Design, Fabrication and Testing of a Remote - Controlled Airplane with High - Payload Ratio

Sasi Kumar M[1] *Aravind.B*[2] *Rahul.V*[3] *Reshma.G*[4] *Shruthi.S*[5]

[1]Assistant Professor, [2345]UG Scholar, Department of Aeronautical Engineering
SNS College of Technology
Coimbatore, India

Abstract : This paper boarder around design, fabrication and testing of a remote controlled airplane with high payload ratio. In the field of aviation, engineers play a vital role in solving complex problems like producing an airplane with high payload ratio, aerodynamic & performance efficiencies and structural safety. However, some of these problem statements are reduced in scale and given to engineering graduates for innovative results and applications. One such society which bridges this gap between industrial engineers and engineering graduates is the Society of Automotive Engineers (SAE). Two members of our project team have already registered for SAE Aero Design Competition 2018 which is going to held in California during April, 2018. The purpose of this project is the gradation of visionary design, manufacturing, system integration and experimentation of a remote controlled airplane with high payload ratio capable of lifting great loads while remaining as light as possible. An optimal design will be developed by maximizing the aerodynamic lift and reducing the aircraft weight without compromising the overall performance. However, the design must stay within the rules and restrictions of the SAE Aero Competition Guidelines.

IndexTerms- **Payload ratio, Aerodynamic Efficiency, Performance Efficiency, Structural Safety.**

I. INTRODUCTION

Remote controlled electric-airplanes are built based on the conceptual design parameters provided by the client and the field of application. The remote controlled airplane our team building is a small scale commercial airplane lifting heavy loads. Aero modeling a commercial airplane, abiding the rules and regulations constrained by the competition guidelines is truly a grandeur task. And to add, we will have to produce a perfect flight to obtain more flight score in the competition. Therefore, our team decided to build a glider so that the piloting would be successful. A well learned engineering graduate would carefully design, research and manufacture precisely to overcome these obstacles and regulations put forth by the SAE. Our team will approach the design process by assessing the previous SAE Aero Design competition experiences, as well as utilizing rough and conservative hand-calculations.

II. RC AIRPLANE- THE BASICS

RC airplanes are small model radio-controlled airplanes that fly using electric motor, gas powered IC engines or small model jet engines. The RC Airplanes are flown remotely with the help of a transmitter with joysticks that can be used to fly the aircraft and perform different maneuvers. The transmitter comes also with a receiver which is installed inside the Model RC Airplanes which receives the commands sent by the transmitter and controls servos. The servos are small motors which are mechanically linked to the control surfaces e.g., ailerons for roll control, elevator for pitch control and rudder for yaw control. The servos move the control rods (which are small rods that connect the servo to different flight controls) which in turn moves the control surface. An RC Airplane can be controlled in flight by using the transmitter from where you can control pitch, yaw and roll of your RC Airplane and you can also control the throttle settings. The receiver which accepts the transmitter signal and the servos attached to it are run on rechargeable batteries. Most popular rechargeable batteries for RC Airplanes include Ni-Cad (Nickel Cadmium) and Li-Po (Lithium Polymer). Lithium Polymer lasts longer and more powerful than the Ni-Cad and the counterparts are expensive.

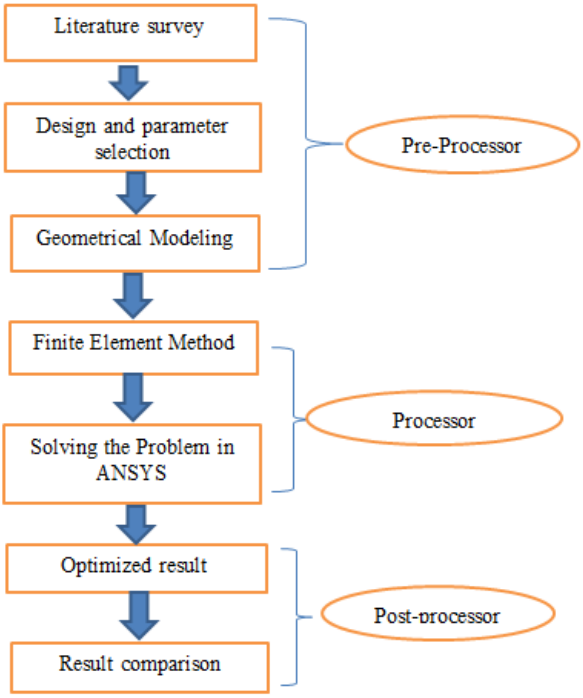
RC Airplanes Propulsion

RC Airplanes fly using either electric motor as propulsive device or IC (internal combustion) gas powered engines or small model jet engines.

