part due to financial constraints and heath risks

Key Goals and Assumptions

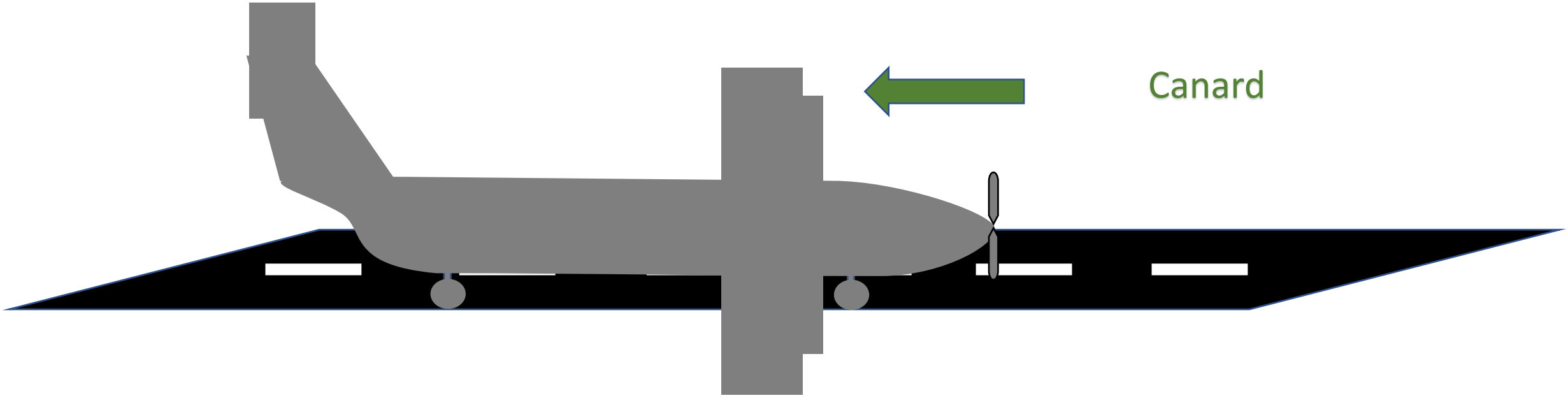
- The plane takeoff, cruise, and land while carrying a cargo load
- Will be flown in atmospheric conditions at sea level



Michenell Louis-Charles

Customer Needs

A signature
Innovation



Michenell Louis-Charles

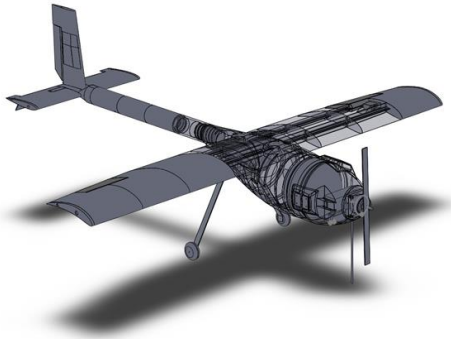
Targets and Metrics

- Generate Lift
  - Coefficient of Lift ~ Greater than 1
- Max Angle of Attack (AoA)
  - For a canard design, AoA< angle between Mean Aerodynamic Centers of the wing
- Weight
  - Less than 55 lbs.

Michenell Louis-Charles

Medium and High Fidelity Concepts

1. Boomtown



2. Rutan Long EZ

3. Rutan Quickie Q2

4. Boeing 747 Dreamlifter

5. Cessna 208 Grand Caravan

6. OMAC Laser 300

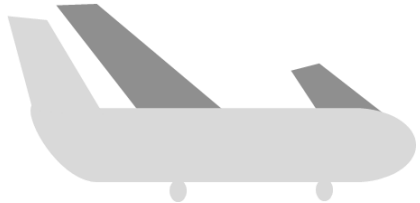
7. Aero Spacelines Super Guppy

8. Kawasaki C-2

Michenell Louis-Charles

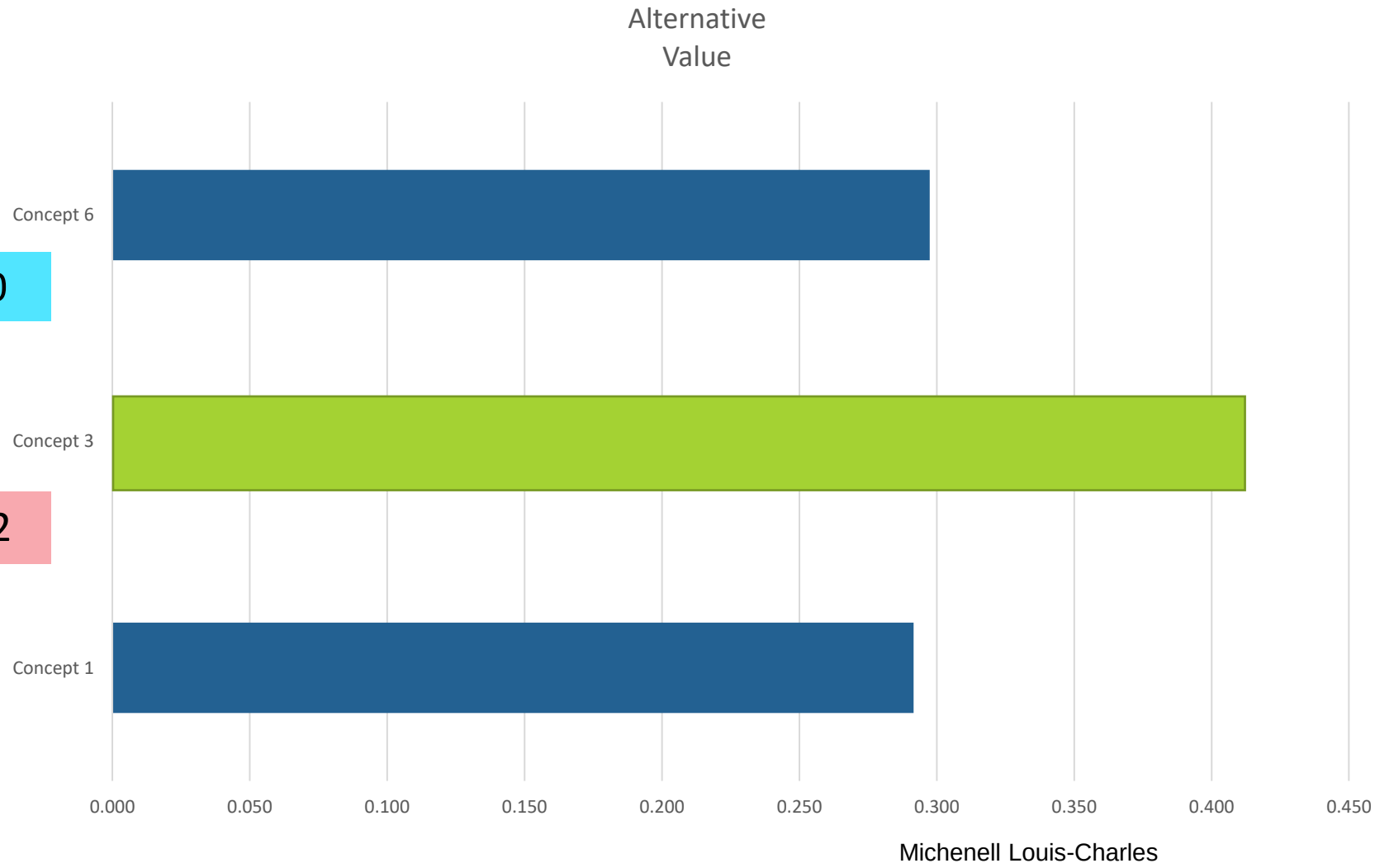
Concept Comparison- AHP

6. OMAC Laser 300



3. Rutan Quickie Q2

1. Boomtown



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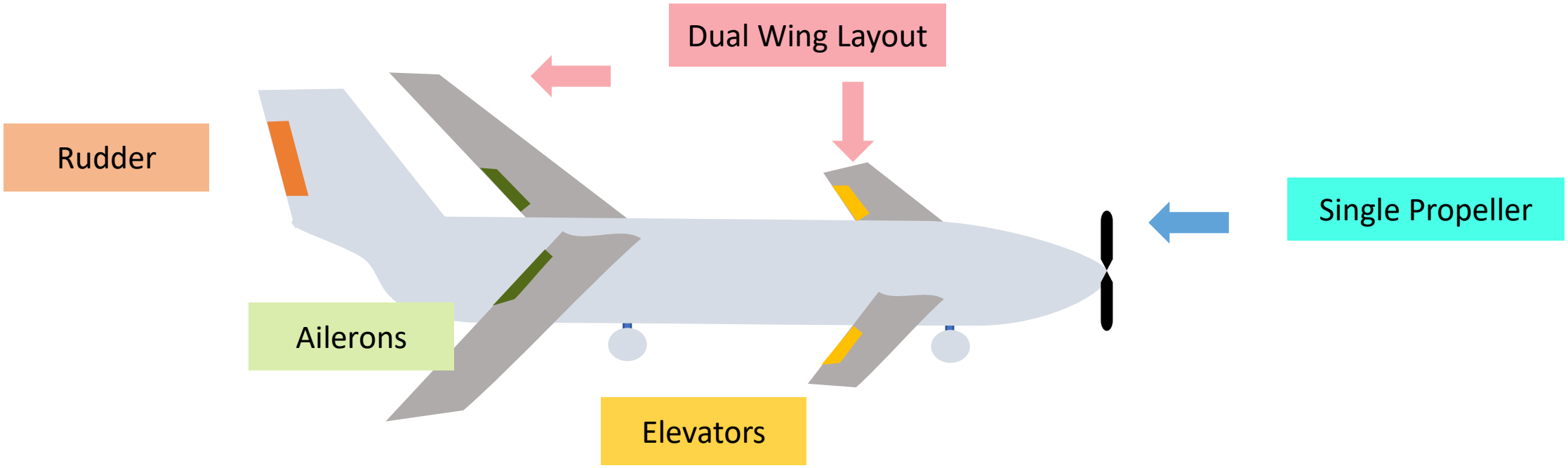
Chosen Design



Concept 3: Rutan Quickie Q2

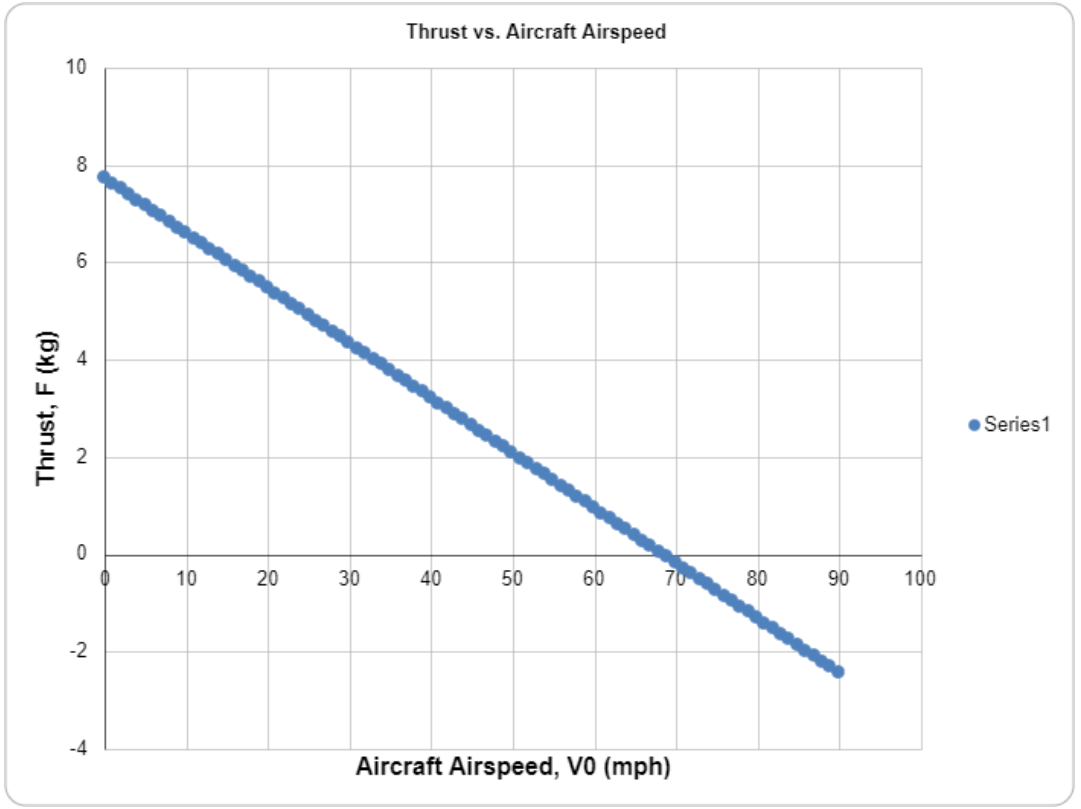
Michenell Louis-Charles

Thrust – Calculations

Calculations

- Static Thrust Calculated ~ 167 lbf
  - Calculated thrust usually 15-30% less than actual static thrust
- Calculated dynamic thrust shown in the graph to the right

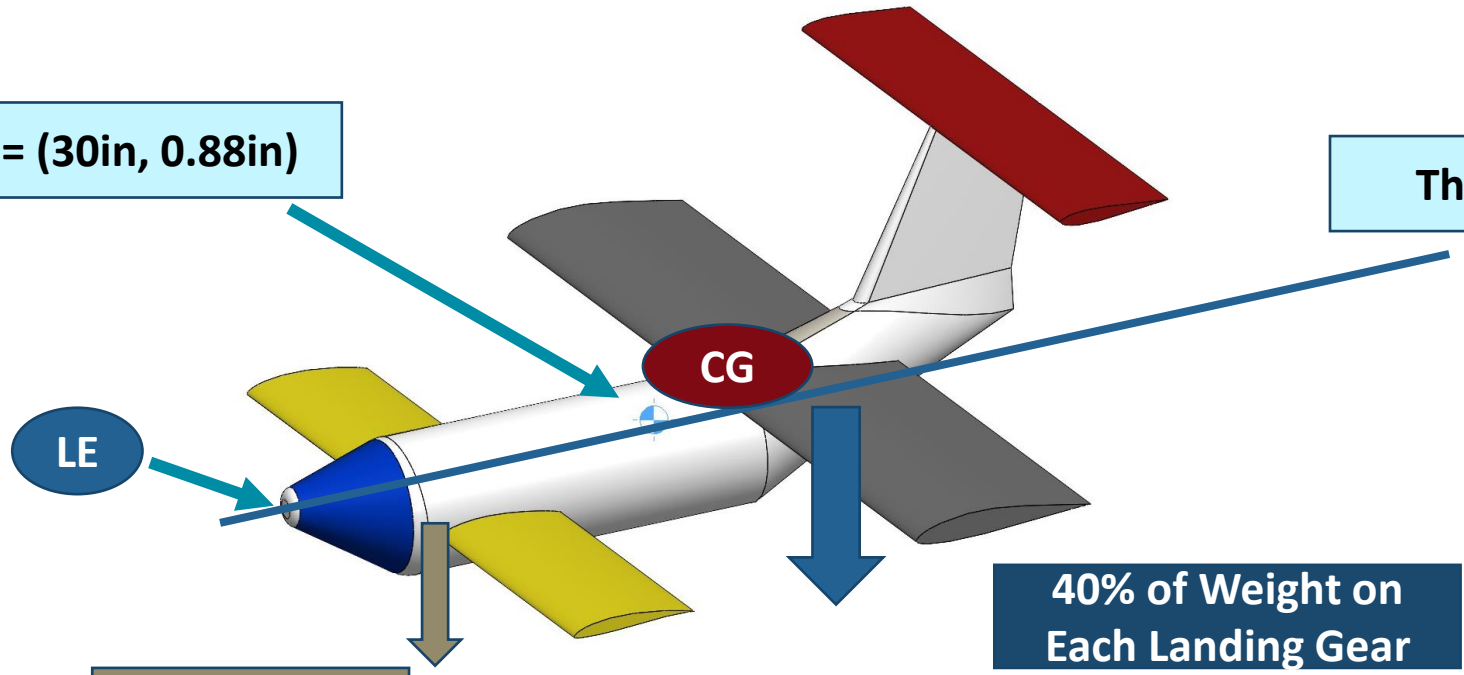
Experimental Thrust ~ 222 lbf



Michenell Louis-Charles

Initial Design Analysis

CG from Leading Edge (LE) (x,y) = (30in, 0.88in)



