DRONE DEVELOPMENT CHALLENGE 2025

DESIGN REPORT

DDC2025080 AEREX

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APPENDIX A - STATEMENT OF COMPLIANCE

SAEISS DRONE DEVELOPMENT CHALLENGE 2025

Certification of Qualification

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Statement of Compliance

As Faculty Advisor:

- I certify that the registered team members are enrolled in collegiate courses.
- I certify that this team has designed, constructed and/or modified the radio-controlled airplane with the intention to use this aircraft in the **SAEISS Drone Development Challenge 2025** competition, without direct assistance from professional engineers, R/C model experts or pilots, or related professionals.
- I certify that this year's Design Report has original content written by members of this year's team.
- I certify that all reused contents have been properly referenced and is in compliance with the University's plagiarism and reuse policies.

Signature of Faculty Advisor	08/03/2025 Date
Signature of Team Captain	08/03/2025 Date

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ABSTRACT

The SAE Drone Development Challenge competition allows teams from many universities to design, build and fly a model aircraft capable of lifting great loads while remaining as light as possible. The purpose of this team was to design a remote-controlled aircraft that will remain light and still be able to lifts heavy payload while staying within the rules and regulations of the SAE Drone Development Challenge guidelines. In order to accomplish this, the aircraft to be designed should be stable, structurally sound using light-weight materials and simple to mend in the case of damage. The following report is a summary of the design process, decisions, analysis, substantiation, and final results of the project. General aircraft parameters were selected through the aircraft design process. The detailed design of the aircraft was modelled using computer aided design software, and the parts were manufactured from balsa wood using the laser-cutting machine.

Keywords: Drone Development, Aircraft, Design process, Payload, Lift

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CHAPTER 1
INTRODUCTION

Team AereX, consisting of 10 students from TKM College of Engineering, shares a common passion for designing UAVs. This design report outlines the various procedures involved in creating the UAV, providing detailed information about the unmanned aerial vehicle developed by Team AereX. The UAV is specifically designed for a particular application, with the design directly complementing its intended purpose. The report covers everything from theoretical discussions, formulas, and methodologies used in the design process to the final conclusions and decisions that shaped the final UAV design. Our focus was on achieving a balanced design for an RC plane that meets the conflicting requirements of maximizing payload fraction while minimizing weight.

Each of the ten team members took on distinct responsibilities to manufacture an aircraft that adhered to all standards and mission specifications. To assist in the design process, we used software tools such as **Fusion 360**, **ANSYS Fluent**, and **XFLR**. Fusion 360 was used to create 3D models, while ANSYS Fluent and XFLR were employed for aerodynamic analysis. The data derived from these simulations helped in selecting the ideal airfoil to maximize lift at low speeds. Following the airfoil selection, we proceeded with designing the wing planform, winglets, empennage, and electronics, each component carefully considered through discussions of their respective advantages and disadvantages. Additionally, various academic journals and research papers were referenced to aid in the design process.

While our early attempts faced challenges, resulting in our pioneers not performing to their full potential, we learned from these setbacks. By reflecting on past mistakes and overcoming the confusion encountered in previous designs, we dedicated our time and efforts to producing an airworthy UAV that met all mission requirements. The following synopsis presents a brief overview of the various aircraft components.

CHAPTER 2

LITERATURE REVIEW

The initial task in our work plan was to understand the concepts and engineering methods involved in designing and operating an aircraft. To achieve this, we consulted a range of publishers, journals, research papers, and other sources. Below are some of the key papers we referred to for our study.

"Airplane Design Part II: Preliminary Configuration Design and Integration of the Propulsion System" by Roskam (1985) provided us with valuable insights into selecting the overall aircraft configuration, choosing fuselage layouts, and integrating the propulsion system. "Aircraft Design: A Conceptual Approach, Sixth Edition" by Raymer (2012) guided us through the process of selecting aerofoils, wing/tail geometry, thrust-to-weight ratios, and wing loading for our project. "Aircraft Design: A Systems Engineering Approach" by Mohammad H. Sadraey (2015) also contributed to our understanding of various design aspects. Additionally, the paper "Empennage Statistics and Sizing Methods for Dorsal Fins" provided useful guidance on the design of the aircraft tail and dorsal fins, including methods for estimating tail parameters. The paper "Wing Design" by Mohammad Sadraey and Daniel Webster (2012) offered critical parameters essential for wing design. Our team also referred to *The International Journal on Aviation, Aeronautics, and Aerospace* for additional guidance.

Through the literature review, we gained valuable knowledge about various aspects of aircraft design, aerodynamic characteristics, and key design parameters. The insights we gathered were instrumental in developing and designing our UAV to meet the specific requirements of the competition.

CHAPTER 3

SELECTION OF OVERALL VEHICLE CONFIGURATION

3.1 WING DESIGN

Wings are essential components of an aircraft, functioning as aerofoils that generate lift when moving through the air. They come in various shapes and sizes, making wing selection a critical step in designing an RC plane. After comparing high, mid, and low wing configurations, we decided to go with a high wing design. This choice was based on its advantages, such as easier take-off and landing, as well as its ability to increase the dihedral effect, which enhances stability.

3.2 FUSELAGE DESIGN

The fuselage is the main body of an aircraft, serving as the central structure to which the wings, control surfaces, and sometimes the propulsion systems are attached. We selected a streamlined fuselage shape to minimize drag. More details about the fuselage can be found in Chapter 6.

3.3 TAIL DESIGN

After analysing various tail designs and considering their advantages and disadvantages, our team decided to go with a conventional tail for our aircraft. A detailed comparison of the different tail types can be found in Chapter 7.

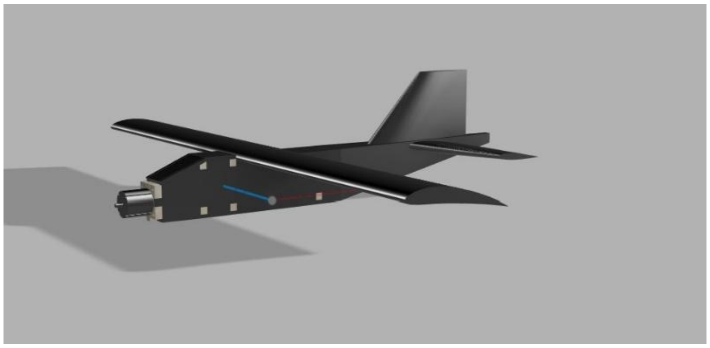


Fig.3.1 Design of the aircraft

CHAPTER 4
WING DESIGN

A crucial step before designing the wing is to identify the desired characteristics that the aircraft should possess so as to achieve the determined flight. In this step, the discernment of the kind of airfoil that should be used is important so as to achieve the formerly said characteristics. The primary requirement of the aircraft was to carry the maximum amount of payload, for that the aircraft should be able to achieve its maximum amount of lift.

