Team Update #5

TEAM NAME: ***Trailblazer 119***
SECTION: 003
TF MENTOR: Max Balasubramaniam

Boost-Ascent Phase Sub-Team

- Zach Zen (PM)
- Jared Steffen
- Donovan Gavito
- Nathan Whittenburg

Glide Phase Sub-Team

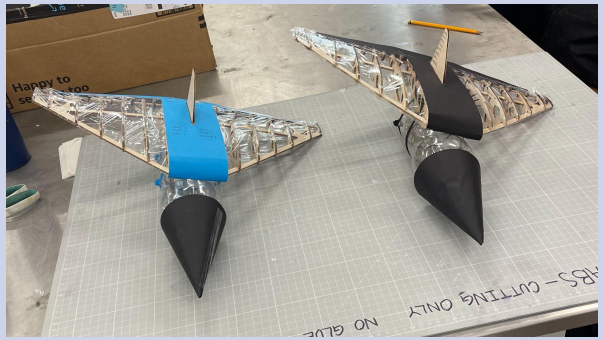
- Brady Sivey (PM)
- Joshua Greeting
- Gage Boothroyd
- Jack Jol

Project Status Overview (For Phase 2 – 4)

Design Status & Requirements

Current Design

- **Configuration:**



- **Key Propulsion Parameters:**
  - Theoretical Mach Cone Size
  - Initial Water Volume
  - Launch Angle 85 degrees
- **Key Aerodynamics Parameters:**
  - Swept/Delta Wing
  - Blunt Nose Cone
  - Max Wing Wetted Area
- **Key Stability & Control Parameters:**
  - High-Mounted Delta Wing
  - Sufficiently Sized Vertical Tail
  - Elevon position stability
- **Weight Parameters:**
  - Launch Weight: 580g
  - Empty / Glide Weight: 180g

Req. #	Requirement	Status
1	Performance Requirements	
1.1	Glide Range (Ground range measured **post-apogee**)	
2	Static Stability & Control Requirements	
2.1	Static Margin	
2.1.1	Horizontal Tail Volume Coefficient (VH)	
2.1.2	Trimmable at different useable CLs	
2.2	Directional / Weathervane Stability	
2.2.1	Vertical Tail Volume Coefficient (Vv)	
2.3	Roll Stability	
3	Geometric / Payload Requirements	
3.1	Mach Cone Restriction (During Boost-Ascent Phase)	
3.3	Payload	
3.4	Launch pad integration	
4	Structural Requirements	
4.1	Wing Stiffness / Strength	
4.2	Control Surface Stiffness / Strength (Including any tail / empennage structure)	
4.3	Pressure Vessel Integrity (No Leaks / Damage)	

Project Management

Schedule

- Tasks Assigned-Working
  - Preliminary Design Review
- Tasks Completed
  - Vehicle boost testing
  - Vehicle glide testing

Budget & Resources

- Budget & Procurement
  - Total: $40
  - Actual
    - Spent: $38.31
    - Remaining: $1.69
  - Supply Chain Issues: N/A
- Training Issues
  - N/A
- Facilities / Equipment Issues: N/A

Current Design Detailed Discussion (Used for Phase 2-4)

- Boost-Ascent Sub-Team
  - Sum of moments analysis indicated there would be a heavy vertical pitch moment on launch due to the weight of the top mounted wing shifting the Center of Mass above the direction of thrust. Some rough calculations were performed to estimate a counter trim angle for the elevon to ensure vertical launch.
    - On launch this trim angle successfully allowed a vertical boost. However the dowel for the elevon got twisted and caused a spinning motion which fortunately assisted with stability on ascent.
    - It reached a height of 15.2 meters with ~400mL of water and 40 psi.
  - Due to the impact of landing nose first, the wing was irreparably damaged and no further testing could be performed.
  - With a higher pressure and slight adjustment of the elevon we believe a much more acceptable height could have been achieved.

