Barrelborne: A Wing-In-Ground-Effect RC Vehicle

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Objectives

Design, build, and test a remote-controlled (RC) Wing-In-Ground-Effect (WIG) vehicle capable of stable flight in ground effect (GE). Gather experimental flight data to evaluate and verify the efficiency advantage of GE flight over conventional out-of-ground-effect (OGE) flight. Prove ground effect is the aerodynamic benefit a wing experiences when flying within about one chord length of the ground for lift benefits and one span length of the ground for drag benefits: the ground interferes with downwash, weakens wingtip vortices, reduces induced drag, and increases lift at the same angle of attack (AoA).

Final Aircraft Specifications

Performance:
Stall Velocity: 34 mph
GE Cruise Speed: 45 mph
OGE Cruise Speed: 70 mph
Takeoff Velocity: 37 mph

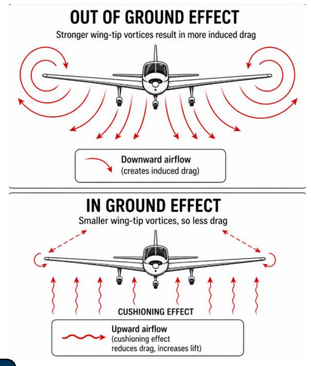
Weight & Balance
Final Weight: 20.025 lbs
CG Location: 17.11 in (from nose)
Center of Pressure: 18.0 in
Static Margin: 7.42%

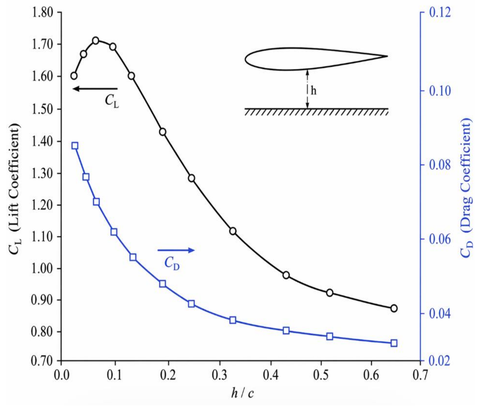
Range & Endurance
GE Range: 53 mi / 70 min
OGE Range: 12 mi / 10 min

Size and Geometry
Wingspan: 5.4 ft
Chord: 12 in / Aspect Ratio: 5.4
Wing Area: 5.4 ft^2
Horizontal Stabilizer Area: 1.2 ft^2
Vertical Stabilizer Area: 0.7 ft^2
Outboard Anhedral Angle: 15°

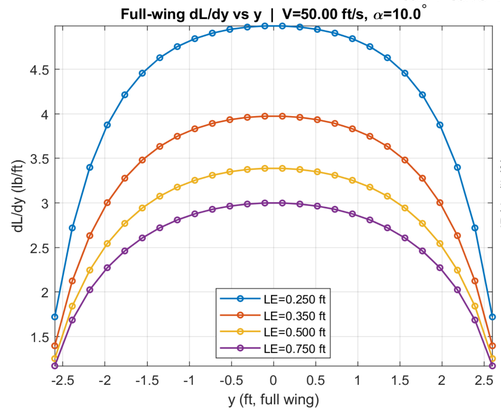
Design Features
Wing Airfoil: FX 63-137
Horizontal and Vertical Stabilizer Airfoil: NACA 0012
Structure: 3D Printed ABS (10% gyroid infill)
Propulsion: 4× Brotherhobby T5 3115

