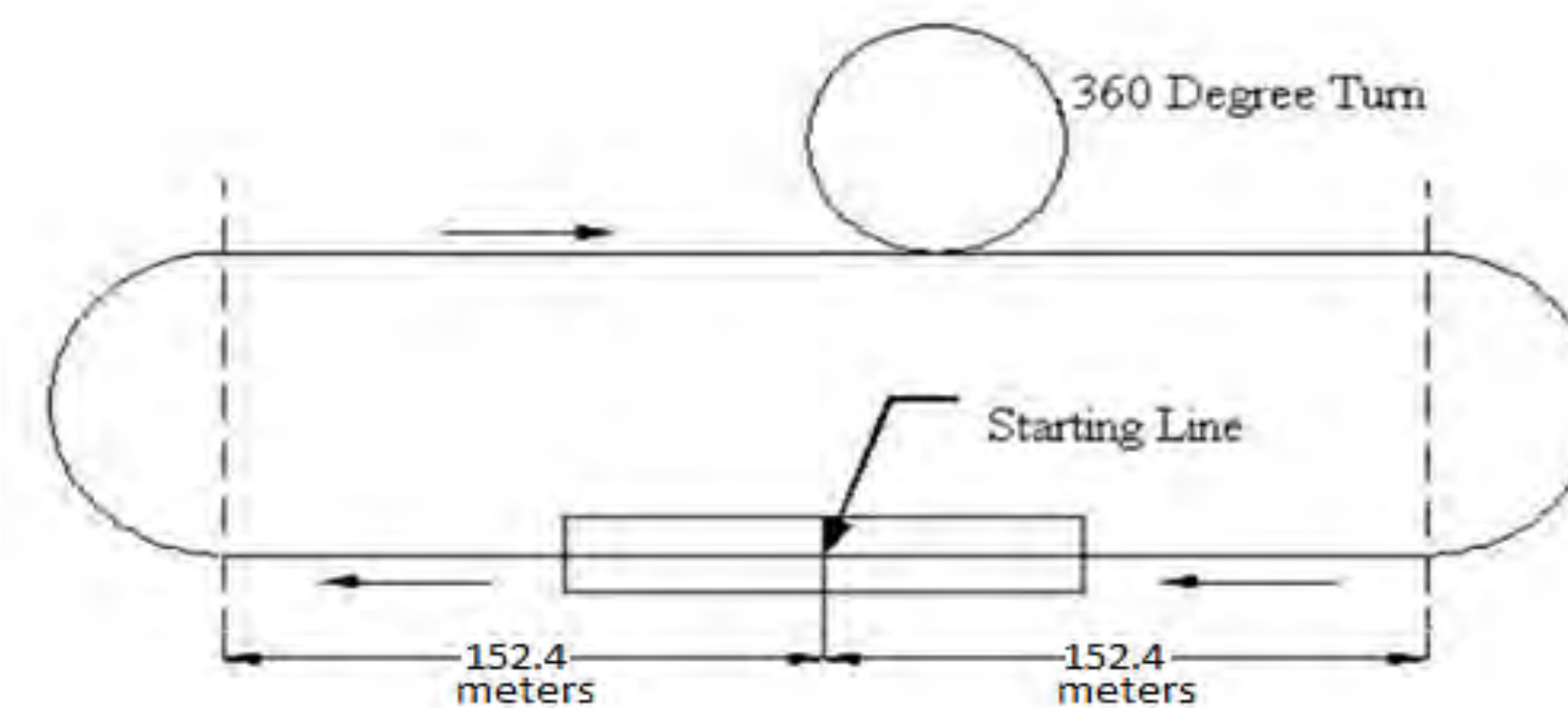


Abstract

The goal of the AIAA DBF 2019-2020 team is to build and iterate an airplane that annihilates the opposition in the AIAA DBF competition in April of 2020. The airplane would have scored as many points as possible by effectively and efficiently completing all missions laid out by the DBF 2020 Rules. The objective for the 2020 DBF competition is to design, build, and test a banner-towing, charter aircraft. To build the most effective plane, subcomponent concepts for the plane must be chosen. These subcomponents include fuselage, wings, restraint system, landing gear, propeller, motor, and battery. After the components are chosen, detailed analysis of each component will be completed to ensure that the optimal design has been chosen for the plane. The overall budget for the aircraft is \$3,200.