Thrust Line

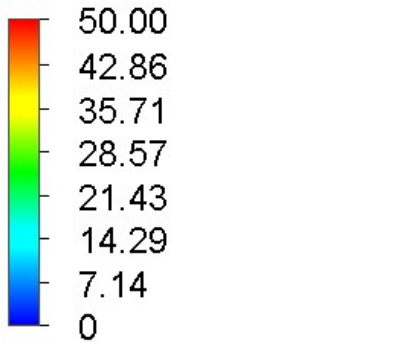
40% of Weight on Each Landing Gear

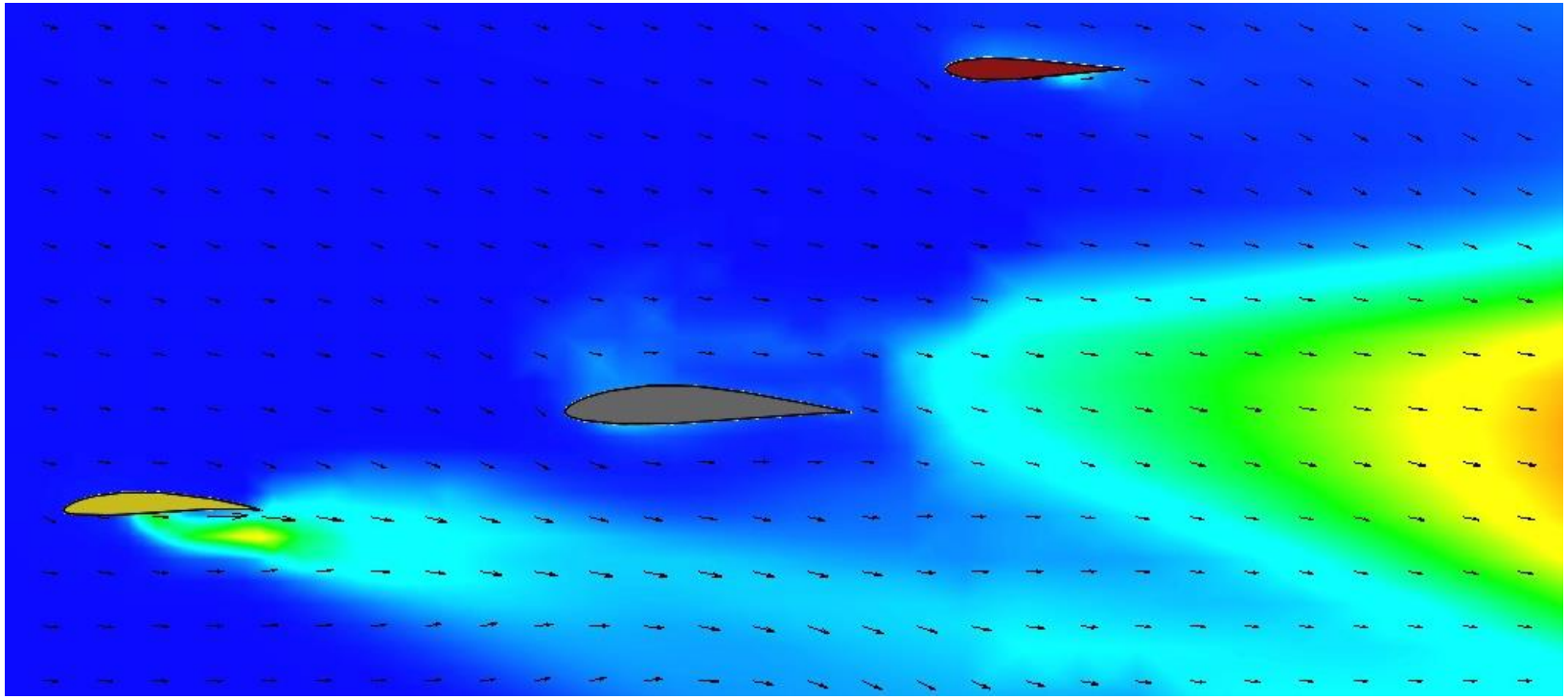
Supports 20% of Weight

Weight Distribution 1:2

Michenell Louis-Charles

Initial Design - CFD – Wing Turbulence





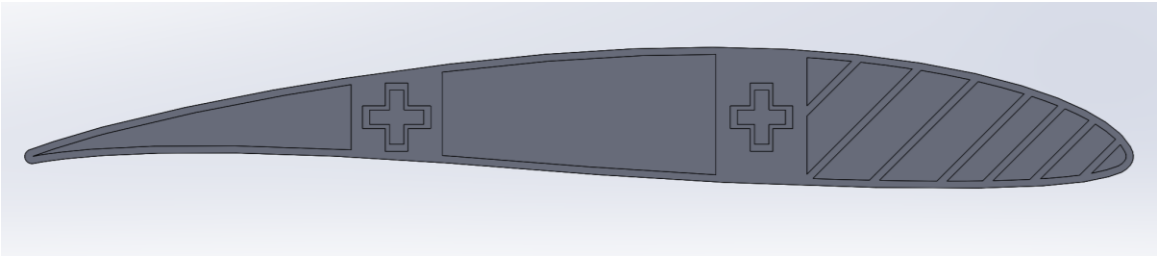
Negligible wake effects between wings

Michenell Louis-Charles

Redesigned Plane

Presenter – Cameron Riley

Canard Test Print – Density Correction



Projected Weight ~ 0.109 lbs.

Actual Weight – 0.211 lbs.