4.1 AIRFOIL SELECTION

Airoil selection generally involves compromise between optimal performance, efficiency and a consistent range of operation. Here we have chosen the airfoil NACA 6412 since it has high lift with reduced drag and it is easy to manufacture with laser cutting. The following aerofoils were studied before selection:

Table.4.1 Types of airfoils and its specifications

Sl No	Airfoil	Specifications
1.	NACA 2424	Maximum thickness 24% at 29.03% chord Maximum camber 2% at 39.54% chord
2.	NACA 2412	Maximum thickness 12% at 29.03% chord Maximum camber 2% at 39.54% chord
3.	NACA 2411	Maximum thickness 11% at 29.03% chord Maximum camber 2% at 39.54% chord
4.	NACA 0012	Maximum thickness 12% at 29.03% chord Maximum camber 0.0% at 0.0% chord
5.	NACA 6412	Maximum thickness 12% at 29.03% Maximum chamber 6% at 39.54%

The comparison of aerofoils using xflr5 software generated the subsequent results.

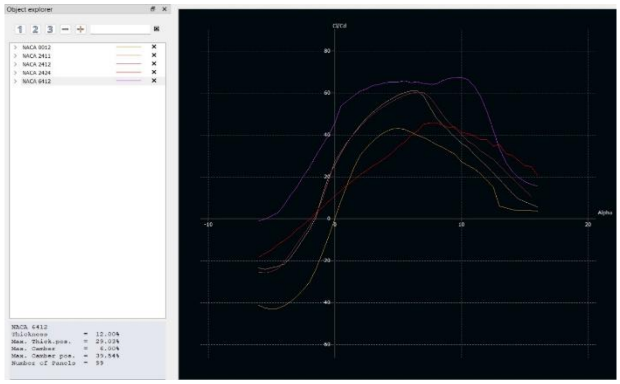


Fig.4.1 Cl / Cd vs α graph

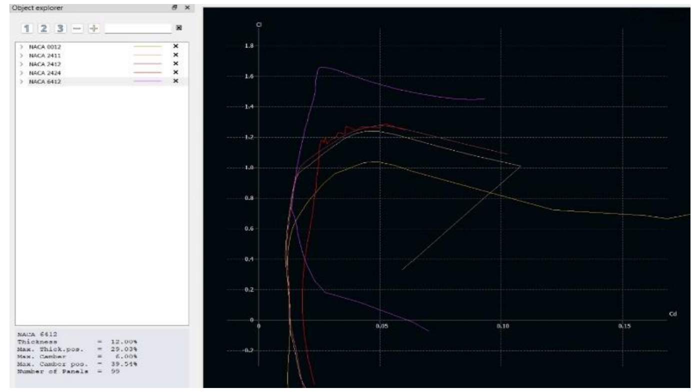


Fig.4.2 Cl vs Cd graph

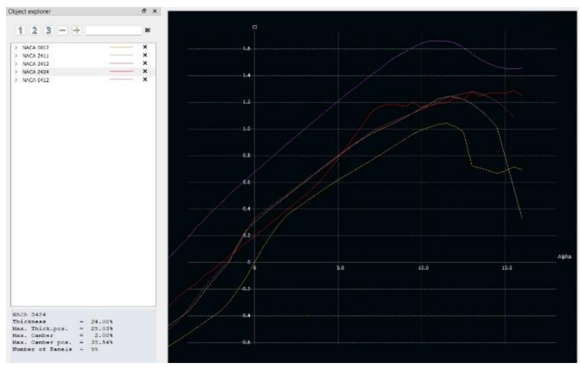


Fig.4.3 Cl vs α graph

4.2 WING MOUNTING STYLE

One of the key decisions made early in the design process is the selection of the wing mounting style, as it significantly influences the aircraft's center of gravity, tail, and landing gear design. The four primary wing mounting types are low wing, mid wing, high wing, and parasol wing. After thorough research, we concluded that a high wing configuration is ideal for our application. The main advantage of this mounting style is its higher ground clearance, which allows the aircraft to belly-land without damaging the props. Additionally, it results in minimal induced drag and offers aerodynamic efficiency.

4.2 WING GEOMETRY

We have selected rectangular wing for our UAV after various group discussions regarding the wing configuration. The calculations for final wing design are given below

Wingspan = 31.49 inch, Aspect ratio = 5.17

Wing area, S= $\frac{b^2}{AR}$; Where b=wingspan=31.49 inch, AR=Aspect Ratio = 5.17

S = $\frac{(31.49^2)}{5.17}$ = 191.80 inch^2

For the calculation of chord lengths:

