Radio Controlled Aircraft Building

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*Abstract_* **The motive of creating this paper is to encourage all the fellow students in the field of Aerodynamics, which is best achieved by creating an aerodynamic model. In this research paper we have tried to include all the essential data required to build a flying model which we hope will help students as the guide to complete their model.A radio controlled plane (RC Plane) is a small flying machine i.e. controlled by an operator on the ground using a hand held transmitter. The plane is controlled using a transmitter communicating with a receiver sending signals to servos on-board the plane.**

Keywords: RC Plane, Material selection, Fuselage, Rudder

I. INTRODUCTION

A fighter aircraft is a military aircraft designed primarily for air-to-air combat against other aircraft, as opposed to bombers and attack aircraft, whose main mission is to attack ground targets. The hallmarks of a fighter are its speed, manoeuvrability, and small size relative to other combat aircraft. Many fighters have secondary ground-attack capabilities, and some are designed as dual-purpose fighter-bombers; often aircraft that do not fulfil the standard definition are called fighters.

II. TERMINOLOGY

A . Drag:

The aerodynamic force resolved in the direction parallel to the free stream due to (1) viscous shearing stresses, (2) integrated effect of the static pressures acting normal to the surfaces.

B. Lift:

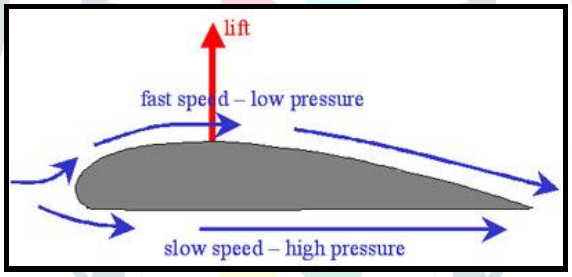

Fig. 1 Lift on airfoil shape of wing

The aerodynamic force resolved in the direction normal to the free stream due to the integrated effect of the static pressures acting normal to the surfaces.

C. Airfoil:

An airplane wing has a special shape called an airfoil. As a wing moves through air, the air is split and passes above and below the wing. The wing's upper or the lower surface is shaped in a form of a curve depending on the requirement of the model. This curve shape causes the air to rushing over it to speeds up and stretches out. This decreases the air pressure over the curved part of the wing.

D. Fuselage:

Fuselage is the main structural element of the RC Airplane or the body of the RC Airplane. The Wing, Horizontal and Vertical Tail are connected to the fuselage. The Engine is also mounted to the fuselage. The fuselage is made up of bulk-heads.

*E.Radio Control***:**

UAVs are the Unmanned Aerial Vehicles, They have transformed the idea of the air power in modern war times. They are smaller than jet aircraft, they are less expensive, and they don't put the pilots at risk when they crash**.** Radio Tx\Rx are basically used to control all the possible functions on a plane. Transmitter transmits control information to Plane.

III. METHODOLOGY

A. Design

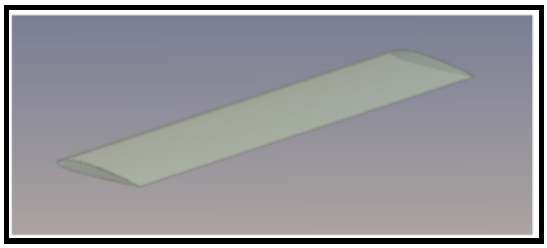

Fig. 2 Aircraft wing model created in CATIA

The above model is designed by using CATIA.

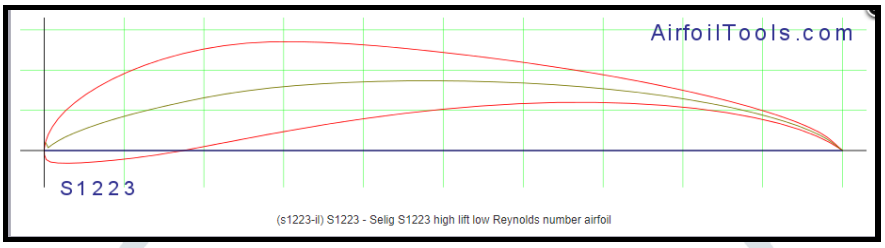

Fig. 3 Air-foil Selection

B. Description of Geometry Model.

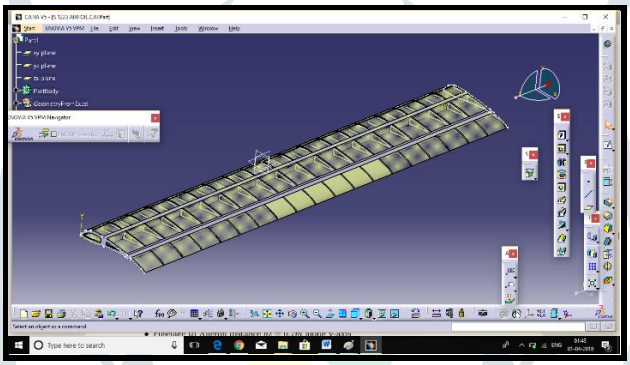

Fig. 4 Designing of wing in CATIA software

C. Material Selection.

Metallurgy has played a key role in the development of aviation. Until recently, some new materials have been applied in aircraft construction, such as titanium alloy, or composite. However, these super alloys are still quite expensive for the aircraft home-builder. With its advantages in weight and cost ratio, aluminium alloy is still used very widely. Aluminium alloy 7075 T6 [11] is also an attractive material, so it is used in the design of this study.

IV. MANUFACTURING OF THE PLANE

A. Wing.
B. Fuselage.
C. Elevators & Rudder.
D. Landing gear.
E. Electronics Used on board.

A.Wing:

Types os wing: i) Rectangular wing ii) Tapered wing iii) Elliptical wing

From above types of wings “tapered wing” was selected which was suitable to carry required lift. According to the lift force, a material which could withstand that force and was light weight had to be a chosen. Hence high density “balsa wood” was a considered a good option.