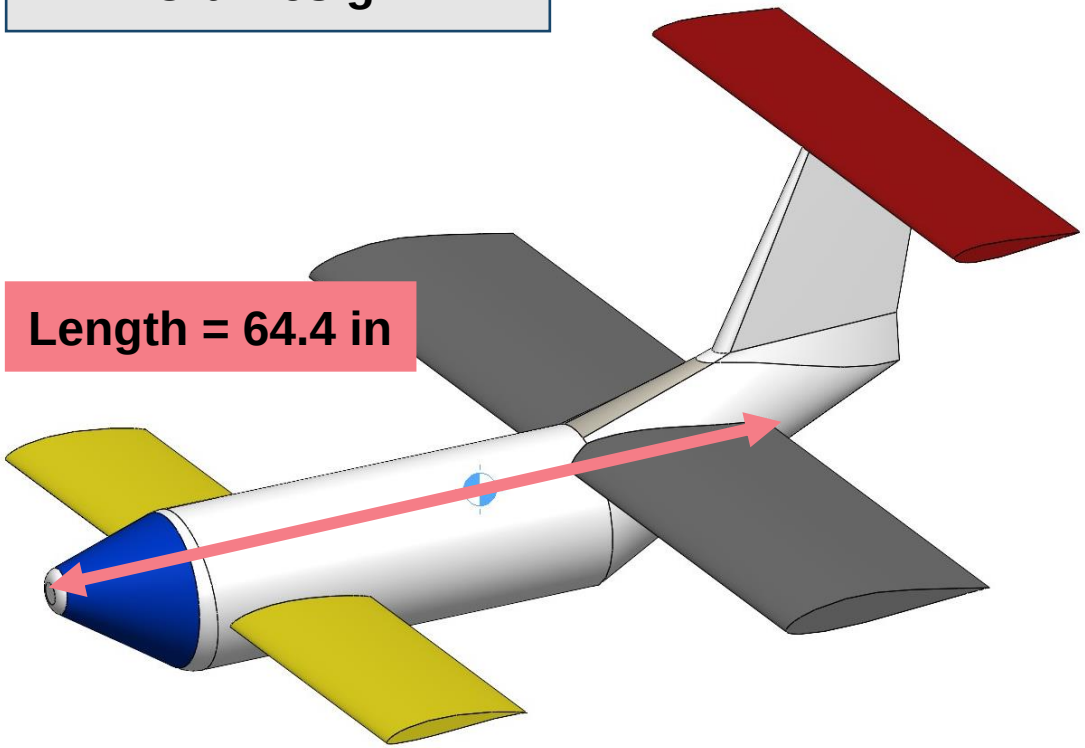
Initial density – 0.00245 lb./in^3

Adjusted density – 0.00474 lb./in^3

Cameron Riley

Redesigned Plane - Comparison

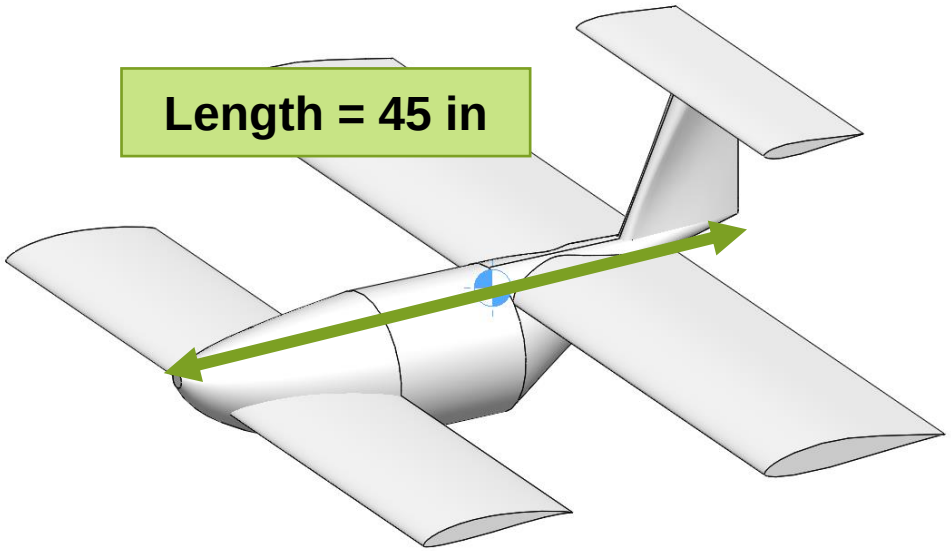
Old Design



Length = 64.4 in

Vs

New Design



Length = 45 in

Reduction in Fuselage Length

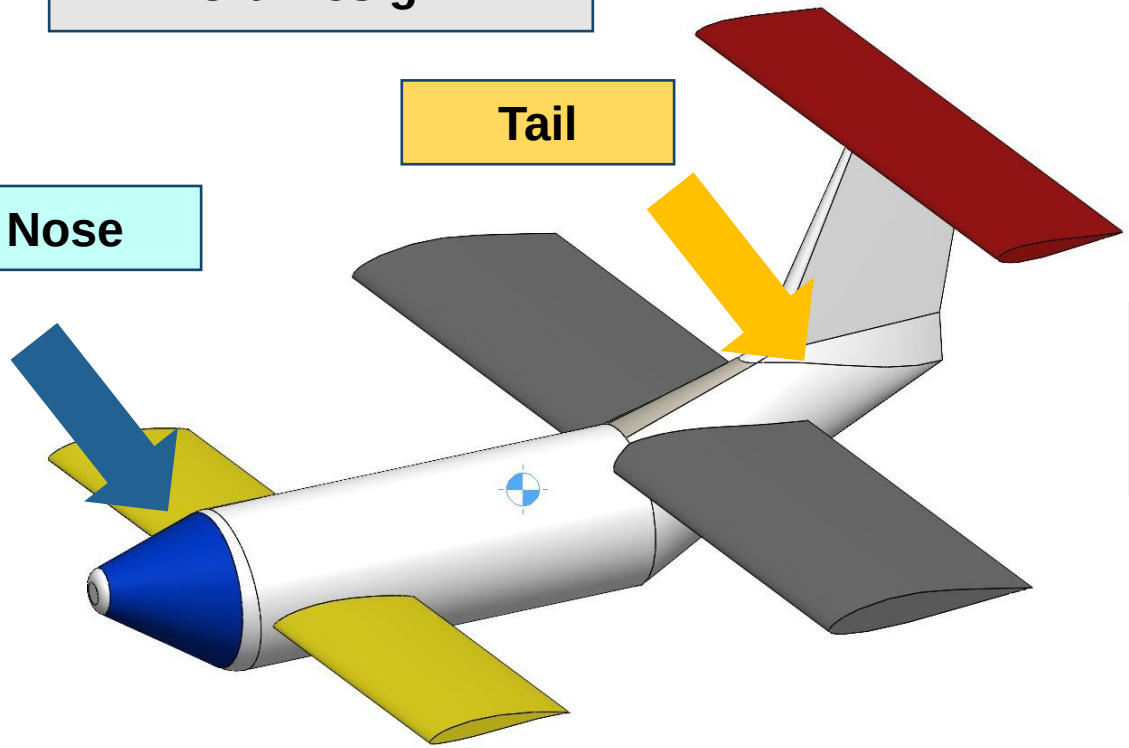
Cameron Riley

Redesigned Plane - Comparison

Old Design

Tail

Nose

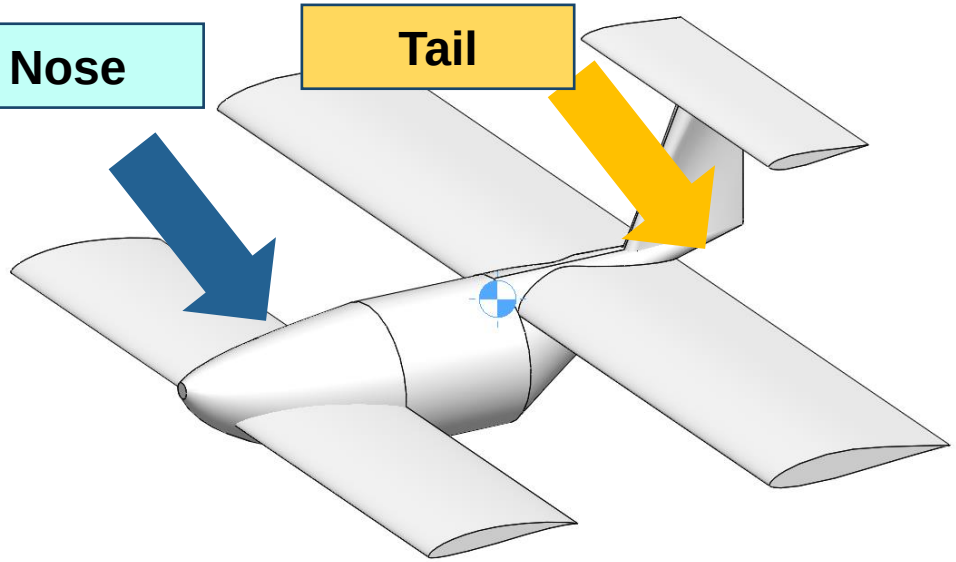


Vs

New Design

Nose

Tail



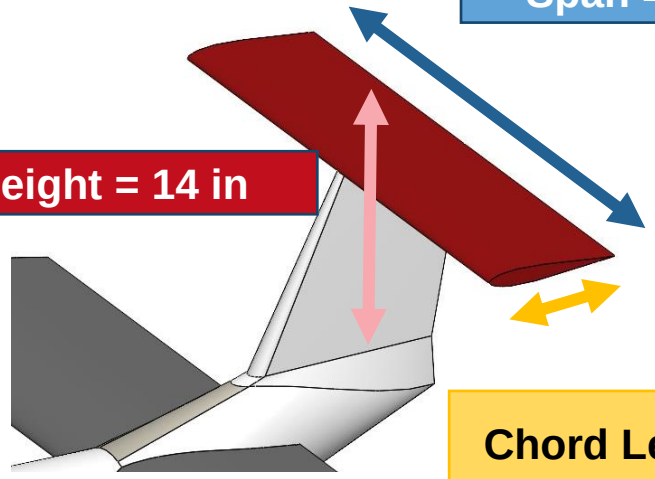
Streamlined Fuselage

Cameron Riley

Redesigned Plane - Comparison

Old Design

Span = 47.5 in



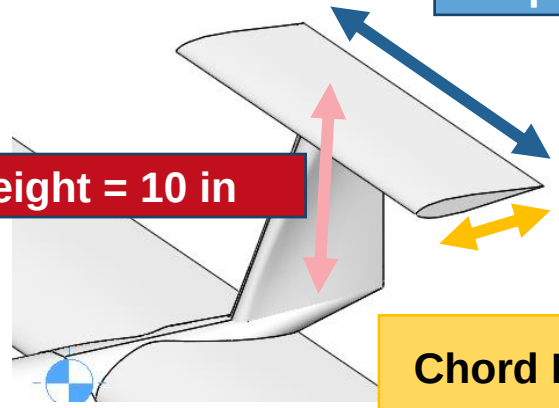
Height = 14 in

Chord Length = 9 in

Vs

New Design

Span = 26.5 in



Height = 10 in

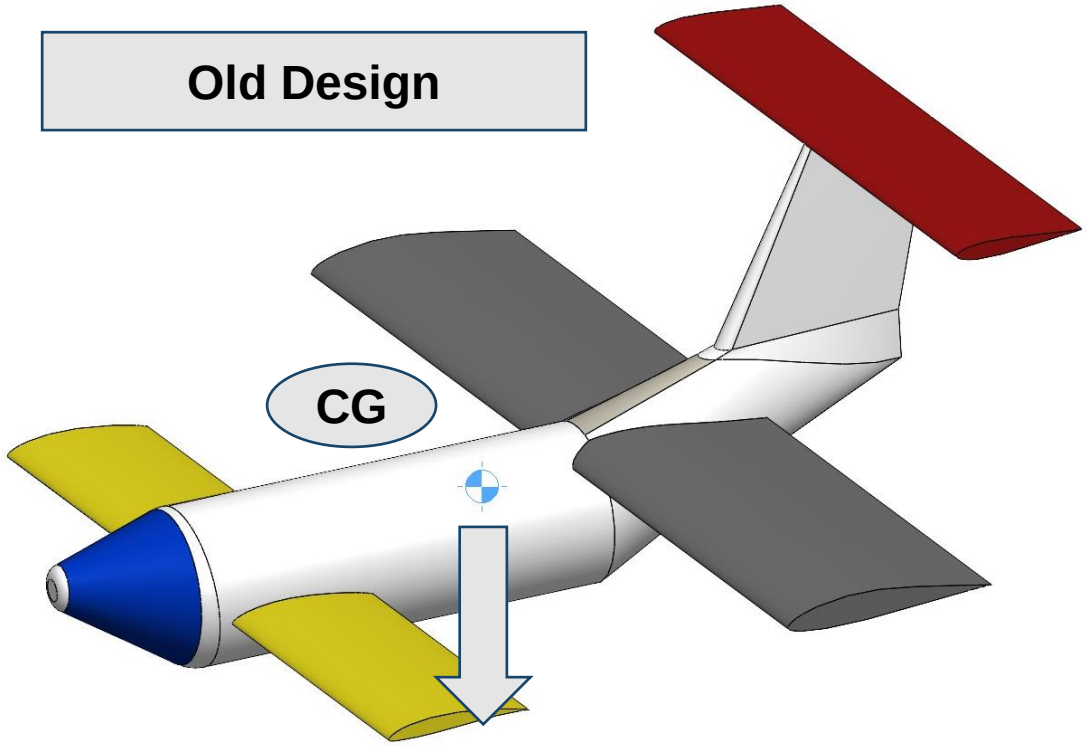
Chord Length = 8 in

Smaller Tail Section

Cameron Riley

Redesigned Plane - Comparison

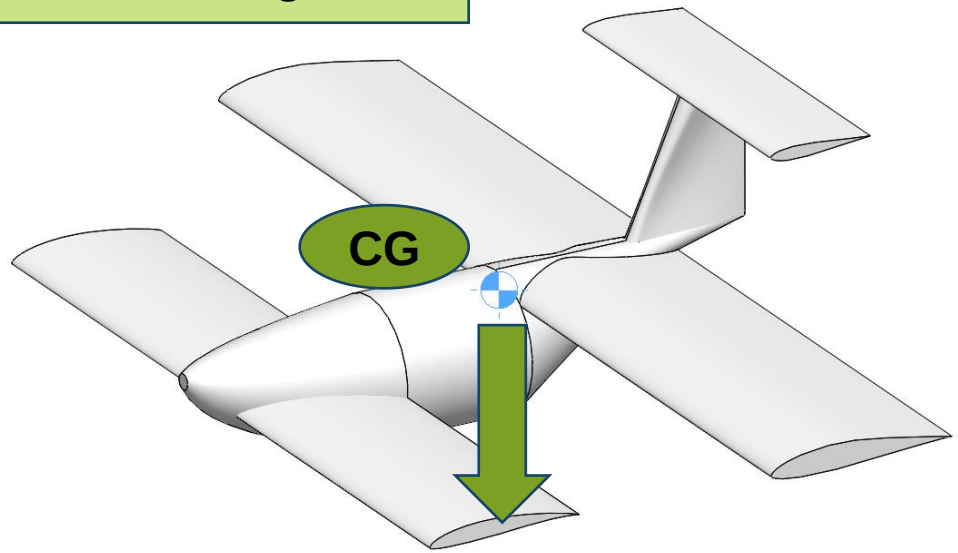
Old Design



Shell Weight ~ 20 lbs.

Vs

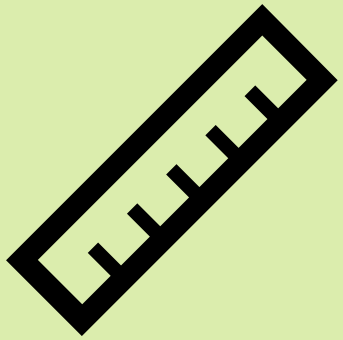
New Design



Shell Weight ~ 10.5 lbs.

