

# Time for Adaption of New Eye to World

Meet Patel<sup>1</sup>,Aniket Parmar<sup>2</sup>,Varun Jaiswal<sup>3</sup>,Rishi Patel<sup>4</sup>,Jayrasinh Parihar<sup>5</sup>,Rishabh Patel<sup>6</sup>  
<sup>1,2,3,4,5,6</sup>Department of Aeronautical Engineering, Sardar Vallabhbhai Patel Insitute of Technology, Gujarat, India

**Abstract:-** The Aircraft that usually operated by some artificial intelligence is referred as a “Drone”. Any aircraft which is not having Pilot on board is termed as “Unmanned Aerial Vehicle”. As technology is increasing day by day all sectors including aviation too has shown some significant changes. There are many types of drones based on their uses also having different size and shapes based on their uses. For example let say quad copters are used for weather surveillance, aerial photography, etc. On other hand drones are also widely used in military operations or in defence sector. Well developed nations are using drones and unmanned aerial vehicles since long time; but when it comes to small nations whose economy is still under developing stage, they are also now advancing towards artificial intelligence in defence sector and it is expected that after 5-10 years all the countries around the world will use drones and UAVs in their defence.

## I. INTRODUCTION TO DRONE

A drone is classified as a “UAV” or an “Unmanned Aerial Vehicle” and it has a designated task that it can carry out, depending upon the requirements of the user. They come in various sizes and configurations which further bifurcates them based on their maneuverability and agility.

Drones can be of the typical copter type, for example, Quadcopter but also can refer to other aerodynamically streamlined aircraft type too, for example, NATO drones.



[Fig. 1] NATO Drone Global Hawk <sup>[4]</sup>

## II. ENDURANCE

The maximum time that an aircraft spend in cursing flight is termed as Endurance. It is given by the ratio of change in fuel weight to the fuel flow rate, while in cruise.

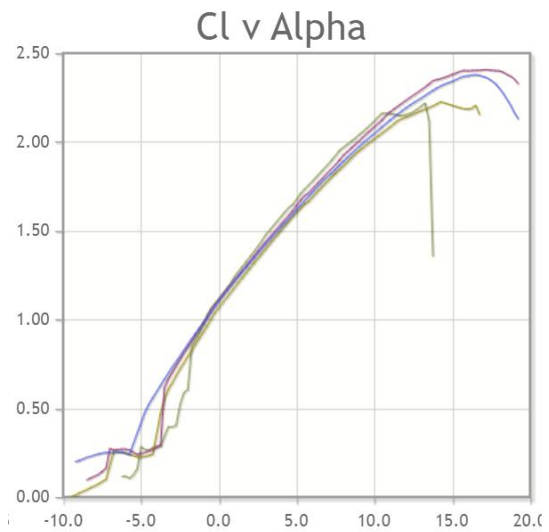
So this is completely dependent on the power plant (engine) characteristics. It can also be improved by having a high lift airfoil, so that a lesser thrust and subsequently lesser fuel flow rate is enough to keep the aircraft in level flight during cruise.

## III. AIRFOIL

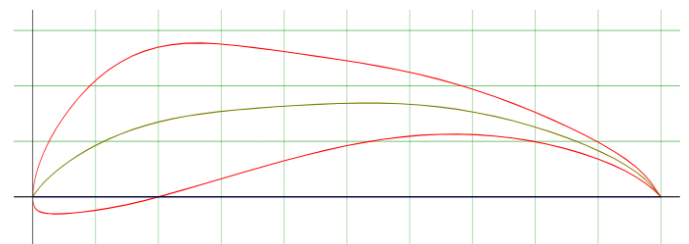
We have chosen the airfoil ‘S1223 RTL’ because of its high lift capability.

The graph between Coefficient of Lift,  $C_L$  and Angle of Attack,  $\alpha$  is for Reynolds Number range of  $2 * 10^5$  to  $5 * 10^5$ .

The design  $C_L$  as calculated in Problem Statement 1 is 2.48 (approx.,).



