AirCargoChallenge 2022

TOPHANE VOCATIONAL AND
TECHNIC HIGH SCHOOL

TEAM#28

TOPHANE AYGÖK UAV TEAM

TOPHANE AYGÖK

Content

1. INTRODUCTION

1.1. EXECUTIVE SUMMARY

This report represents preliminary design decisions, manufacturing planning and prestudy of UAV of AYGÖK team from TOPHANE VOCATIONAL AND TECHNICAL HIGH SCHOOL participating in Air Cargo Challenge 2022. The AYGÖK team aims to compete in a fair competition without encountering any problems. Being the winner is the most important goal. In the competition , the aircraft abilities such as cargo carrying capability, maneuverability and speed will be tested. AYGÖK team determined the priorities and flight criterias according to the score table of the contest in order to get the best overall score. The objective is transporting the maximum payload on the runway in the shortest time possible. According to the results of the analyzes and designs, the team's vehicle will have high wing and conventional tail type. In the design of the cargo bay mechanism, the aim is to organize the payloads in a balanced state and to keep the drag force minimum.

1.1.1.Design Process

Since, maximum efficiency in all properties of the UAV at the same time is not possible, essential features was being focused on. The aim of the design was producing a fast plane which have enough maneuverability to fly in a snake shaped runway while carrying maximum load possible. Because of one of our priorities is to achieve the predicted payload transportation with a highly stable and smooth flight the team focused on calculations of aerodynamic efficiency. Also, wings were designed as specific fragmentary to fit into the transportation box. The electronic elements that will be used in the aircraft are ESC, lipo battery, servos, RF receiver modules and engine. Furthermore, fuse will be used as security measures.

1.1.2.Core Task Requirements and Design Features

The general geometry and capabilities of the aircraft were determined according to the score parameters. It is decided to choose an efficient airfoil and to minimize the drag forces for a fast UAV design with capable of carrying maximum payload. To return in minimum radius on the snake shaped runway, the ability of maneuverability was paid attention in the design of aircraft. In summary, the aircraft is intended to have low drag coefficient and low stall speed, not to be aggressive while rolling and to be stable on the pitch axis.

1.1.3.System Performance Features

According to the agreed design concept, final design of the aircraft has high wing configuration, T- tail and body. Also take-off weight of the aircraft considered as 1.5 kg and expected a high stability on its pitch axis. Maximum lift capability of the UAV will reach to 3 kg when the payloads were loaded for flight. The main material of the wings was determined after considering previous experiences and wood options, as a result balsa was chosen. Because of the structural concerns, it was decided to support the balsa components with carbon tubes. Furthermore, the fuselage was selected to be a lightweight composite carbon tube to high strength.

1.2. PROJECT MANAGEMENT

1.2.1 Team Organisation

The team consists of 6 members, each having different tasks for the production of the UAV systems. These tasks are depending on the personal abilities, knowledge and interests, each member has a specific task in the team organization.

The main topics of the UAV design are aerodynamics, structure, autopilot systems, and testing. All team members will focus on their own topics besides also work in collaboration during design process, because all the design categories are related to each other.

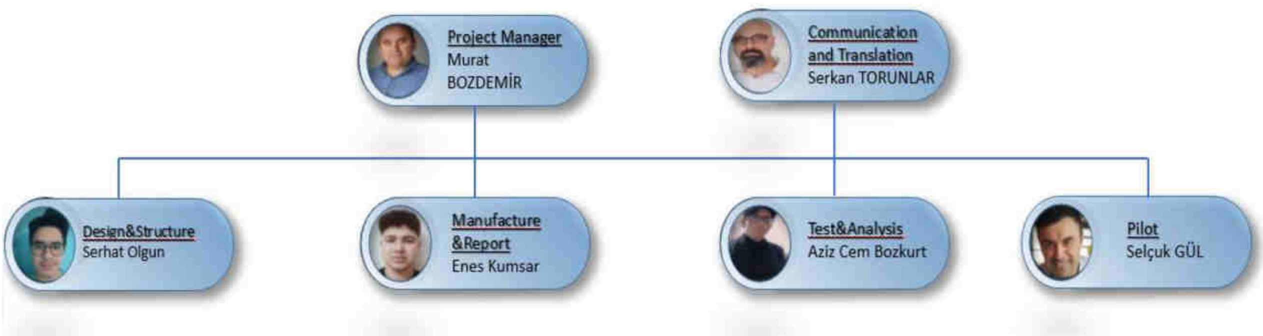

Figure 1.2 Shows the team organization.

1.2.2 Time Scheduling

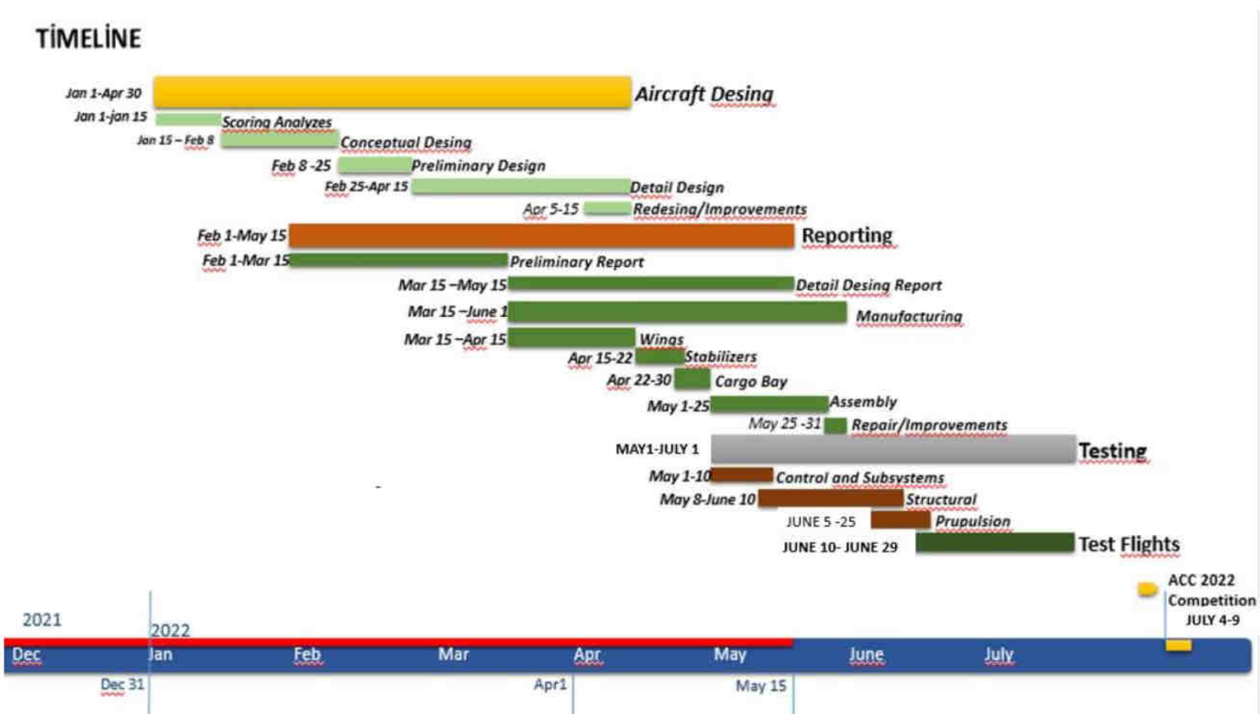

Figure 1.2.2 Timeline

The AYGÖK team believes that it is essential to sustain all the steps of the preparation process with a well-planned organization. Thus, time will be used effectively; all processes will end on time. Also, there will be enough time for testing and production stages. Our approximate timeline is shown in Figure 1.2.2.

1.2.3. Financial Budget

No	Item	Unit Price	Quantity	Price
1	Carbon Pipe	TRY 1.000	5	TRY 5.000
2	Balsa	TRY 200	15	TRY 3.000
3	Carbon sheet	TRY 1.000	2	TRY 2.000
4	Servos	TRY 300	6	TRY 1.800
5	Motor	TRY 1.000	1	TRY 1.000
6	Propellers	TRY 120	1	TRY 120
7	ESC	TRY 600	1	TRY 600
8	Battery	TRY 950	1	TRY 950
9	Landing Gear	TRY 150	2	TRY 300
10	Plywood	TRY 600	2	TRY 1.200
11	Glue	TRY 50	6	TRY 300
12	Cables	TRY 20	10	TRY 200
13	Filament	TRY 180	2	TRY 360
14	Tools	TRY 130	8	TRY 1.040
	Grand Total			**TRY 17.870**

2. AERODYNAMİC DESIGN

2.1 Wing Type Configurations

Wing Type Configurations				
Criteria	Coefficent	Flying Wing	Conventional	Biplane
Weight	30	1	0	0
Stability	20	0	1	1
Manufacturability	20	0	1	0
Speed	10	0	1	0
TOTAL	100	50	70	50

Table 2.1 Wing Design Configurations

Our priority was to make the most efficient plane which is able to generate lift to carry maximum weight with smallest wing size to be able to fit into the transportation box which dimensions are determined by the contest rules by comparing three wing configurations against each other. After the researches were done it was determined that conventional wing configuration will be used because of the number of reasons which are:

- Conventional wing design was more suitable to divide into smaller parts,
- Since the aircraft designed as a carrier conventional wing design will provide enough stability,
- For the carrier type aircrafts conventional wing design is more suitable in terms of speed and maneuverability.

2.2 Wing Design Configurations

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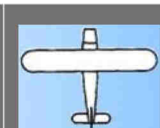
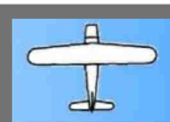
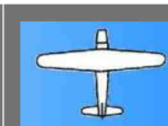
Wing Design Configurations				
Criteria	**Percent Factor**	**Rectangular wing**	**Sweptback Wing**	**Tapered Wing**
Lift	0.4	6	9	10
Stability	0.2	10	8	6
manufacturability	0.2	10	8	6
Control	0.2	9	8	5
Total	1	8.2	8.4	7.6

Table 2.2 Wing Design Configurations

The top view design of the wing also has effects on the characteristics of the aircraft. The sweep ratio of the wing (up to 0.4) increases the efficiency of the lift force. But this situation also increases the aggressiveness of the aircraft. The advantage of having the quadrangular wings is the ease of production. The sweptback wing has a higher lift force and a more stable structure. Considering all these criteria, it is determined that sweptback wing is more advantageous for the challenge as shown in the Table 2.2.

2.3 Tail Configurations

Tail Configurations				
Criteria	**PERCENTAGE FACTOR**	**V TAIL**	**CONVECTIONAL**	**T TAIL**
Control and Balance	30	-1	1	1
Weight	35	0	0	0
Production	15	-1	1	1
Drift	20	1	1	-1
Total	100	-25	65	25

Table 2.3 Tail Configurations

There are three types of tails which are conventional, T-tail and V-tail commonly used among the UAVs having similar sizes and aims. T-tail has been chosen for number of reasons.

Those are:

- More simplified production process compared with others,
- To reach safer take-off and landing conditions for horizontal tail wing,
- To avoid unregulated flow, which affects the efficiency of the elevator, generated by main wing.

2.4 Landing Gear Configurations

Landing Gear Configurations				
Criteria	Percentage Factor	Rear Wheel	Front Wheel	Under the wing
Number of Wheels	20	0	0	1
Drag Effect	20	0	0	1
Weight	40	0	0	1
Balance	20	1	1	0
Total	100	20	20	80

Table 2.4 Landing Gear Configurations

In the determination of the landing gear type, most important facts that considered were the take-off and landing safety of the plane. Since the position of the payload of the aircraft is closer to the nose and has a tall landing gear will be attached under the payload cargo bay. Since the total mass center is also closer to the nose, Tail-Dragger type has been chosen.

2.4.1 Aerodynamic Design and Sizing

In this section, dimensions of main components and some design trades have been determined.

2.4.2 Airfoil Selection

Lift has an opposite direction to the weight and the wing generates almost all of the lift force. Lifting force in the wings consists of pressure difference from airfoil design. When selecting airfoil, only the coefficient of C_l is not considered, C_d and C_m coefficients are also important parameters. For this reason, these 3 parameters will be taken into consideration when making the selection. Many airfoils were analyzed and three of them showed high performance. These; thin profile with high cambered, thin profile with low cambered and medium profile with middle cambered.