Shell Weight Reduction

Cameron Riley



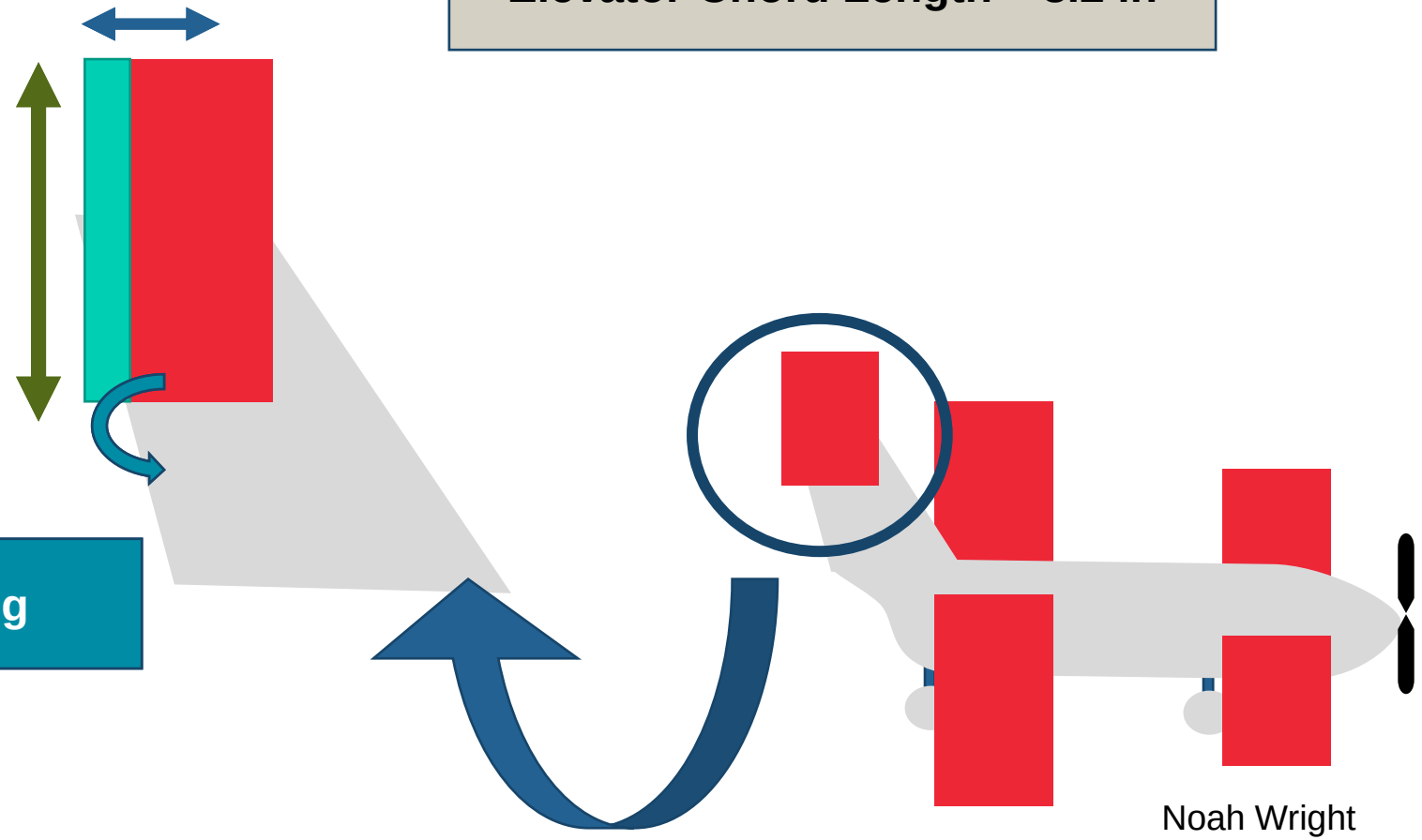
Stability Calculations and CFD

Presenter – Noah Wright

Pitch Stability – Controls - Elevator

Elevator Chord Length – 3.2 in

Elevator Span – 26.5 in



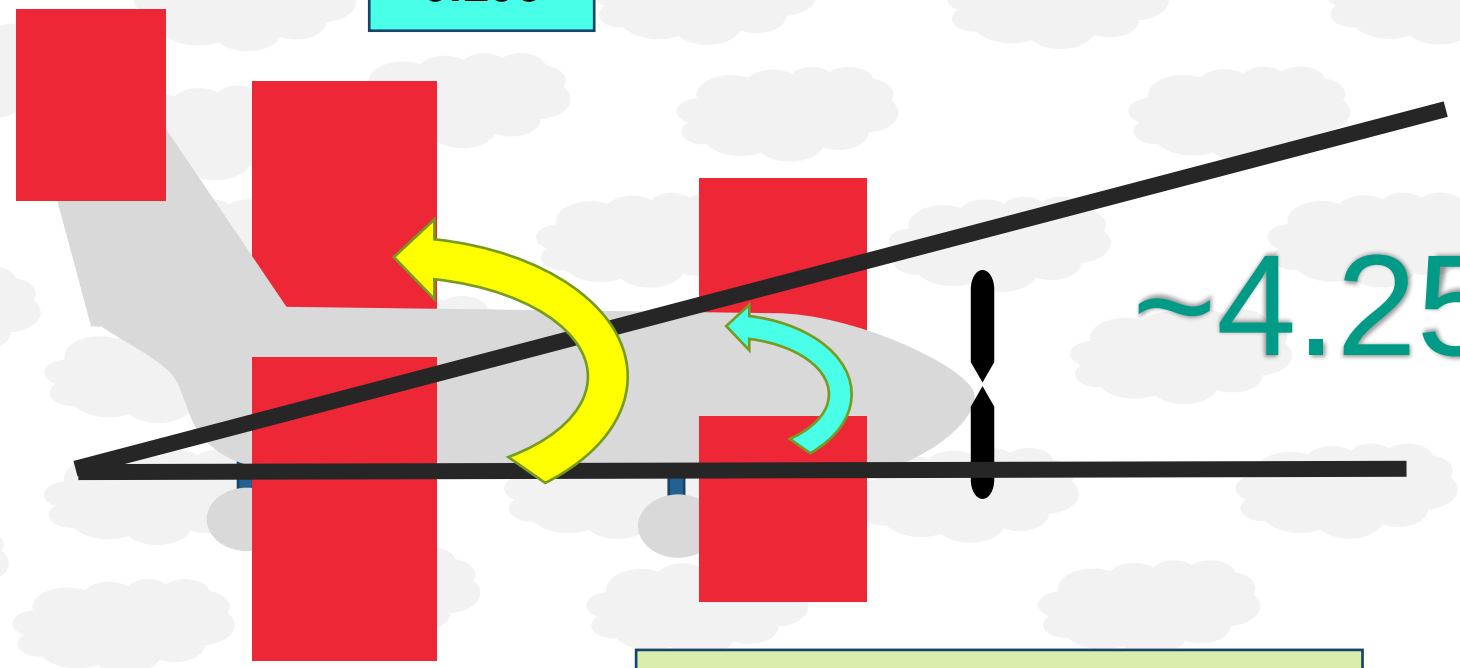
Deflection angle – 30 deg

Noah Wright

Pitch Stability

Coefficient of Moment

0.106



~4.25 deg

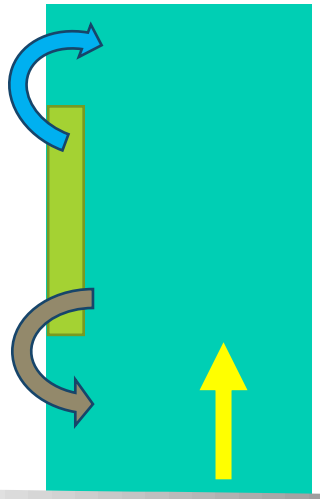
Equilibrium Angle of Attack

Noah Wright

Roll Stability – Controls - Aileron

Upward Deflection Angle – 20 deg

Downward Deflection Angle – 8 deg

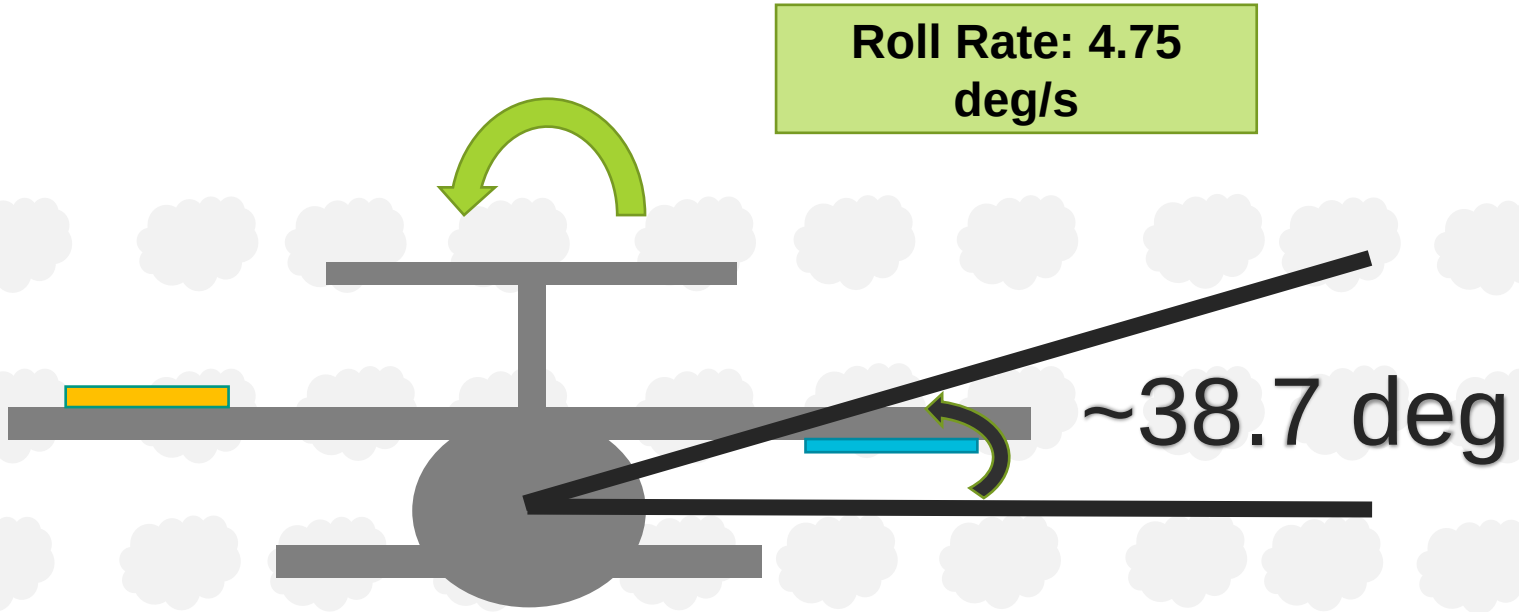


Differential Setting : 2.5:1

Distance to Fuselage – 15.25 in

Noah Wright

Roll Stability

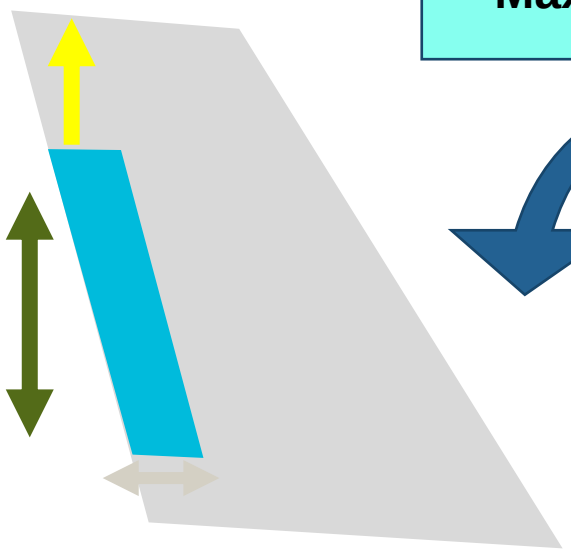


Noah Wright

Yaw Stability – Controls - Rudder

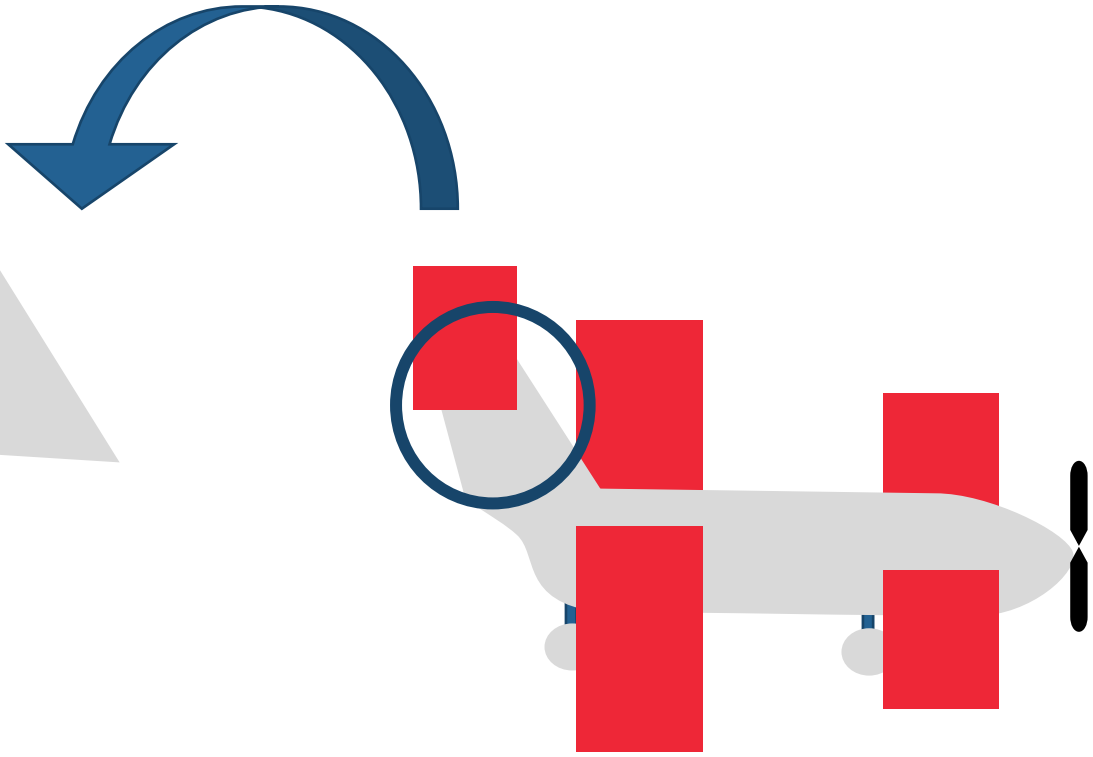
Distance to the top of the tail – 1.5 in

Maximum Deflection – 25 deg



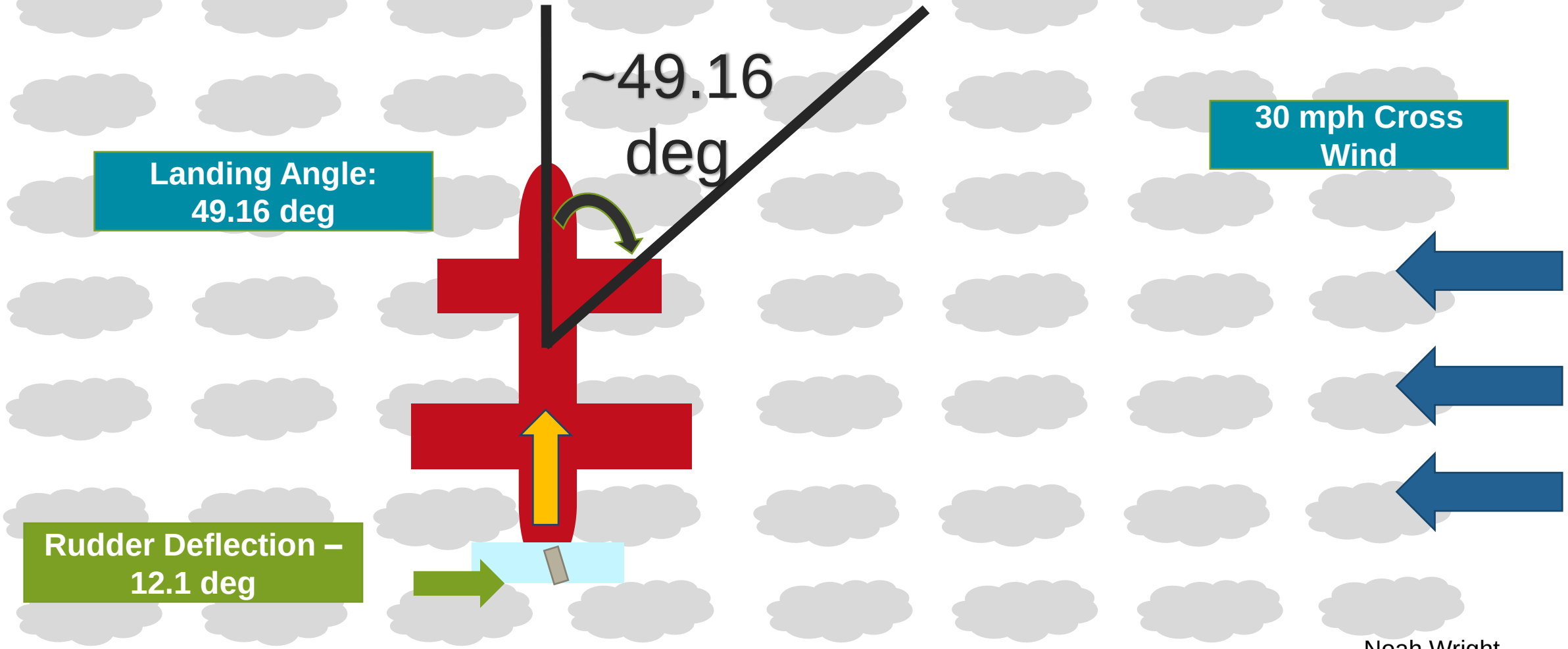
Rudder Span – 7 in

Rudder Chord Length – 2.4 in



Noah Wright

Yaw Stability – Operation

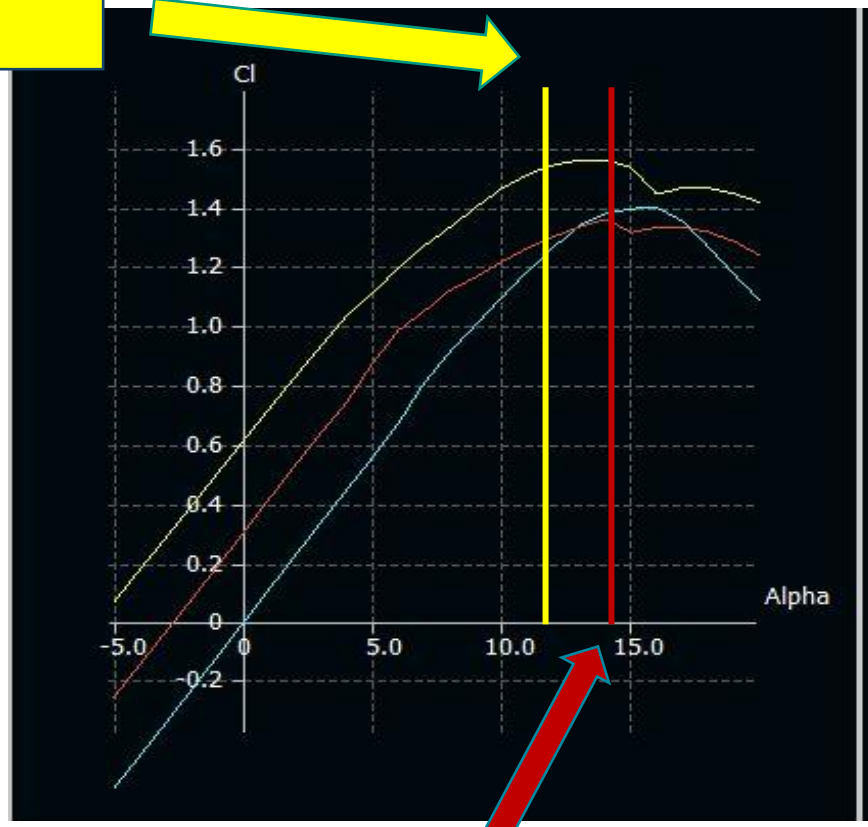


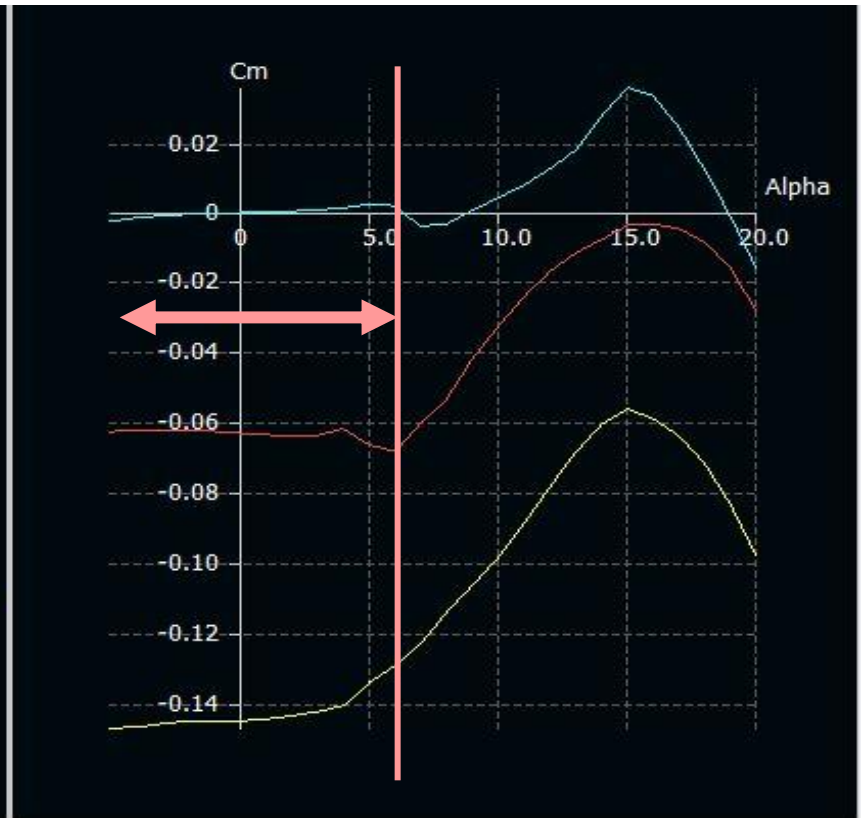
Noah Wright

Xfoil Analysis

Canard Stall

Tail
E168 (12.45%)
T1_Re2.000_M0.03_N9.0
Main
E197 (13.49%)
T1_Re2.000_M0.03_N9.0
Canard
E214 (11.1%)
T1_Re2.000_M0.03_N9.0