Customer Needs and Requirements

- The aircraft must take off in 6.1 meters (Missions 1 & 3)
- The aircraft must carry as many passengers as possible (Mission 2)
- The aircraft must deploy, tow (up to 10 min), and release a banner with minimum length of 25 cm while in flight (Mission 3)
- Maximum allowable wingspan is 152 cm
- The aircraft must fly the path below for the competition
- The aircraft must complete 3 laps in 5 minutes (Missions 1 & 2)



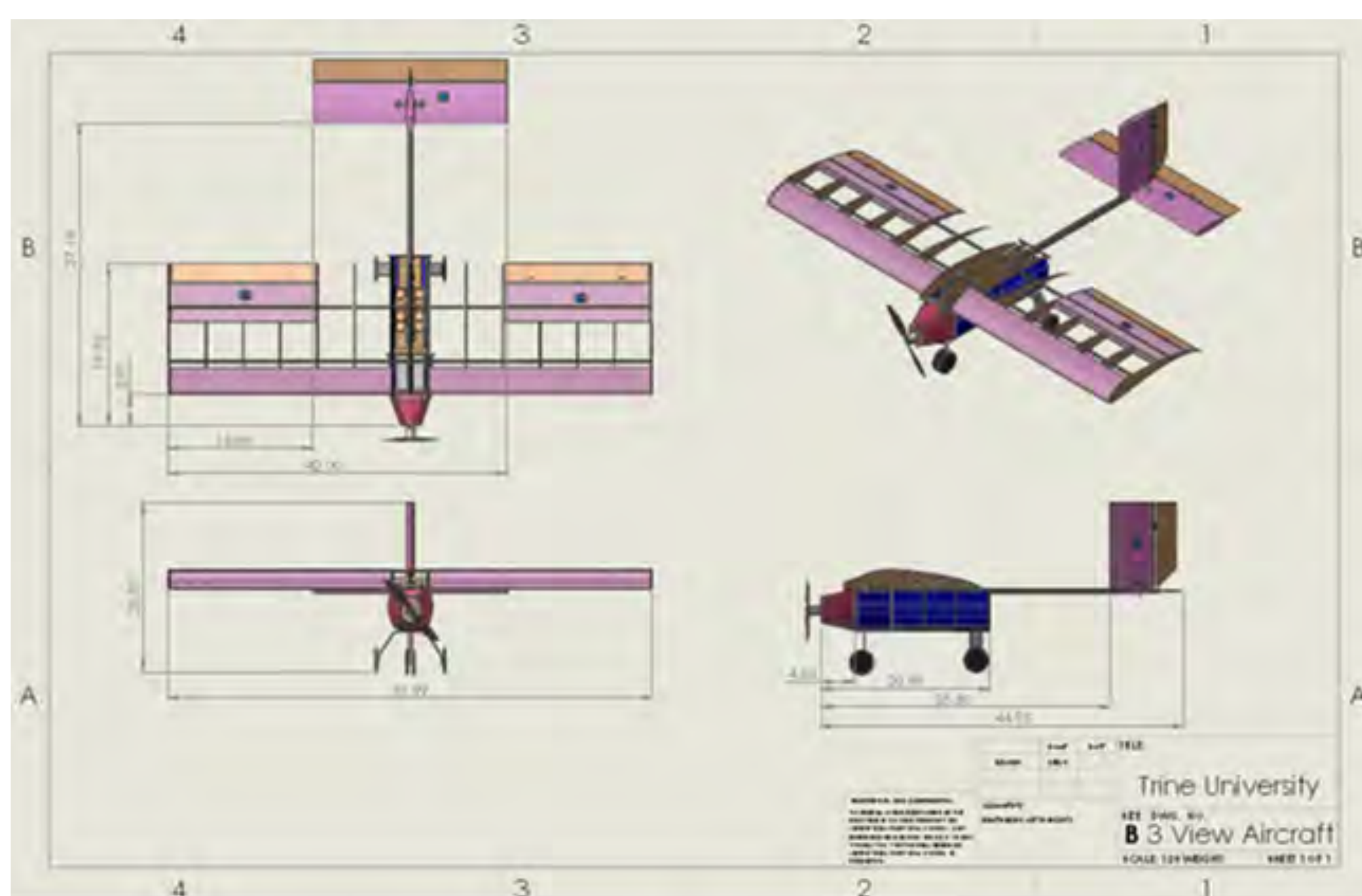
Concept Selection



- Tricycle configuration chosen for landing gear
- Conventional tail chosen for the tail design
- Velcro strap chosen for passenger/luggage restraint system
- Claw mechanism chosen for banner deployment mechanism
- At3520 Motor chosen for propulsion system

Design Solution

Design was based on plane sizing guide from M. H. Sadraey's Aircraft Design Textbook.



