

Cargo Plane

Advisor: Professor John C. LaRue

Abstract

The Cargo Plane senior design project's main goal was to design a plane, composed mainly of wood, capable of lifting a payload two and a half times its weight. Aerospace and Mechanical Engineering students worked to handcraft the wooden fuselage, wings, and tail. The plane was divided into sub teams in order to split the workload and was finished one month before competition to allow time for testing. Students learned the importance of time management, meeting deadlines, and balancing cost versus benefit. Cost-benefit analysis was used in terms of buying materials and in the design of the plane itself.

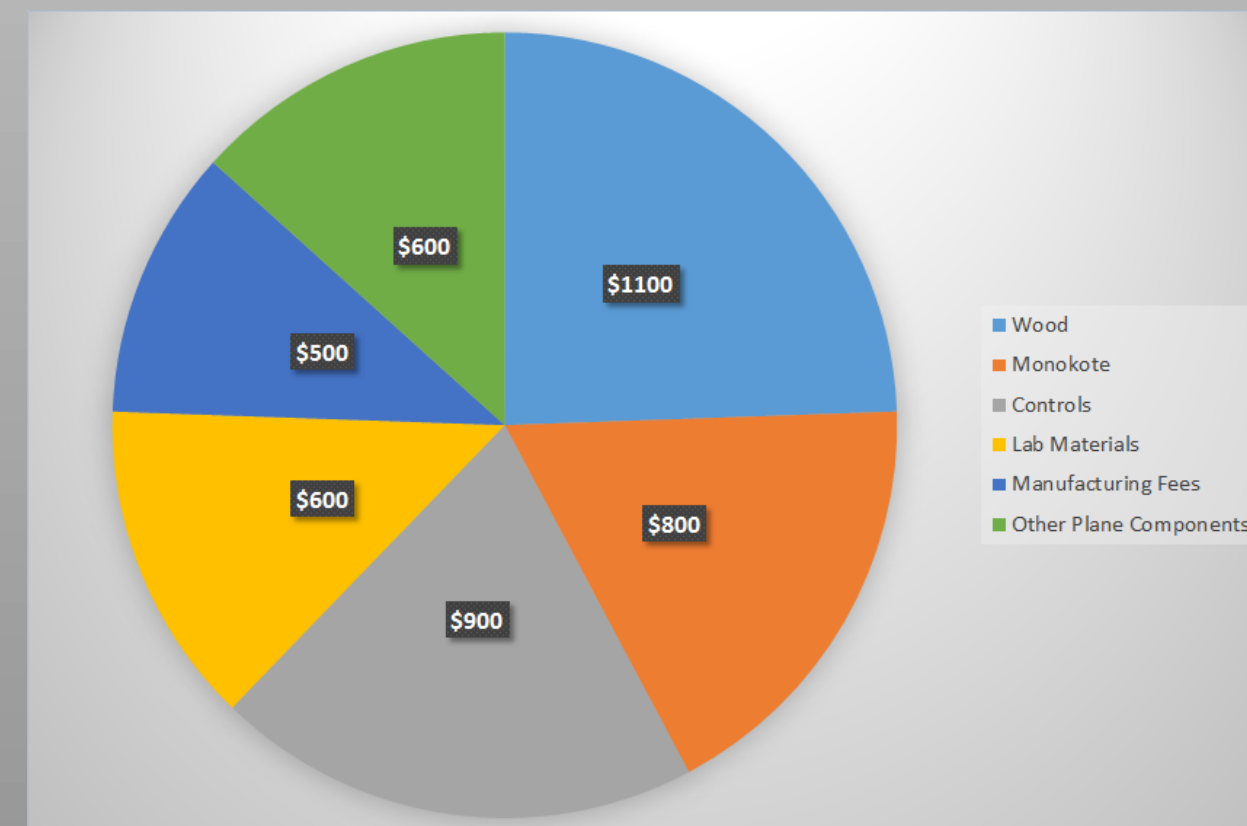
Goal

Engineer a battery powered aircraft capable of flying with a take off weight of 55lbs.