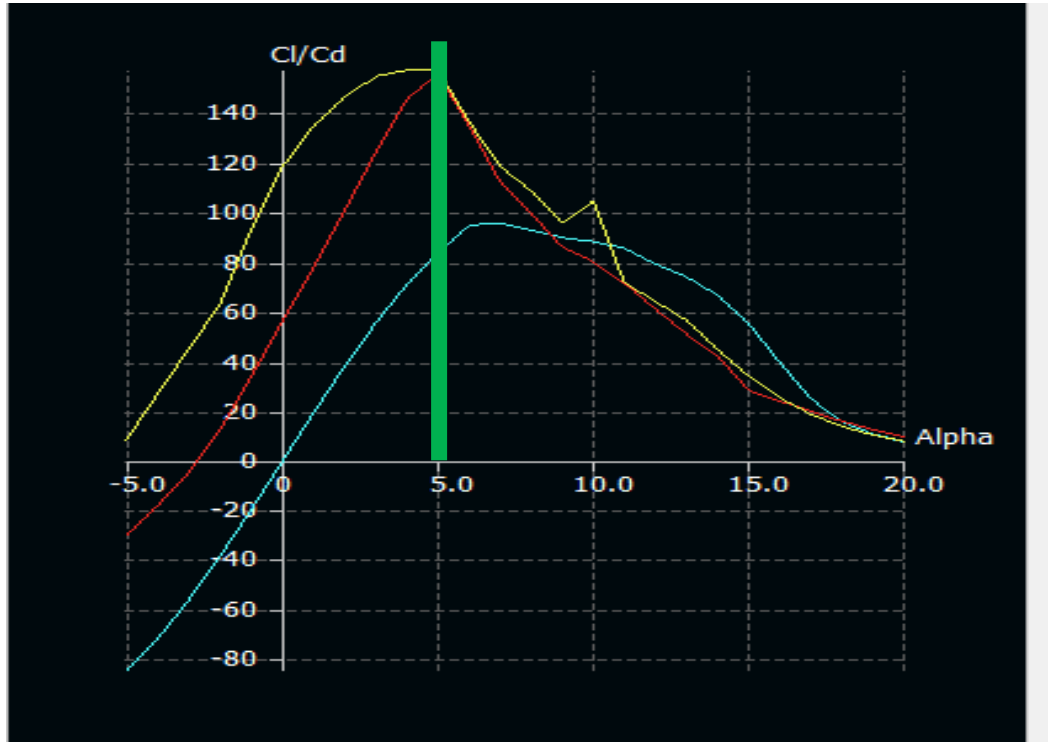
Main Wing Stall

Constant Moment Region

Noah Wright

Xfoil Analysis

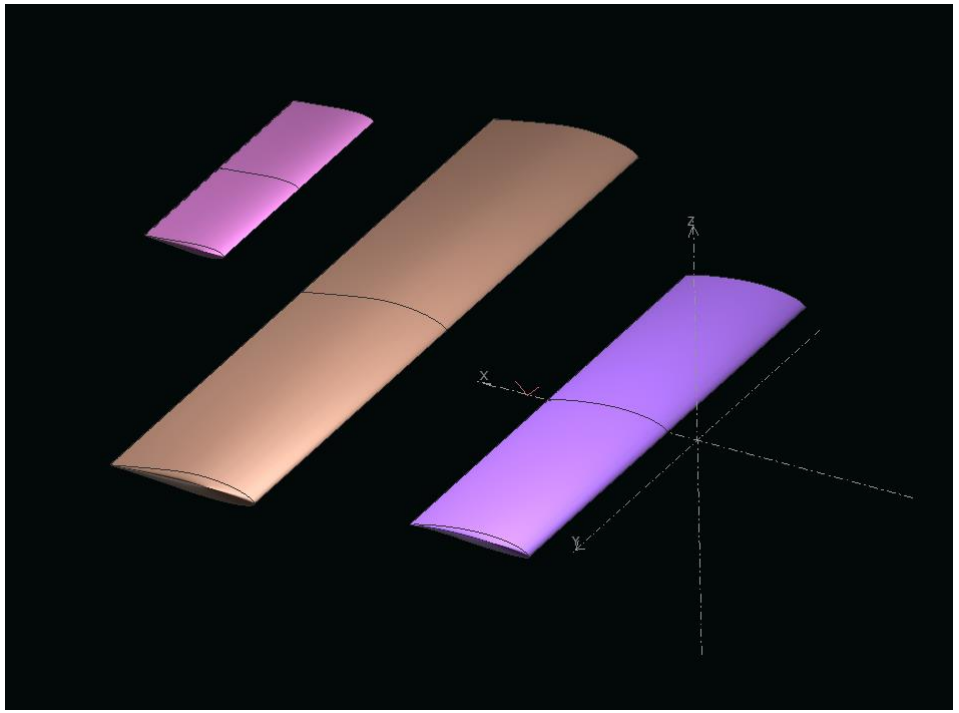
Tail
E168 (12.45%)
T1_Re2.000_M0.03_N9.0
Main
E197 (13.49%)
T1_Re2.000_M0.03_N9.0
Canard
E214 (11.1%)
T1_Re2.000_M0.03_N9.0