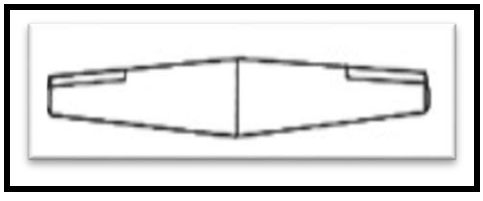

Fig. 5 Tapered wing

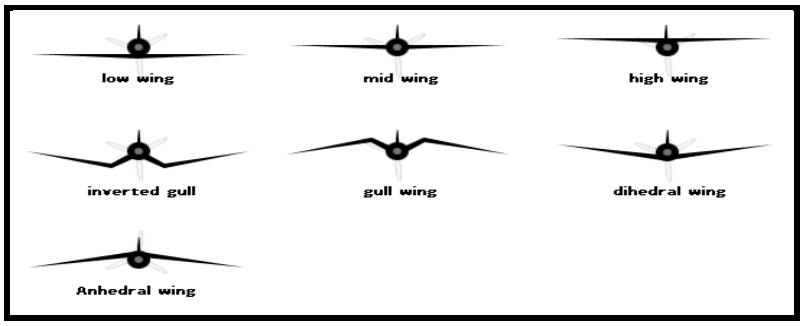

Fig. 6 Types of wing position

B. Fuselage:

First of all, the fuselage was made by using suitable thick balsa wood. The required bonding of fuselage was achieved by using surface mat & resin.

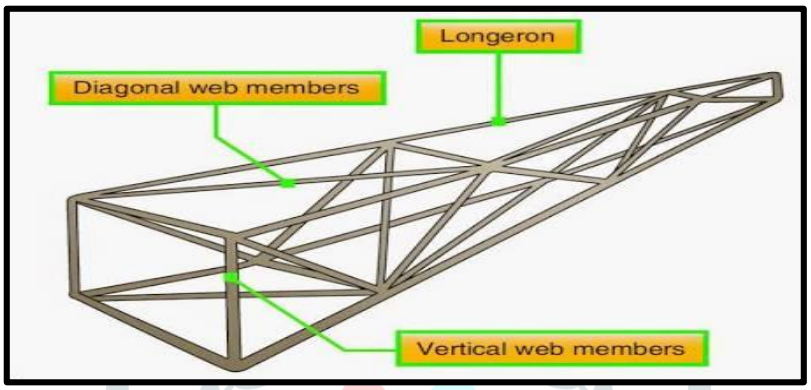

Fig. 7 Fuselage Structure

C. Elevators & Rudder:

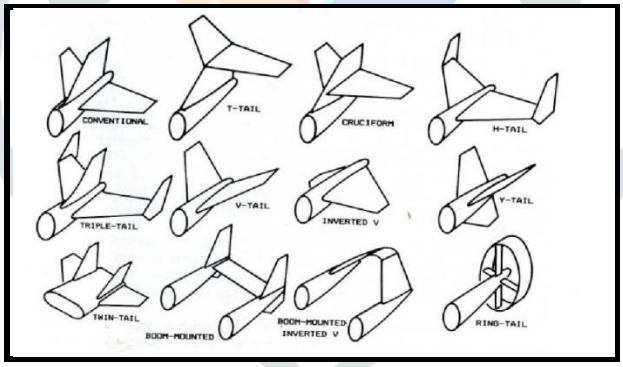

Fig. 8 Various types of Tails

From the basis of above types T-Tail was selected.The elevators & rudder are made by using same material of required thickness, since it had high toughness & could be rigid throughout the flight.

D. Landing Gear:

There were mainly three landing gears are used. i) Left side landing gear ii) Right side landing gear iii) Main (nose) landing gear. All of those landing gears are made of alloy steel

E. Electronics used on board:

i. Motor: The motor which should give required thrust was used with suitable outer & inner diameter. Weight of motor is around 600g. & total 2 no. of motors are used.

ii. Electronic Speed Controllers (ESC):

The ESC's are used to control speed produced by the motor. Total 2 no. of ESC's were used to control speed.

iii. Batteries:

Total 4 no. of lithium polymer batteries are used with required voltage & current.

iv. Transmitter & Receiver:

To control the movement of elevators for take-off and landing and also the throttle of the motor a 2.4 GHz transmitter and 12 channel receiver was used.

V. FLIGHT TEST & PERFORMANCE

Extensive flight testing was done in different conditions which included different tail wind velocities. It was found that the plane didn't have major problems for designed flight duration of about 4-5 minutes. Also crash test was performed and it was seen that the motor mount detached as per requirement and the motor and propeller were saved.The symmetric airfoil provided good manoeuvrability and not a very high lift (provided good lift up to stall condition and no stall occurred. (The overall lift wasn't very high) as expected. The electronics combinations of motor, ESC, Servos also proved to be the right combination.

VI. CONCLUSION

Based on aerodynamic analysis of the airflow over aerofoil, the following conclusions can be made: Pressure is lower on the upper surface of aerofoil and reaches its maximum at the point of attack. Meanwhile, the flow velocity on the upper surface is faster than the lower surface of aerofoil. Therefore, lift generation theory was demonstrated to be consistent by simulation method. Lift force is larger about 22.5 times than drag force. It allows lifting the weight of the flying objects. Computed lift and drag coefficients using the numerical simulation were found in good agreement with the theory for aerofoil. This method is likely to be highly applicable to continuing research and development on the aircraft. Finally, it is felt that the aerofoil shaped wing might be a very good option for manufacturing the experimental future UAVs.

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