[Fig. 2]  $C_L$  Characteristics of S1223 RTL <sup>[6]</sup>



[Fig. 3] S1223 RTL Plot <sup>[6]</sup>

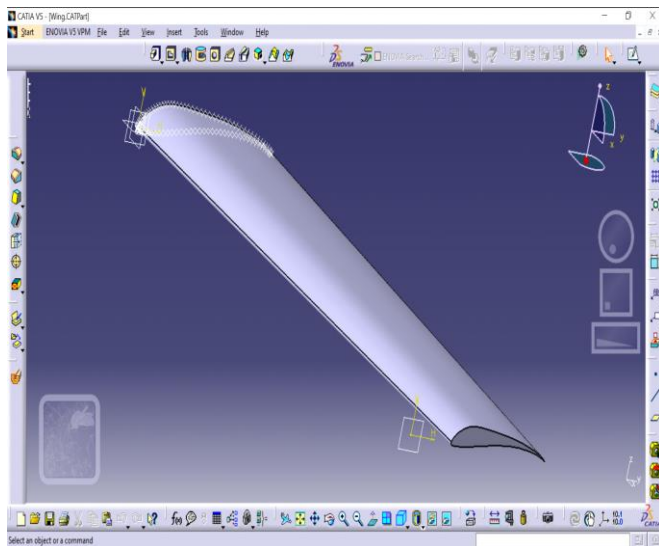
This airfoil is a Richard T. LaSalle modification of the S1223 to S1223RTL  
 Max thickness 13.5% at 19.9% chord.  
 Max camber 8.3% at 55.2% chord  
 The Dat file is taken for this airfoil from airfoiltools.com [6]

The root chord is 100 mm and the tip chord is 70 mm.

**IV. CATIA WING MODELLING**

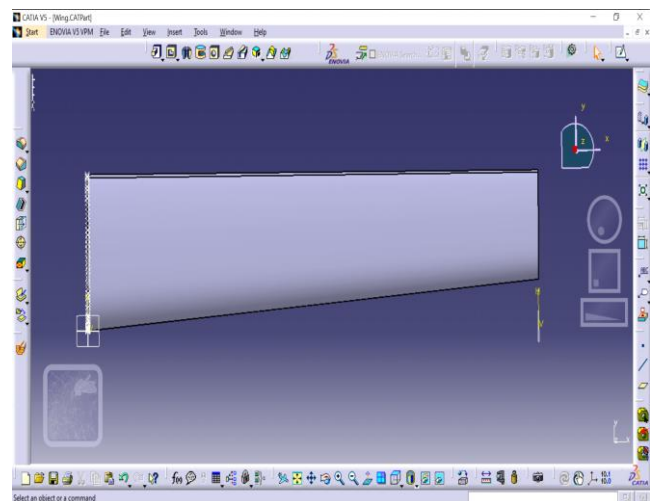
The wing has been modelled using the airfoil profile selected above. The airfoil profile points, from Dat file, was fed into excel file ‘GSD\_PointSplineLoftFromExcel’. Using View Macros, the airfoil profile is successfully input into the CATIA Part Design Sketch.

Then an offset plane is created and the airfoil is projected in the same. The airfoil is scaled and translated to get the tip of the wing. With the trailing edge coinciding, this gives us a Delta configuration wing.

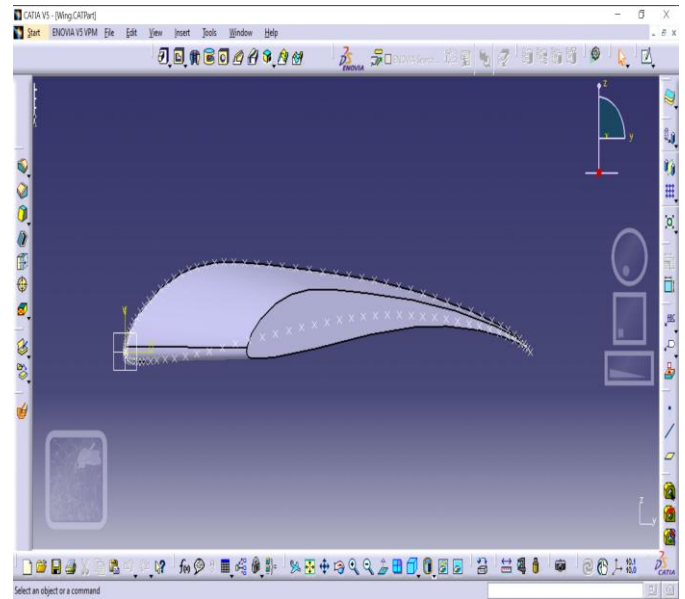


[Fig. 4] Modelled Wing

The top view below clearly shows the delta configuration. Further the 0.7 factor scaling done can be witnessed in the side view of the wing, showing the difference between the root and tip airfoil chords.



