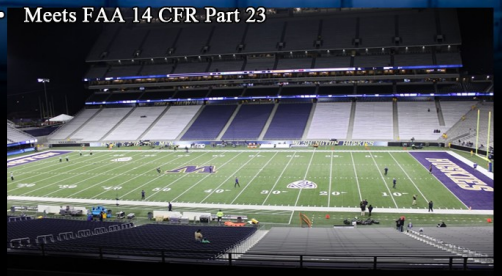
Hybrid Electric STOL Air Taxi

Introduction

- Problem Statement
  - Current regional air travel is inconvenient and inefficient.
  - A new, hybrid-electric aircraft with strict runway requirements is to be developed to remedy these challenges.
- Motivation and Background
  - Transportation has been a driving force in growing metropolitan areas and connecting people.

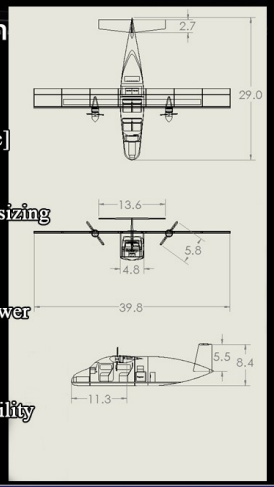
Product Requirements

- STOL: 300ft runway with 50ft vertical obstacle at both ends
- Cruise speed of 150 knots (170 knots preferred)
- Hybrid electric propulsion with tech available in 2028
- 400 nmi range plus 45 minute reserve
- 3 passengers + 1 pilot
- 15 minute turn-around time between missions of 50 nmi
- Meets FAA 14 CFR Part 23



Design Approach

- Weight approximation using Roskam's rapid weight sizing method[c]
- Trade studies vs. other aircraft to adjust body sizing
- In depth performance review for takeoff, landing, cruise, and power characteristics
- Digital DATCOM to finalize sizing and stability of aircraft

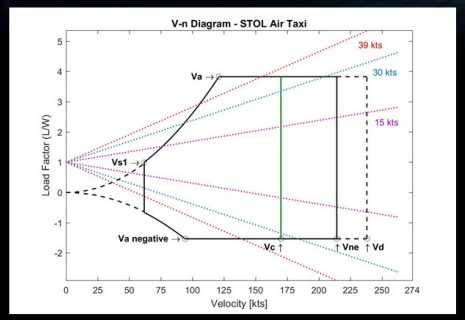


Key Specifications

- Wing
  - Span: 40ft
  - Chord: 4.0ft
- Horizontal Tail
  - AR: 6.0
- Vertical Tail
  - AR: 1.68
- Length: 28.9ft
- MTOW: 3953 lbs
- Ground roll: 224 ft
  - Takeoff gradient: 33°
- Power: 241 hp
- Flight Time: 3 hr 17 min
- Top-mounted wing
- Fixed, tricycle landing gear
- Unpressurized cabin

Aerodynamics and Flight Mechanics

- Stall Speed : 35 knots
- Cruise Speed : 170 knots
- Range : 450 nmi (including reserves)
- Max Lift Coefficient of 3.4 using high lift slats and fowler flaps
- Takeoff and landing achieved in 300 feet at max weight



Power Systems and Propulsion

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- Takeoff and landing achieved in 300 feet at max weight
- Stall Speed : 35 knots
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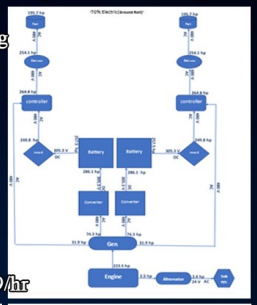
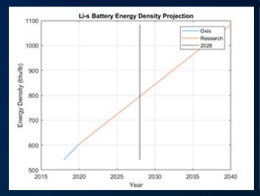
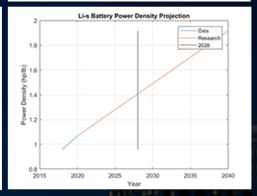
- Range : 450 nmi (including reserves)

Key Specifications

- 241 hp turboshaft engine
- Projected technology available in 2028
- Lithium Sulfur Battery
  - Battery power density = 1.41 hp/lb = 2.32 kW/kg
  - Battery energy density =795.53 btu/lb = 514 Wh/kg
  - Voltage: 305V
  - Maximum current: 630A
  - Cycles: 1500 (until 80% capacity)
  - 100% battery energy utilization
- Fuel cost: $96/hr
  - Cessna 182 [a]: $60/hr
  - Airbus AS350 [b]: $209/hr





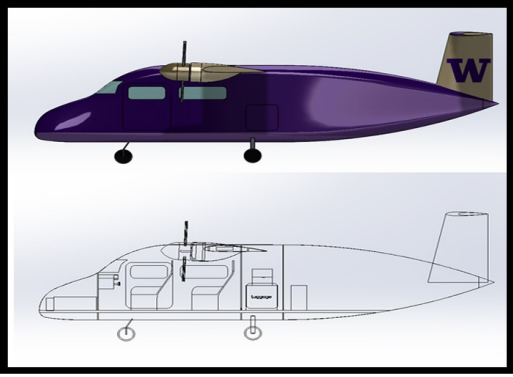


Key Specifications

Working between other groups to maintain design continuity:

- Power Systems - Volume integration of components inside fuselage.
- Aero/Flight - Ensuring design has correct wing surfaces and external geometry.
- Stability - Calculating and maintaining CG of plane and allocating space for control surfaces.

Generally, maintaining CAD model and keeping it up to date with the input from the other groups.



Completed Work

- Design approach trade studies
- Overall aircraft characterized and sized
  - Flight parameters
  - Aircraft performance and stability
  - Propulsion architecture
  - High-level design
- Analysis of flight cost and fuel consumption completed

Future Work

- Detailed component design required to build prototype
  - Minutiae of power system and subsystem electronics
  - Actuator design
  - Advanced structure optimization
- UAS demonstrator
  - Flight testing
- Study on passenger comfort during steep climbs and descents

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Citations

[a] CESSNA 182: THEN AND NOW FLYING A 182 FROM OREGON TO CALIFORNIA. (2008, March 1). Retrieved May 29, 2018

[b] Chase, M. (2016, February 1). Helicopter Comparison: Airbus AS350-B3 versus Bell 206L-4. Retrieved May 29, 2018

[c] Roskam, J. (1986). Rapid sizing method for airplanes. Journal of Aircraft,23(7), 554-560.

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