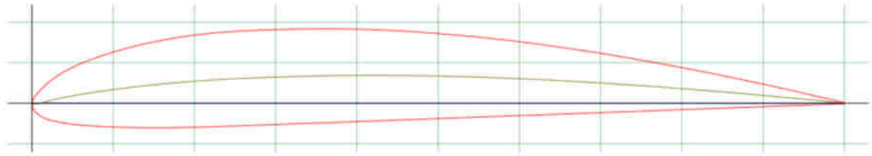


Figure 2.4.2.1 clark y

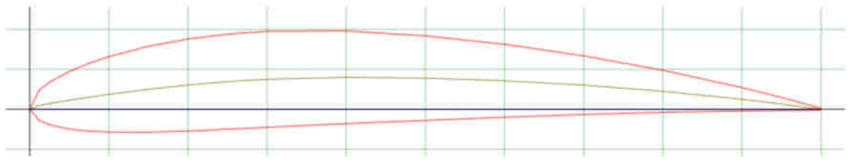


Figure 2.4.2.2 NACA 4412

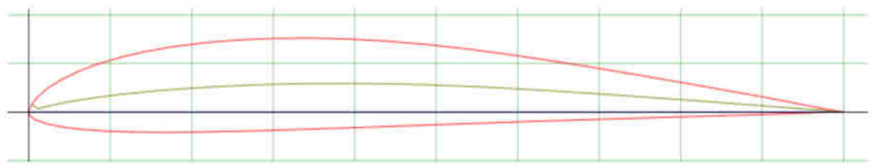
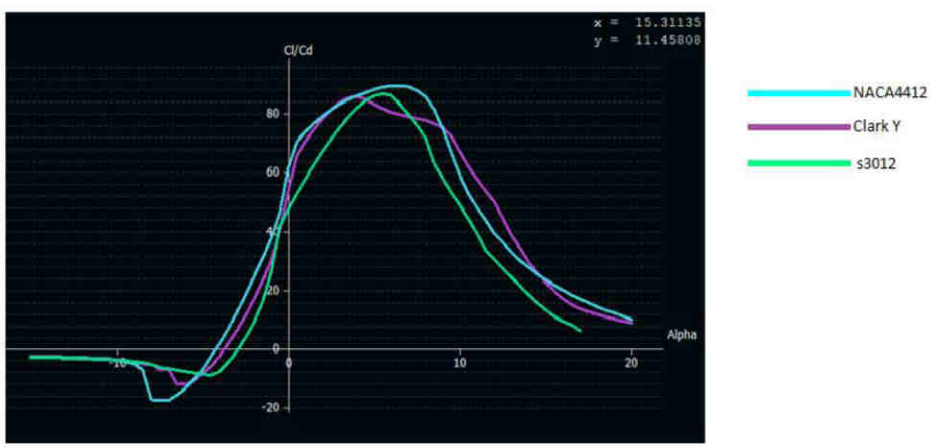
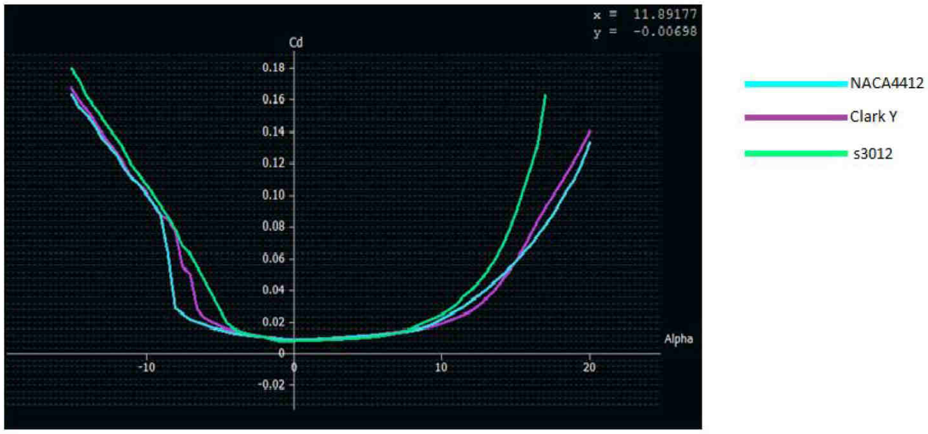


Figure 2.4.2.3 s3021

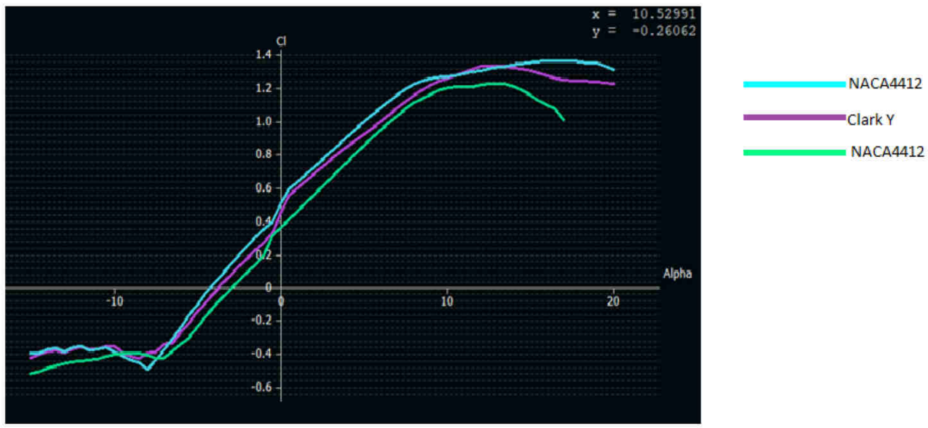
Airfoil that has high C_l coefficient to carry the maximum weight, low C_d coefficient as a limited amount of thrust, and a low C_m coefficient for a stable flight, will be selected. In order to analyze these criteria, $C_l - \alpha$, $C_l/C_d - \alpha$ and $C_m - \alpha$ values were calculated using XFLR5 program and these values were compared by graphing method. The aircraft will be designed to bear a load of 3 kg, and the aircraft that will carry this load flies usually between about 200.10^3 – 250.10^3 Reynolds. So the analyzes were made in 200.10^3 Reynolds Number.



Graph 2.4.2.4 $C_l - \alpha$



Graph 2.4.2.5 $C_l/C_d - \alpha$



Graph 2.4.2.6 $C_m - \alpha$

Considering the three parameters in airfoil selection, it is important to ensure optimum efficiency. The $C_l - \alpha$ graph shows the lift coefficient according to the angle of attack and the S3021 profile provides the highest lift. The $C_l/C_d - \alpha$ graph gives the ratio of drag force corresponding to the lift force, and the most efficient profiles according to this criterion are NACA 4412-CLARK Y profiles. The $C_m - \alpha$ graph shows the aggressiveness of the profile on the pitch axis and the most stable profile is CLARK Y. Considering all three of these parameters, the most efficient and stable profile is NACA 4412, which is decided to use this profile on the aircraft.

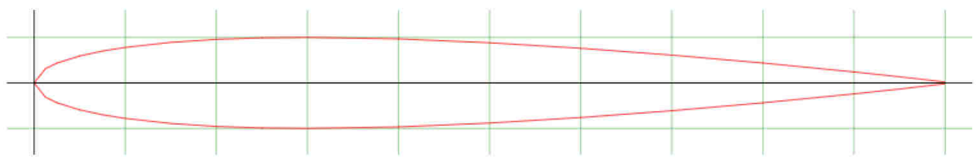
2.4.3 Wing and Tail Sizing

Since the sizes of the aircraft restricted by the competition rules and the main goal of the competition is to carry the heaviest payload possible it was aimed to make an aircraft which can obtain maximum lift with its restricted size. The aircraft is intended to carry 1,5 kg of payloads and total weight is expected to be 3 kg with its payloads, engine, battery and avionics. The formula of the lift force that the wings must produce to carry this weight;

$$W = L = \frac{1}{2}\rho.V^2.S_{wing}.c_L \quad \rightarrow \quad S_{wing} = \frac{2W}{\rho.V^2.c_L}$$

The wing area of the aircraft was calculated by taking aircraft cruise speed 20 m/s acceptance due to wind speed and limited thrust. As a result of the calculation, it was determined that the wing area should be 0.38 m^2. A taper ratio of 0.6 was given to the wing in order to obtain a higher efficiency in lift. So the wing dimensions are determined as 1600 mm wingspan, 250 mm root chord and 180 mm tip chord. In order to get maximum efficiency from the wing, the wing is placed on the body at an angle of 3°. 6° dihedral angle was given to the wing from two places to get a stable flight.

The symmetrical wing profile (NACA 0010) is used in the tail so that it is possible to provide a moment balance. In order to maintain the force balance and adequate pitch and yaw movement, tail sizes were determined as follows; 550 mm horizontal tail span, 178 mm vertical tail span and 170 mm chord.



The rough view of the aircraft with the specified measurements is shown in the Figure 2.6.2. More detailed drawings will be shown in the following headings.

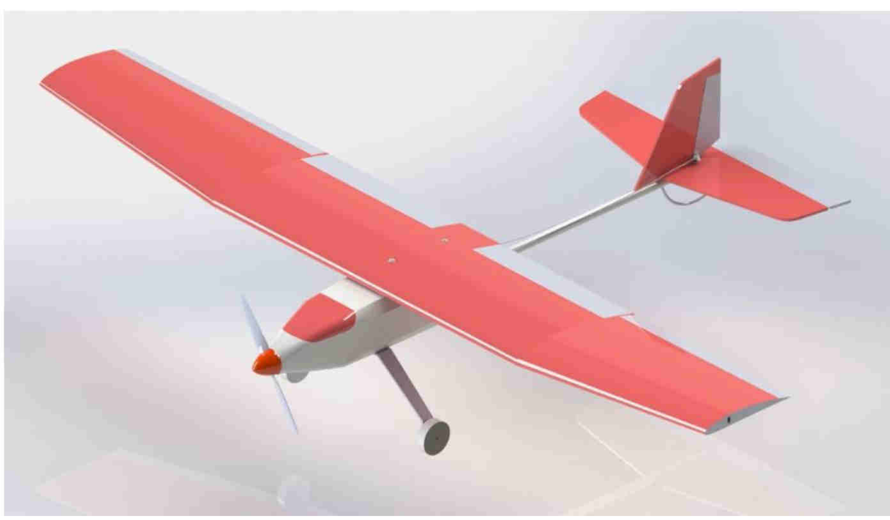
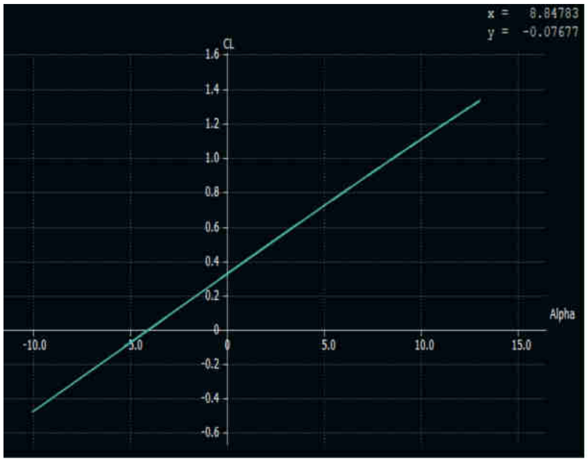


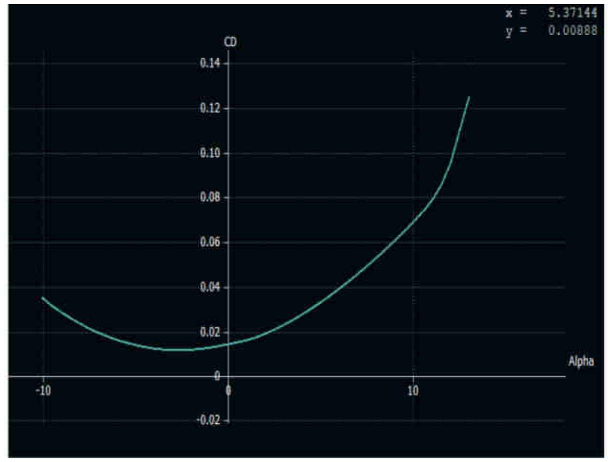
Figure 2.6.2 General View of Aircraft

2.4.4 WING ANALYSIS

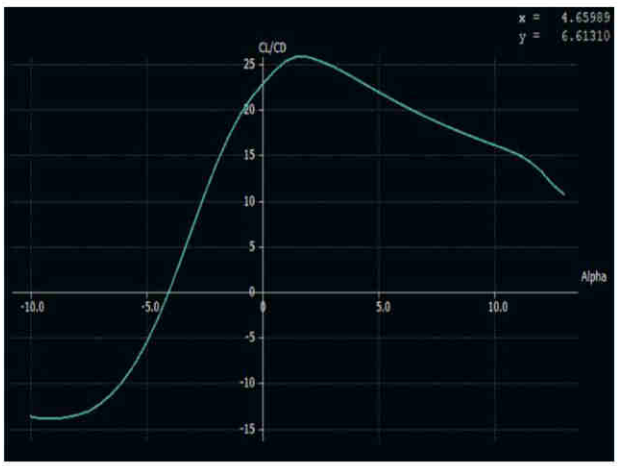
The calculation parameters and sizing have tested by analysis software. Using the Xflr5 and Ansys Fluent cfd tool wing analysis has done in different configurations. The result are shown by the graphics down below.