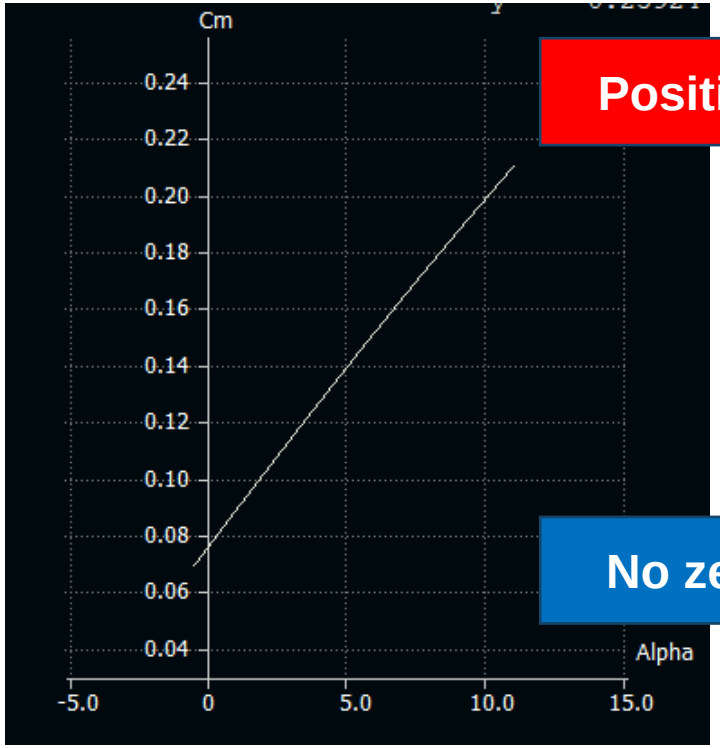
Optimum Performance Angle: 5 deg

Noah Wright

XFLR5 Analysis



1st Attempt Wing Layout in XFLR5



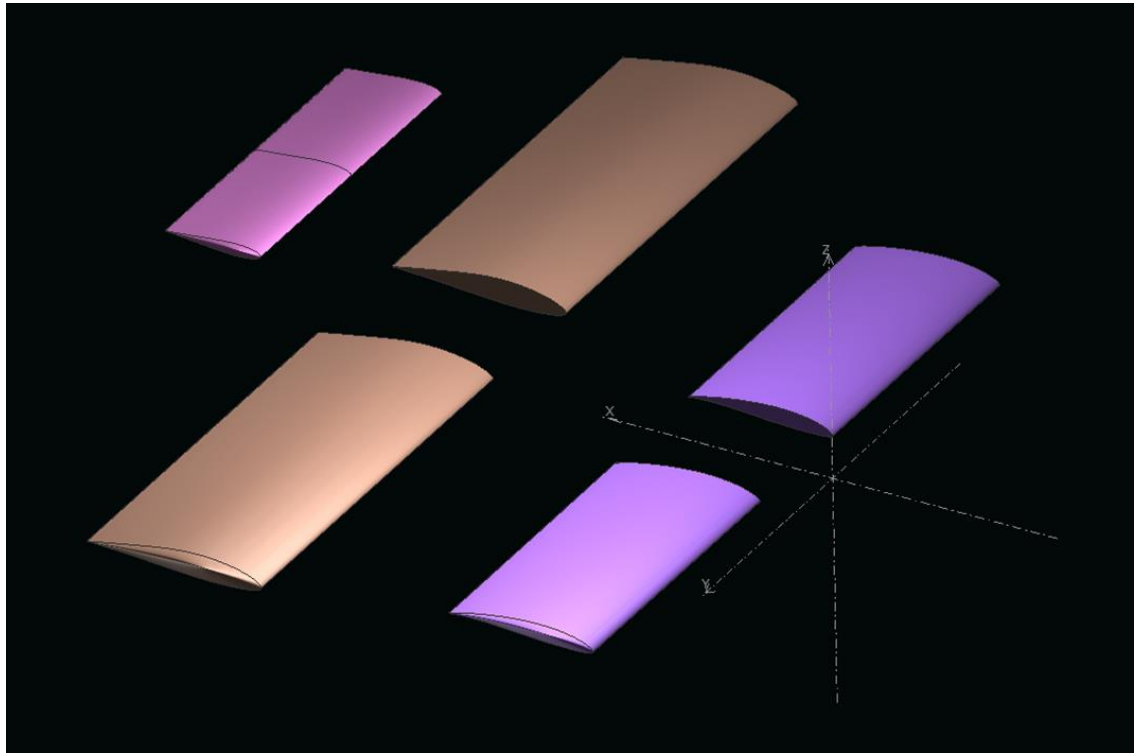
Positive Slope

No zero value

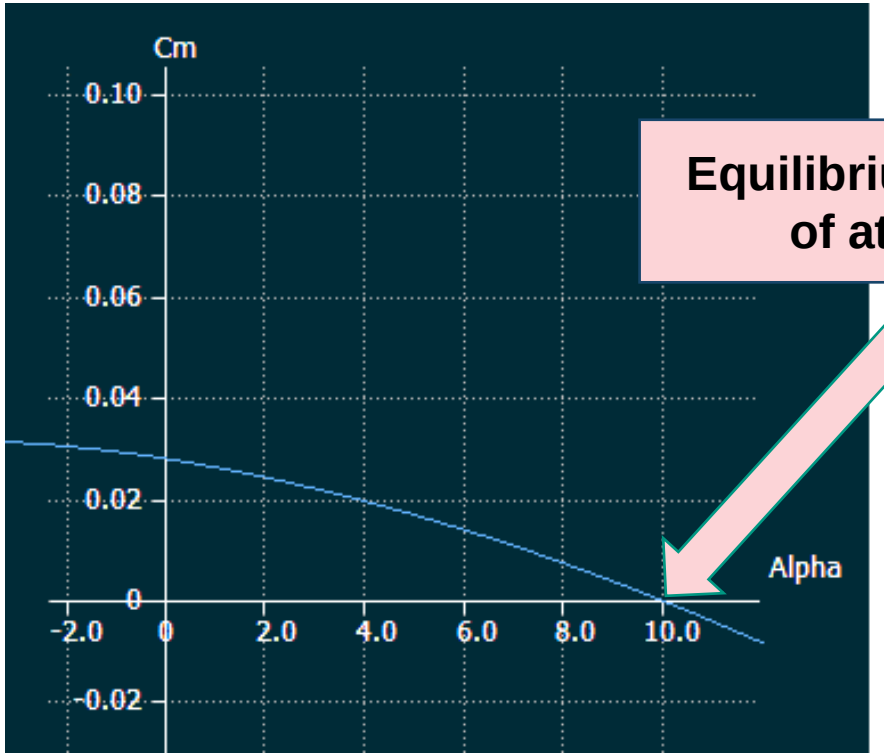
Coefficient of Moment Plot

Noah Wright

XFLR5 Analysis



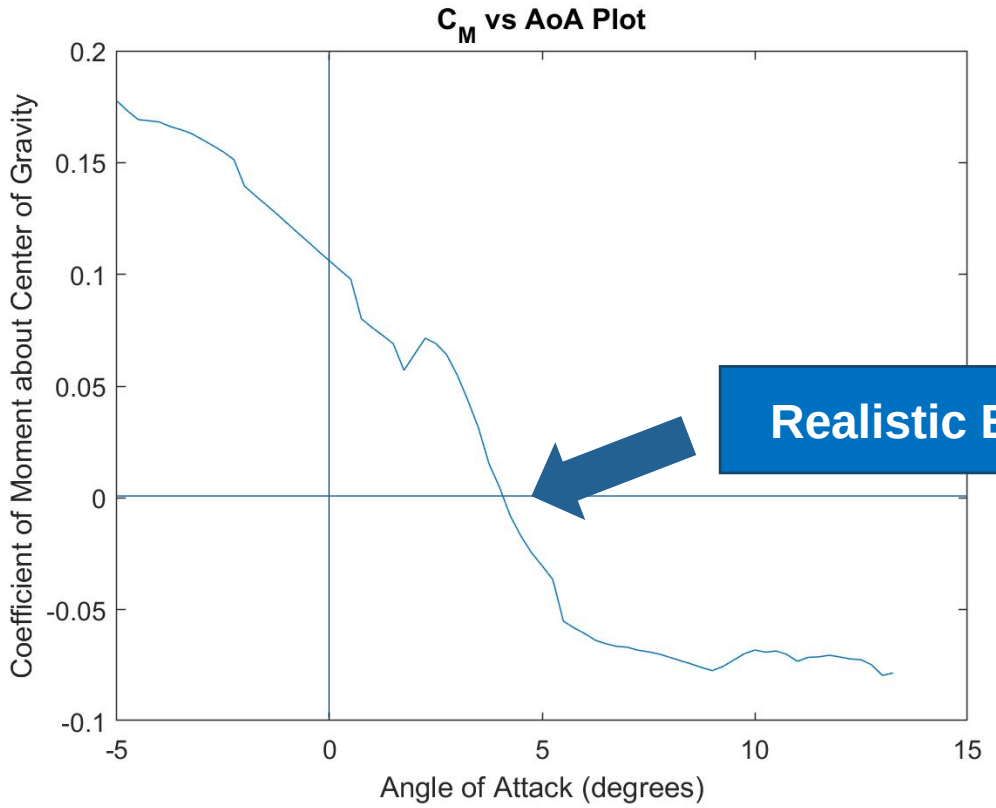
Current Wing Layout in XFLR5



Coefficient of Moment Plot

Noah Wright

MATLAB STABILITY



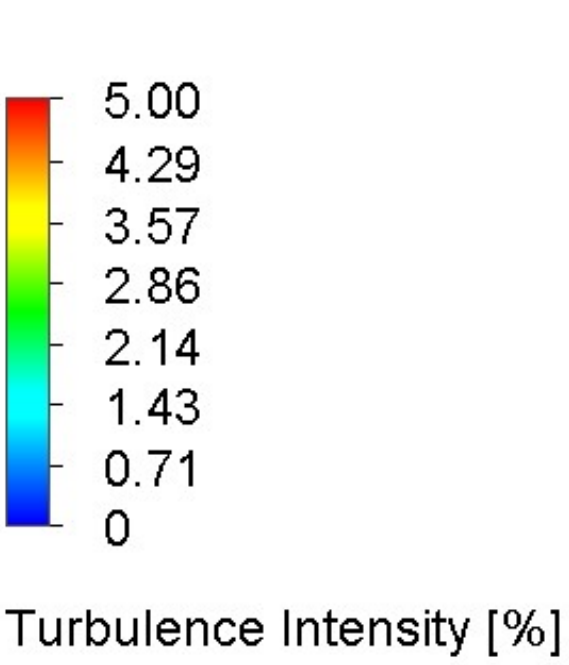
Negative Slope

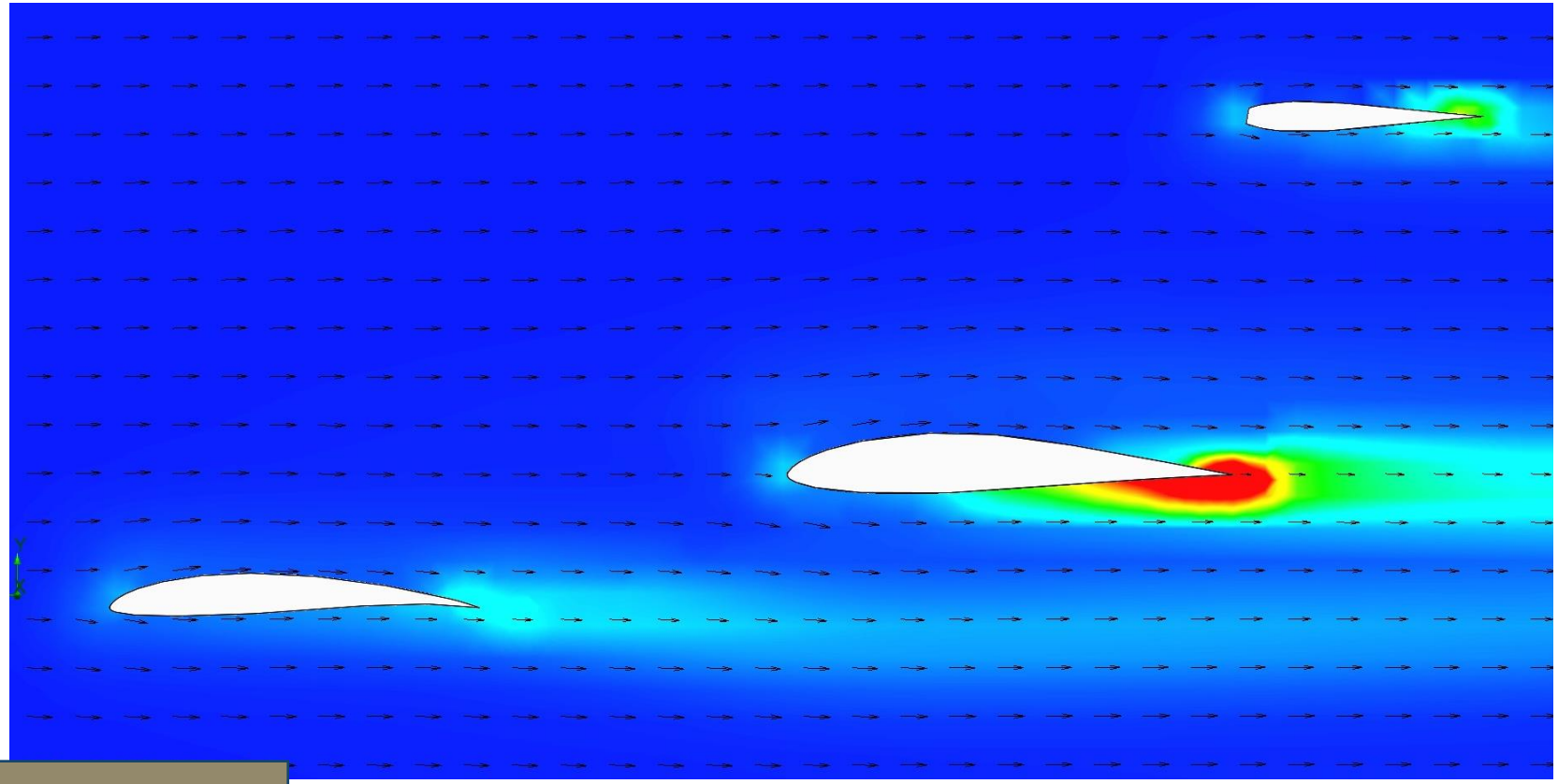
Realistic Eq. AoA

MATLAB Coefficient of Moment Plot

Noah Wright

Wing Turbulence - Wake

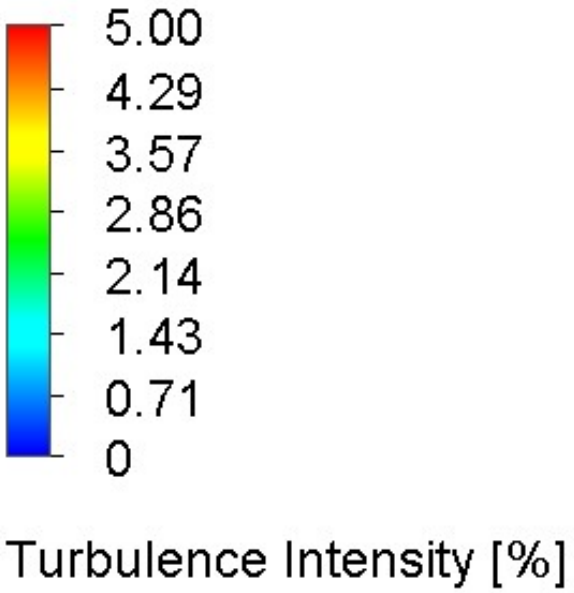


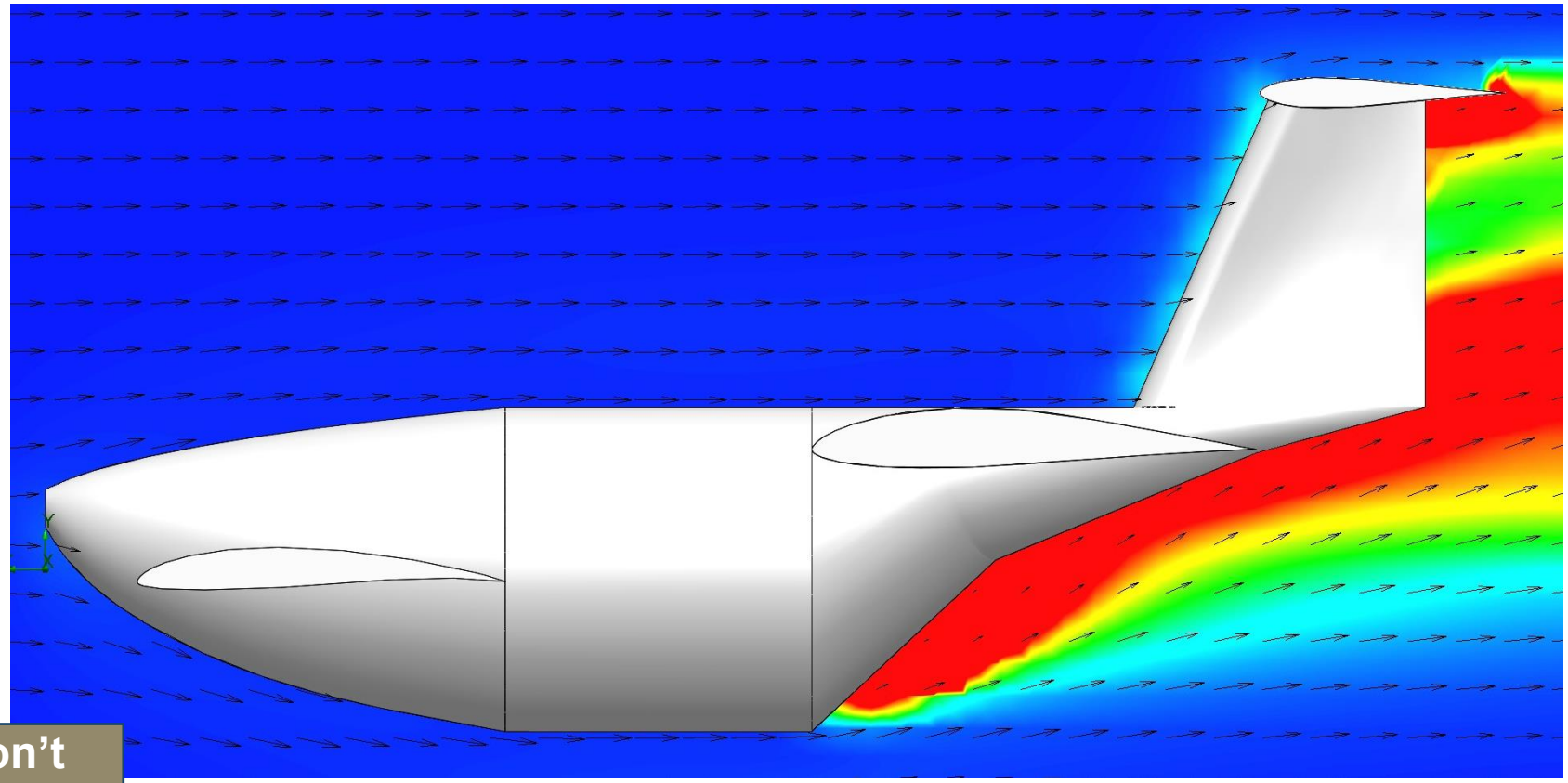


Negligible wake effects between wings

Noah Wright

Fuselage Turbulence

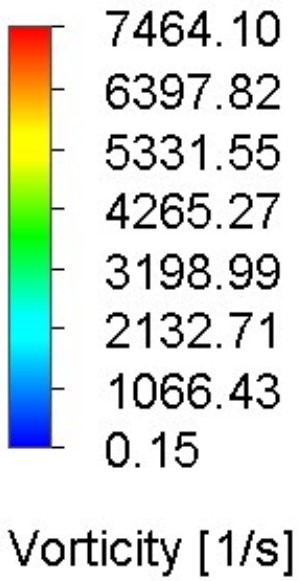




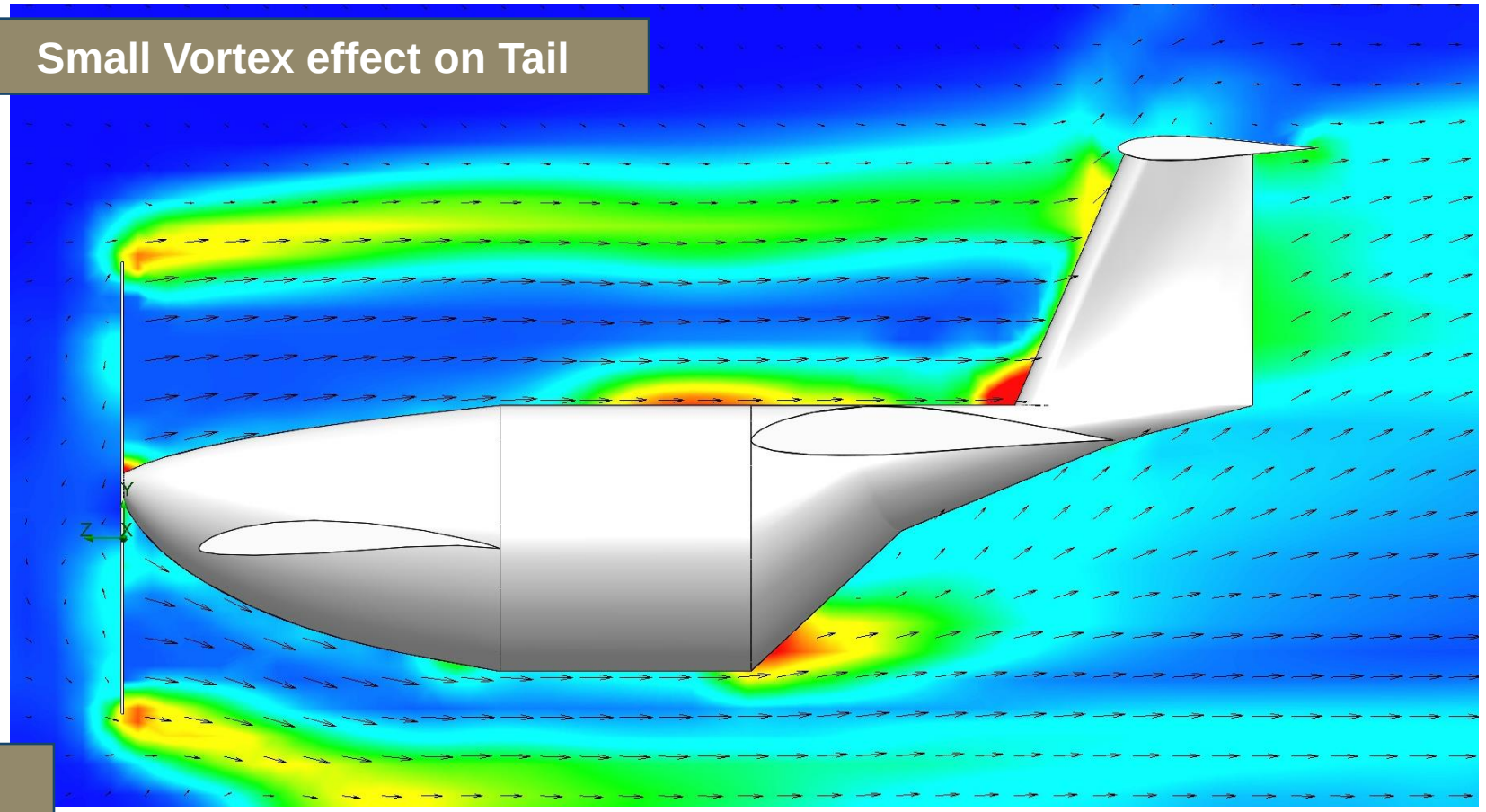
Tail Turbulence – Won't affect flight

Noah Wright

Propeller Vorticity



Small Vortex effect on Tail



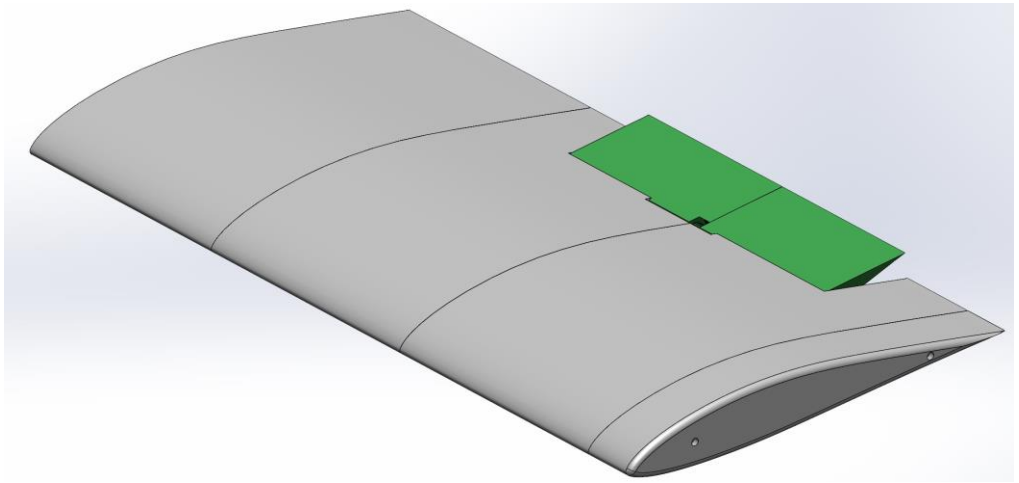
Ground Effects

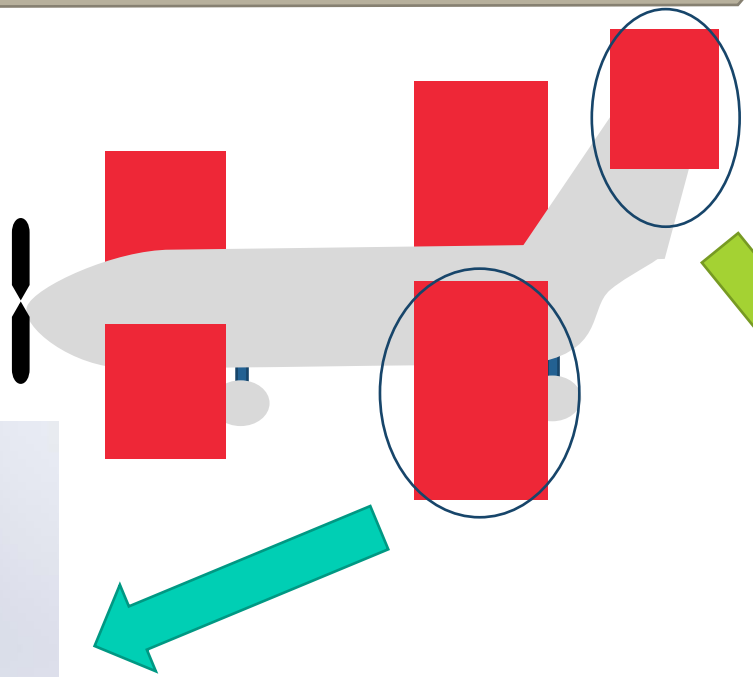
Noah Wright

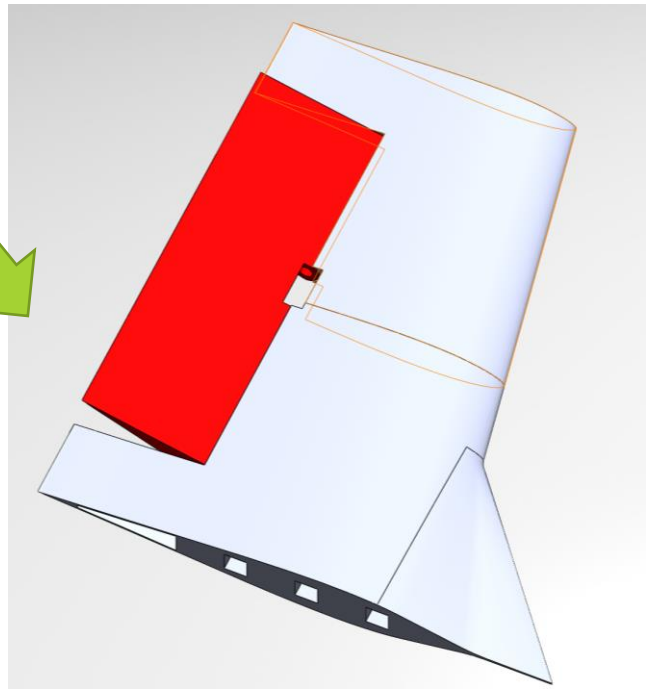
Current Work

Cameron Riley

Current Work – CAD Assistance





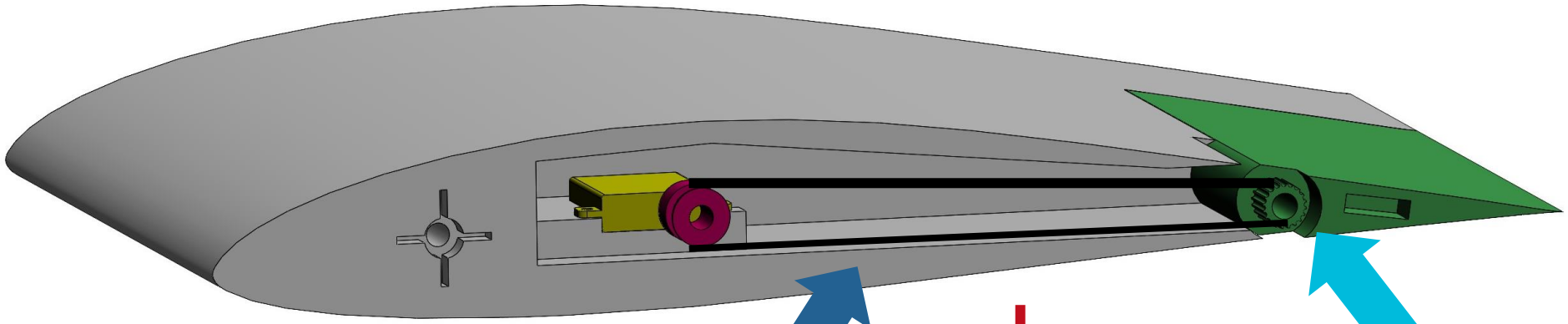