S= 0.1237 m^2=191.80 inch^2

$b \times d$=0.1237

d=0.154 m=6.09 inch

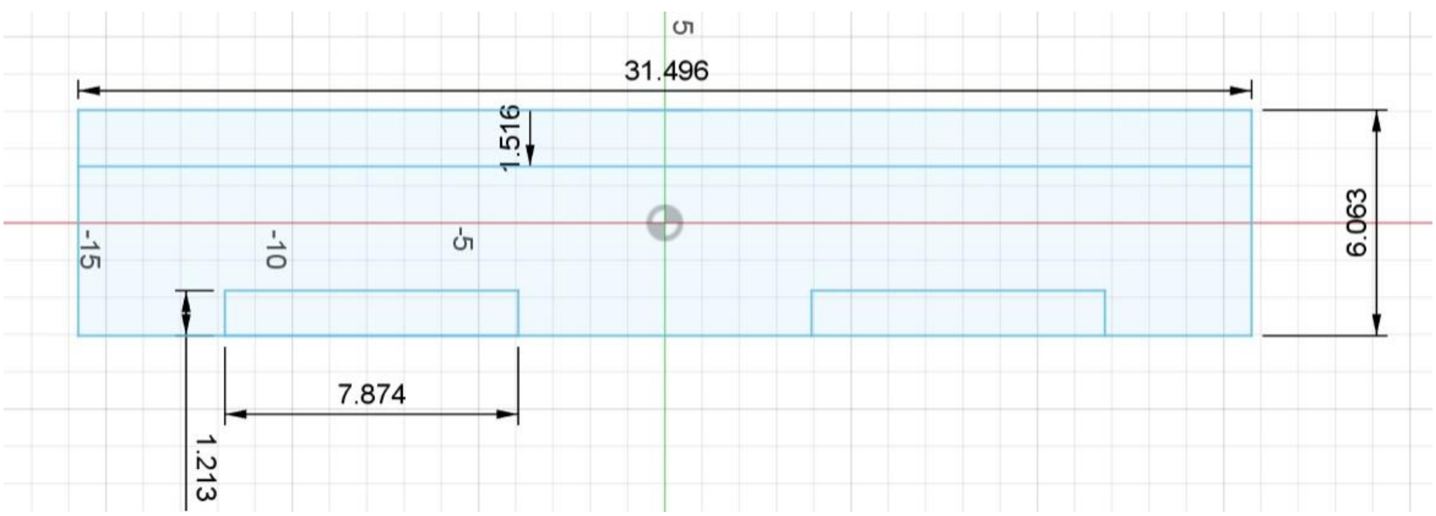


Fig.4.5 Wing geometry

CHAPTER 5
FUSELAGE DESIGN

5.1 FUSELAGE SIZING

We have selected an aerodynamically stream lined design for the fuselage as shown in the Fig.6.1.The main two criteria we considered in deciding the structural design was minimum weight and maximum mechanical properties. So we choose a combination of stringers and rib made of balsa wood for the fuselage framework. Coming into the sizing section, we have used the percentage method to calculate the various dimensions of fuselage.

Obtained results:

Chord length = 6.09 inch

Wingspan = 31.49 inch

Fuselage length = 75% of wingspan = 75% $\times$ 31.49 = 23.617 inch

Nose length = 20% $\times$ 23.617 = 4.7234 inch

Tail length = 40% $\times$ 23.617 = 9.4468 inch

Height of fuselage = 2.93 inch (measured from fusion 360)

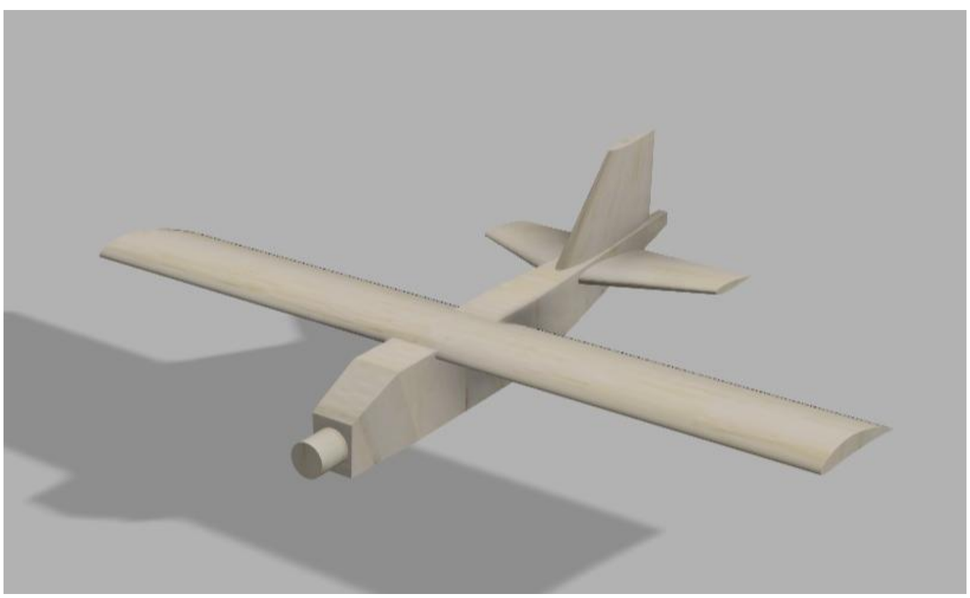


Fig.5.1 Fuselage sizing

CHAPTER 6
EMPENNAGE

6.1 TAIL DESIGN

The stability and manoeuvrability of a UAV are significantly influenced by its tail design, which also plays a crucial role in maximizing lift. In a conventional airplane, the vertical and horizontal surfaces serve as the primary lifting surfaces. The horizontal and vertical tails mainly serve the functions of providing directional stability and ensuring longitudinal trim, respectively.

For our RC airplane, we have analysed and compared two tail designs: the conventional tail and the V-tail. The conventional configuration provides adequate stability and control while minimizing structural weight. It also offers sufficient ground clearance for belly landings. Additionally, it is simple to construct and cost-effective to maintain. On the other hand, the V-tail design offers advantages such as higher cruise speed and reduced induced drag. However, it has a more complex flight control system due to the simultaneous use of the two lifting surfaces for pitch and yaw. The construction of a V-tail is also more challenging.

Given that ease of manoeuvrability is a key factor for our application, and after thorough group discussions and brainstorming sessions based on the gathered information, we have decided to proceed with the conventional tail design despite the advantages offered by the V-tail.

6.2 HORIZONTAL TAIL

6.2.1 AIRFOIL SELECTION

After analysis, we chose the NACA 0012 airfoil for our tail design due to its lightweight, symmetric shape, and consistent behaviour at both positive and negative angles of attack. It allows the wing to stall before the tail, improving stability. The airfoil is also strong and easy to fabricate due to its minimal camber, making it ideal for both the vertical and horizontal tails.

6.2.2 TAIL SIZING

Aspect ratio and taper ratio are taken in a range of 2.3 - 5 and 0.3- 1 respectively. On optimization we got the value of aspect ratio and taper ratio as 2.4 and 0.5 respectively. We had used the following equations for calculating the tail dimensions. $\frac{b^2}{S_h} = 2.5$. To find S_h; $S_h = \frac{C_H \times S_W \times C_{MAC}}{L_H} = \frac{0.484 \times 0.123 \times 0.154}{L_H}$

Horizontal tail arm, $L_H = 46.2\%\ of\ fusalage\ length$= 0.2772 m = 10.913 inch

$S_h = \frac{0.484 \times 4.842 \times 6.062}{10.913} = 1.3$ inch^2

Horizontal tail span; $b_{HT} = \sqrt{2.5 \times 0.0332}$=0.28m= 11.02 inch

We have taper ratio, λ=0.5

Root chord; $C_{RHT} = \frac{2.5}{b(1+\lambda)} = \frac{2 \times 0.332}{0.28(1+0.5)}$ = 0.158 m = 6.2204 inch

