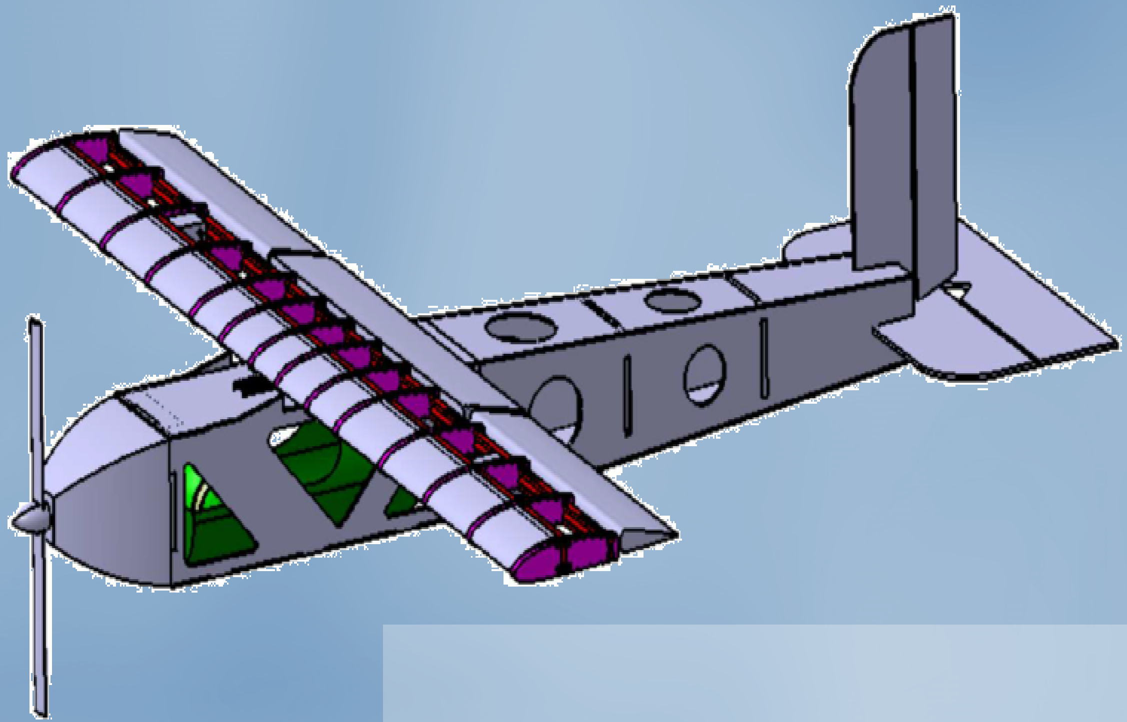
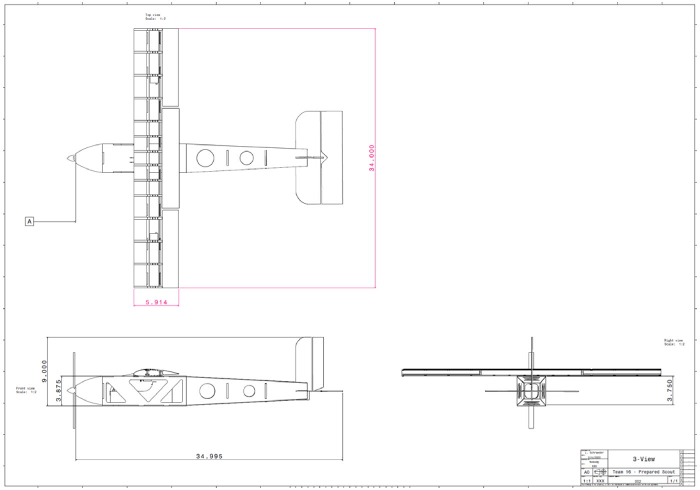


Project: Prepared Scout

Team 16 – WSU-Boeing Bronze Propeller Competition

Mission

- Aircraft must be hand-launched
- Fly five total laps
- Drop a “first aid” payload in a 20’x20’ target area after the second lap
- Return to base for refit in the shortest time possible in a field environment.

