INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Department of Aerospace Engineering

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AE 153 – Introduction to Aerospace Engineering
AE 705 – Introduction to Flight

Assignment - II
GLIDER DESIGN COMPETITION

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INTRODUCTION

The aim of this project is to design two gliders: one that has a good range (accurately hitting a pillar at a distance of about 15 meters) and another that has considerable endurance (freely gliding for a considerable amount of time).
The objectives of this project include:

a) learning the design process of a glider,

b) the practical understanding of parameters such as range and endurance that determine the performance of flight

This report provides background information regarding the design of the glider.

DESIGN

SCHEDULE OF ACTIVITIES:

- Finalizing Design specifications.
- Fabrication of parts.
- Glider design and performance calculations.
- Assemblage and alterations of parts (if required).
- Test Flights.

At the moment of developing this report, we have finalized the design specifications and are fabricating the gliders as explained in the following sections.

DESIGN CONCEPTS CHOSEN

The following materials are used in the fabrication of parts:

a) Balsa wood (sticks)
b) Depron foam sheets
c) Glue gun
d) Glue and glue sticks
e) Cutter
f) Emery paper
g) Rubber band
h) Clay for CG balance

GLIDER FOR RANGE

We have used Depron foam sheets for the wing and empennage since it is denser and stronger compared to balsa wood, hence averting damage.

The glider specifications are as follows:

a. Span 600mm
b. Fuselage Span 340 mm
c. Horizontal Stabilizer Span 150 mm
d. Vertical Stabilizer Height 75 mm
e. Dihedral Angle 15º
f. Multi-hedral angle 45º

Figure 1: Glider for Range

Figure 1: The wing

The fuselage has been made with a bulk head such that the center of gravity lies in front of the aerodynamic center leading to longitudinal stability.
A rubber band mechanism is used to attach the wing to the fuselage rather than attaching it directly to the fuselage. This prevents direct and sudden impact to the wing while landing, hence reducing the amount of damage on the glider.
If a glider with level wings banks at an angle, one wing will be at a positive angle of attack and other one at a negative angle of attack, thereby making the glider more prone to further rolling. Hence, for lateral static stability (for better range), the wings are set to a dihedral angle of 15º.

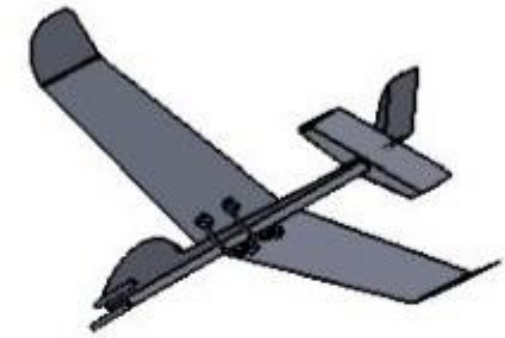

Figure 2: Glider for Range - Isometric View

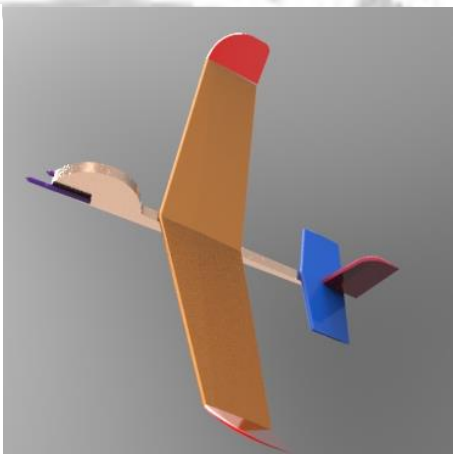

Figure 3: Glider for Range: Design 1

Rigid objects have been used at the fuselage as the bulk head instead of clay since the latter would deteriorate with friction against the ground during landing. It also acts as a damper, hence preventing damage to the structure. Given below is an assembly drawing that represents the glider for maximum range.

