AEM 313 MEMO

Subject: Aerodynamics I Aircraft Project Grading

TO: AEM 313 **Date:** 4 Jan 2017

CC: **Memo:** AEM313-Proj-Grading

From: Charles O'Neill

REF: **Ext:** 8-5161

Summary:

This discusses the grading rubric used for the project report. The competition results are given in a results section.

Discussion:

Your memo consisted of two parts: a summary and a discussion. The summary is worth 20 points. The objective of this summary is for someone not versed in the project to spend 15-20 seconds to become completely familiar with your aircraft. Specifics are:

- Is there a short description of the objective and constrains? Payload, wood size.
- Are the aircraft configuration and dimensions explicitly stated? Span, AR, etc.
- Did you discuss the operating point? Cl or V.
- Did you mention flight test results and modifications?
- Did you include a photo?
- Was the summary too long?

The Discussion section is worth 30 points. The objective is to discuss in detail your process and decisions used in the development of your glider. You colleagues should be able to reproduce your aircraft and development process based on your writings. Specifics are:

- Did you discuss the objective and constraints in more detail?
- Did you evaluate multiple methods and configurations for feasibility? Example: is a ballistic "launch" of just the quarters better than an aircraft. How did you arrive at your particular configuration? Did you investigate the energy available in a rubber band? Did you investigate powered flight?
- Did you discuss the physics of gliding flight? Did you find examples of existing solutions for inspiration?
- Did you create an engineering (numerical) model of the competition? (Yes, we did this in class.)
- Did you investigate airfoils versus Re? XFOIL? Wind-tunnel?

- Did you identify the key design variables (Remember Pareto's law: 80% of results from 20% of actions). Was your analysis focused on the 20%? Wild goose chases?
- Did you show figures comparing L/D to Cl and AR?
- Once you picked a configuration (based on your engineering model), did you refine the model based on flight test results and higher-fidelity weight and drag estimates?
- Did you perform flight tests, document the results, and improve your design based on your observations?
- Did you exactly specify your aircraft's specifications and geometry sufficient for your instructor or a colleague to reproduce your aircraft?
- Were reported values clear? Engineering nomenclature? Overall feel of project?

The project report average was an 81%.

Results

The competition was held on the 1st of December in the SRC south gym. Two teams flew the maximum distance (135 feet diagonal). The winning team's glider was constructed by Kristen Bobo and Avery Carrico and flew at a **non-zero** altitude for the entire 135 foot journey. 211 flights were scored. Overall distance and rankings are given in Figure 1.