Main Wing

Tail Wing – Vertical Section

Cameron Riley

Current Work – Control Surface Motion



Belt

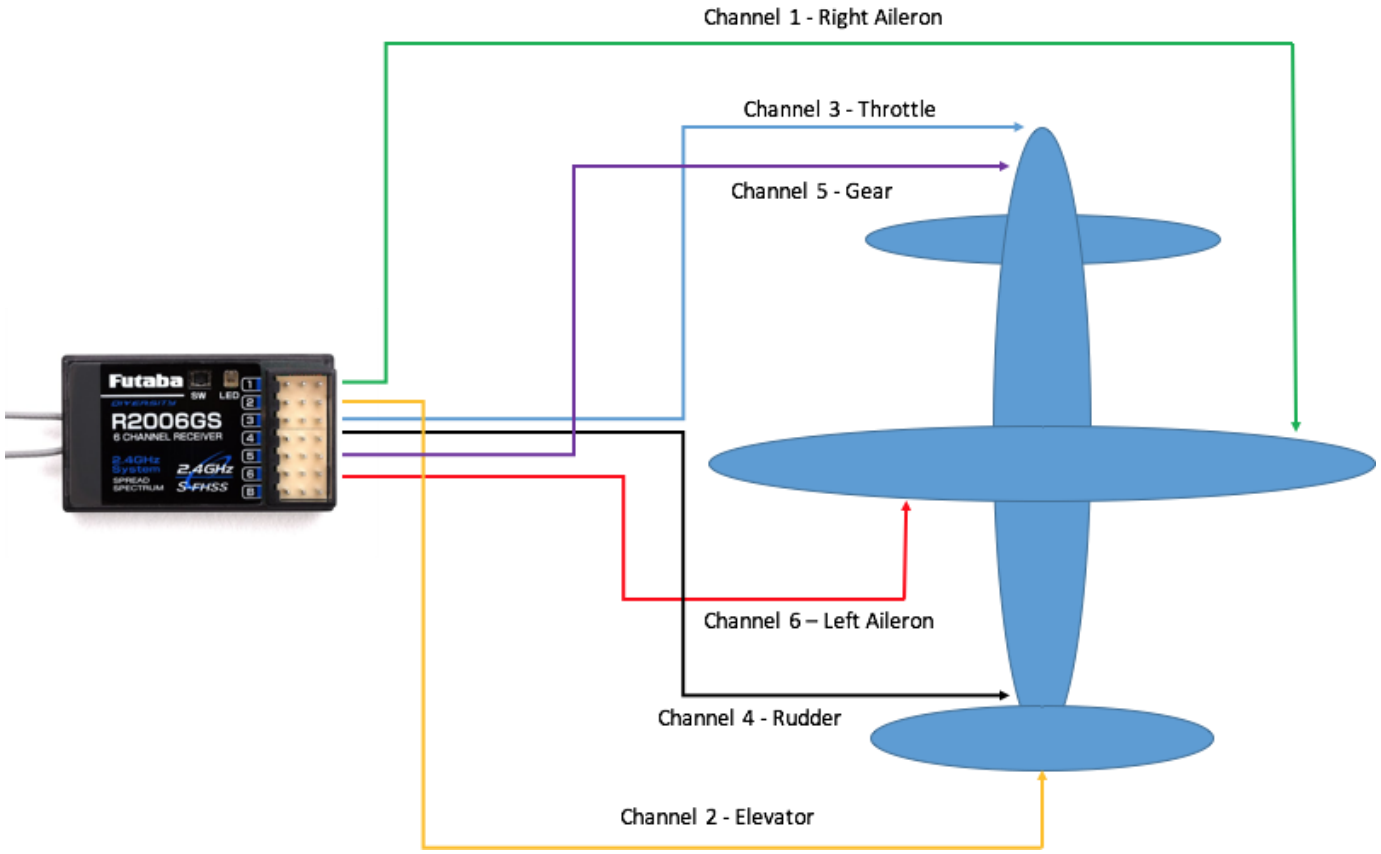
Control Surface Gears

Cameron Riley

Current Work – Wiring

Method of splicing wires

Soldering or Crimping



Cameron Riley

Current Work – Programming

Throttle

Yaw, Pitch, Roll Control

Adjusting the transmitter settings to favor our plane

Cameron Riley

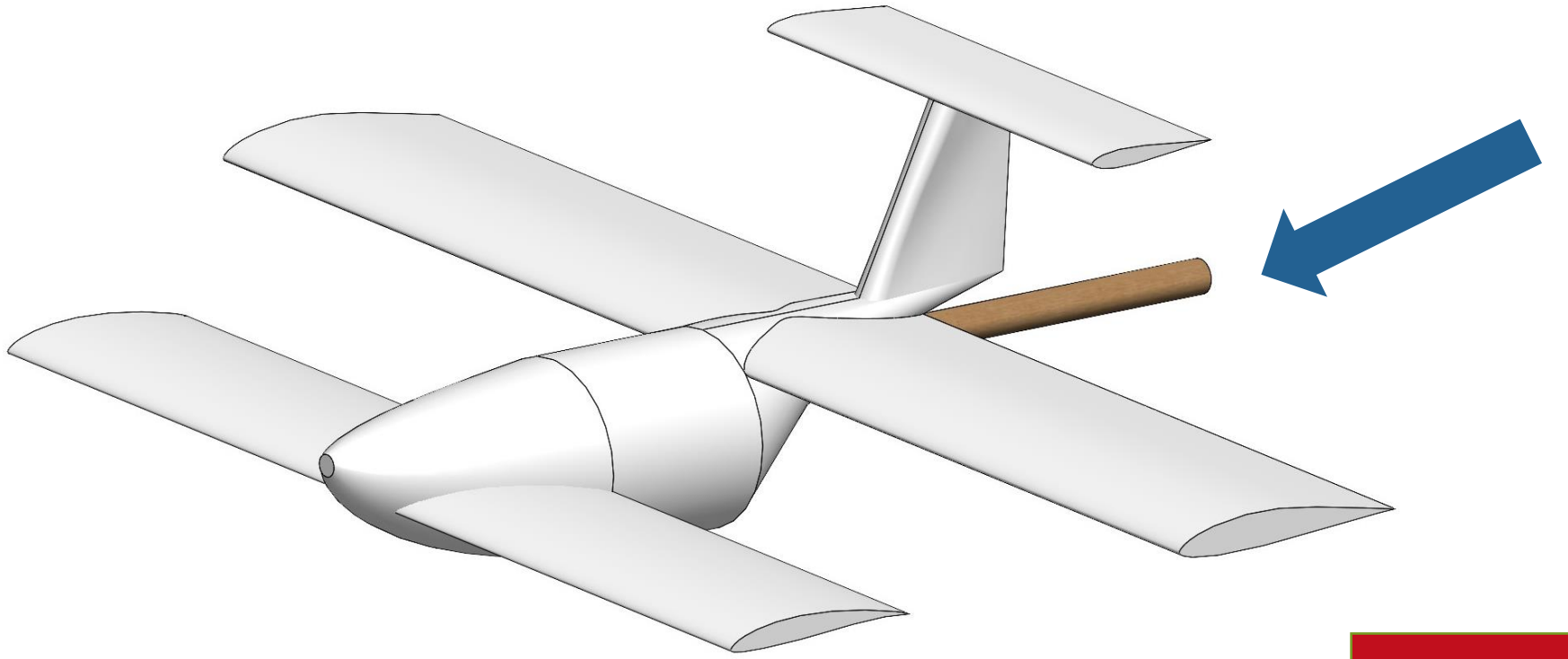
Current Work – Wind Tunnel Testing

FCAAP Wind Tunnel

A Wind Tunnel Experiment

Cameron Riley

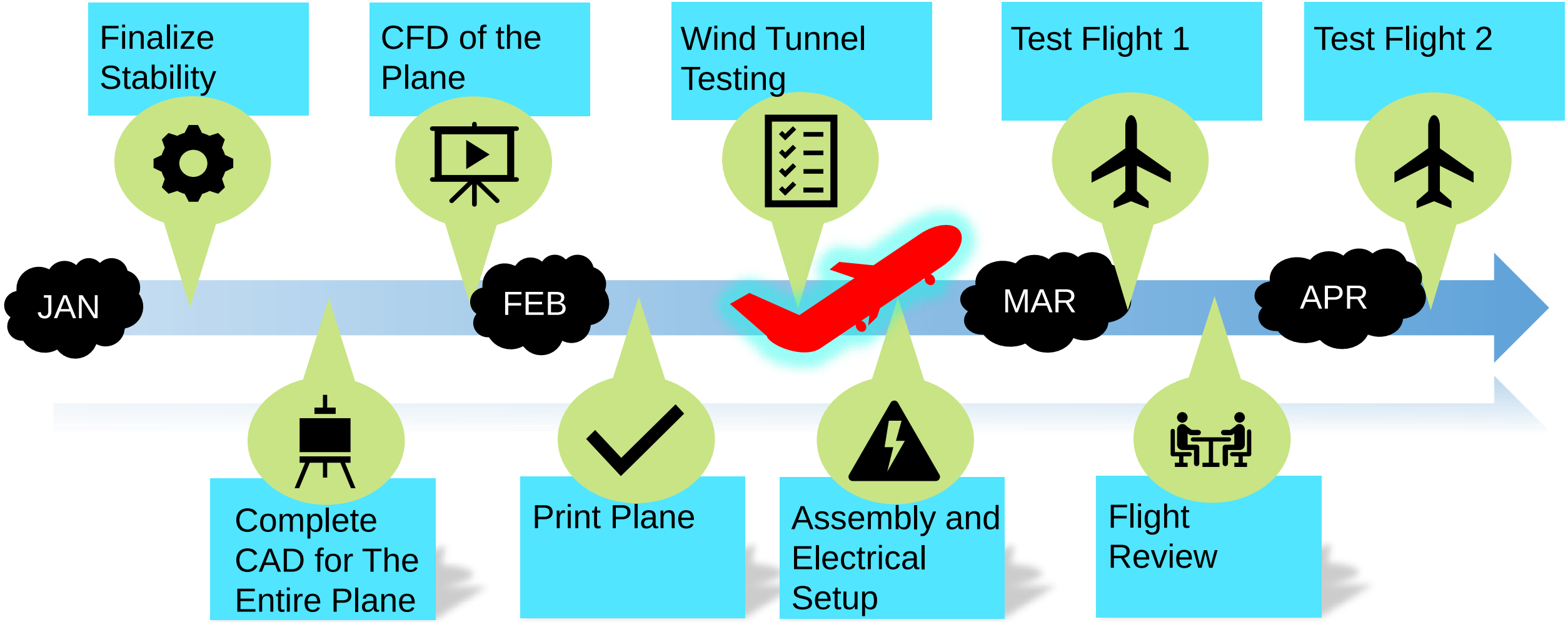
Current Work – Wind Tunnel Testing



Support for the wind tunnel test

Scale – 2:13

Cameron Riley


Finalize Stability
CFD of the Plane
Wind Tunnel Testing
Test Flight 1
Test Flight 2
JAN
FEB
MAR
APR
Complete CAD for The Entire Plane
Print Plane
Assembly and Electrical Setup
Flight Review

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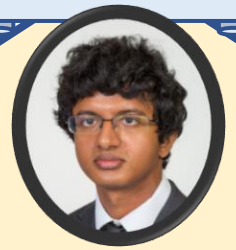
SAE Aero Design Competition 2021 Rule Book. Available on: https://public.3.basecamp.com/p/38Lpy4uyTLpNkwTZbtwjgtBZ

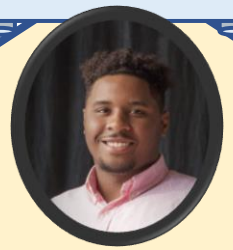
Tail Types. What-When-How. N.d. http://what-when-how.com/flight/tail-designs/