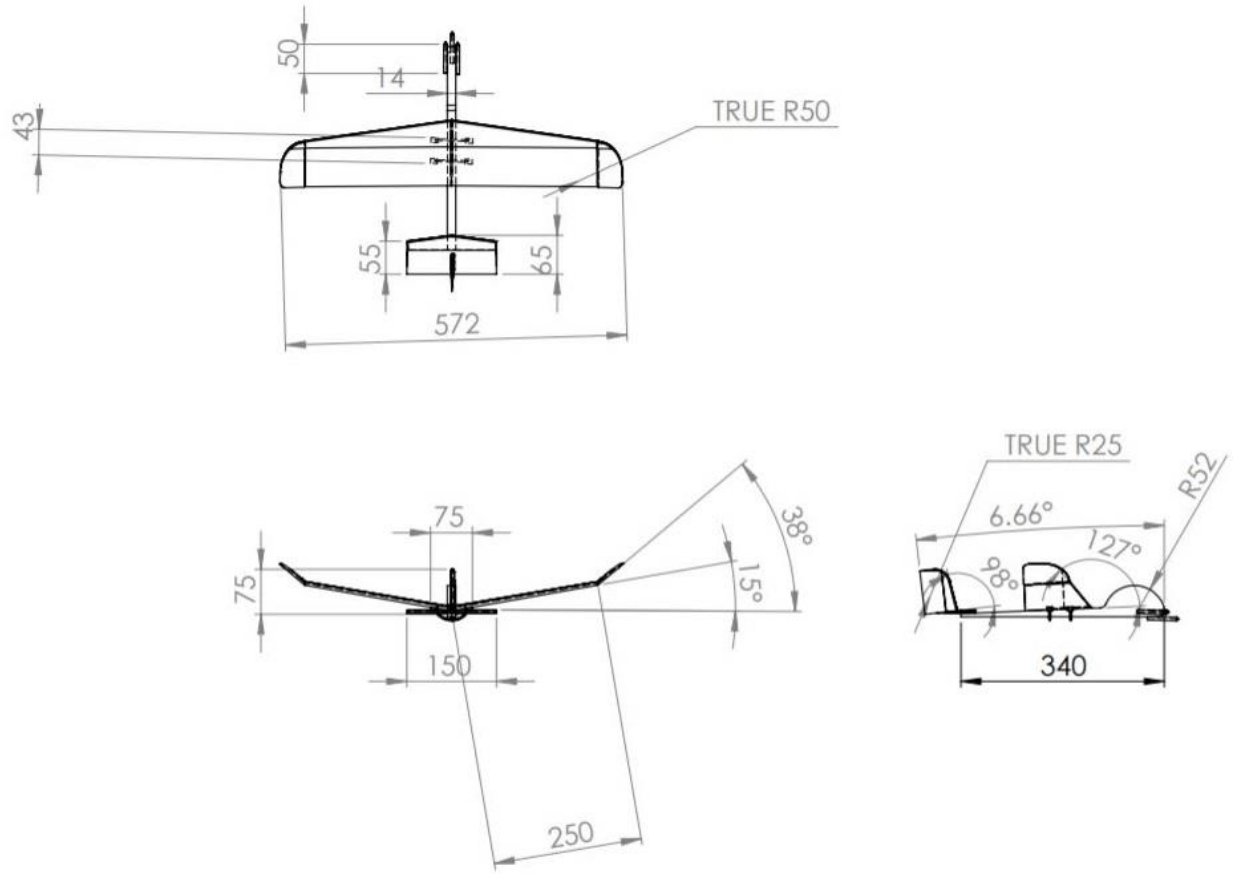

Figure 4: Glider for Range - Top, Front, Side Views

Given here is a video that records a trial with the glider for maximum range:
https://www.youtube.com/watch?v=xmdnIqhsia4

