

**Project 1.2.13 Glider Design: Flight Data**

Introduction

When designing an aircraft or other vehicle for flight, aerospace engineers must test their designs, gather data, analyze the data, and then determine what revisions must be done to the design in order to enhance the design and improve performance.

In this project, you will begin to test your glider and analyze what the data are telling you. Based on the information, you will then determine what revisions you will need to do to your project.

Equipment

* Engineering notebook
* AERY Glider Design Software printout of plans for your custom glider design
* Wood to Construct Glider
* Glue
* Modeling Clay
* Glider Catapult
* Measuring Tape
* Stopwatch
* Project 1.2.14b Glider Design: Competitive Flights Rubric

Procedure

1. Construct a glider using the plans developed in the previous project.
2. All flight test data should be collected under the same conditions as will be experienced in the competitive flights. Use the same catapult, facility, tape measures and stopwatches, etc.
3. Prior to the first test flights, be certain to estimate the point value of your design and construction. Use the Project 1.2.14b Glider Design: Competitive Flights Rubric as a guide for assigning point values to the glider’s attributes.
4. Flight tests should include at least two trials prior to making adjustments to the glider. The exception to this rule is when a test flight results in flight characteristics that may cause irreparable harm to the glider.
5. For each test flight, record appropriate data and estimate the point value of the flight.
6. After each test flight series, make adjustments to the glider to improve flight performance.
7. Record all flight data and complete the analysis for the three competitive flights.

|  |
| --- |
| **Glider Design: Flight Data Recording Form** |

|  |  |  |  |
| --- | --- | --- | --- |
| Team Number |  | Team Member 1 |  |
|  |  | Team Member 2 |  |
|  |  | Team Member 3 |  |

**Summary Data: Glider Design and Construction**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Aerodynamic Characteristics | | |  | *Enter a rubric score* |
|  | Main Wing and Stabilizer (shape, symmetry, alignment) | | |  |
|  | Leading and Trailing Edges (rounding, taper, straight) | | |  |
|  | Angles of Incidence (match to plans) | | |  |
|  |  | 2/3 are 4's (Bonus of 1) | |  |
|  |  | 2/3 are 5's (Bonus of 2) | |  |
|  |  |  |  |  |
| Appearance and Durability | | |  | *Enter a rubric score* |
|  | Construction (neatness, accuracy, gaps) | | |  |
|  | Decorations (neatness, creativity, appropriateness) | | |  |
|  | Durability (due to construction quality) | | |  |
|  |  | 2/3 are 4's (Bonus of 1) | |  |
|  |  | 2/3 are 5's (Bonus of 2) | |  |
|  |  |  |  |  |
|  |  | **Sub-Total:** (34 possible) | |  |
|  |  |  |  |  |

**Individual Event Data: Flight Performance**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Flight | Time Aloft (seconds) | Distance (feet) | Velocity (feet/second) | Pitch Stability | Directional Stability |
|  | 1 | 5.2 | 21 | 4.03 | Nose down slightly | Veered 1.5 feet to the right |
|  | 2 |  |  |  |  |  |
|  | 3 |  |  |  |  |  |
|  | 4 |  |  |  |  |  |
|  | 5 |  |  |  |  |  |
|  | 6 |  |  |  |  |  |
|  | 7 |  |  |  |  |  |
|  | 8 |  |  |  |  |  |
|  | 9 |  |  |  |  |  |
|  | 10 |  |  |  |  |  |
|  | 11 |  |  |  |  |  |
|  | 12 |  |  |  |  |  |
|  | 13 |  |  |  |  |  |
|  | 14 |  |  |  |  |  |
|  | 15 |  |  |  |  |  |
|  | 16 |  |  |  |  |  |
|  | 17 |  |  |  |  |  |
|  | 18 |  |  |  |  |  |
|  | 19 |  |  |  |  |  |
|  | 20 |  |  |  |  |  |
|  | 21 |  |  |  |  |  |
|  | 22 |  |  |  |  |  |
|  | 23 |  |  |  |  |  |
|  | 24 |  |  |  |  |  |
|  | 25 |  |  |  |  |  |

**Competition Data: Flight Performance**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flight Number | Distance (feet) | Pitch Stability | Directional Stability |
|  | 1 |  |  |  |
|  | 2 |  |  |  |
|  | 3 |  |  |  |
|  |  |  |  |  |
|  |  | *Ave Distance* | *Ave Pitch* | *Ave Directional* |
|  |  |  |  |  |
|  |  |  |  |  |
| Flight Characteristics | |  |  | *Enter a rubric score* |
|  | Distance (Straight line, <24', 24-36', >36') | | |  |
|  | Pitch Stability (Uniform descent, gentle pitching, drastic) | | |  |
|  | Directional Stability (Straight, gentle turn, sharp curve) | | |  |
|  |  | 2/3 are 4's (Bonus of 1) | |  |
|  |  | 2/3 are 5's (Bonus of 2) | |  |
|  |  |  |  |  |
|  |  | Total Score:(17 Possible) | |  |
|  |  |  |  |  |

Conclusion

1. Was the glider as stable as you expected? Why or why not might this be so?
2. What techniques did you use to “trim” the glider for straight and gently descending flight?
3. How many test flights were required to get the glider trimmed for long distance, straight-line flight? Was this expected? Why or why not?



**Project 1.2.14b Glider Design: Competitive Flights Rubric**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Category | 5 Points | 4 Points | 3 Points | 2-0 Points | Score |
| Safety | Safety issues identified; possible solutions addressed | Issues identified but minimally addressed. | Issues identified but not addressed. | Missing. |  |
| Aerodynamic Characteristics | Main wing and stabilizers are shaped correctly and symmetrically and are aligned.  Glider has uniformly rounded leading edges and tapering trailing edges.  Angles of incidences closely match with plans. | Main wing and stabilizers are correct in size, shape and placement.  Leading and trailing edges are smooth and straight.  Angles of incidences are slightly off the plans. | Main wing and stabilizers are incorrect size, shape or placement.  Leading and trailing edges are rough or uneven.  Angles of incidences are incorrect. | Little resemblance to the AREY design. |  |
| Appearance and Durability | Glider is neatly and accurately constructed with joints that are seamless.  Decorations are neat, creative, and attractive.  Glider can withstand casual impacts with little or no damage. | Glider is neatly and accurately constructed but with small gaps and imperfections in joints.  Decorations are appropriate.  Glider suffers damage on casual impact due to material failure, not construction error. | Glider in inaccurate with significant or multiple gaps or flaws.  Decorations are inappropriate or unattractive.  Glider suffers damage easily or due to construction errors. | Glider construction shows little attention to quality. |  |
| Flight Characteristics | Flight path   1. Exceeds 36 feet in distance. 2. Slopes uniformly downward without changes in pitch. 3. Is level in a uniform straight line without changes in yaw. | Flight path:   1. Exceeds 24 feet in distance. 2. Rises or sinks gently (pitch). 3. Curves gently left or right (yaw). | Flight path:   1. Is less than 24 feet in distance. 2. Rises or sinks dramatically (pitch). 3. Curves sharply left or right (yaw). | Glider did not launch or structurally failed during flight. |  |
|  |  |  |  | Total Score |  |