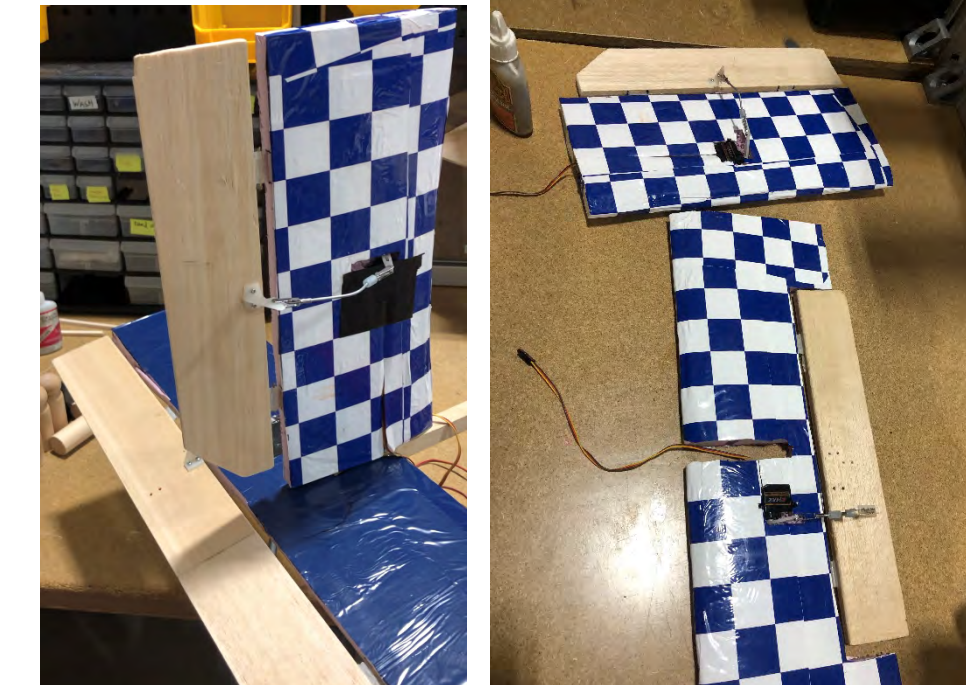
Manufacturing

Wing



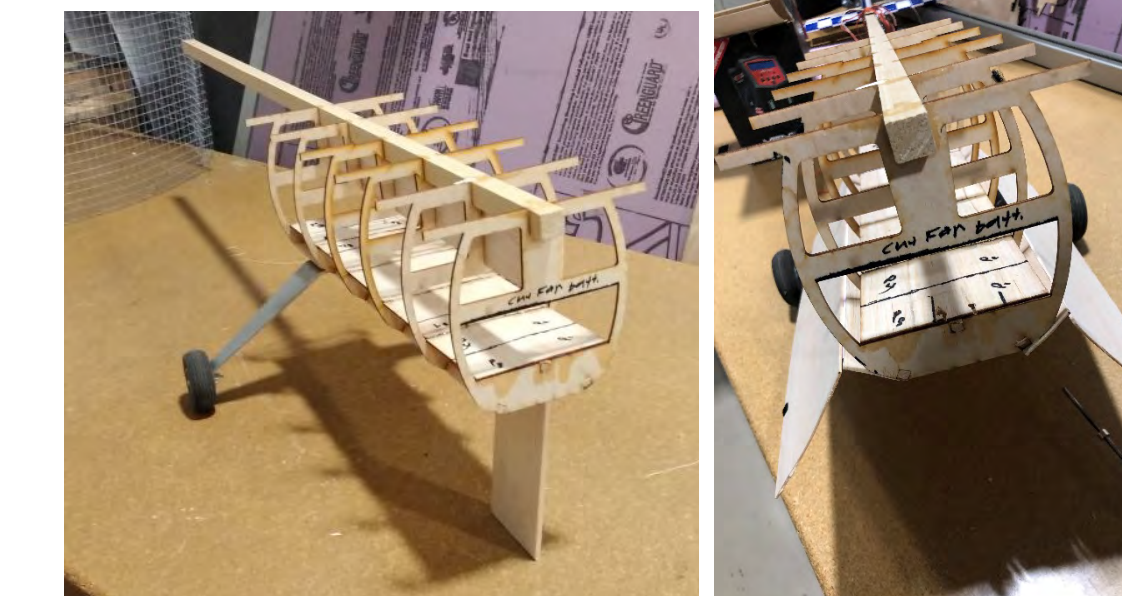
- Foam Leading Edge for applying Monokote
- Ailerons to control roll
- Balsa ribs with basswood spars

Tail



- Carbon Fiber L-brackets to connect tail to boom
- Balsa control surfaces connected with hinges

Fuselage



- Plywood cross-sections lined up
- Balsa sheets glued to cross sections



- Final Plane Design

Testing and Validation

Test 1:

- Wing Tip Test
- Simulates Competition Structural Test
- Plane is held by both end of wing
- Plane must not fracture to complete wing tip test

Test 2:

- First Flight Test
- Gathered data for takeoff distance
- Takeoff distance was approximately 4.9 meters, satisfying the takeoff requirement.

Test 3:

- Second Flight Test
- Tried to test plane maneuverability
- Due to elevator issue, plane suffered a crash shown below

Test 4:

- Final Flight Test
- Tested plane endurance and speed
- Plane flew for approximately 3 minutes at 55 ft/s before batteries needed charged



Acknowledgments

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