GLIDER FOR ENDURANCE

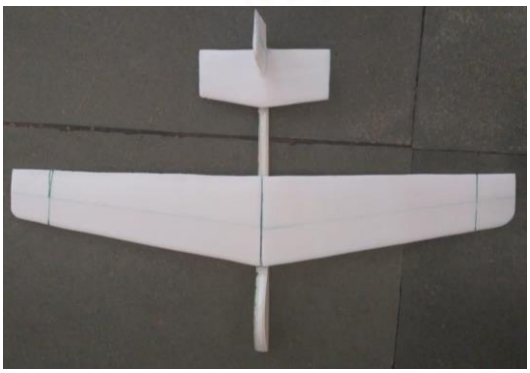

Figure 6: Glider for Endurance

The glider specifications are as follows:

a) Wing Span 70 cm
b) Fuselage Span 34 cm
c) Horizontal Stabilizer Span 20 cm
d) Vertical Stabilizer Height 10 cm
e) Dihedral Angle 0º

Wing span has been considerably increased to generate more lift, hence sustaining flight for a larger period for the given fuselage span. The vertical stabilizer is kept at an incident angle with respect to longitudinal axis to achieve considerable yaw. Endurance is further achieved with a short period mode (longitudinal mode) in the initial phase followed by a Dutch roll (instability caused by coupling rolling and yawing moments). These have been demonstrated in the test videos.

Given here is a video that records a trial with the glider for maximum endurance: https://www.youtube.com/watch?v=lUrRm3Skqlw

ALTERNATE DESIGNS

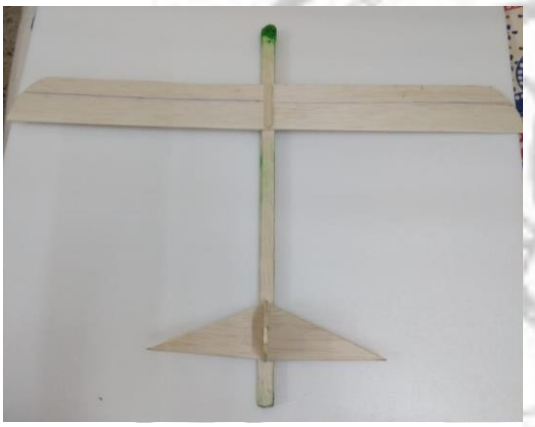

Figure 5: Glider for Range

We have developed a glider for maximum range using balsa wood which was modified and developed using stronger foam sheets for the wings and fins in later iterations.

Given here is a glider design adopted from the Internet. Our designs remain almost identical despite a number of variations in the parameters.

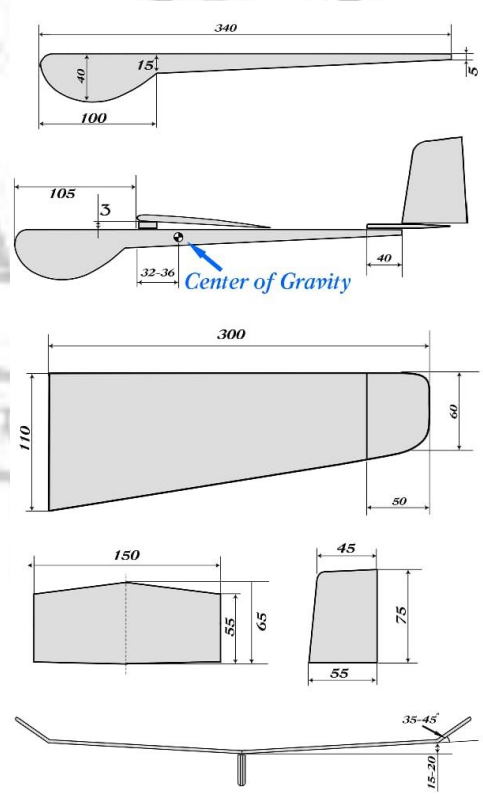

Figure 6: Glider for Endurance

CONCLUSION

The team has developed two gliders – one for maximum straight-line range and the other for air-borne endurance. Apart from the photographs taken, the videos also serve the purpose of confirming the work done. The future scope of the project involves preparing a stable glider superior in the required properties with respect to the gliders created until now.

REFERENCES

- https://www.instructables.com/id/Balsa-Wood-Glider/
- https://mirror.yandex.ru/mirrors/ftp.flightgear.org/docs/www.4p8.com/eric.brasseur/glider2.html
- students.iitk.ac.in/aeromodelling/downloads/glider.pdf
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