Requirements

- No fiber-reinforced plastic (landing gear & motor mount excepted)
- Single Motor
- 1000 Watt power limiter
- Payload of tennis balls as "passengers" and metal plates as "luggage"

Budget



Team Breakdown

Tyler Gorman
 Brandon Ialenti
 Luyao Zhao
 Jesus Martinez
 Anthony Colin
 Gabriela Arevalo
 Pedro Salcedo
 Julian Elizarraras
 Victor Cabanas
 Vu Nguyen
 Joseph Rivera
 Ernesto Peralta
 Tyler Rasmussen

Team Lead
 Wing
 Wing
 Wing
 Wing
 Tail
 Tail
 Tail
 Fuselage
 Fuselage
 Fuselage
 Fuselage
 Motor, Controls

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Wing

- Rectangular planform for ease of manufacturing
- 12.1 ft span and 1.73 ft chord
- Eppler 423 airfoil for high lift at low speed
- High wing configuration for better stability
- High strength, light weight Aluminum Alloy 6061-T6 spars with balsa ribs, stringers and leading edge reinforcement
- Monokote wing surface wrap

Tail

- Conventional empennage configuration
- Symmetric NACA 0012 airfoil
- Volume coefficient parameters are $V_h=0.7$ and $V_v=0.04$
- Horizontal tail with 5.46 ft span and 1.36 ft chord
- Vertical tail with 1.64 ft span and 1.82 ft chord

Controls

- Remote Controlled
- Ailerons, Elevator, and Rudders controlled by servos
- Servos: small motors that move flight control systems



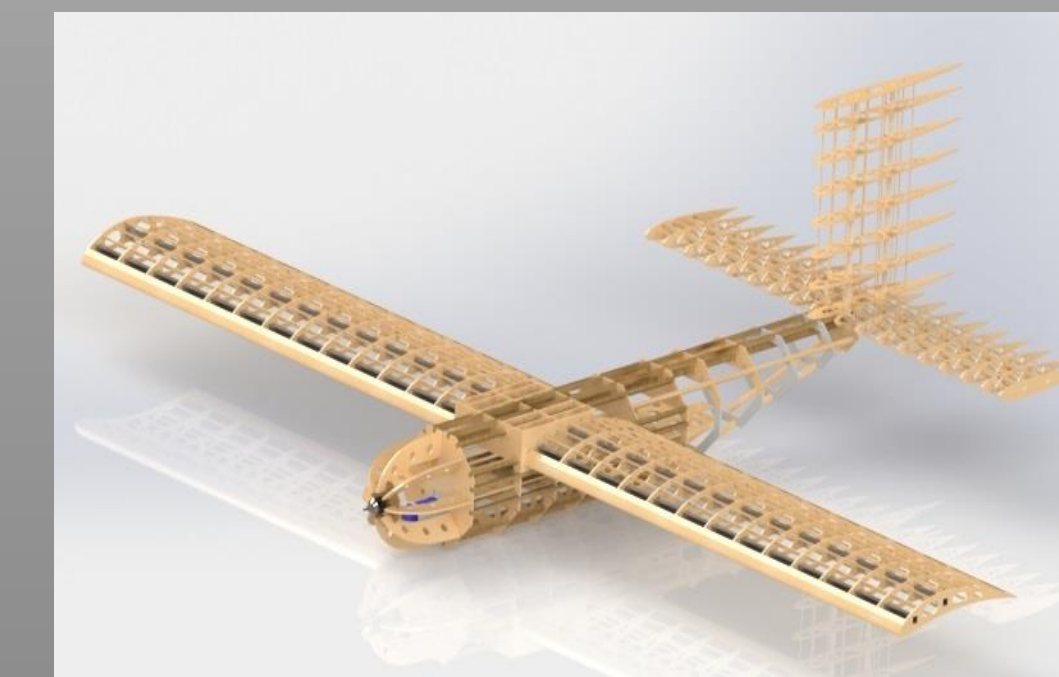
Fuselage

- 76" x 12" x 12" full scale dimensions
- Birch plywood, poplar, and balsa bulkheads
- Fully loaded fuselage weighs 40lbs
 - A total of 56 passengers (tennis balls) are held in a single deck
 - Passengers' luggage weighs 28lbs and is kept below the lower passenger deck, similar to a commercial aircraft
- Laser cut using RapidTech and Fabworks facilities
- Aluminum rod/boom connects fuselage to tail
- The CG of the entire plane is found near the landing gear placement, one quarter chord of the wings



Landing Gear

- Tricycle (nose gear) Arrangement
- Main gear, 18" x 5" x 8" aluminum 6061-T6, fixed to fuselage
- Nose gear: high tensile music wire, 6061-T6 aluminum and aircraft quality 4130 alloy steel tubing
- 3" Tires: Threaded lightweight tires



Fall

- Wing Design
- Fuselage Design
- Tail Design
- Dimension Balancing



Winter

- Model Testing
- Manufacturing Component Assembly



Spring

- Assembly
- Plane Testing
- Final Report