$\frac{C_{THT}}{C_{RTH}} = 0.5$

Tip chord; $C_{THT} = 0.5 \times 0.158 = 0.079$ m = 3.11 inch

Mean Aerodynamic Chord; $C_{MAC,HT} = \frac{2}{3} \times C_r \left[\frac{\lambda^2+\lambda+1}{1+\lambda}\right] = \frac{2}{3} \times 0.158 \left[\frac{0.5^2+0.5+1}{1+0.5}\right]$ = 0.1228 m= 4.834 inch

The results obtained are:

Parameter	Value
Horizontal tail arm, l_{HT}	10.913 inch
Horizontal tail area, S_{HT}	1.3 sq. inch
Horizontal tail span, b_{HT}	11.02 inch
Tip chord, C_{THT}	3.11 inch
Root Chord, C_{RHT}	6.2204 inch
Mean Aerodynamic Chord, $C_{MAC,HT}$	4.834 inch

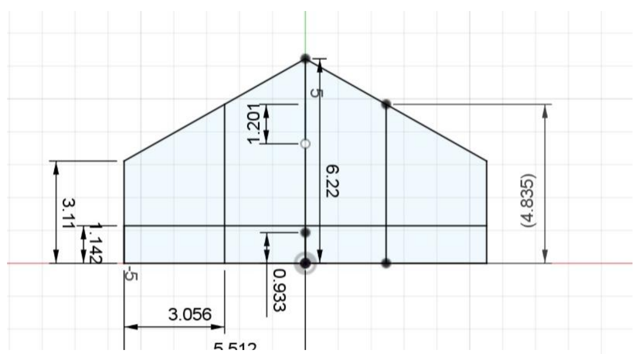


Fig.6.1 Horizontal stabilizer tail sizing

6.2.3 HORIZONTAL TAIL INCIDENCE

The horizontal tail incidence is chosen such that during the cruise, the lift required from the tail,to make the airplane pitching moment zero, is produced without elevator deflection. After analysis, the team decided to choose an angle of 6 degrees. At this angle of incidence, the positive pitching moment coefficient was obtained at zero angle of attack of the aircraft. This shows the aircraft was longitudinally stable. Negative moment would act if the angle of attack becomes positive and vice versa.

6.3 VERTICAL TAIL

6.3.1 AIRFOIL SELECTION

For vertical tail we had selected same airfoil as that of horizontal tail. ie, NACA 0012.

6.3.2 TAIL SIZING

Aspect ratio and taper ratio are taken in a range of 0.4 –1.4 and 0.3- 0.6 respectively (Roskam, 1985). On optimization we got the value of aspect ratio and taper ratio as 0.7 and 0.5 respectively.

AR= $\frac{b^2}{S_v}$, Where S_{VT}=surface area of vertical tail

$S_{VT} = \frac{C_v \times S_W \times b_w}{L_v}$

Here Vertical tail arm, L_{VT}=41.8% of fuselage length=$0.418\times 0.6 = 0.2508\ m$= 9.874 inch

$S_{VT}=\frac{0.0380\times 0.123\times 0.8}{0.2508}$ = 0.015 m^2 =23.25 $inch^2$

Vertical tail span, $b_{VT}=\sqrt{AR \times S_V}=\sqrt{0.7 \times 0.015}$=0.1024 m= 4.031inch

Root chord, $C_{RVT}=\frac{25}{2b(1+\lambda)} = \frac{2\times 0.015}{0.102(1+0.5)}$ = 0.19 m= 7.48 inch

We know, $\frac{C_{TVT}}{C_{RVT}} = \lambda$

C_{TVT}=0.19× 0.5=0.095m =3.74 inch

Mean Aerodynamic chord, $C_{MAC,VT}=\frac{2}{3} C_R \left[\frac{\lambda^2+\lambda+1}{1+\lambda}\right] = \frac{2}{3} \times 0.19 \left[\frac{0.5^2+0.5+1}{1+0.5}\right]$=0.147 m= 5.787 inch

Aerodynamic chord=25% of $C_{MAC,VT}=0.25\times 0.147 = 0.03675\ m = 1.4468\ inch$

Obtained results:

Table.6.2 Vertical tail parameters

Parameter	Value
Vertical tail arm, l_{VT}	9.87 inch
Vertical tail area, S_{VT}	23.25 sq. inch
Vertical tail span, b_{VT}	4.03 inch
Tip chord, C_{TVT}	3.74 inch
Root Chord, C_{RVT}	7.48 inch
Mean Aerodynamic Chord, $C_{MAC,VT}$	5.787 inch

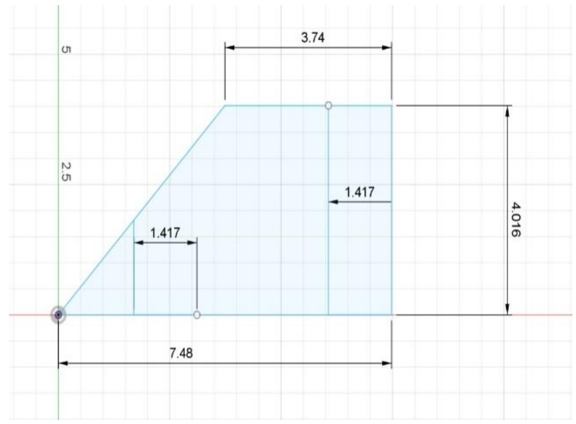


Fig.6.2 Vertical stabilizer tail sizing

CHAPTER 7

CONTROL SURFACE SIZING

7.1 AILERON

Aileron is the primary control surface used to control the roll of the aircraft. The aileron is a hinged surface and is placed along the trailing edge of each wing. The size of aileron varies with the type of UAV. Considering the type of UAV for our purpose we selected an Aileron with span equals 25 % of the wingspan rather than a full span aileron. The chord of aileron is calculated to be 20% of the Root chord of the wing. An inboard aileron span of 70% of wingspan is provided.

Aileron length = 25% of wingspan(assumed)= 7.87 inch

Aileron height = 20% of root chord(assumed)= 1.212 inch

Total Aileron Area =7.87×1.212=9.538 inch

Fig.7.1 2D drawing of aileron sizing

7.2 ELEVATOR

The elevator is also a hinged control surface of the UAV and controls the aircraft's pitch. It is located on the horizontal stabilizer of the UAV's tail part. The total area of the elevator was taken to be 25% of the horizontal stabilizer area and thus the dimensions of the elevator are calculated.