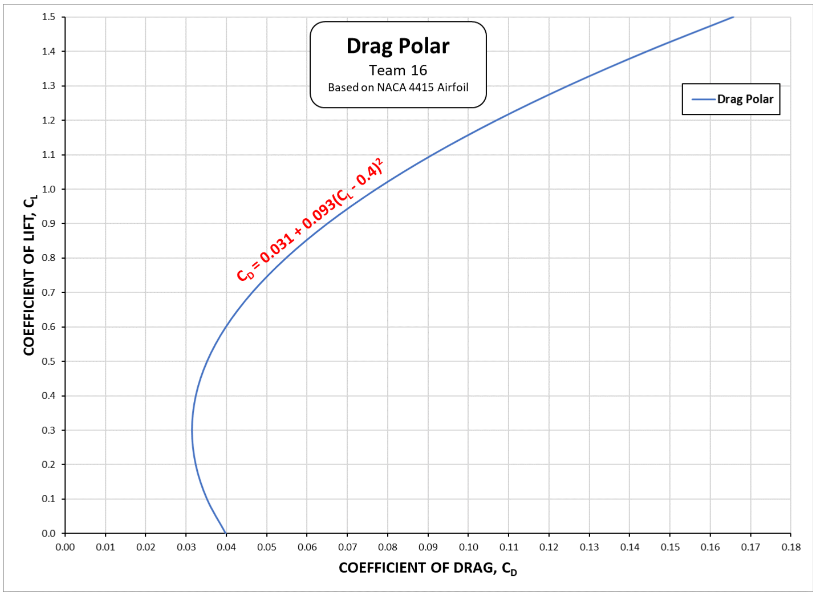


KEY DESIGN PARAMETERS

Parameter	Design Prediction
Wing Area	194 sq-inches
Wing Span	34 inches
$C_{D,0}$	0.031
$C_{L\ max}$	1.0
$(L/D)_{max}$	19
Wing Airfoil	NACA 4415
Aerodynamic Center Location	9.0 inches
Horizontal Tail Airfoil	Flat Plate
Vertical Tail Airfoil	Flat Plate
Horizontal Tail Area	75 sq-inches
Vertical Tail Area	25 sq-inches
Horizontal Tail Span	12.2 inches
Vertical Tail Span	7.1 inches
$C_{M,0}$	-0.29
$C_{M\text{-}alpha}$	-0.035 per deg
Static Margin	7.4 %
Required Elevator Deflection for Trim at V_{Cruise}	2.0 deg
Required Elevator Deflection for Trim at $1.2V_{Stall}$	2.5 deg
Required Elevator Deflection for Trim at Maneuver Point	2.1 deg
Max Power Available	240 W
Propeller Diameter	9.0 inches
Total Propulsion System Weight (motor, battery pack, wires, connectors, fuse, prop, etc.)	0.43 lb
Battery Pack (nominal volts, # of cells, & mAhr)	11.1V, 800 mAhr
Maximum Current Draw	17.5A
Endurance	120 seconds
Stall Speed	20 ft/s
Max Speed	80 ft/s
Corner Speed (V^*)	50 ft/s
Minimum Turn Radius	40 ft
Empty Weight (ready to fly, no payload)	1.8 lb
Maximum Payload	0.38 lb
CG Location	7.8 inches
Wing Tip Deflection at V^*	0.9 inches
+/- n_{max}	+8 g, -5 g
Microcontroller	Arduino Feather
GPS Unit	Adafruit GPS Module – 10 Hz 66 Channel
Total Vehicle Cost	$150,000
Time to Build	1,000 hours

Aerodynamics

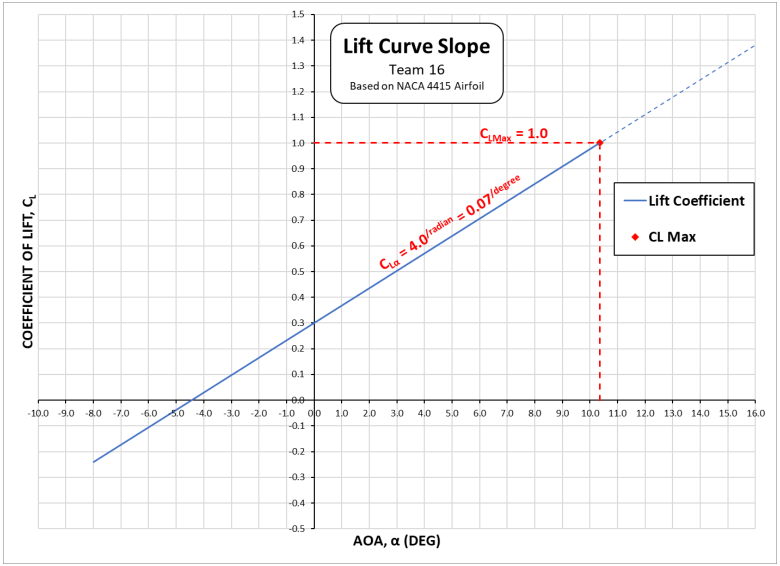
Matt Decker



- Venerable NACA 4415
  - Allows for lift at very slow speeds – necessary for hand launching
- $C_{D,0}$ of 0.031
- Viscous Drag Factor, K of 0.093