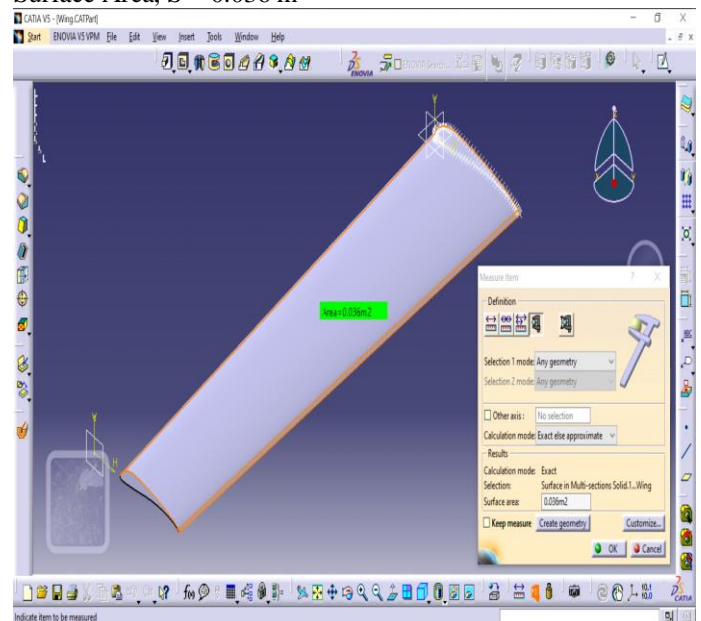
[Fig. 5] Top View



[Fig. 6] Side View

Using Measure Item tool, the surface area of the wing is found. As the wing in itself is only 400mm span, the surface area will be quite small.

Surface Area,  $S = 0.036 \text{ m}^2$



[Fig. 7] wing geometry

**V. PROPULSION UNIT**

The PBS TJ150, with a maximum thrust of 1,500 N, is the most powerful turbojet engine produced by PBS. Its advantage is its compact design, low weight with a thrust of up to 1,500 N, and low fuel consumption in the given power category. The generator output is 750 W. One of the PBS TJ150 engine versions enables landing on water. The PBS TJ150 engine is a single-shaft jet engine consisting of a radial compressor, radial and axial diffuser, annular

combustion chamber, axial turbine and a fixed outlet nozzle. [7]

The model is made using CATIA as shown below.

## PBS TJ150 Engine Parameters

Technical parameters	SI units
Max. thrust	1,500 N
Weight	18. 9 kg
Outer diameter	272 mm
Length	518 mm

[Table 1] Engine Parameters [7]

The length and the diameter of the engine is noted for the design of the model.

### VI. AERODYNAMIC PARAMETER CALCULATIONS

The common cruise speed for a fixed-wing long range drone is 250 m/s

Using an optimum thrust of 1000 N, as maximum thrust is not needed in cruise.

Using the thrust equation,

$$T = m' * V$$

- $m' = T / V = 1000 / 250 = 4 \text{ kg/s}$

The dynamic pressure at cruise altitude and velocity,

$$q = \rho * V^2 / 2 = 0.41356 * 250^2 / 2 = 12923.75 \text{ N}$$

The Lift is then given by,

$$L = q * S * C_L = 12923.75 * 0.036 * 2.48 = 1153.8324 \text{ N}$$

The dynamic pressure at sea level altitude,

$$q = \rho * V^2 / 2 = 1.225 * 250^2 / 2 = 38281.25 \text{ N}$$

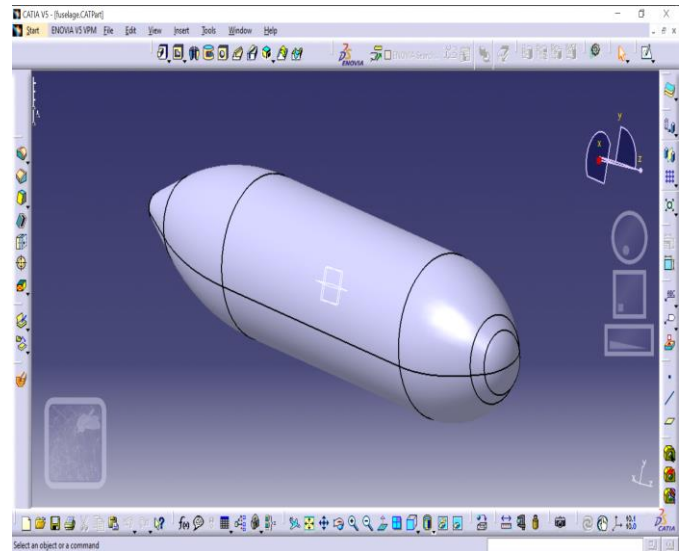
Due to this excessive pressure, near transonic velocity is not possible in sea level atmosphere.