Span of elevator= span of control surface=0.28 m=11.023 inch

Area of elevator = 12.865 inch^2

Area of control surface= span of control surface×height of control surface

Hence, height of control surface= $\frac{8.3\times10^{-3}}{0.28}$ =0.029 m=1.1421 inch

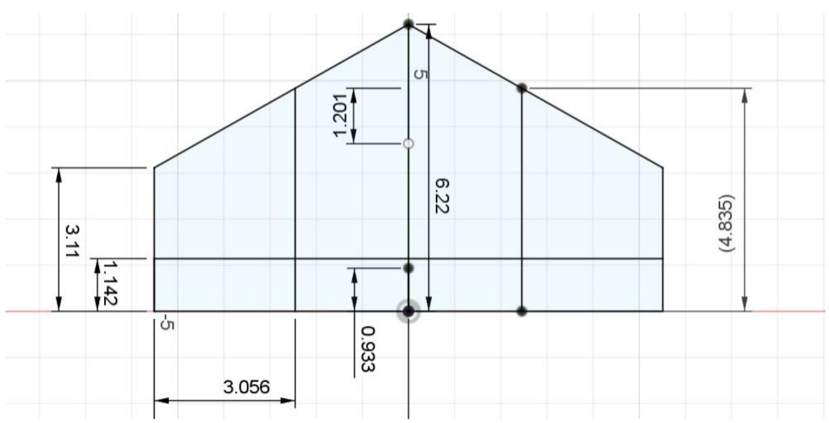


Fig.7.2 2D drawing of elevator sizing

7.3 RUDDER

The rudder is the control surface located on the vertical stabilizer, it is hinged and controls the yaw of the UAV. The area of the rudder is considered 25% of the total vertical stabilizer area.

Span of control surface=span of rudder=0.102 m=4.01 inch

Area of rudder = 5.81 inch^2

Area of control surface = span of control surface$\times$height of control surface

Hence, height of control surface= $\frac{5.81}{4.01}$ =1.417 inch

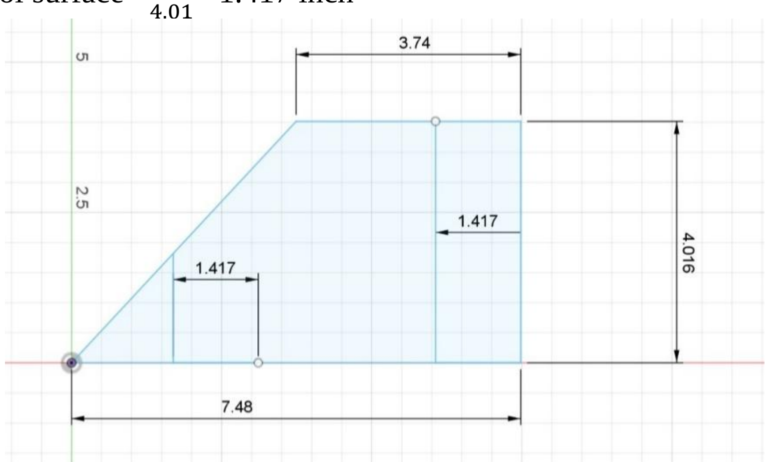


Fig.7.3 2D drawing of rudder sizing

CHAPTER 8
ELECTRONIC SYSTEM

8.1 SERVO SIZING

A total of 3 servos are used, one for aileron, one for the elevator and one for the rudder. The servos are sized with respect to the force that the respective control surface experiences. The torque required to determine the servo size is given as:

$$\textit{Torque (oz-in)} = 8.56 \times 10^{-6} \left(\frac{(C^2 V^2 L\, sin(s_1)\, tan(s_1))}{tan(s_2)} \right)$$

Where C represents control surface chord in cm, V is the speed in mph, L is control surface length in cm, s_1 for maximum control surface deflection in degrees and s_2 for maximum servo deflection in degrees.

The torque calculated to move the control surfaces are:

T (Aileron) = 1.2 oz-in

T (Elevator) = 1.4 oz-in

T (Rudder) = 0.8 oz-in

SG90 9g plastic gear analog servo is selected after considering a safety factor to avoid overloading of the servos.

8.2 THRUST CALCULATION

The Thrust by Weight ratio of our UAV is fixed to be 0.5 from earlier model analyses.

Thrust / Weight = 0.5

Weight of aircraft = 1.6 Kg

Thrust available = 1.6×0.5 = 0.8 Kg

By considering a factor of safety, we have selected a motor which can give a maximum of 1.380 Kg thrust.

8.3 THRUST ANALYSIS AND CLIMB RATE CALCULATION

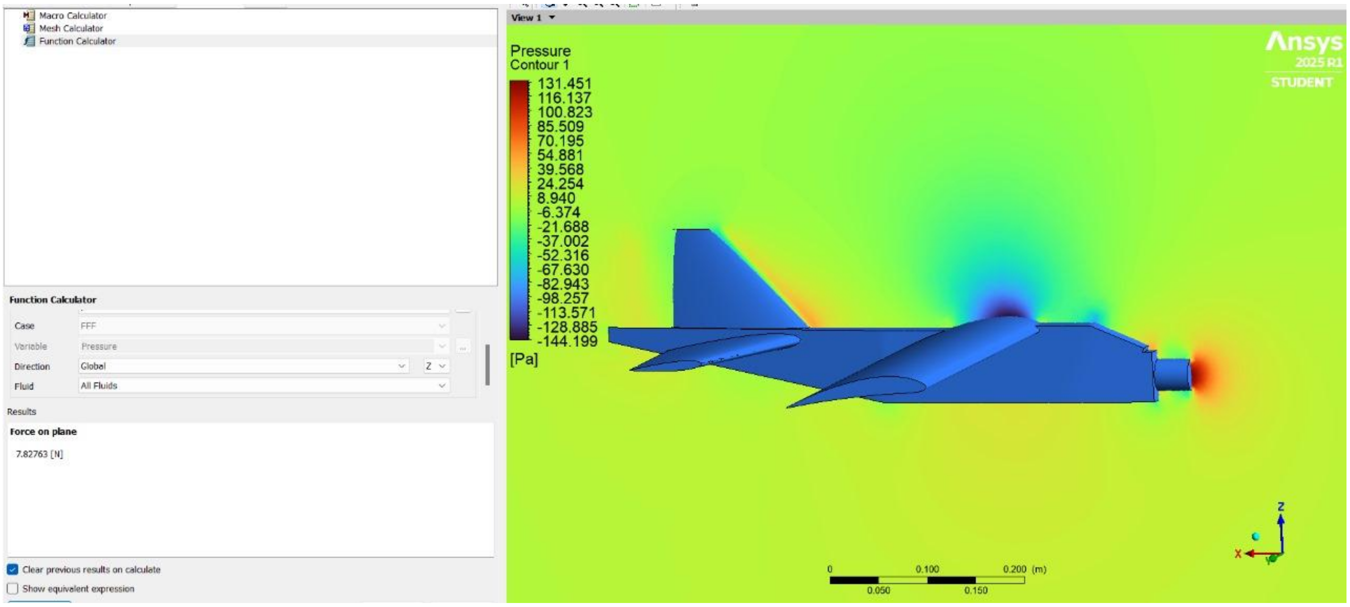


Fig.8.1 Ansys analysis result of the UAV (symmetrical half section)

