

Overview

The objective for this year's competition was to design and build an RC plane that satisfied the 2024 Design, Build, Fly rules. The competition consisted of designing a medical transport aircraft to operate in an urban environment. The airplane had to transport medical personnel and a weighted medical cabinet, be quickly reconfigured to transport passengers, and capable of stable flight. The plane's capabilities were demonstrated over the course of three flight missions and one ground mission, each with different test parameters and requirements.

Flight Missions

Mission 1 - Proof of Flight: Complete three laps and land successfully. Full points are earned for completing the mission.

Mission 2 - Medical Transport: Fly three laps as quickly as possible with a medical cabinet and patient. The score is determined using mission time and medical cabinet weight.

Mission 3 - Passenger Transport: Fly with as many passengers as possible and complete as many laps as possible in five minutes. Score is calculated using number of passengers carried, laps flown, and battery capacity.

Ground Mission: Fold/unfold the wings and load/unload all payload configurations as quickly as possible. The score was calculated using the total time needed to configure the plane.

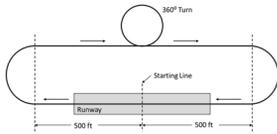


Figure 1: Flight Path



Figure 2: Medical Cabinet and Patient (left) and Passenger Cassettes (right)



Figure 3: Folded Wings

Design Description

The design of the plane primarily focused on optimizing the medical cabinet weight for Mission 2, number of passengers and laps for Mission 3 while meeting the competition requirements. This resulted in a plane with a high payload capacity and high thrust. The plane's aerodynamics were determined using MachUp4 and XFOLL. In addition, the aircraft had the following aspects:

- 5 ft. XPS/fiberglass wings
- "Avenger" style folding wings
- Retractable tricycle landing gear
- 6.5 ft. balsa wood fuselage
- Single two blade 18x10 in. propeller
- E-Flite Power 90 Brushless Motor
- 3300mAh 8S 70C LiPo Battery
- Mechanically locking cargo doors

"The Silverbolt"



Figure 4: "Silverbolt"

Performance Review

The aircraft's aerodynamics simulated using Unreal Engine 5 and the first Vehicle prototype. SolidWorks FEA, a wing tip test, and a second prototype were utilized to evaluate the wing and fuselage structure. Both prototypes were enabled with multiple sensors to measure in-flight

performance. The propulsion system was tested using a thrust test stand to evaluate forces and currents at varying throttle speeds to determine the optimum propeller/throttle combination. The design can complete all the competition missions, completing the Ground Mission in 5 min 45 sec, Mission 2 with a 5 lbs. medical cabinet averaging 45 sec per lap, and completing 7 laps with 60 passengers in five minutes

| Dynamic Modes | Value | Handling Quality |
|---------------|---------------------|------------------|
| Short Period | $\zeta = 0.81$ | Level 1 |
| | $\omega = 14.96$ | |
| Phugoid | $\zeta = 0.073$ | Level 1 |
| | $\tau = 0.06$ | |
| Dutch-Roll | $\zeta = 0.26$ | Level 1 |
| | $\omega = 8.73$ | |
| Spiral | $t_{double} = 5.34$ | Level 3 |

Figure 5: Dynamic Modes

Competition Constraints

Aircraft Constraints:

- 5 ft. maximum wingspan
- The plane must take off within 20 ft.
- Must fit inside a parking spot 2.5 ft. feet wide
- Maximum of 100 W-h and 100 amps fuse must be used

Payload Constraints:

- Must use provided wooden 3.5 in. dolls as passengers, medical staff, and crew. A 5.5 in. doll must be used for the patient
- Passengers and medical cabinet must be securely restrained without touching and upright and perpendicular to the floor

Conclusion

The final plane met all of the design requirements for 2024 Design, Build, Fly competition, placing 22nd out of 107 competitors. Additionally, through the design process, the team developed skills in aircraft design, manufacturing, time management, and budgeting. With these new skills, the team believes that the current design could be improved by further implementing weight reduction tactics and improving the weight-to-thrust ratio. Overall, the team is satisfied with the performance of the plane and is grateful for the learning opportunities presented throughout the project.

Acknowledgements & The Senior Team

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Figure 6: Competition Team