LinkedIn Information

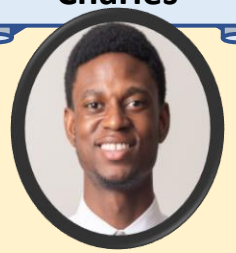
Sasindu Pinto



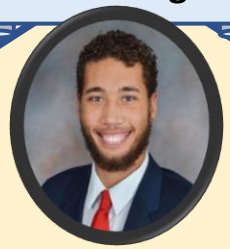
Cameron Riley



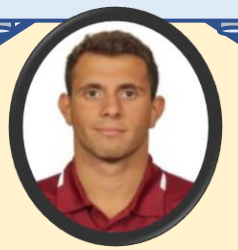
Michenell Louis-Charles



Noah Wright



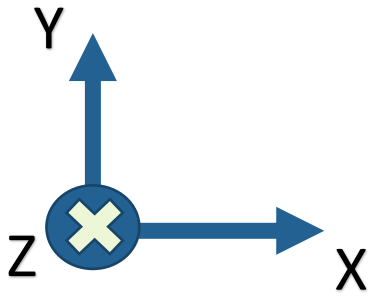
Adrian Moya



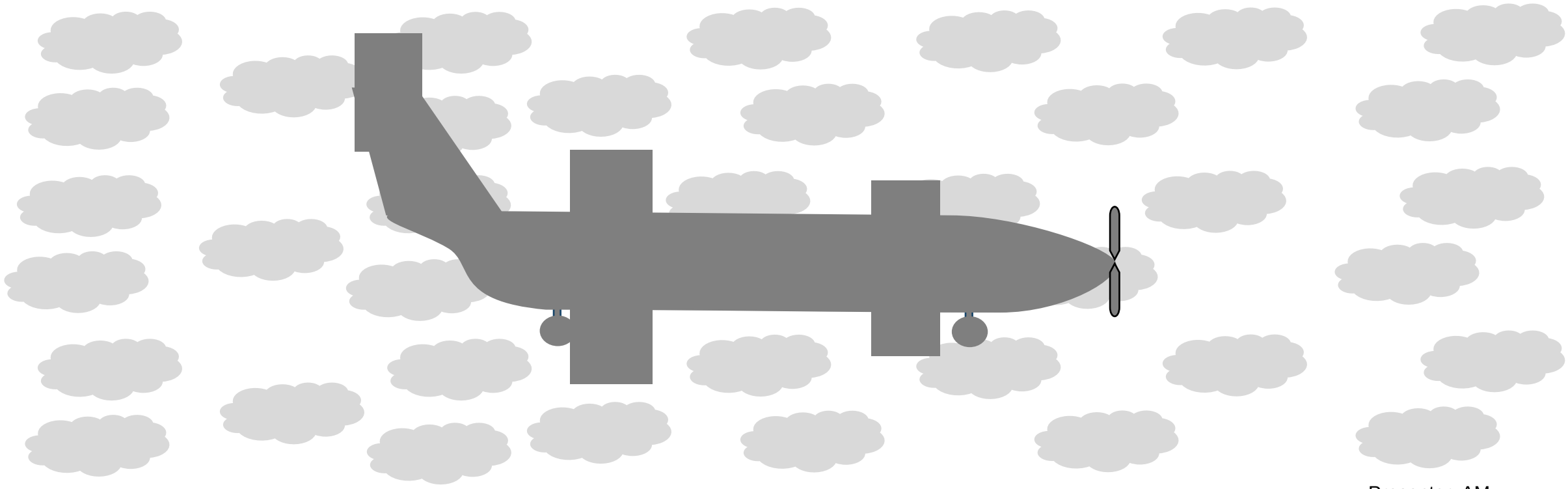
Cameron Riley

Backup Slides

Key Definitions

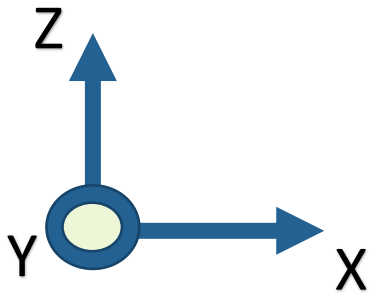


Pitch

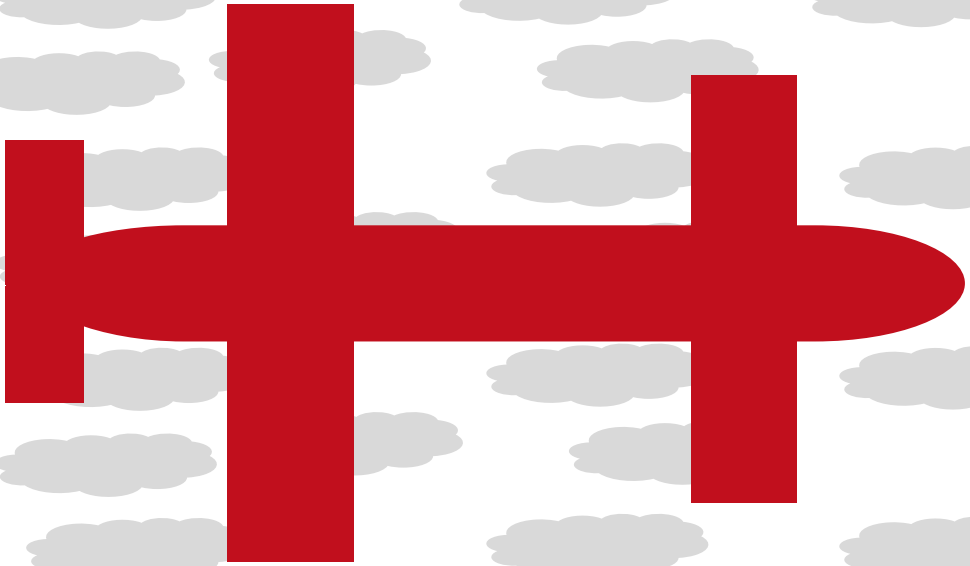


Presenter: AM

Key Definitions

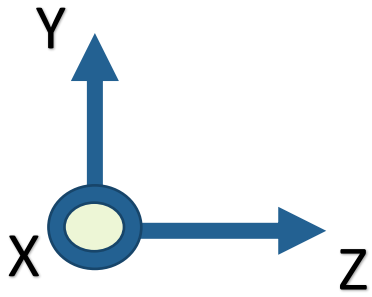


Yaw

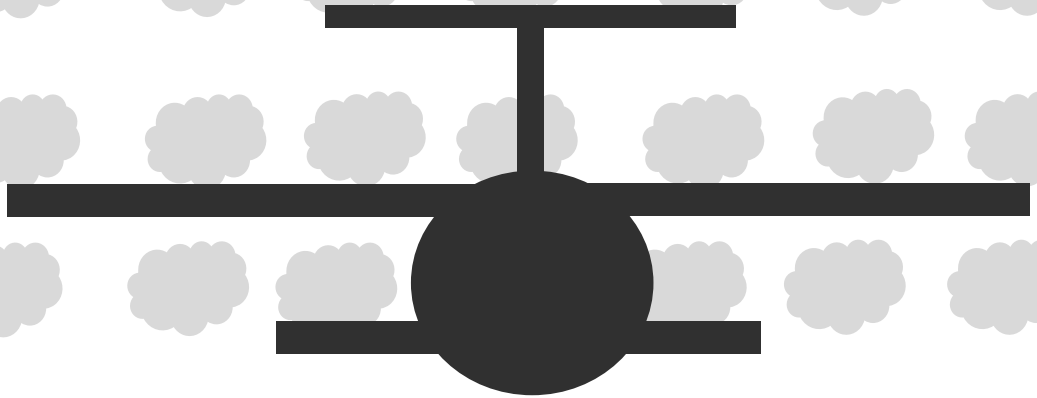


Presenter: AM

Key Definitions



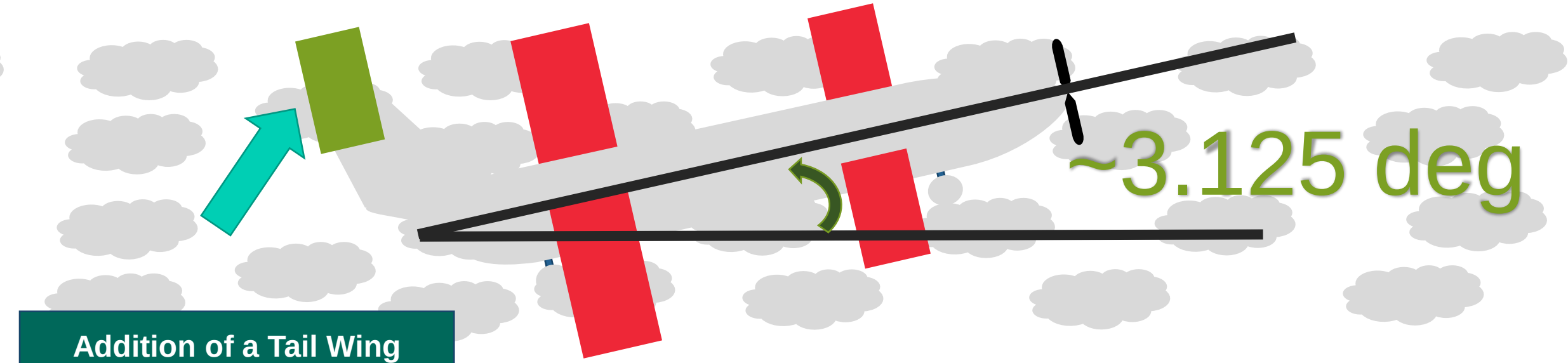
Roll



Presenter: AM

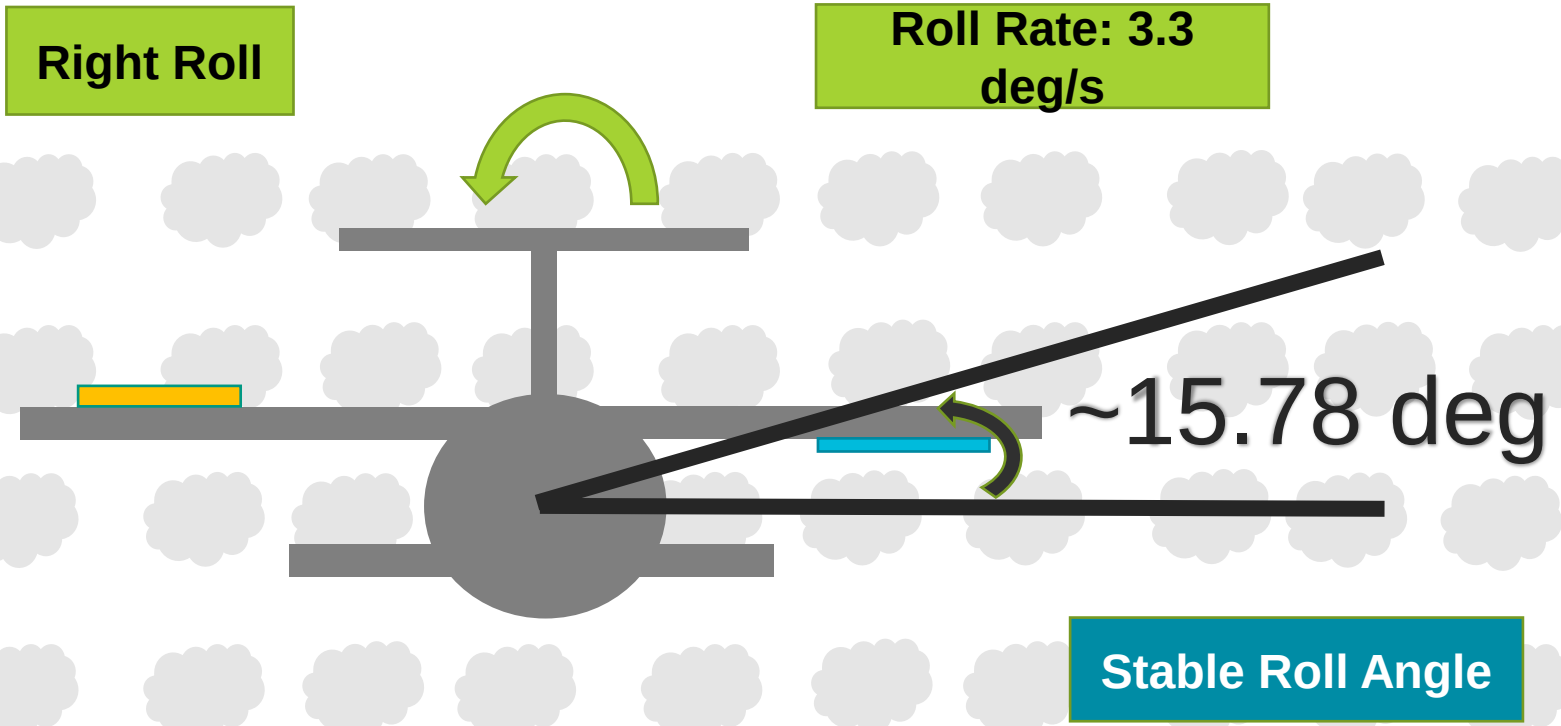
Initial Design - Pitch Stability

Equilibrium Angle of Attack



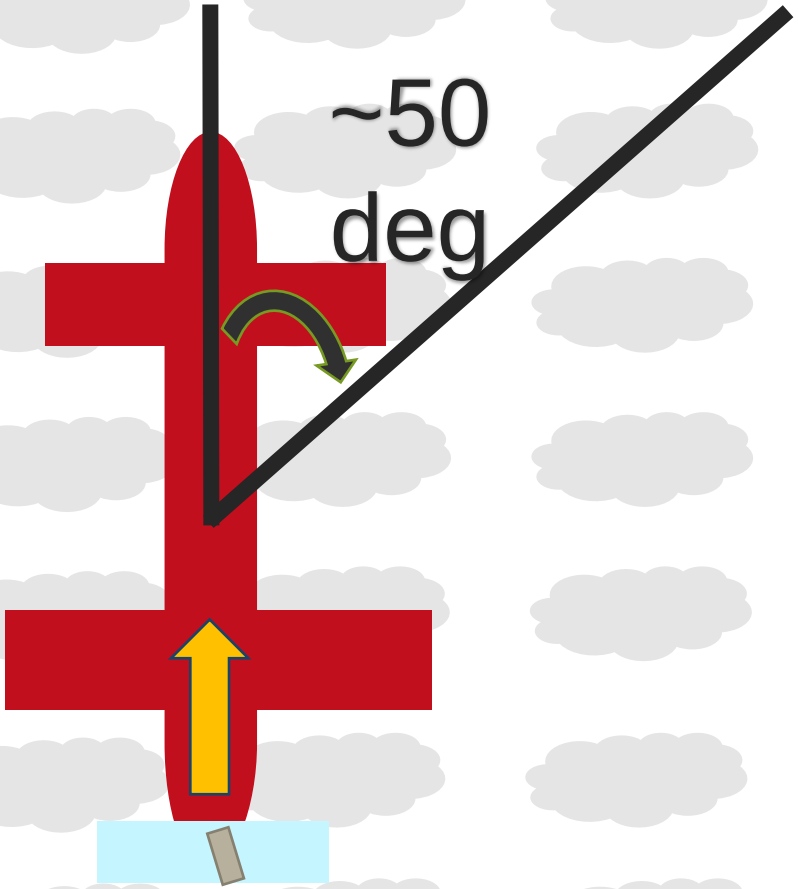
Addition of a Tail Wing

Initial Design - Roll Stability



Yaw Stability – Operation

Landing Angle: 50 deg



10 mph Cross Wind