Design and Fabrication of RC Delivery Aircraft:

Col. Pollo J. Rosso

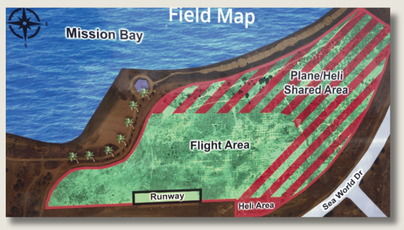
Mark Gabriel Samac, Johnpierre Khachi, Jeffrey Denenberg, Jeff Bratman, Justin Rector, Joseph Tuazon · MAE 155B: Aerospace Engineering Design II · Faculty Advisor: Dr. John Hwang

Main Aircraft Specifications

Empty Weight (kg)	1.4
Gross Weight (kg)	2.125
Payload 1 Weight (kg)	0.68
Payload 2 Volume (cm^3)	700
Thrust-to-weight	0.5
Cruise Speed (m/s)	20

	Chord (m)	Span (m)	Area (m^2)	AR
Wing	0.2	1.35	0.27	6.75
Horizontal Stabilizer	0.12	0.58	0.07	4.83
Vertical Stabilizer	0.15	0.27	0.04	1.8

Mission



Location: Mission Bay Field (SEFSD)

- **Mission 1:** Perform successful empty weight flight
- **Mission 2:** Take off with both payload 1 and 2, successfully eject payload 2 midair at a designated point, land safely with payload 1

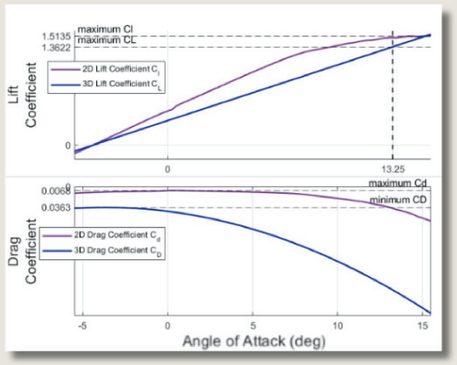
Flight Score

$$J(x) = \frac{r_{W_p} W_p(x) + r_{V_p} V_p(x) - c_e E_f(x) - c_c}{T_f(x)} - \frac{c_{W_g} W_g(x)}{t_l} - c_f$$

Key Variables: W_p = payload 1 weight, V_p = payload 2 volume, T_f = flight time, W_g = gross weight, E_f = energy consumption

Design Decision: We focused on maximizing the weights carried, the key factor influencing our flight score

Aerodynamics



Wing Airfoil Selection: NACA 4412

Key Aerodynamic Parameters:

- C_{Lmax} = 1.3622, C_{Dmin} = 0.0363, $C_{D,0}$ = 0.035
- Maximum L/D of 35.838 @ 13.25° AOA
  - Taildragger design achieves desired angle

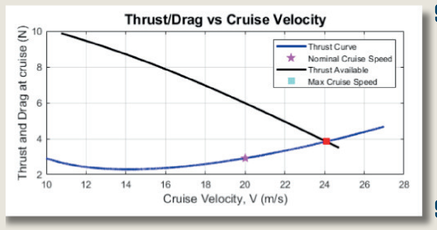
Empennage Airfoil Selection: NACA 0012

Planform Area (in % of wing):

- Horizontal Stabilizer: 19%, Vertical Stabilizer: 11%

Propeller Choice: At 9000 RPM, the 9x6E easily meets the 3N minimum thrust for nominal cruise speed

Stability & Performance



Stability Parameters (% from MAC):

- Neutral Point: 58
- CG (Empty Flight): 24.73
- CG (Payloads 1 & 2): 24.04
- CG (Payload 1): 23.97