- Glide Sub-Team
  - The glide testing started off very poorly. The aircraft seemed to have zero lateral directional stability and did a spiral nose dive into a bush below.
    - It only reached 9.1 meters
  - The team decided to create a much bigger tail with cardstock paper.
    - This gave the glider more lateral stability.
    - The glider reached 16.7 meters and flew in a much more straight path.
  - Glider weight was an issue as the glider was too light and was easily swept away by wind.
  - We felt that if given more time to perfect the glider weight and throwing velocity, we could have gotten a much better glide.
    - The glider was too structurally damaged too continue.

Detailed Requirements Status (Used for Phase 2-4)

Req. #	Requirement	Threshold	Objective	Current Design Status & Issues
1	Performance Requirements			
1.1	Glide Range (Ground range measured **post-apogee**)	120 m	MAX	Complete.
2	Static Stability & Control Requirements	Natural Static Stability		Complete.
2.1	Static Margin	0.1-0.3	0.15	Complete. Evaluated to be 0.27.
2.1.1	Horizontal Tail Volume Coefficient (VH)	VH = 0.3	VH = 0.6	N/A - Delta Wing Design, Elevons
2.1.2	Trimmable at different useable CLs			Complete.
2.2	Directional / Weathervane Stability			Complete.
2.2.1	Vertical Tail Volume Coefficient (Vv)	Vv = 0.02	Vv = 0.05	Complete, had to be resized during testing.
2.3	Roll Stability	Natural Static Stability		Complete.
3	Geometric / Payload Requirements			Complete.
3.1	Mach Cone Restriction (During Boost-Ascent Phase)	M = 1.5	M = 2.0	Kept within M = 2.0. Complete.
3.3	Payload	Meet volume & security requirements	-	Complete.
3.4	Launch pad integration	Pass Fit Test, Non-pressurized / pressurized (2 min)		Complete.
4	Structural Requirements	Survive multiple launch iterations / glide iterations		Minimized weight lead to weak internal structures
4.1	Wing Stiffness / Strength	Pass Wingtip Lift / Deflection Test (Elastic behavior, no fractures or damage (30 sec).		Wings were strong towards aerodynamic and lifting forces, but weak to impacts. Mounting points in particular.
4.2	Control Surface Stiffness / Strength (Including any tail / empennage structure)	Pass Wind Flutter Test (30 sec)		Brakes added to Elevon to ensure proper control surface stiffness. Complete.
4.3	Pressure Vessel Integrity (No Leaks / Damage)	Pass Pressurization Test (2 min)		Complete.

Schedule Detailed Discussions (Working Copy)

Work Breakdown (Phases and Tasks)

Start	End	Duration	Label
4/3/2023	5/4/2023	31	Phase 4: Preliminary Design
4/4/2023	4/13/2023	9	Prototype Testing and Adjustment
4/14/2023	4/23/2023	9	Prototype Test Analysis / PDR Prep
4/24/2023	5/4/2023	10	PDR Presentations Window
			Insert new rows above this one

Upcoming Team Meetings

Date	Meeting Purpose
4/18/2023	Post Flight Analysis Discussion
4/25/2023	PDR Wrap up and Review: Assign speaking topics

- Post Flight analysis in progress, team as a whole is preparing for PDR Presentations and breaking down design characteristics noted during testing.
- Team will be using LoggerPro for video analysis for boost phase and numerous angles for video analysis for glide phase.

Budget and Resources Detailed Discussion

- Budget Details
  - (2) 1.25 L Bottles purchased at $1.44 per bottle with one acting as a spare. An additional
  - (1) Sheet of 36” * 6” * ⅛” balsa purchased from hobby lobby for initial prototyping. $5.99 per sheet. Expecting to need at least 2 to complete prototyping.
  - $10 spent on industrial cling wrap.
  - $5.86 spent on adhesives for wood and cling wrap.
  - $10 spent on Bass wood to reinforce wing structure.
  - (1) $0.79 Cardstock purchased for nose cone and wing top surfacing.
  - (2) $0.39 Dowels purchased for Elevon axle.
- Resource Details
  - Glowforge and 3d Printers used to fabricate the wing. Precision cuts allowed for friction fit moveable parts and well balanced symmetric structure.
  - Having access to a shop outside of campus allowed for construction of prototypes in a much more available schedule as the campus shop was often busy or closed.