Graph 2.6.3.1 Lift/attack (CL/alpha) Cl-Alpha



Graph 2.6.3.2 Drag coefficient / Angle of attack Cl/Cd-Alpha



Graph 2.6.3.3 Lift coefficient / drag coefficient (CL/CD)

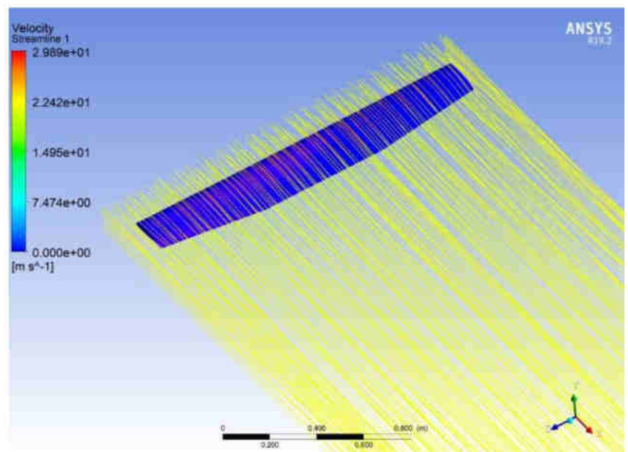
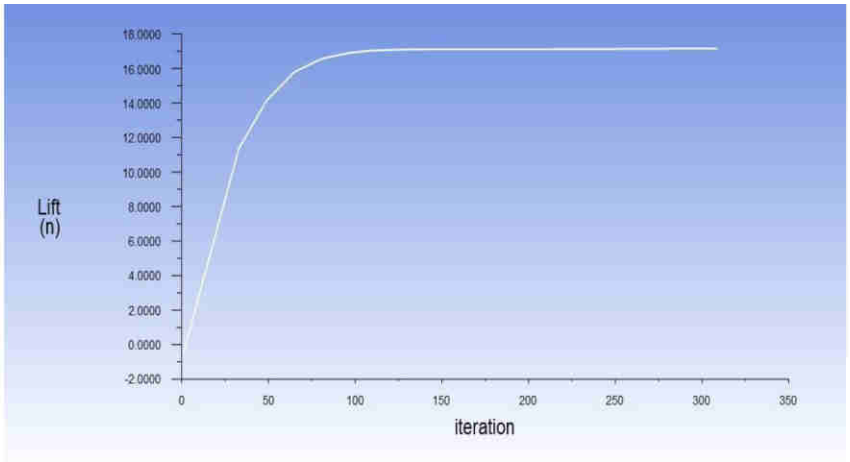


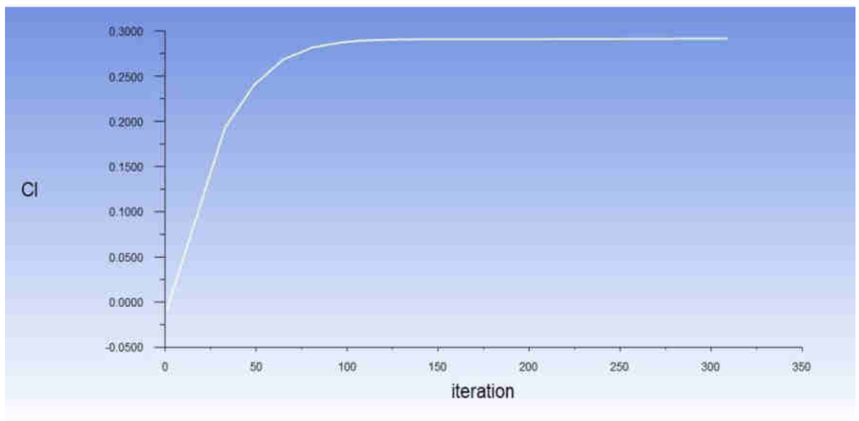
Figure 2.6.3.4 Wing surface Flow analysis

According to the results, the wings will provide maximum efficiency while flying. It is occurred a lift coefficient of 1.3 (*Graph 2.6.3.1 Lift/attack (CL/alpha) Cl-Alpha*) during a cruise flight. Stall velocity is calculated according to the data obtained from the analysis.

$$V_{Stall} = \sqrt{\frac{2W}{\rho S c_{L_{max}}}} \quad , \quad (c_{L_{max}})_{3D} = 0{,}9.\left(c_{L_{max}}\right)_{2D} . \cos(\Delta)$$



Graph 2.6.3.5 Lift calculation obtain from ANSYS Fluent



Graph 2.6.3.6 lift coefficient

Lift	(n)	Cl	()	Drag	(n)	Cd	()
wing	17.157163	wing	0.29156373	wing	1.1363643	wing	0.019311036

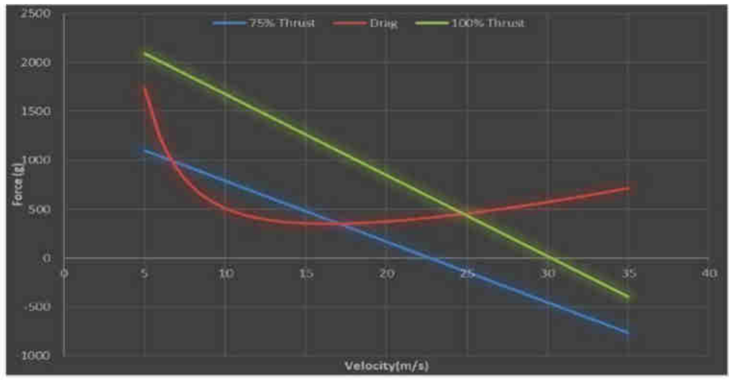
2.5 Estimation of Drag and Thrust

Drag is a force that acts on the opposite direction to the aircraft motion and prevents movement. Drag calculation for an aircraft is crucial for determining the trust requirements and speed capabilities of the aircraft. On the aircraft flying at subsonic speeds three types of drag occur, these are parasite drag, induced drag and crud drag. Parasite drag is also called zero lift drag. Induced drag comes with generation of lift. Crud drag is created by external factors such as production failure.

$$D = \frac{1}{2}\rho V_\infty S C_D$$

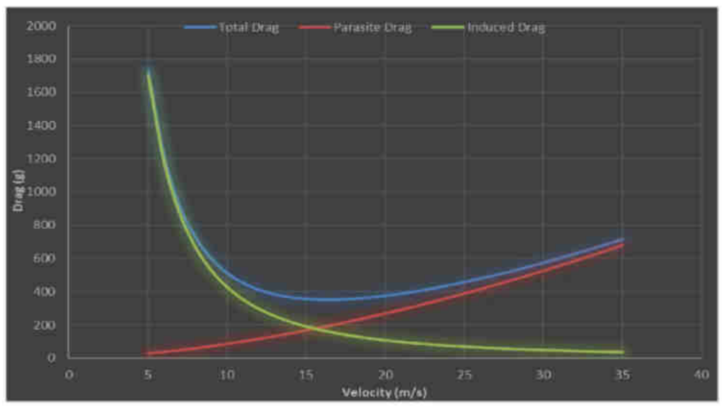
Total drag coefficient is sum of parasite and induced drags for aircraft that fly at subsonic speeds

$$CD = CD0 + CDi + CDcrud$$



Graph 2.5.1 Drag - Thrust Compare

In calculation of zero lift drag coefficient, each component of the plane (fuselage, wing, horizontal and vertical tail, landing gear) have been handled separately.



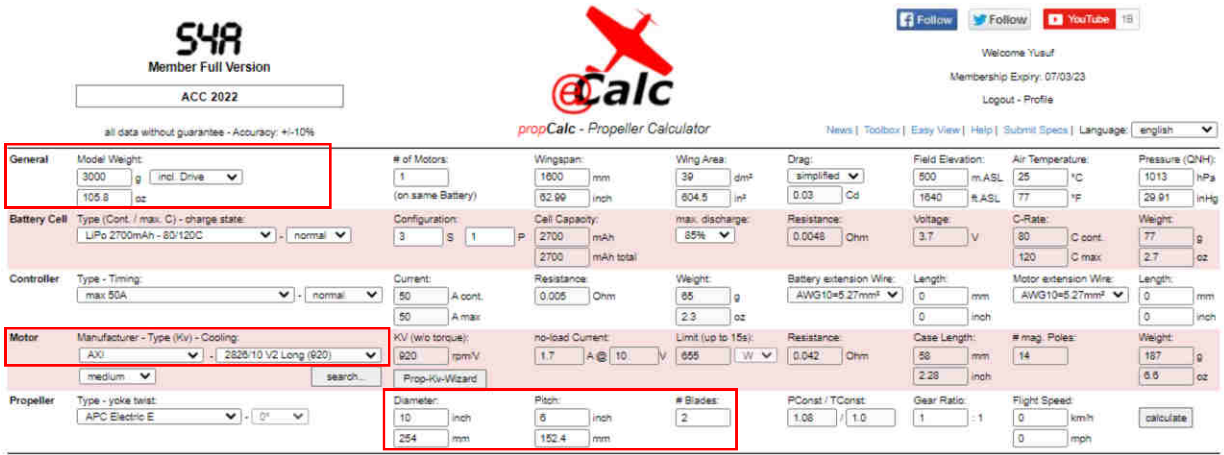
Graph 2.5.2 Drag Values by Velocity

2.5.4 Thrust Calculation

AXI Gold 2826/10 engine and 10x6 propeller will be used in aircraft. The thrust force is calculated using the properties of these components. Thrust equation,

$$F = 4{,}3923 * 10^{-8}.RPM.\frac{d^{3,5}}{\sqrt{pitch}}(4{,}233x10^{-4}.RPM.pitch - V_0)$$

Approximately 80 percent of the engine output is efficient and the thrust force is calculated by taking this situation into account. When we entered the values of our engine and aircraft on the eCalc site, as a result of the calculations, it was seen that our flight time was maximum 7 minutes and the static thrust value was 1200 gr at 8000 rpm. Our aircraft draws a current of 19 -20 amps at approximately 80% gas.

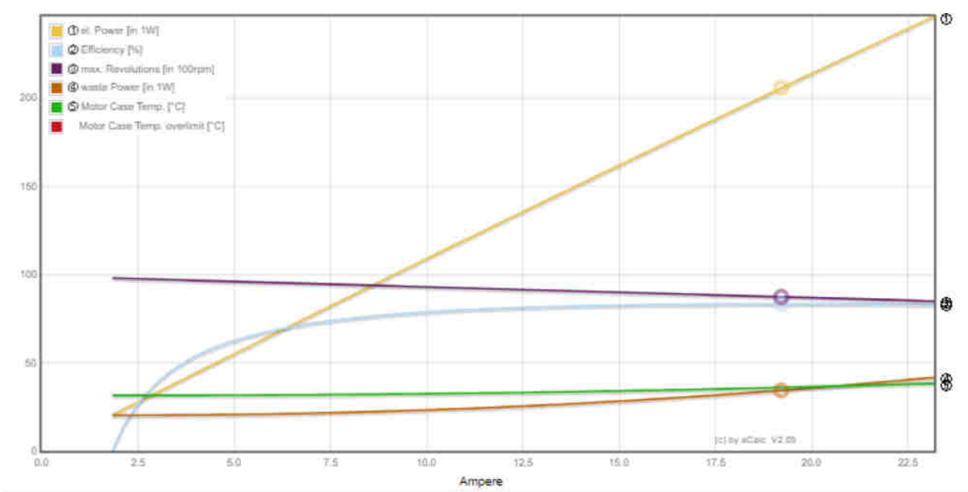


Graph 2.5.4.1 - Thrust Calculation

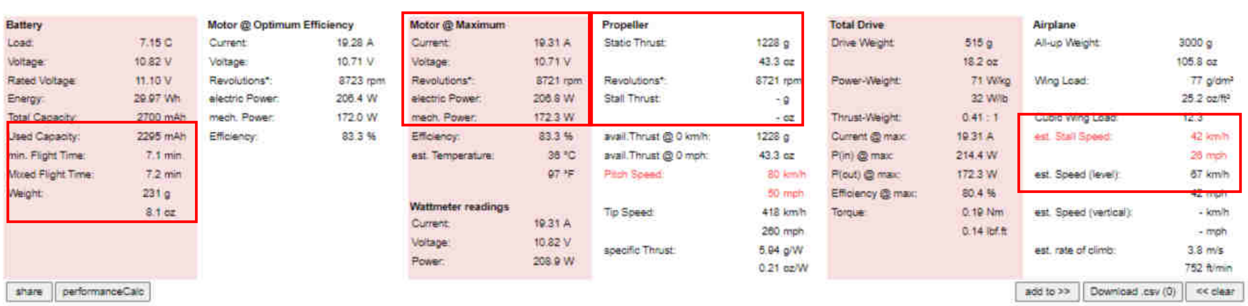
General	Model Weight	Diameter:	Pitch:	#Blades:
	3000 g incl. Drive	10 inch	6 inch	2
	105.8 oz	54 mm	152.4 mm	