Aerodynamics

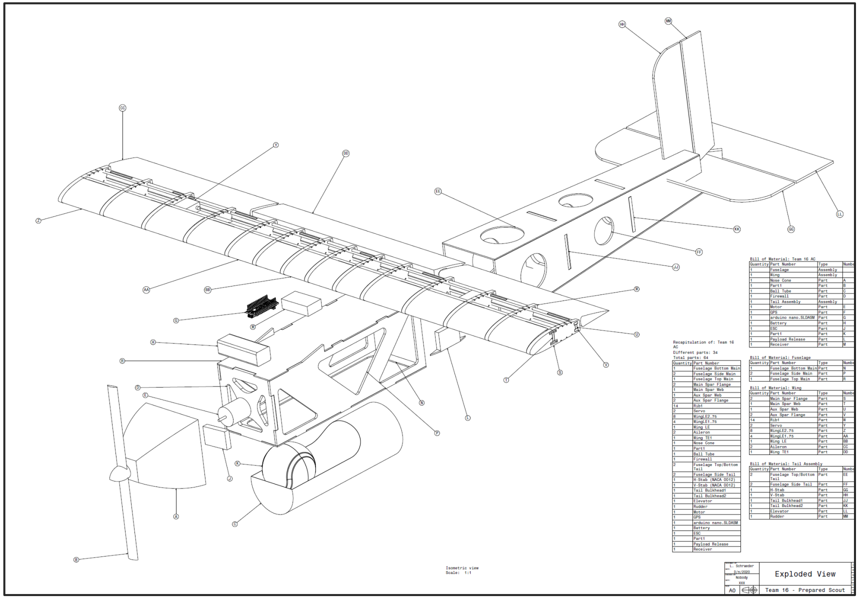
Matt Decker



- $C_{L,Max}$ of 1.0
- $C_{L,\alpha}$ of 4.0/radians
- $C_{L,0}$ of 0.3

Structures

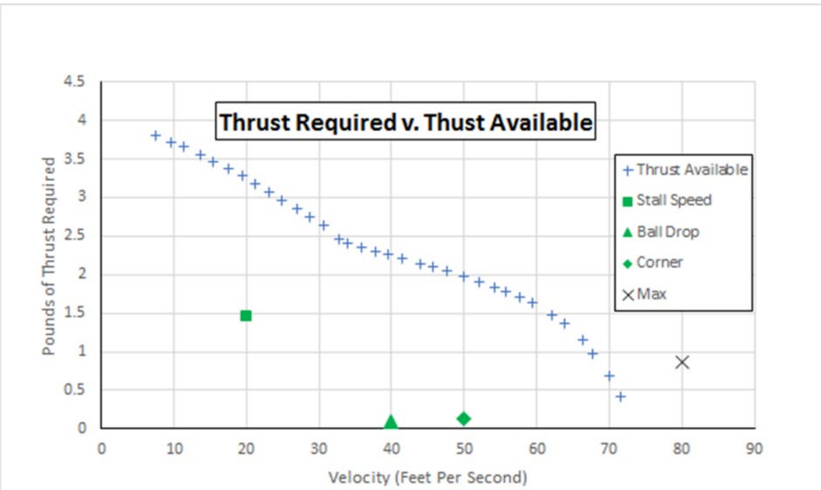
Logan Schraeder



- Dual-spar (primary and secondary) wingbox design
- Primarily balsa (spars, stringers, fuselage) and polystyrene foam (rib, LE, TE)
- Parasol wing attached via thick rubber band system
- Reinforced key structural components and load paths; lightened non-critical or low-load areas