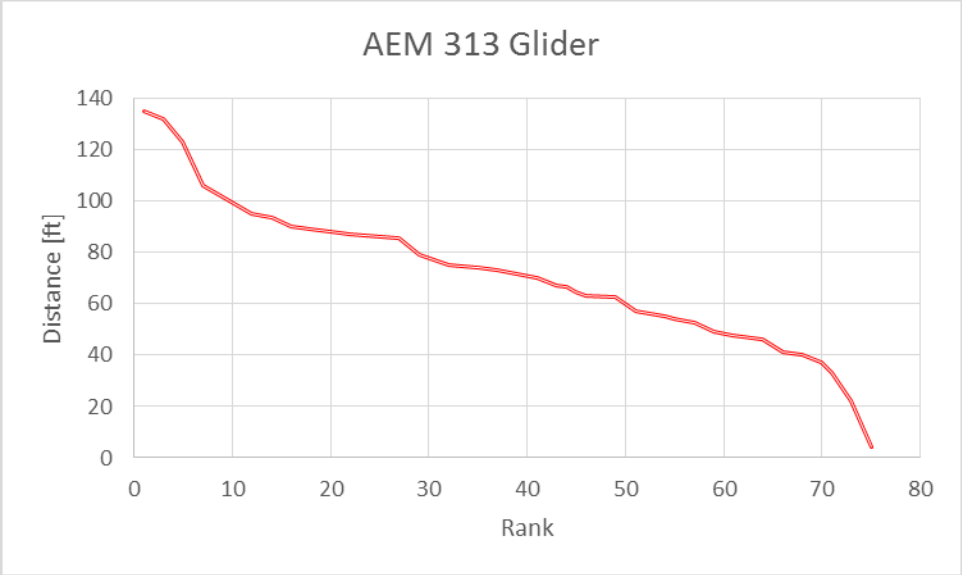
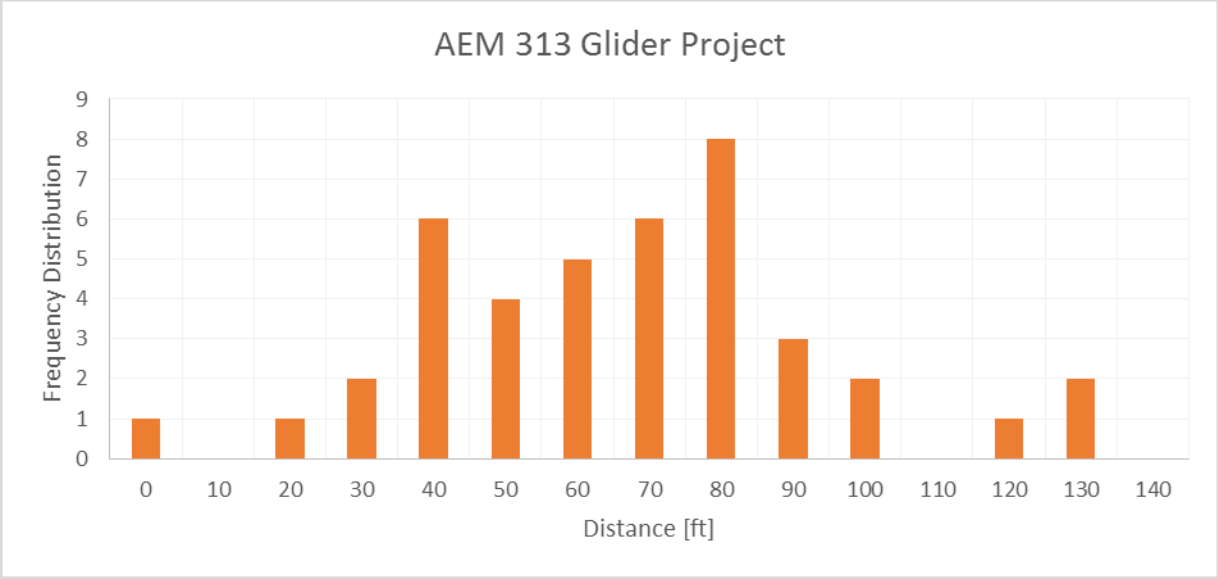


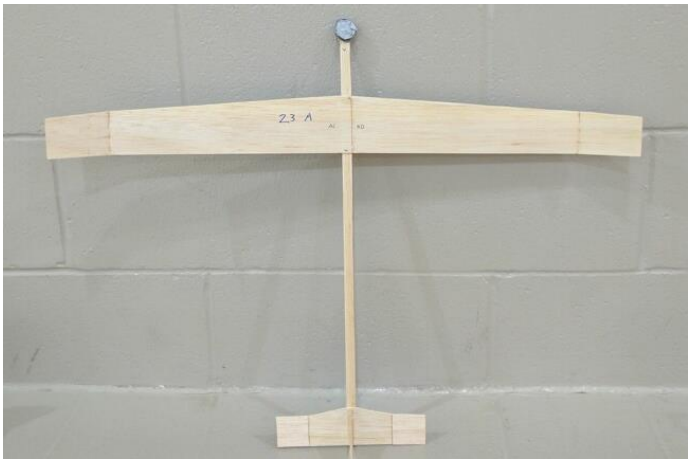
Figure 1: Distance Ranking

Your instructor neglected the impact that the smooth floor would have on the competition, as legally exploited by several teams. Flight distances were measured to the final resting point of the quarters (except in cases where the gliders structurally failed). Your instructor's gliders were identically those shown in class, except that both were repaired after a small child crushed them. The instructor reference distance was 89 feet. The average graded distance was 71 feet. The average flight distance was 61 feet; most teams significantly improved their distance through multiple flights.



The winning glider, 23A, is shown below. This aircraft required an additional horizontal tail area added during the competition for pitch stability.

- Total Span: 30in
- Winglets: 3in each
- Fuselage: 20in
- Root chord: 3in
- Tip chord: 2in
- Tail length: 7.5in
- Tail root width: 2in
- Tail tip width: 1.5in
- Tail height: 2.5 in
- Quarter chord wing to tail: 16.25in



Remarks

This was an interesting competition. Many competitors indicated that this glider competition was particularly useful by combining theoretical and real-world aerodynamics. Your instructor was pleased and discovered several important points for future students and classes.

A couple of teams learned about flutter (aerodynamic-structural dynamics) the hard way. Even your instructor's aircraft exhibited signs of flutter (albeit a limit cycle that was not

destructive, yet **stole** energy and thus distance from the glider). If you didn't have flutter, you are not scared of it yet…. https://youtu.be/OhwLojNerMU

Thank you for quite a semester.

Dr. O'Neill