Motor Manufacturer – Type(Kv) = Cooling:

AXI - 2826\10 V2 Long (920)



Graph 2.5.4.2 - amp power usage



Graph 2.5.4.3- Thrust Calculation

Used Capacity : 2295mAh	Motor@Maximum	Propeller	est. stall speed: 42 km/h
min. Flight Time : 7.1 min	Current : 19.31 A	Static Thrust:1228g 43.oz	est. speed(level): 67 km/h
Mixed Flight Time : 7.2 min	Voltage : 10.71 V	Revolutions*:8721 rpm	

Weight : 231g   Revolutions*: 8721 rpm Stall Thrust: -g
8. 1 oz   electric Power: 206.8W   -oz
Mech. Power: 172.3W

2.5.5 Drag and Thrust Calculation Results

Each effect effecting drag was calculated by creating excel sheet. Drag values are calculated according to increasing speed. Results,

Then, these values were compared with the thrust values and the cruise speed was determined. The aircraft will be given %100 Thrust during the taking off, and %75 thrust while cruise flight. As can be seen in Graph 2.6.5.2, the maximum speed that can be reached on cruise flight is 40 m/s.

Finally, the distribution of drag forces acting on the aircraft in the cruise flight was calculated

2.6 Stability and Control

2.6.1 Stability

It is called stability when the pitch yaw and roll movements formed on the plane due to undesired movements such as wind, turbulence during flight are corrected by the aircraft and turned into the first flight again.

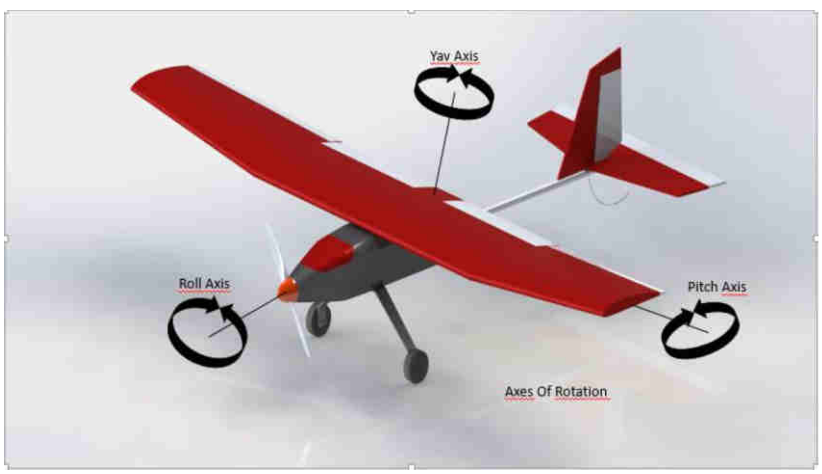


Figure 2.6.1 Axes of Rotation

Stability is divided into two parts; Static stability and dynamic stability.

2.6.1 Static Stability

Static stability is feature of the occurrence of an inverse force against deterioration in the direction of the plane. The $C_m - \alpha$ graph is calculated as follows with the help of the XFLR5 program.

2.6.2 Dynamic Stability

Dynamic stability is the correction of the deviations in the plane direction over time. The reactions of the aircraft against deviations can lead to greater deviations over time and this situation is called dynamically unstable.

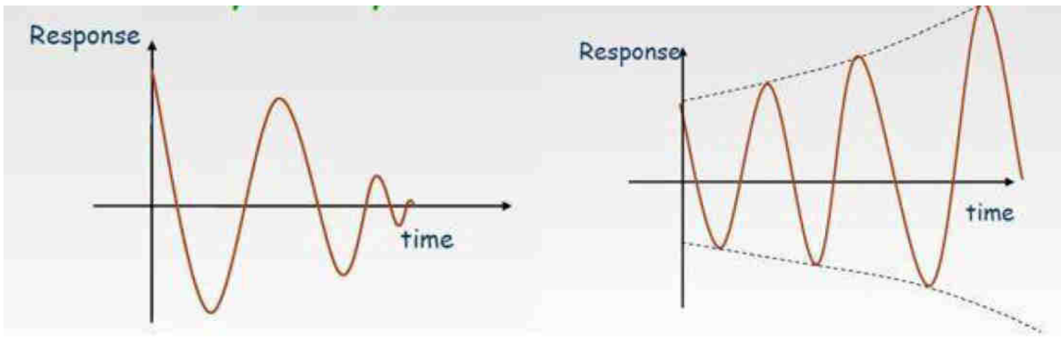
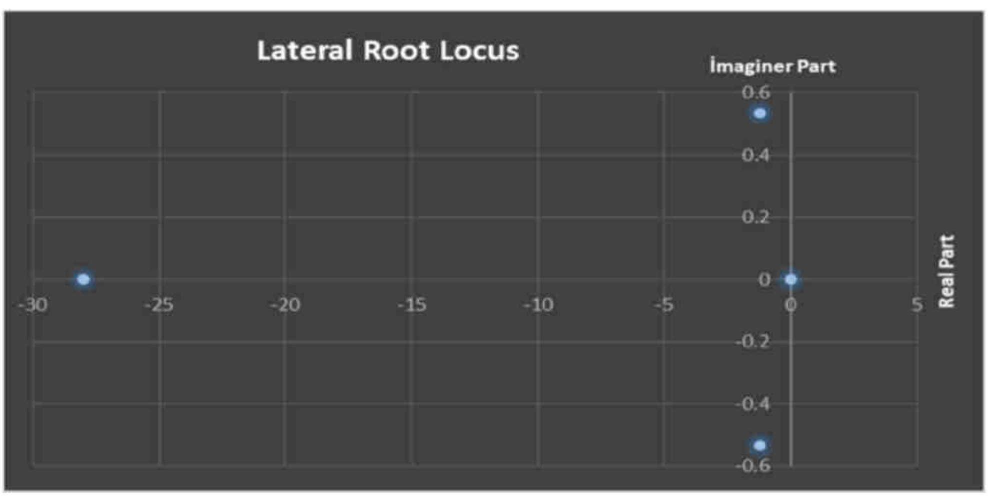


Figure 2.7.1.2 a) Dynamically Stable b) Dynamically Unstable

Lateral (Horizontal) stability

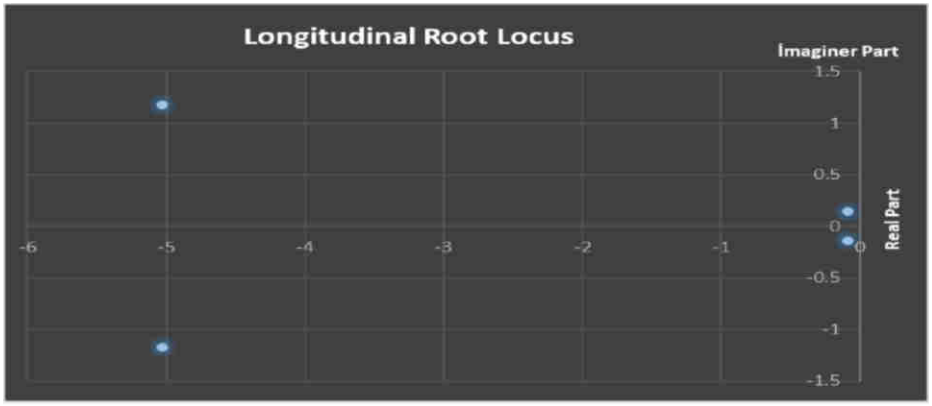
Polyhedral angle causes the loss of transport besides giving stability. The team has designed a vertical tail with an area of 0.02 m^2 to provide sufficient directional stability in a distance of 610 mm from the center of gravity. It is also given 3° of polyhedral angle, ensuring optimal stability without high loss of lift. The lateral stability characteristic is calculated by analyzing using XFLR5 program.



Graph2.7.1.1 Lateral Root Locus

Longitudinal Stability

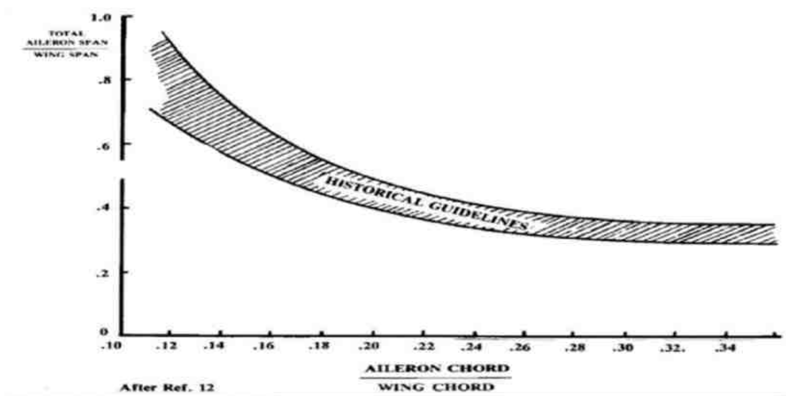
The team designed a horizontal tail with an area of 0.05 m^2 to provide sufficient stability in a distance of 600 mm from the center of gravity. Since the center of gravity is ahead of the aerodynamic center, it gives the tail an angle of 0° to provide the necessary moment balance for the center of gravity to provide the required longitude stability.



Graph 2.8.1.2 Longitudinal Root Locus

2.6.3 Control

It will have non-aggressive maneuverability and a balanced sailing aircraft design. Each aileron is designed to be 430 mm long with 0.013 mm^2 area and is placed on the right and left wing panels to gain more momentum. In order to increase the glide ability of the aircraft during turns, a dihedral angle of 6 degrees has been given.



Graph 2.8.2 Control Surface Sizing

In our Aygök aircraft, 2 flaps will be used for the targeted take-offs and landings of 40 meters. The flaps will give the necessary deceleration with a downward movement of -30 degrees. The flap area of 0.04 mm right and left to reduce our speed to between 20-30 km/h

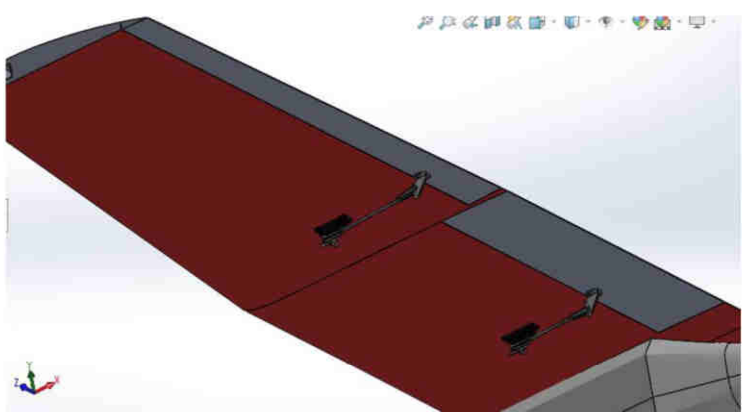


Figure 2.9 Center of Gravity of Components

2.7 Weight and Balance

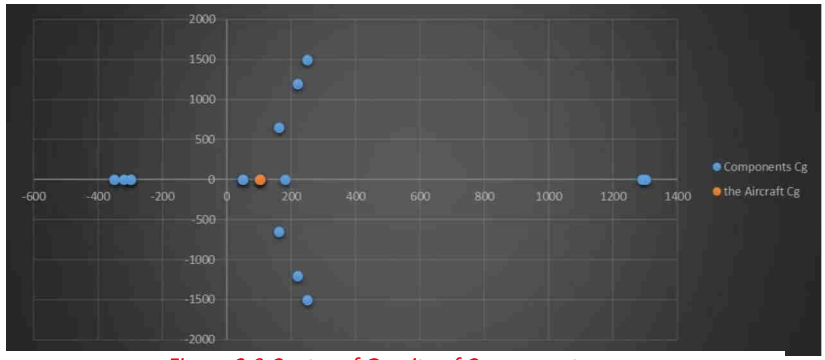


Figure 2.9 Center of Gravity of Components

The weight of aircraft is approximately 1,5 kg without payloads. This weight was obtained by calculating details on the excel table. The center of gravity is arranged close to the quarter cord, which is the aerodynamic center of the wing. The payload used have been tried to minimize the impact of center of gravity of our aircraft. The weights were adjusted in a balanced manner about the y axis so that the aircraft cannot roll by itself. Because it was designed as a top wing to increase aircraft stability, it gives a nose-down moment around z-axis. The elevator was set down to remove this effect from the middle.