Propulsion

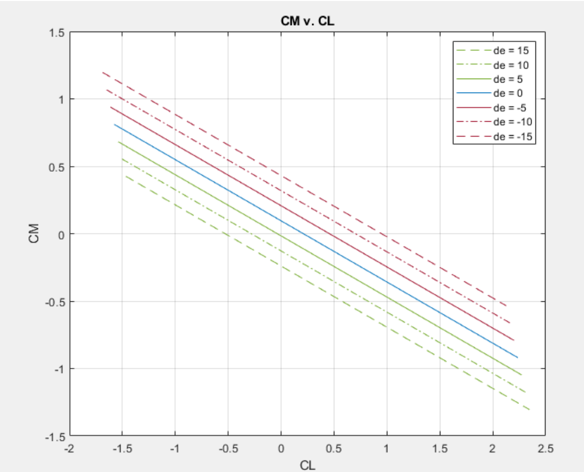
Ethan Betzen



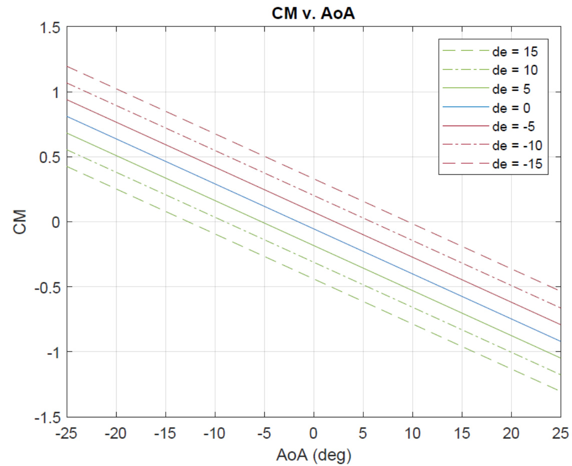
- **Motor: Scorpion SII-2215-900Kv**
- **Battery: Venom LiPo 3S 11.1V 850mAh 50C**
- **Propeller: APC 9 x 9 Thin Electric**
- **ESC: Great Planes ElectriFly Silver Series 12A**

Stability and Controls

Logan Schraeder



C_M v. C_L at Stall. Note that at stall an effective C_{LMax} of ~0.95 is still achievable.



C_M v. AoA at Stall. Calculated by iteratively solving the 2x2 longitudinal stability matrix.

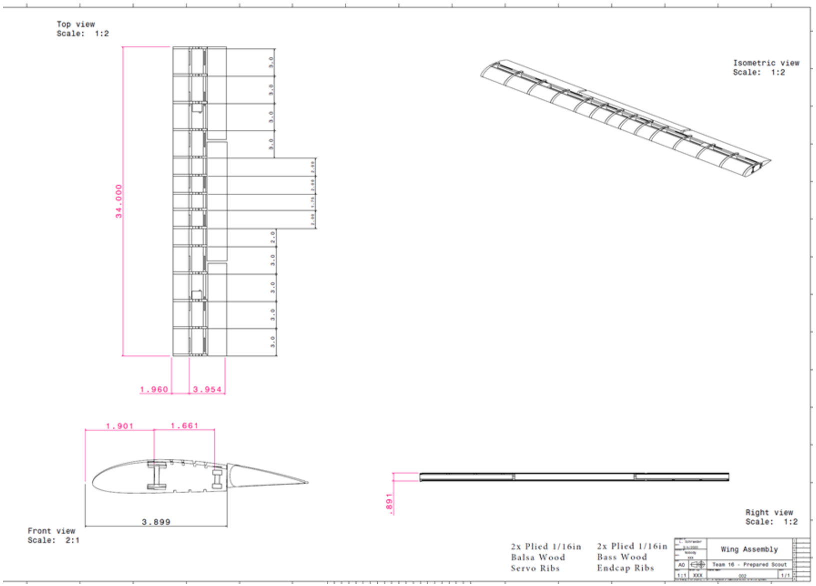
- **Static Margin of 7.4%**
- **Control surface deflections of +/- 15 degrees**
- $C_{M\alpha} = -0.035$
- **Trimmable at AoA up to +/- 25 degrees**

Drop Mechanism and Targeting

USAF C-130 Hercules executing a Joint Precision Airdrop (JPADS). JPADS is typically used to quickly resupply forces in remote areas. Photo credit: Ken Cheung.

- Targeting/"navigation" duties handled by Arduino Feather & IMU + Adafruit GPS
- 3-ball payload dispensed via "ramp door"-style tube similar to a LAPES or JPADS system
- Actuated by a servo-less electromagnet jettison system
- Programmed to drop after second lap using a combination of GPS and inertial measurement data

Detailed Design and Construction



- Utilizes a number of self-aligning parts in critical areas
  - Fuselage, wing spars
- Tooling for ply-up uniformity and ease-of-assembly
- Lightening holes in non-critical components, reinforced ply-ups in critical areas
- Low parts count = simpler, easier, and less expensive to build (and repair)
  - 71 total parts

MEET OUR TEAM

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