Static Margin: 17%

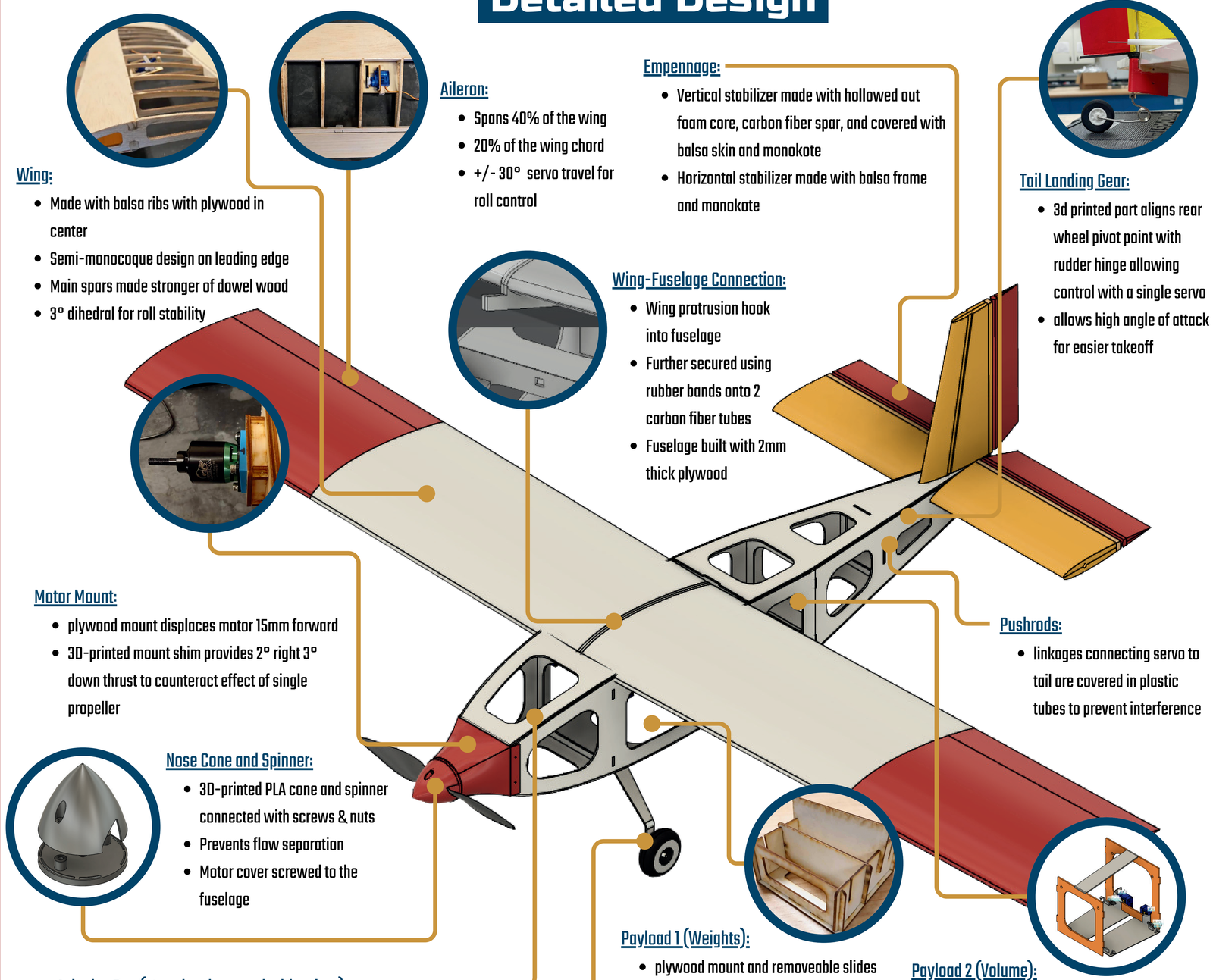
Takeoff Distance: 14.7 m

Cruise Speed: 20 m/s

Stall Speed: 10 m/s

Climb Angle: 15°

Detailed Design



Wing:

- Made with balsa ribs with plywood in center
- Semi-monocoque design on leading edge
- Main spars made stronger of dowel wood
- 3° dihedral for roll stability

Aileron:

- Spans 40% of the wing
- 20% of the wing chord
- +/- 30° servo travel for roll control

Empennage:

- Vertical stabilizer made with hollowed out foam core, carbon fiber spar, and covered with balsa skin and monokote
- Horizontal stabilizer made with balsa frame and monokote

Tail Landing Gear:

- 3d printed part aligns rear wheel pivot point with rudder hinge allowing control with a single servo
- allows high angle of attack for easier takeoff

Wing-Fuselage Connection:

- Wing protrusion hook into fuselage
- Further secured using rubber bands onto 2 carbon fiber tubes
- Fuselage built with 2mm thick plywood

Motor Mount:

- plywood mount displaces motor 15mm forward
- 3D-printed mount shim provides 2° right 3° down thrust to counteract effect of single propeller

Pushrods:

- linkages connecting servo to tail are covered in plastic tubes to prevent interference

Nose Cone and Spinner:

- 3D-printed PLA cone and spinner connected with screws & nuts
- Prevents flow separation
- Motor cover screwed to the fuselage

Avionics Bay (stored and secured with velcro):

- Motor: Cobra C-2217/16 Brushless, Kv=1180
- Speed Controller: Flite Test 40 Amp ESC
- Battery: Tattu 11.1V 1800mAh 3S 45C LiPo
- Reciever: FrSky Taranis Receiver X8R 8 Channel 2.4 GHz
- ESC: Powerwerx Watt Meter-Bare, DC Inline Power Analyzer

Payload 1 (Weights):

- plywood mount and removeable slides
- each slide accommodates a set amount of weights totaling up to 2lbs max
- Secured to fuselage using velcro

Payload 2 (Volume):

- 3d printed bomb-bay style doors actuated by 2 servos
- 4-bar linkage allows full 90° opening
- return springs assist door to fully closed position

Main Landing Gear:

- Bent higher to induce higher angle of attack in tandem with the rear landing gear
- Mounted to the fuselage with reinforcement for higher strength