No	Component	Weight (g)	X (mm)	Y (mm)
1	Fuselage	310	75	-68
2	Left Wing Panel	90	65	13
3	Right Wing	90	68	28
4	Center Wing	120	68	28
5	Tail	100	695	-65
6	Motor and Prop	230	-210	-68
7	Landing Gear	60	16	-205
9	Payloads (4 or 5 piece)	1500	82	-75
10	Payloads Store	30	82	-75
11	ESC	50	-126	-95
12	Battery	250	-105	-105
13	Receiver	15	-120	-65
14	Left Wing Servos (1 piece)	15	80	15
15	Right Wing Servos (1 piece)	15	80	15
16	Center Wing(Flap)(2 piece)	30	90	25
17	Tail Servos (2 piece)	30	255	-60
18	Receiver battery	64	70	32
13	**Total**	**3.000**		

Table 2.7 Component Weight and Location

2.8 STRUCTURAL DESING

2.8.1 Wing Structure

Foam for the inner structure will be used as the main material in the wing, and 60 gr fabric will be used as the covering material. In addition, carbon fiber pipes were used as spar. The payload area will be constructed as a closed area inside the fuselage. To ensure maximum efficiency, the wing has a defined 3^0 angle of attack and dihedral angles of 6 degrees across the wing.

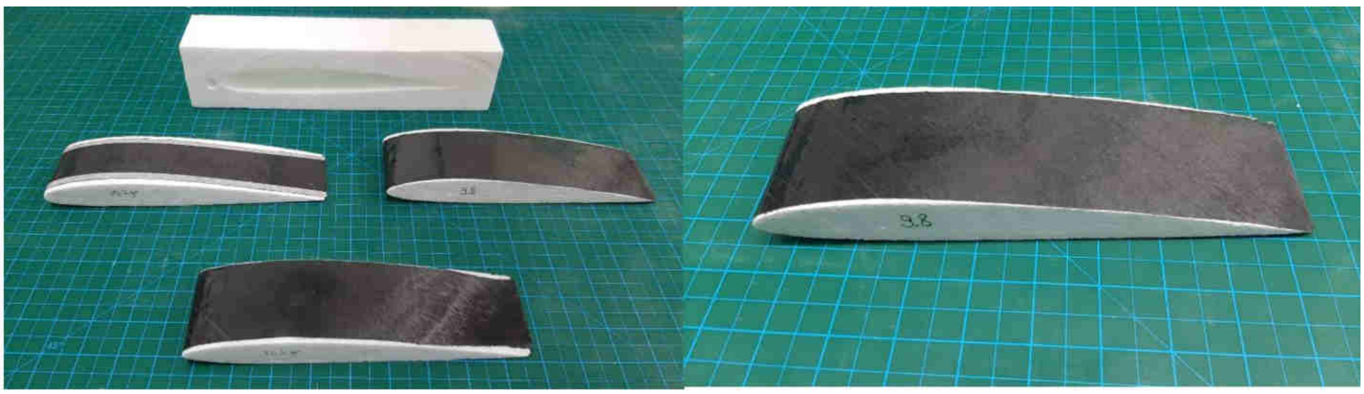


Figure 3.1.3. Wing production trials

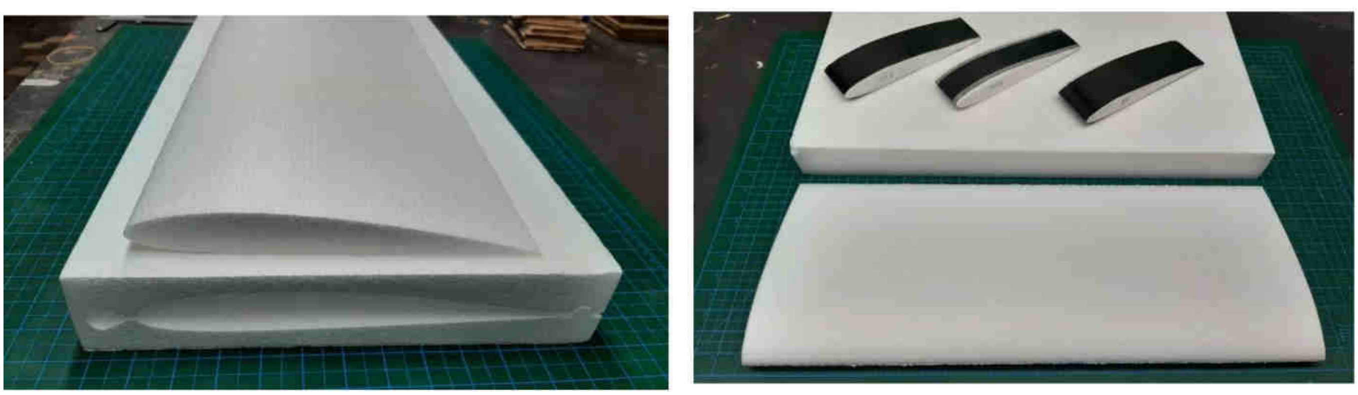


Figure 3.1.3. Wing core & cavity

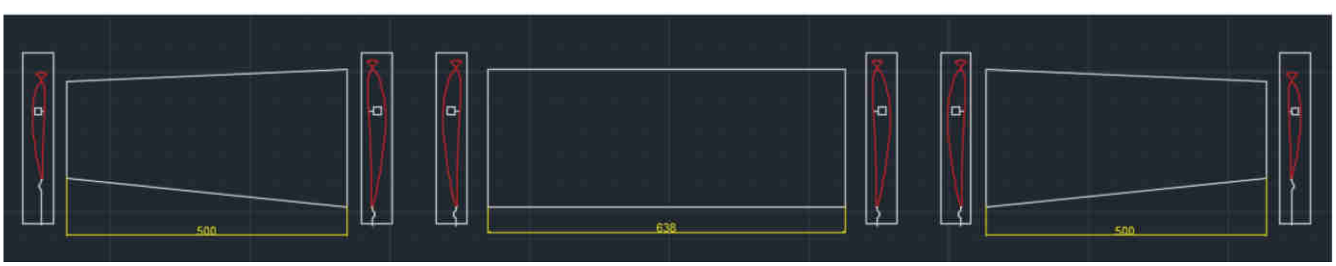


Figure 3.1.3. Wing Foam cutting line

In order to produce the wings of our aircraft quickly and cheaply, we will use the wing cutting techniques of our own design. In this way, we will obtain carbon wings with very high quality surfaces. With this technique and cutting method, we have the opportunity to produce directly without metal molds.. 3.1.3. Wing Foam cutting line

Wing connection Figure 3.1.3. Wing Structure will be attached to the body with 2 M3 metal screws as seen. All assembly of our aircraft will be completed by tightening 4 screws;

2 wing attachment screws

1 landing gear attachment screw

1 elevator connection screw

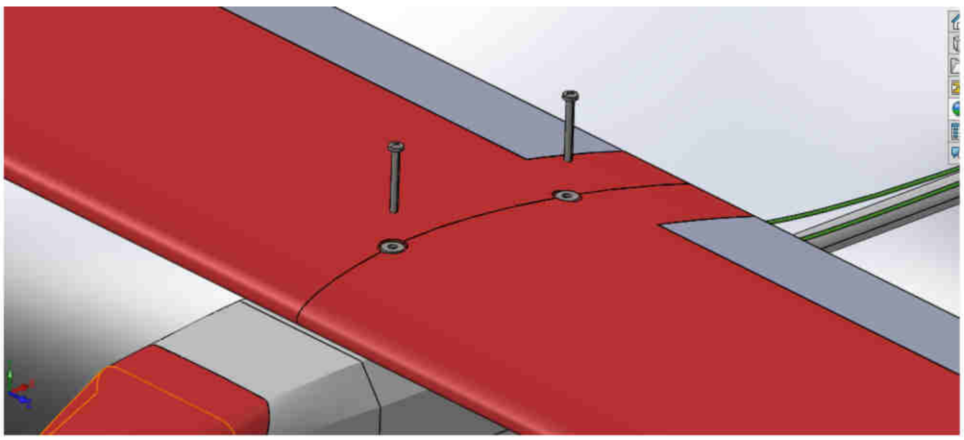


Figure 3.1.3. Wing Structure

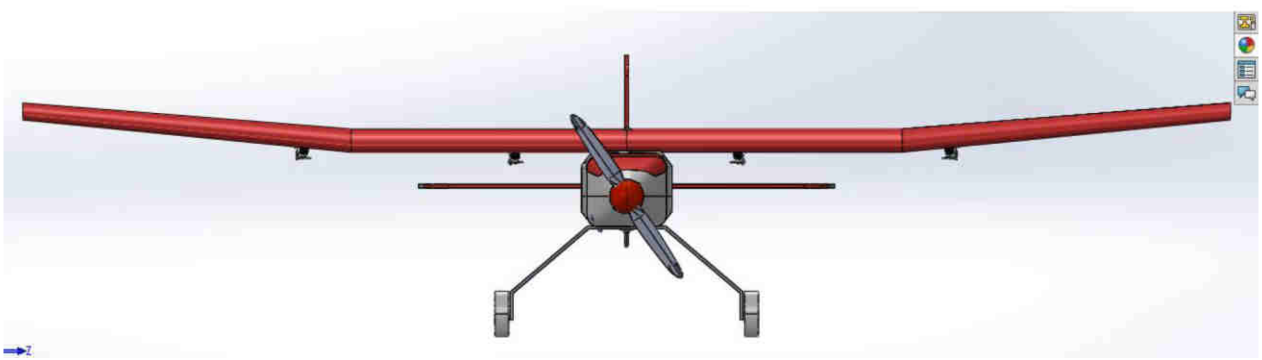


Figure 3.1.4. Dihedral View

Carbon joiners were used to provide these dihedral angles. In order to provide the angle of attack, the part connecting the wing and the fuselage has been elevated. 3.1.4. Dihedral View

2.8.2 Joiners

We will cut carbon joiners from 3 mm carbon sheet with cnc machine. With 3 plate cuttings, we will obtain a 9mm wide carbon joiner.

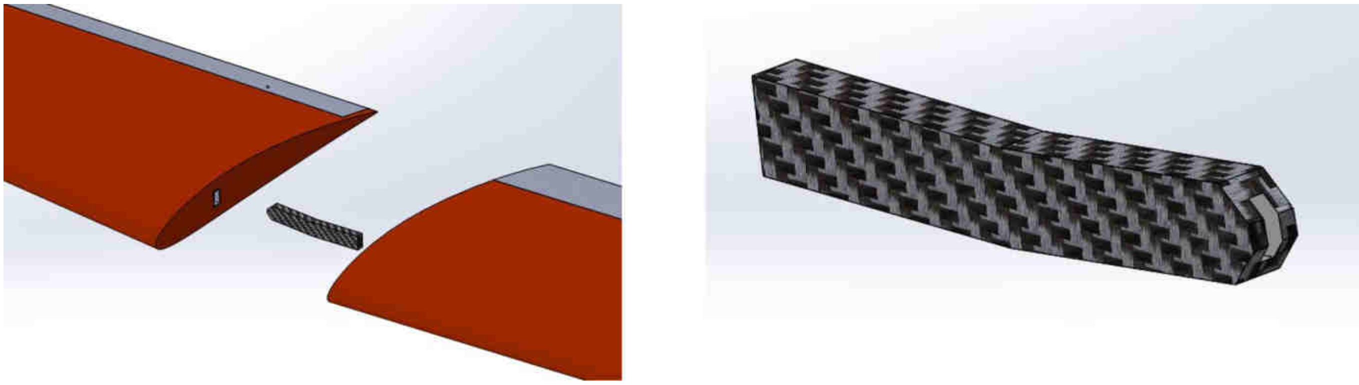


Figure 3.1.5. Carbon Joiner Dihedral View

Figure 3.1.6. Angle of Attack

The winglet was designed to increase the efficiency of the wing tips after the need was identified in the analysis results.