The Lift is then given by,

$$L = q * S * C_L = 38281.25 * 0.036 * 2.48 = 3417.73 \text{ N}$$

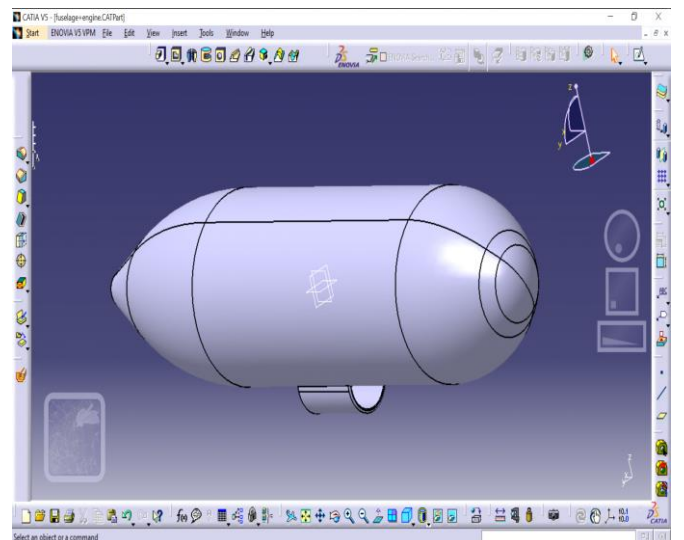
### VII. FUSELAGE

The fuselage is modelled to be simple and effective. There is no need for a cockpit as this is supposed to be unmanned. The fuselage has to support essential avionics, control system and surveillance equipment. Further fuel for a 48hrs surveillance mission must be carried.

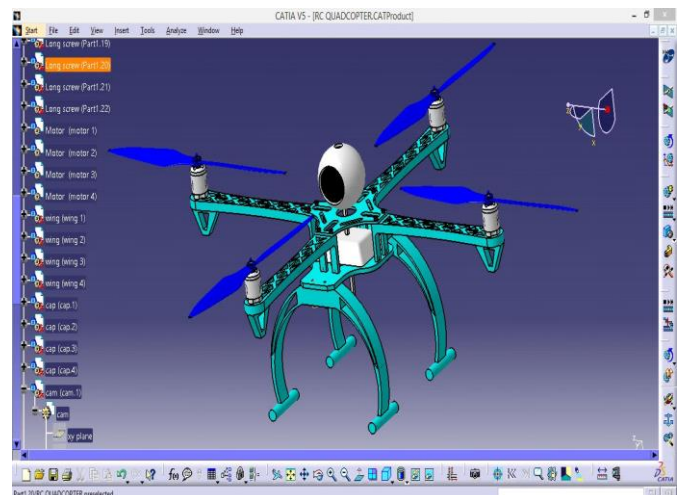


[Fig. 8] Fuselage

The propulsion unit is placed on the belly of the fuselage. The placement is shown below.



[Fig. 9] Engine Placement



[Fig. 10] Final model in CATIA

## VIII. CONCLUSION

To sum up, due to advancement in technology people around the globe can easily afford the drone for their private uses or for their entertainment. Drones are not only used for entertainment purpose or in defence related activities but now some delivering agencies are now focusing on the uses of drones to deliver their parcels across the whole country. The major benefit of the drones is that it reduces man work. For example if drones are used to deliver parcel than it will increase the speed of the work and on other hand it will also decrease the man effort.

Many people nowadays are choosing artificial intelligence as their professional hobby and for that people drones and UAVs plays a key role for their career and as there are copious choices in the field of AI, people will also get vast opportunities for their career and we hope that this sector would how some significant advancements in near future.

## REFERENCES

- [1]. [https://www.engineeringtoolbox.com/international-standard-atmosphere-d\\_985.html](https://www.engineeringtoolbox.com/international-standard-atmosphere-d_985.html)
- [2]. <https://www.sensorsone.com/local-gravity-calculator/>
- [3]. <http://www.aerodynamics4students.com/properties-of-the-atmosphere/sea-level-conditions.php>
- [4]. <https://www.defencetalk.com/nato-drone-project-set-to-continue-47912/>
- [5]. [https://en.wikipedia.org/wiki/Endurance\\_\(aeronautics\)](https://en.wikipedia.org/wiki/Endurance_(aeronautics))
- [6]. <http://airfoiltools.com/airfoil/details?airfoil=s1223rtl-il>
- [7]. <https://www.pbs.cz/en/Aerospace/Aircraft-Engines/Jet-Engine-PBS-TJ150>