Structural Design Course

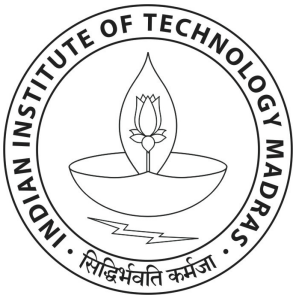
A Report

submitted by

X GROUP

as part of the course

AS 5220: STRUCTURAL DESIGN



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ABSTRACT OF THE PROJECT

The objective of this airplane design is to build an aircraft capable of carrying a payload much greater than its structural weight. The mission profile includes take-off, a 360 degree turn and landing on the same airplance strip.

So far the wing design has been completed and is undergoing fabrication.

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ABBREVIATIONS AND NOTATIONS

$2D$	Two dimensional
$3D$	Three dimensional
α	angle of attack
b	wing span

CHAPTER 1

INTRODUCTION

This introduction chapter summarizes the main aerodynamic features of our airplane and the cost estimate to construct it.

1.1 MISSION REQUIREMENTS

The objective of this airplane design is to build an aircraft capable of carrying a payload much greater than its structural weight. The mission profile includes take-off, a 360 degree turn and landing on the same airplance strip as Fig 1 shows.

1.2 CONFIGURATION CHOICE

Following are the salient features of the configuration considered:

- The airplane is a monoplane due to ease of construction and need for lesser thrust to counter induced drag.
- High wing of aspect ratio 8 was chosen because of stability considerations. Also, most of the similar airplanes have a high wing configuration.
- Airfoil was chosen to be S1223 because of its high lift characterestics, deep camber and thin wing. It is also highly suitable for low speed flights

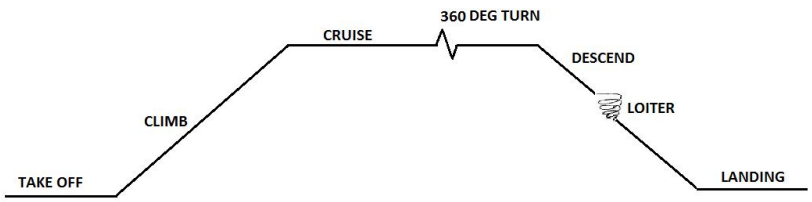


Figure 1.1: Mission Profile

Table 1.1: Details of the aircrafts available in literature.

Brief description	Overall Weight (kg)	Wing Span (m)	Aspect Ratio	Weight fractions		
				Pay load	Power plant	Structural
X1	a_1	b_1	c_1	d_1	e_1	f_1
X2	a_2	b_2	c_2	d_2	e_2	f_2
X3	a_3	b_3	c_3	d_3	e_3	f_3

- No wing sweep or taper was chosen due to ease of construction and the fact that our airplane wing operates only in the low speed regime
- A conventional tail was chosen as it provides adequate stability and control and is easier to construct than other complex tail configurations

1.3 SUMMARY OF WORK DONE AS PART OF THE AERODYNAMIC DESIGN

Brief description accompanied by data/weight estimates and diagrams.

1.3.1 Data Obtained from Literature Survey

Table 1.1 gives the details of existing aircrafts of similar configurations for which data were accessible.

1.3.2 First Weight Estimate

The first weight estimate of the aircraft was done based on data from our literature survey. The first weight estimate comes out to be 1.495 kg.

1.3.3 Second Weight Estimate

The second weight estimate was done by choosing our powerplant by taking data from the chosen airfoil. The chosen powerplant is

- Motor : Avionic C3536 brushless motor (see **?**) Prop : 11x7; 1.3 Kg thrust ;

ESC 30A

- Battery : 3S Lipo; 11.1V 25C, 2200 MaH (see **?**)

Taking into account the powerplant weight, the second weight estimate comes out to be 1.642 kg.

1.3.4 Views of the Designed Airplane

The three view configuration along with the 3D view is outlines in Fig 1.2

1.3.5 V-n Diagram

Figure 1.3 shows the envelope of the final V-n diagram for the chosen aircraft.

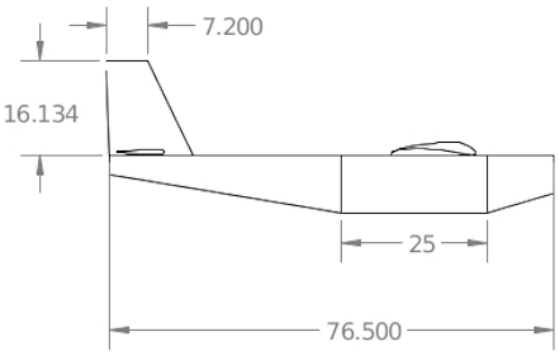
1.3.6 Some performance parameters

A few important performance parameters are highlighted below

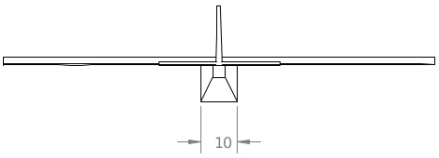
1. Thrust-to-weight ratio : 0.63 (Considering 80% efficiency)
2. Endurance : 4 min
3. Range : 2.4 km
4. Maximum Load Factor : 1.43
5. Take-off distance : 30 m
6. Landing distance : 50 m
7. Climb Angle : 6 deg
8. Wing Loading : 93.342 N/m^2