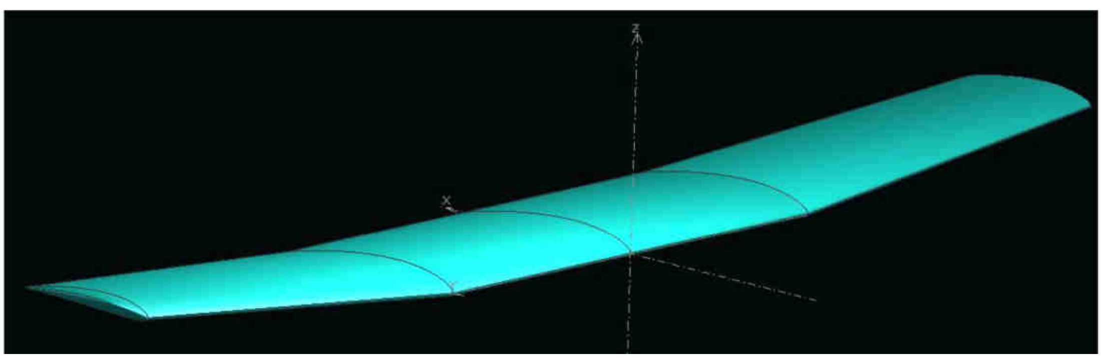


Figure 3.1.5. Wing Structure

2.8.3 Wing Analysis

Wing structure loaded to ansys program. Calculated loads were applied to this structure. The results showed that the structure is ready for the flight and no deformation encountered. To make structure lighter few arrangements made then final design has obtained.

Figure 3.1.1 Wing center of gravity calculation

2.8.3 TAIL

The conventional tail configuration consists of two parts. One of them is the elevator and the other is the rudder. The tail is connected to the body with the help of specially designed carbon fiber plates.

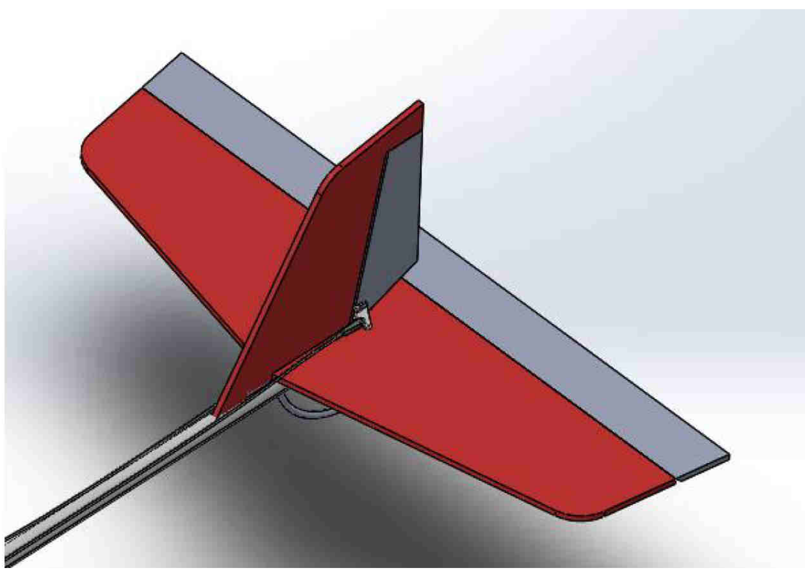


Figure 3.2.1 Tail Structure

An easy mounting method has been determined for the screw connection of the elevator on the body. In this way, the tail is connected to the trunk pipe. In addition, the rudder will be fixed by sticking it to the channel opened into the carbon fiber pipe.

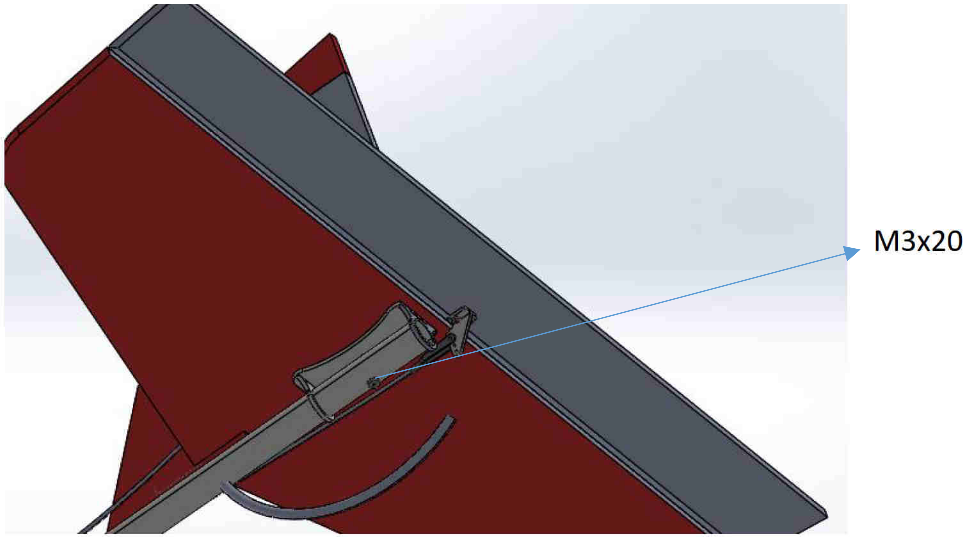


Figure 3.2.2. Horizontal Stabilizer Connection

1 mm steel wire will be used to control the elevator and its rudder. The movement from the servos in the body to the body pipe will be with the help of steel wire and plastic pipe.

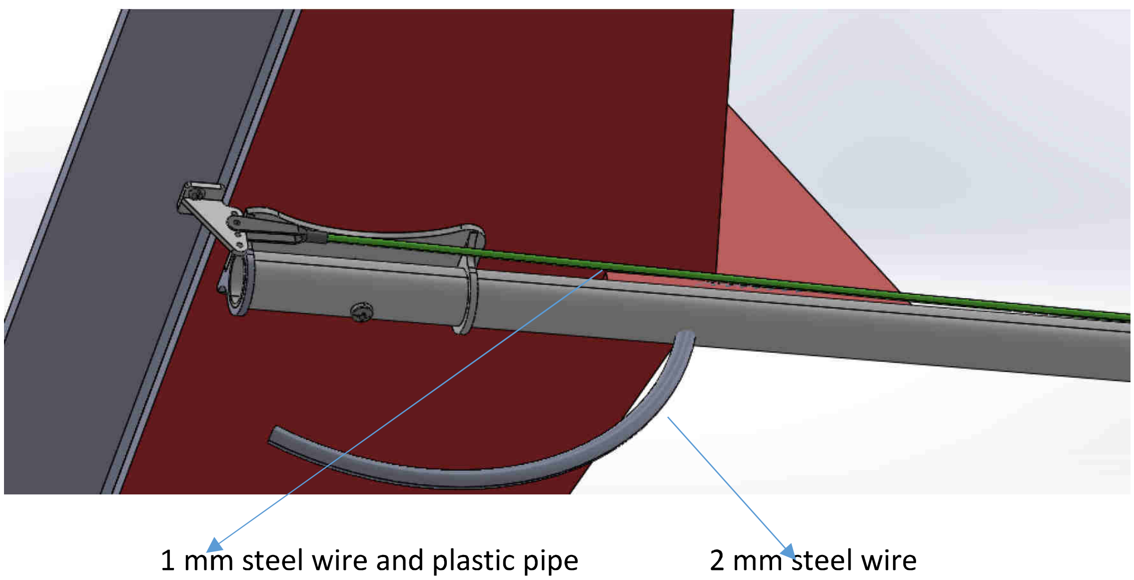


Figure 3.2.3. Elevator control wire

Moreover, the horizontal tail has an angle of attack of 0 degree. This angle of attack is achieved by mounting on the body tube surface. The carbon fiber pipe between the fuselage and the tail is bonded to the fuselage with epoxy.

Figure 3.2.3. Angle of Attack on Horizontal Stabilizer (0 ^{0})

2.8.4 Landing Gear

For the landing gear a commercial product ready made from carbon material will be used. In order to shorten the assembly time, it will be mounted with a single screw and 2 pins. In addition, it may enter the transport box without any problems by turning 90 degrees without being disassembled.

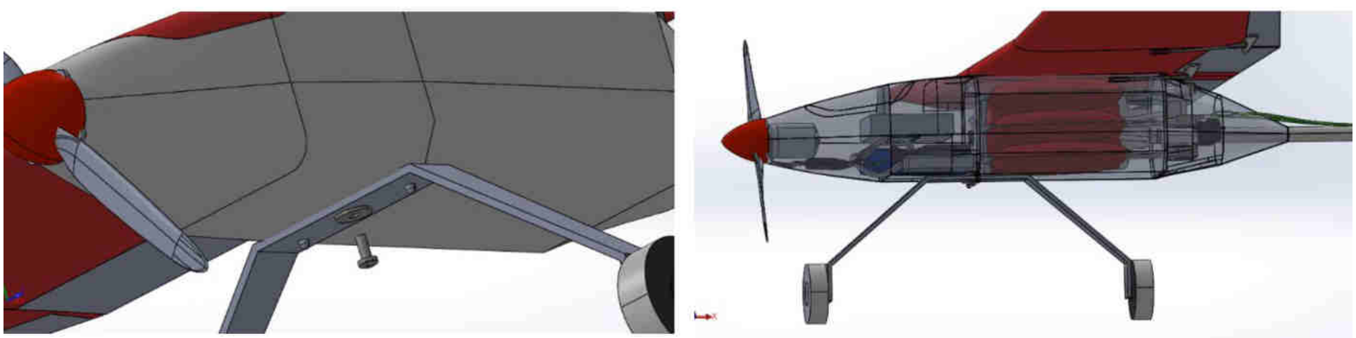


Figure 3.2.4. Landing gear 0^0 and 90^0 position

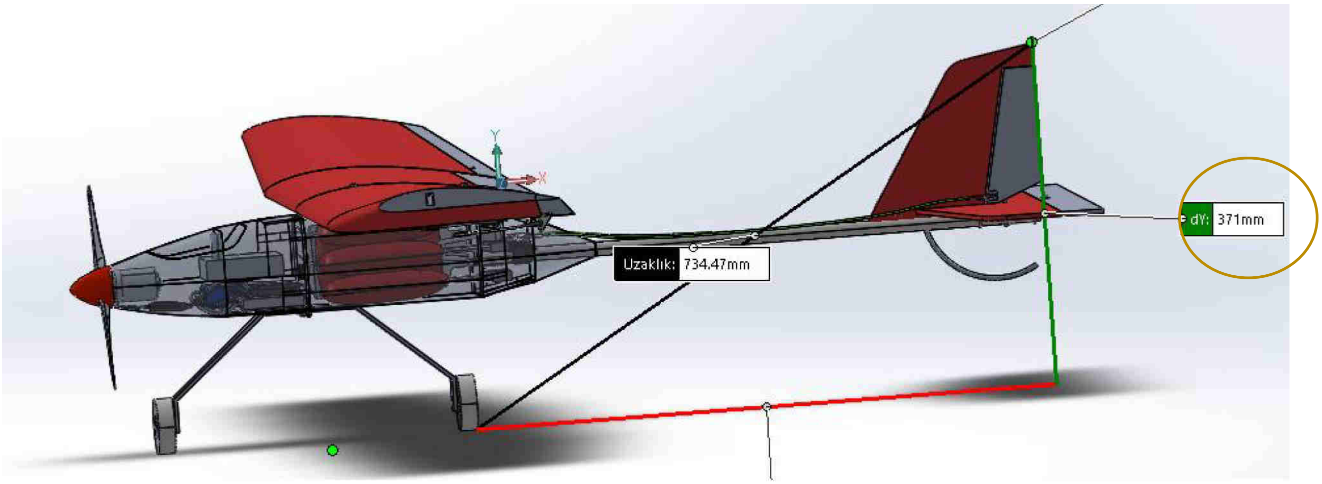


Figure 3.3.1

2.8.4 PAYLOAD BOX AND COVER

Requested things from the teams on the task; carrying the maximum load on the desired route in minimum time. In addition, there is a possibility of extra points for the time the aircraft is loaded. Shorter amount of time of loading means more points for the team.

$$Time\ Bonus\ =\ 24\ (1 - \frac{t}{120s})\ for\ t\ <\ 120s$$

$$Time\ Bonus\ =\ 0\ for\ t\ \geq\ 120s$$

For this reason, the mechanism of the box in which the payload will be carried has been designed to facilitate the loading process. First of all, the volume is determined according to the dimensions of the 300 mlt blood bags specified in the rule book. Later, in order to reduce the amount of friction that will occur due to the system being inside the body, it was designed with a pointed front and back. In addition, the cover is prepared as the plug-in mechanism. Since the entire system is inside the aircraft and at the center of gravity, the landing gear is designed to be in front of this system.