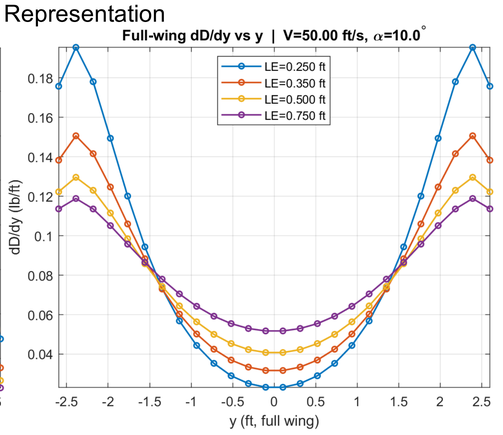
Ground Effect Analysis



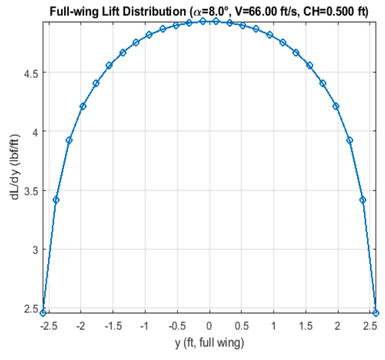


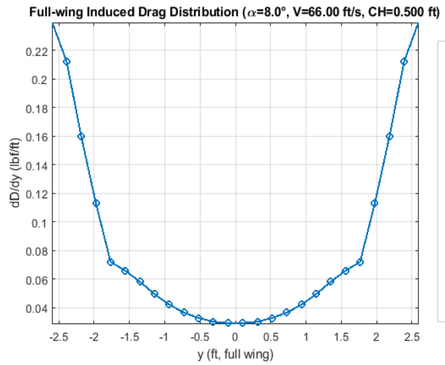
Flat Plate Representation

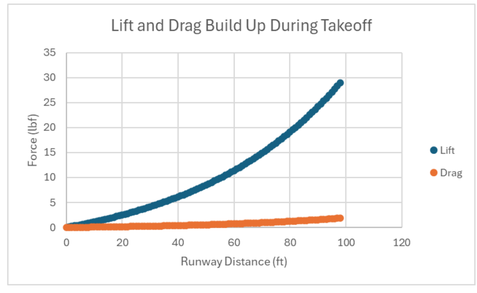


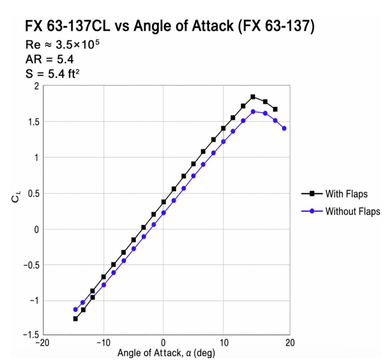


Lift & Drag Analysis

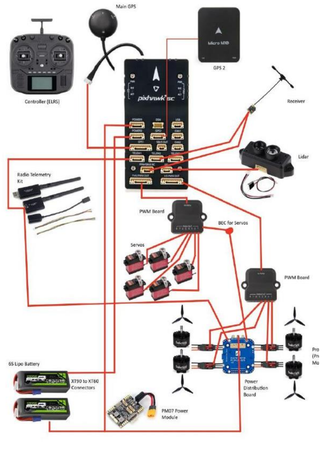


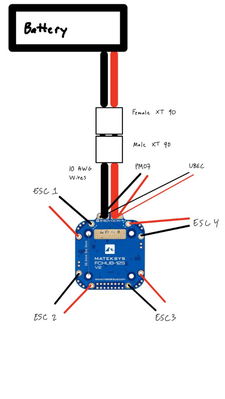




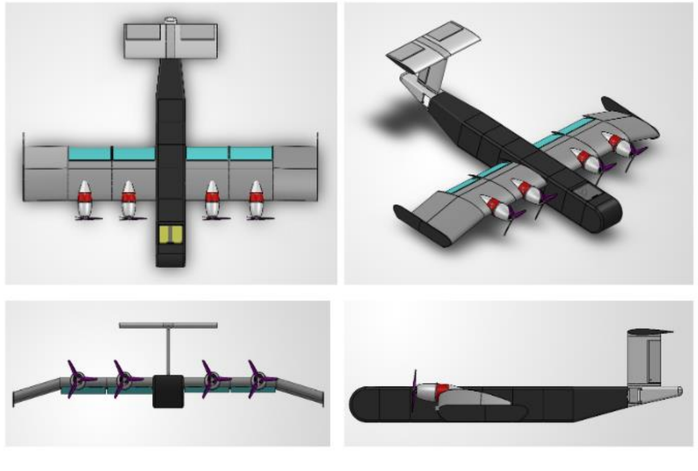


Avionics & Wiring

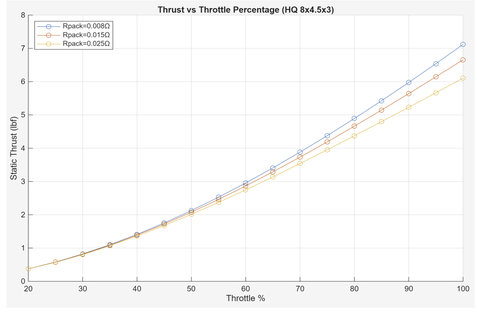


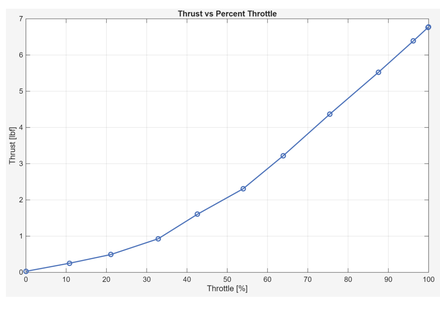


Final Airframe & Build



Bench Test Results





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