An ansys analysis of CAD model was carried out to analyse the lift to drag ratio of the UAV. The climb rate (r/c) of the UAV is calculated as follows,

r/c = $\frac{power\ available - power\ required}{weight} = \frac{velocity(thrust\ available - thrust\ required)}{weight}$

To calculate the available and required power

$\frac{lift}{drag} = \frac{weight}{thrust}$

Lift= 15.65 N (from Ansys analysis)

Drag = 1.6 N (from Ansys analysis)

Lift/drag = 9.78

Weight = 1.6 Kg

Hence the thrust required is calculated,

Thrust required = 0.160 Kg

Thrust available = 0.8 Kg

Velocity = 15 m/s

Then climb rate, r/c = $\frac{[16(0.8-0.160)]}{1.6}$ = 6.4 m/s

8.4 ENDURANCE CALCULATION AND POWER PLANT SELECTION

Wattage = weight of the airplane × power performance level= 3.52in ×79 w/lbs (from previously available data) = 278.08

Cell count =3

Nominal voltage= 3 × 3.7 = 11.1 v

Current = wattage/nominal voltage= 278.08/11.1= 25.05 A

ESC current= 25.05×1.14= 30 A

Capacity of battery = 2200 mAh

RPM = 0.4896× wingspan^2 - 162.66 × wingspan + 20786 = 16149.33

KV rating= RPM/ Nominal voltage= 16149.33/11.1= 1454.89 KV

From these calculations we understood that ESC must be capable of 3S LiPo battery and minimum 30A.

8.5 MOTOR, ESC AND BATTERY SELECTION

A motor which can provide a maximum thrust of 1380g is selected for the UAVs selected purpose. The motor is of 1450 KV and weighs 102 g (including connectors). ESC which consumes 30A and a 2200 mAh battery is selected to comply for the mission purpose.

CHAPTER 9

STABILITY AND MASS DISTRIBUTION

The stability conditions are that the moment coefficient (Cm) should be greater than zero at zero angle of attack (Alpha), and the slope of the Cm vs. Alpha graph should be negative. We used trial and error to find the best center of gravity (C.G.) position, starting at 6.968 inches from the nose tip. The analysis showed that Cm was greater than zero at Alpha = 0, but the slope of the Cm vs. Alpha graph was negative.

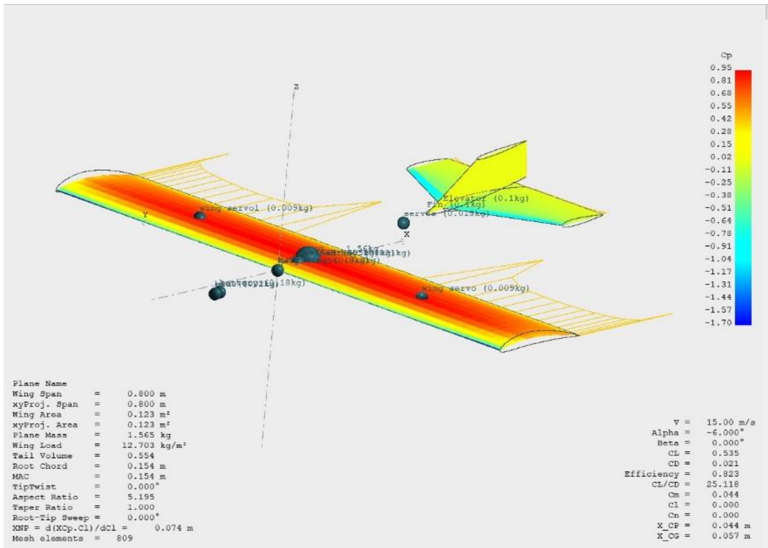


Fig.9.1 Stability and mass analysis in Xflr5

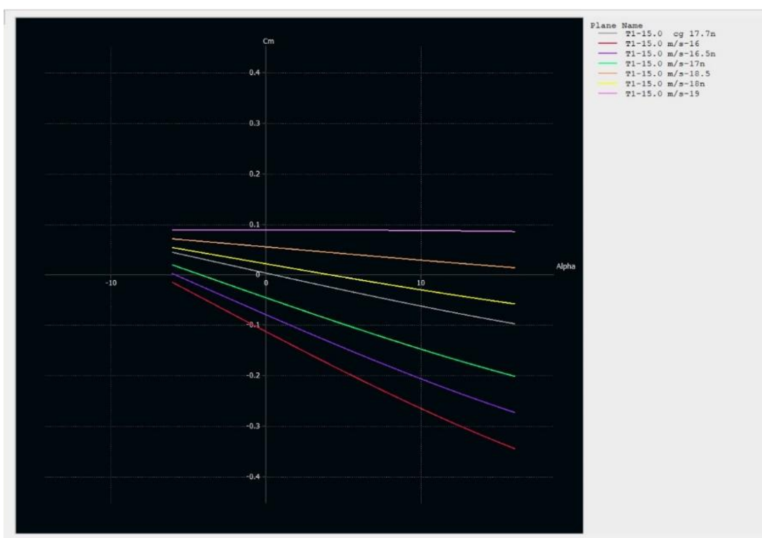


Fig.9.2 Cm vs Alpha curve

Table.9.1 Mass distribution and moment arm of components

Sl No	Description	Mass (Kg)	Moment Arm (in)
1	BLDC motor	0.1	-4.274
2	ESC	0.02	-4.685
3	Propeller	0.007	-0
4	Battery	0.180	-4.370
5	Receiver	0.008	1.535
6	Servo wing×2	0.018	4.96
7	Elevator and rudder servo	0.018	4.641
8	Fuselage	0.13	0.00
9	Payload Bay	0.021	1.496
10	Payload	0.500	1.496
11	Flight controller	0.009	1.496

In the next trial, the C.G. was positioned at 7.48 inches from the nose tip. The results showed that Cm was greater than zero at Alpha = 0, and the slope of the Cm vs. Alpha graph was zero. This indicates that the aft center of gravity position has been reached.