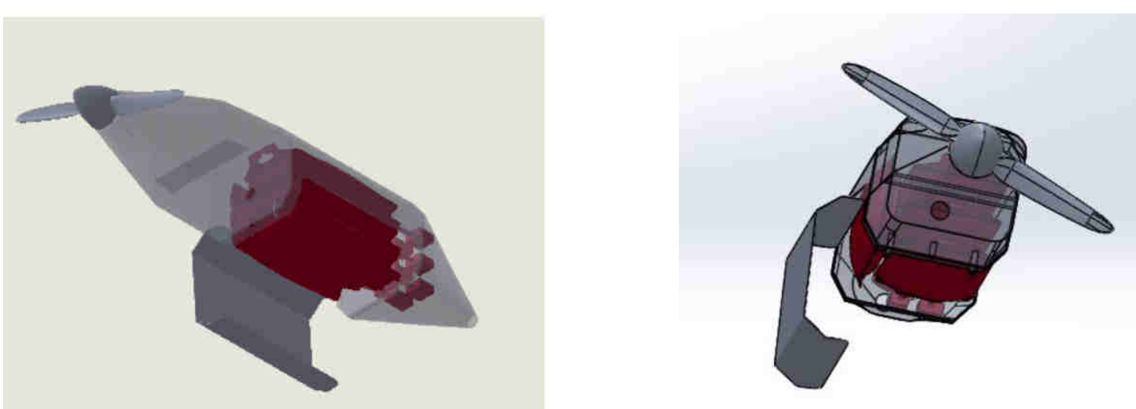


Figure 3.3.2. a) Payload box and cover

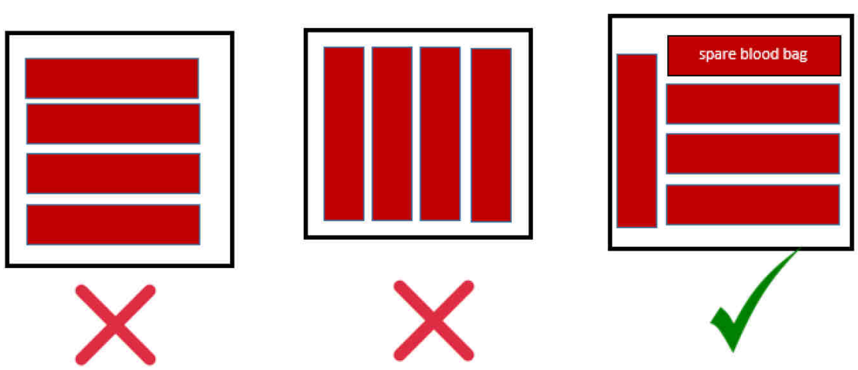
For an easy assembly of the cargo bay to the body, it is planned to use the apparatus shown in the figure. As a result, it is possible to assemble the part quickly.

3.PAYLOAD PREDICTION

After the aerodynamic analyzes, it is seen that the aircraft can carry a payload that has a mass of max 1.2 kg or 1.5kg. If we consider the height of the plane flying at approximately sea level, our estimate is confirmed by the formula given.

We will start the first test flights with 4 blood bags. A maximum of 5 blood bags can be placed in the cargo area of our aircraft. In the wing elevation analysis, we determined that our plane could fly with a total weight of 30 newtons, or about 3 kg. The weight of our aircraft will be approximately 1.4 – 1.5 kg. As a result, a maximum 1.5 kg payload will be carried inside our aircraft. We will place the payloads on the plane quickly and safely to get the most points in the competition. Our preference will be a 300 ml blood bags. Three different options were evaluated for placement of the payload. We preferred 1 vertical and 3 horizontal placement to be able to carry an additional blood bag. By the help of this choice, we also prevented the moving of payload during the flight

We will quickly place the blood bags under the fuselage. With this hinged system, we will complete the pre-flight assembly without exceeding the loading time.



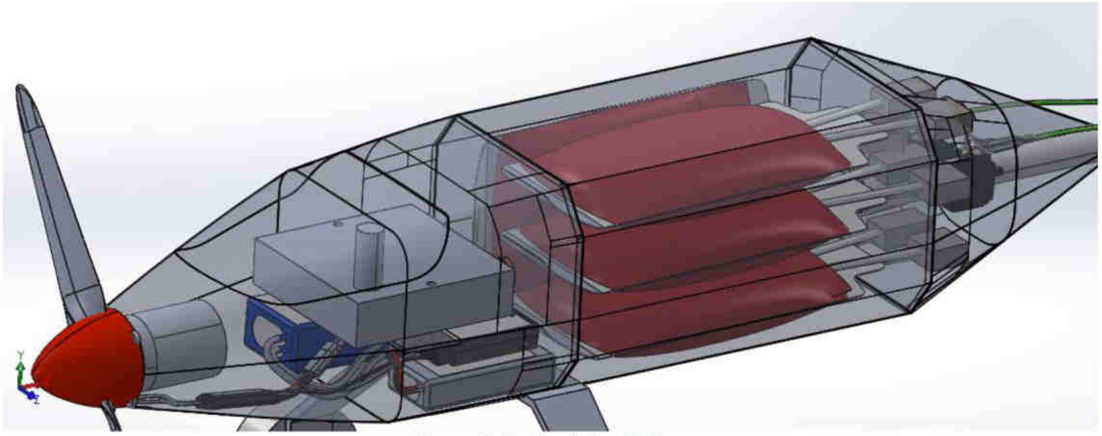


Figure 4. Payload Prediction

4.OUTLOOK

Figure 5.1. Final Design

During the conceptual design, the advantages and disadvantages were compared with specific factors. In the end; monoplane high wing with dihedral for the wing selection, conventional tail for the tail selection, single tractor motor for propulsion system, tail dragger for landing gear and payload system, have been chosen. Then by CFD analysis flow on the wing surface observed. Furthermore, strength of the structure tested under the aerodynamic forces by using ANSYS Structure. Finally manufacturing process has started according to the determined design. Trials were made for the method of covering the wings with carbon fabric on foam. The middle panel and side panels were cut on a 4 axis cnc foam cutting machine.

ADDITIONS-1

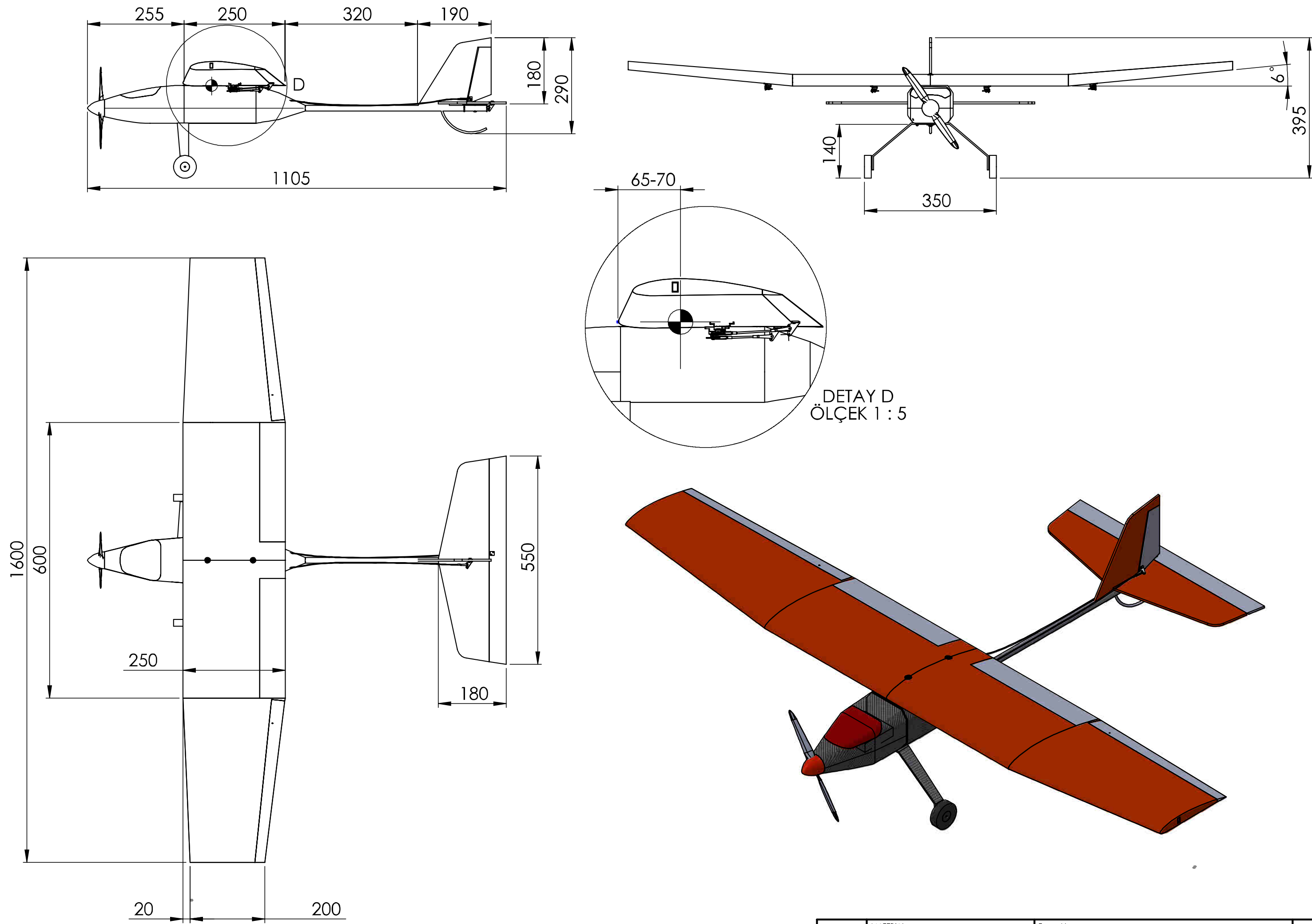
Pictures of Electronic Parts

Source

https://www.ecalc.ch/setupfinder.php

Tophane aygök Teknofest UAV 2020 report

Tophane aygök Teknofest UAV 2021 report



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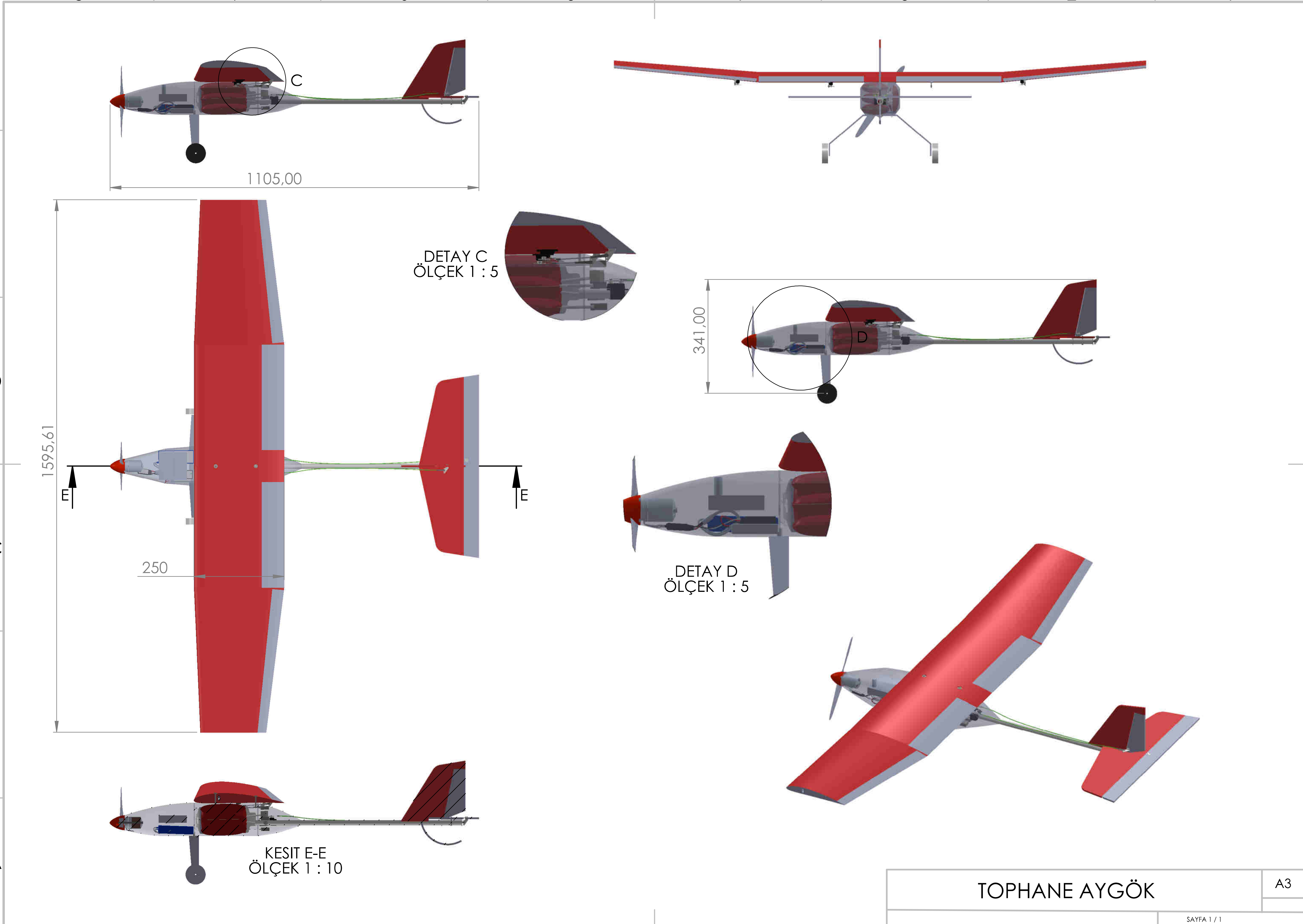
SING	WHIGHT:2800-3000gr	NAME Enes KUMSAR	PAGE 1 / 3