1.4 BILL OF MATERIALS WITH SUGGESTED VENDORS

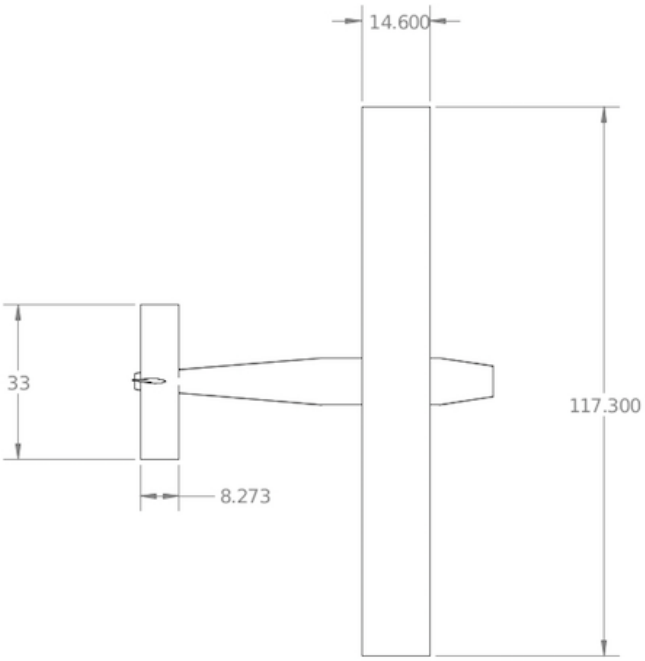
Table 1.2 gives the details of the materials required for fabrication as well as suggested vendors and approximate cost



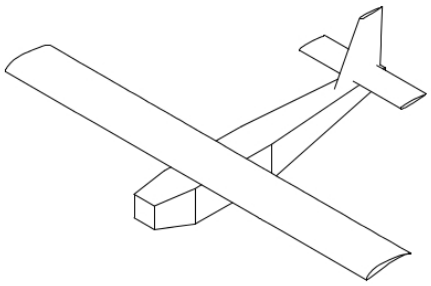
(a) Side View



(b) Front View



(c) Top View



(d) 3D View

Figure 1.2: Three view and isometric view of the airplane

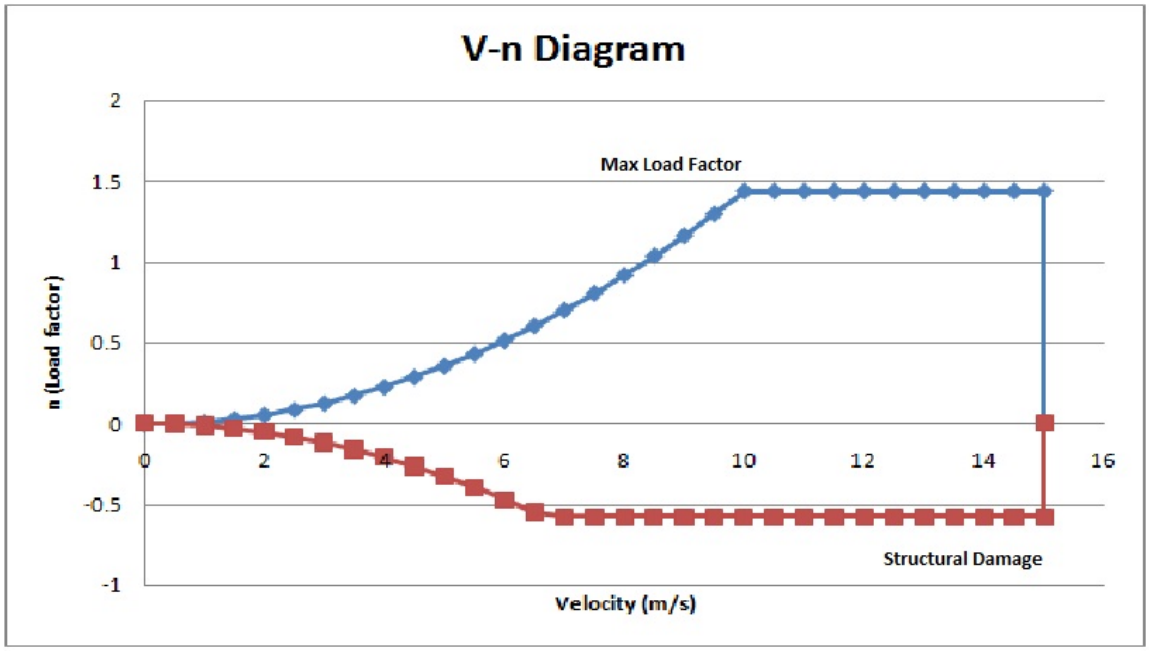


Figure 1.3: Flight envelope: V-n diagram for the given airplane.

Component	Price(Rs)	Suggested Vendor
Motor	1400	See ?
Battery	3395	See ?
Balsa Wood	4000	
Aluminium	1000	
ESC(electronic speed controller)	1000	See ?
Servo motors (4 Nos)	1860	See ?
Propeller 11x7	200	RcBazaar
Miscellaneous	2500	
Total	15400	

Table 1.2: Aircraft cost estimation

REFERENCES

1. Motor Specifications : http://rcbazaar.com/products/2442-avionic-c3536-kv1050-brushless-motor.aspx

2. Battery Specifications : http://www.muav.in/?wpsc-product=battery-lipo-gens-ace-3s-rechargeable-11-1v-25-c-2200-mah

3. ESC : http://www.muav.in/?wpsc-product=esc-rcforall-30-amps

4. Servo : http://www.muav.in/?wpsc-product=hs-55s

5. Airplane entries for the competition organized by SAE International

APPENDIX