Therefore, the aft C.G. is at 7.48 inches from the nose tip. In the next trials, the C.G. was positioned at 7.283 inches and 7.086 inches from the nose tip. In both cases, Cm was greater than zero at Alpha = 0, and the Cm vs. Alpha graph showed a negative slope. As a result, a stable C.G. position was found.

By further moving the center of gravity (C.G.) to positions of 6.692 inches, 6.496 inches, and 6.299 inches from the nose tip, a negative slope was achieved for the Cm vs. Alpha curve, and the Cm value at Alpha = 0 became zero, meaning the graph passed through the origin. This indicates that any further reduction in the distance from the nose tip would lead to a negative Cm value, which is unacceptable. Therefore, the forward C.G. position was determined to be 6.92 inches from the nose tip.

CHAPTER 10

APPLICATION

The effectiveness of any technology can be gauged by how well it meets the needs of society and enhances the lives of individuals. In our design of the UAV, we have closely considered its potential applications, particularly in the realm of surveying, where it can bring substantial benefits. UAVs have the capability to transform traditional surveying methods by making them more efficient, cost-effective, and safer.

UAVs for surveying can be employed in a wide range of sectors to collect high-resolution, accurate data. The primary advantage of using UAVs in surveying is their ability to capture large amounts of data quickly and accurately while drastically reducing operational costs. For instance, in land surveying, UAVs equipped with advanced sensors, such as high-resolution cameras, LiDAR, and GNSS (Global Navigation Satellite Systems), can create detailed maps and models of the land. These UAVs can fly autonomously over the designated area, gathering data in a fraction of the time it would take traditional ground surveys or manned aircraft.

By utilizing UAVs for surveying, we can access hard-to-reach locations with ease. Areas that were previously dangerous or difficult to survey—such as mountains, forests, or disaster-stricken zones—can now be mapped without putting human surveyors at risk. Moreover, the high resolution of UAV-captured imagery allows for precise topographic data, helping urban planners, engineers, and construction professionals make better decisions based on up-to-date information.

Another significant benefit of UAV surveying is the increased efficiency and reduction in costs. Traditionally, surveying large areas involved significant labour and equipment expenses. UAVs cut these costs by offering a quicker and less resource-intensive method of data collection. Furthermore, UAVs can be equipped with specialized sensors tailored to different types of surveys, such as thermal cameras for infrastructure inspections, multispectral cameras for agricultural mapping, or LiDAR for highly accurate terrain mapping.

UAVs also play a key role in creating accurate 3D models and digital elevation models (DEMs) for urban planning and development. These 3D models are used in simulations to plan infrastructure, detect potential hazards, and optimize land usage. By providing real-time data, UAVs allow for quicker adjustments to projects and a more dynamic approach to planning.

In essence, UAVs for surveying not only make the process more cost-efficient and faster, but they also open the door for safer, more precise, and environmentally friendly data collection. By embracing UAV technology, we can improve the quality and accuracy of surveys, whether for construction, agriculture, or environmental management, ultimately enhancing decision-making and improving societal well-being.

CHAPTER 11

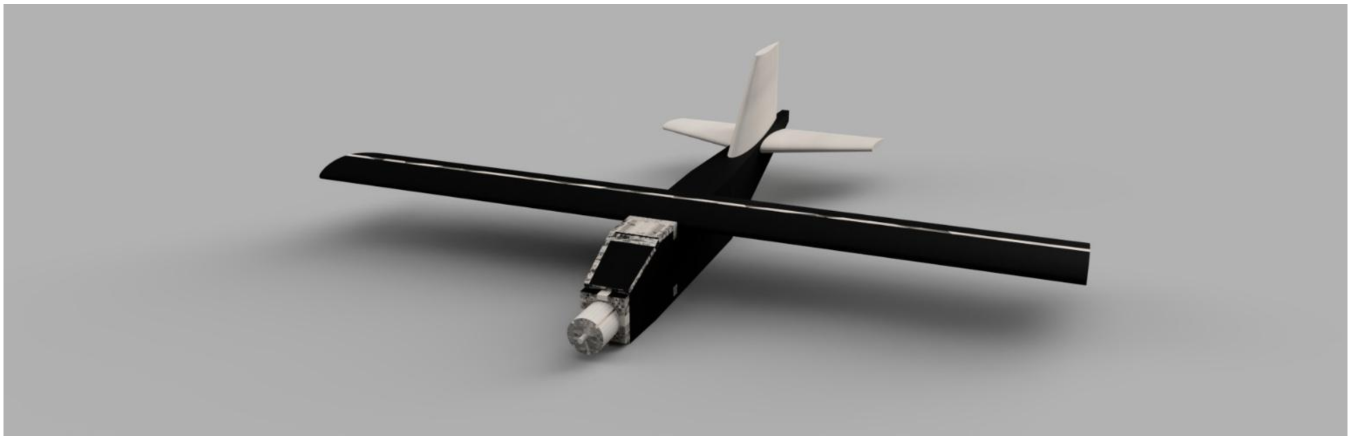
CONCLUSION

We, the AereX team, engaged in several group discussions and brainstorming sessions to develop the design of the RC plane detailed in this report. Throughout the process, we faced various challenges, and an iterative design approach helped us refine our final product. Our primary goal was to ensure our design adhered to the key characteristics of the micro class, specifically achieving the minimum empty weight and maximum payload fraction.

Overall, our team focused on finding effective solutions to meet the design requirements. This project proved to be an invaluable learning experience, expanding our knowledge and providing insight into the core principles of aerodynamic analysis, in addition to basic aircraft design. During this design phase, we gained new technical skills that enhanced our understanding of the aeronautical field. Careful attention was given to eliminate any potential issues that could compromise the aircraft’s smooth flight.

We are confident that our aircraft will successfully meet all the competition's objectives and perform excellently during the flight phase.