TOPHANE AYGÖK

A3

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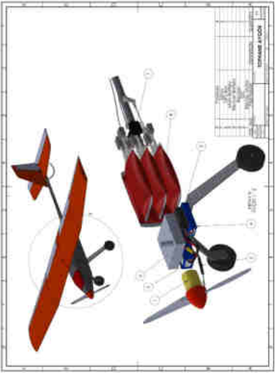

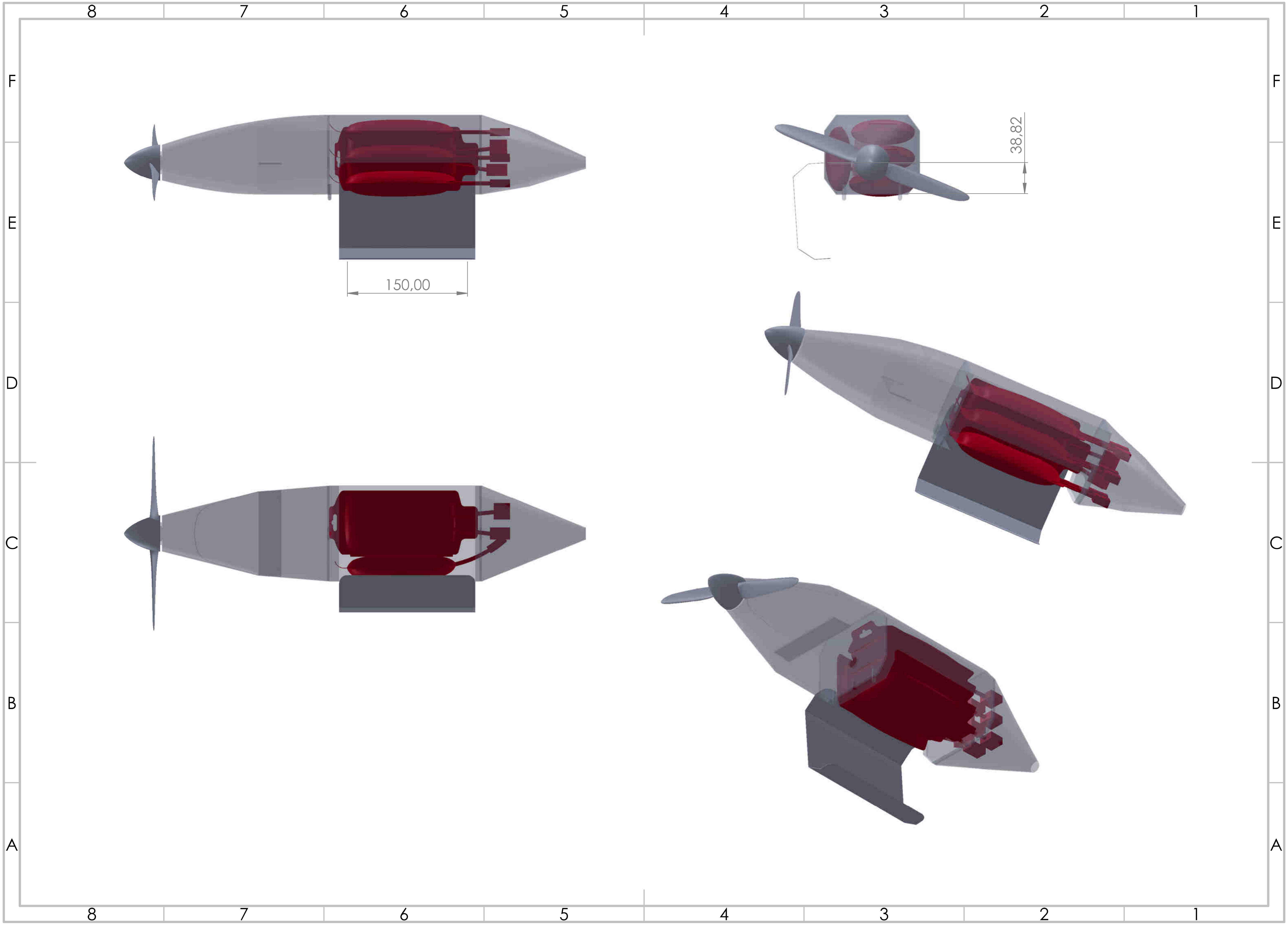
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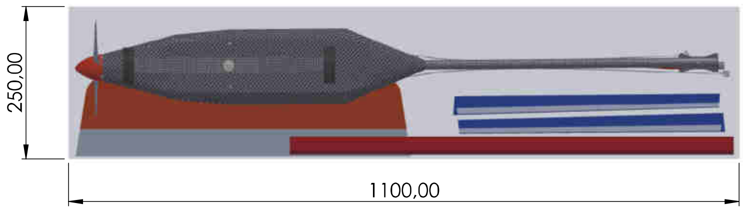
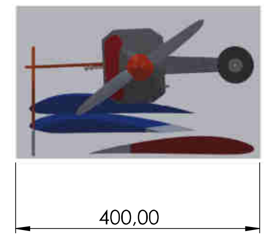
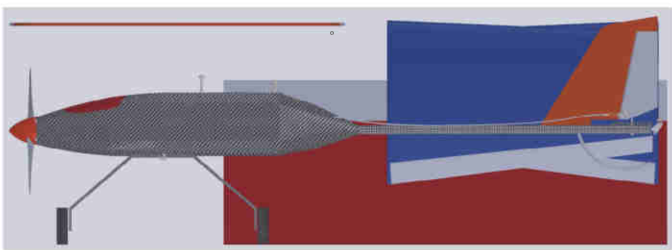
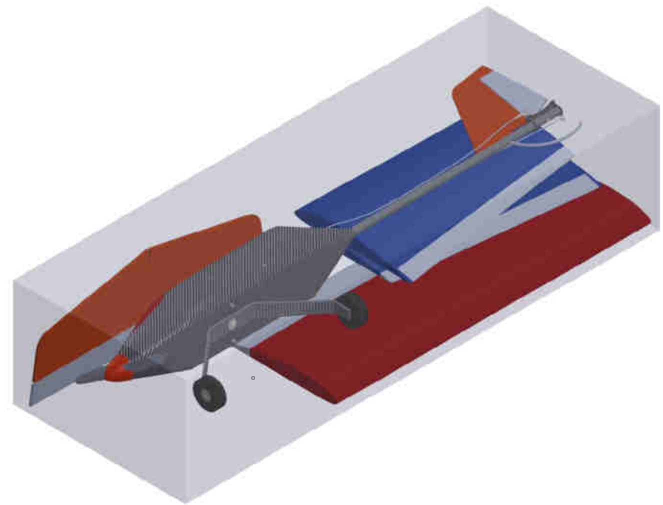
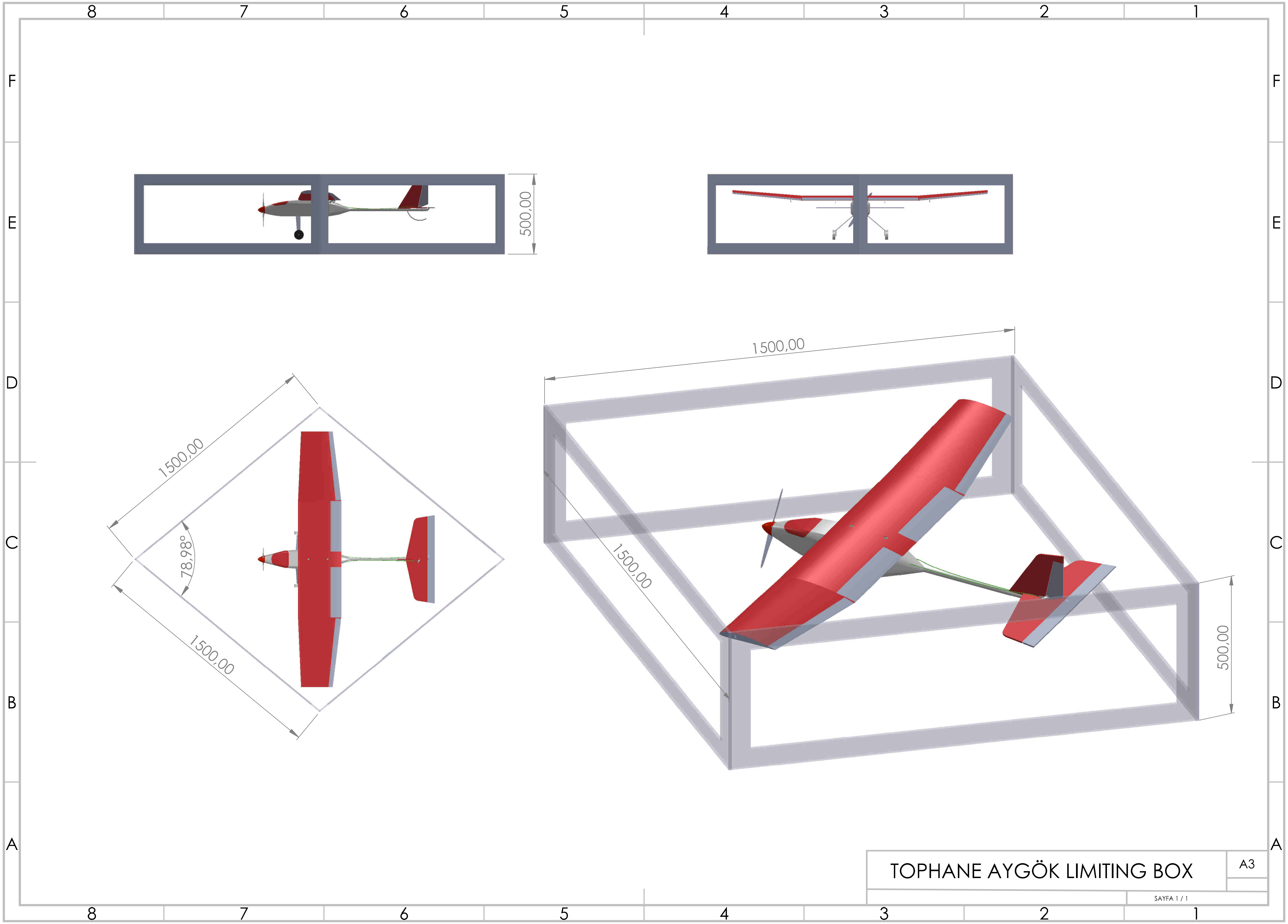








DATE	MATERIAL	Team Name	A3
15/03/2022	Transfer Box	TOPHANE AYGÖK	SCALE:1:20
SING			
	WHIGHT:2800-3000gr	NAME Enes KUMSAR	PAGE 1 / 1



TOPHANE AYGÖK LIMITING BOX

A3

SAYFA 1 / 1