Fig.12.1 Final rendered image of the UAV



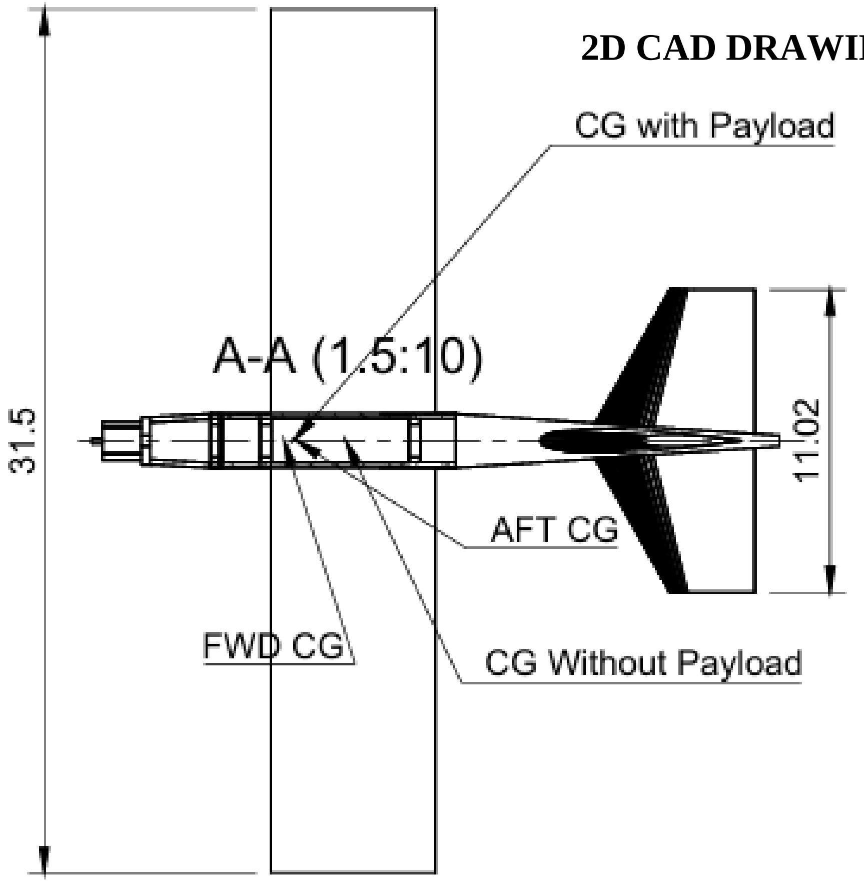
CHAPTER 12

TECH DATA SHEET: WEIGHT BUILD UP

Sl No.	COMPONENTS	WEIGHT (Kg)
ELECTRONIC ASSEMBLY		
1	BLDC Motor (with mountings)	0.102
2	Electronic Speed Controller	0.023
3	LiPo Battery	0.180
4	Propeller	0.007
5	Servo Motor (x4)	0.036
6	RC Receiver	0.0149
WING ASSEMBLY		
7	Ribs (Balsa wood)	0.0131
8	Spar and stringers (Balsa wood)	0.0120
9	Skin (Balsa sheet)	0.015
10	Miscellaneous (adhesive, duct tape, skin coat)	0.005
FUSELAGE ASSEMBLY		
11	Frames (Balsa wood)	0.073
12	Stringers (Balsa wood)	0.00101
13	Skin (Balsa sheet & plastic glass sheet)	0.02568
14	Miscellaneous (adhesive, duct tape)	0.010
EMPENNAGE ASSEMBLY		
15	Ribs (Balsa wood)	0.0059
16	Spar and stringers (Balsa wood)	0.0012
17	Skin (Balsa sheet)	0.0202
18	Miscellaneous (adhesive, duct tape)	0.006
PAYLOAD BAY		
19	Frame (Balsa wood)	0.00058
20	Miscellaneous (adhesive etc.)	0.006
TOTAL WEIGHT		**0.5488**

CHAPTER 13

2D CAD DRAWING

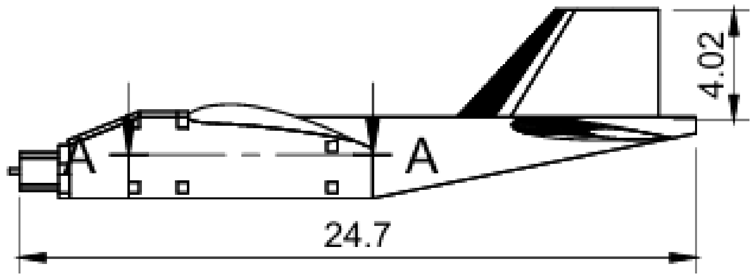


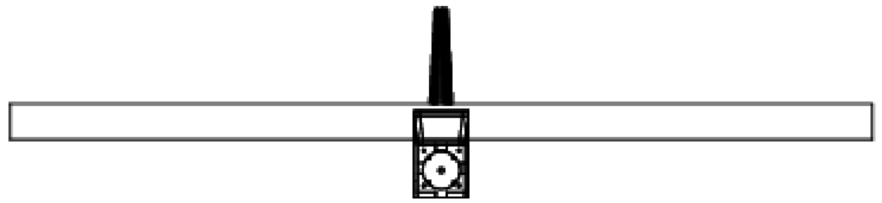
STABILITY CALCULATION	
Forward Limit	X6.929; Y0; Z0.15748
Aft Limit	X7.48; Y0; Z0.13748
CG with Payload	X7.00; Y0; Z0.15748
Empty CG	X7.52; Y0; Z0.026

SUMMARY DATA INFORMATION TABLE	
Wingspan	31.5 in
Empty Weight	1.1 kg
Payload	0.500 kg
Net Weight	1.6 kg
BLDC Motor	Make: DYS D3536-5; 1450kv; Max Current: 45A; No-Load Current: 3.5A; Max Power: 655W
Propeller	1045

WEIGHT AND MASS DISTRIBUTION TABLE

SL No:	Description	Mass (Kg)	Moment Arm (inch)	Resultant (kg*inch)
1	BLDC Motor	0.1	-4.724	-1.03928
2	ESC	0.02	-4.685	-0.2061
3	Propeller	0.07	-4.803	-0.74110
4	Battery	0.180	-4.370	-1.7340
5	Receiver	0.008	1.535	0.0270
6	Servo Wing (x2)	0.018	4.96	0.1964
7	Elevator and Rudder Servo	0.018	4.691	0.1837
8	Fuselage	0.13	0.000	0.0000
9	Payload Bay	0.021	1.496	0.0368
10	Payload	0.500	1.496	1.649
11	Flight Controller	0.009	1.496	0.0296





Created By: **Team AereX**	Title: **UAVARX 2D**
Team ID: **DDC2025080**	Date: 07/03/2025
Class: **Micro**	Scale: **1.5:10**
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