RC Electric Motors

Our team has decided to use electric motors as we have registered for regular class. Electric motors are mostly used in model RC Airplanes because of the ease in use. Electric Motors give the advantage of low-cost, easy to use. The throttle of electric motors is controlled using a speed controller which comes with the motor. The speed controller lead is connected to the receiver. The transmitter then can control the throttle of electric motor just as other controls.

III. METHODOLOGY



IV. DESIGN

Draft views of RC airplane

The CAD models are designed using CATIA V5 and ANSYS 18 will be used for FEA & CFD Analyses. The various model views are shown in the Fig.1 and Fig.2.

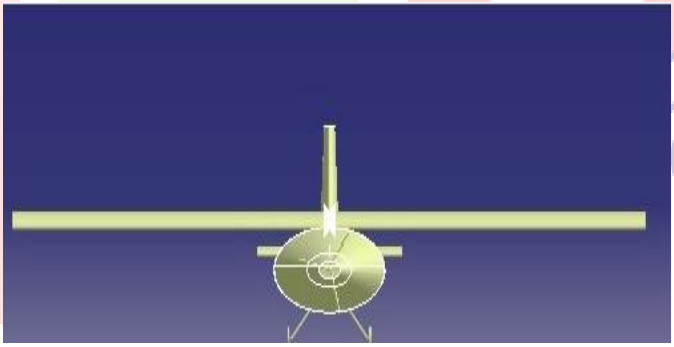


Fig. 1 Front view of the airplane

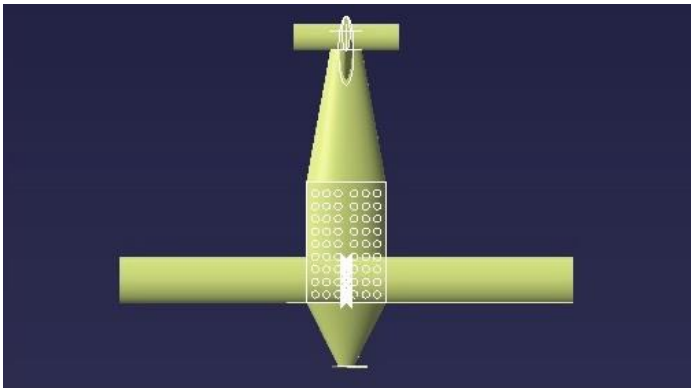


Fig. 2 Top view of the airplane

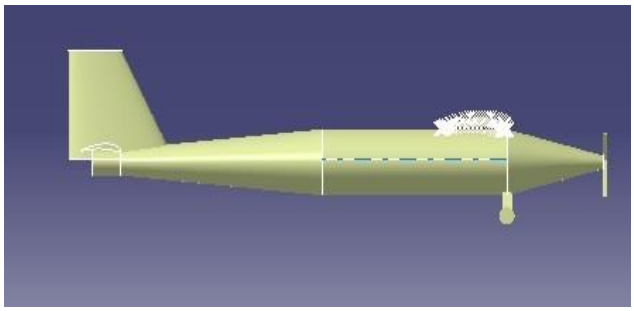


Fig. 3 Side view of the airplane

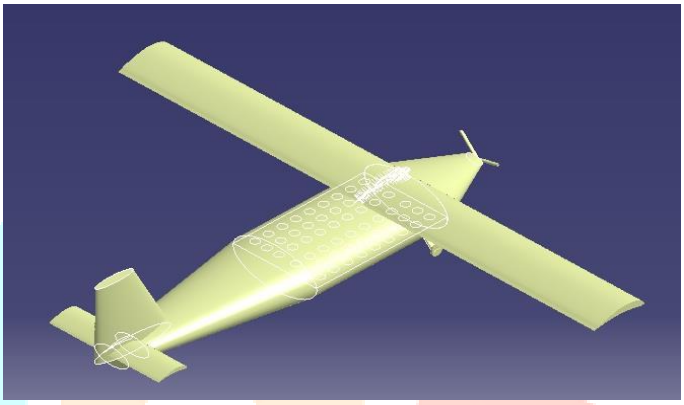


Fig. 4 Isometric view of the RC Airplane

V. ANALYSIS

Landing gear analysis

The Landing gear is imported into the ANSYS 18.1 for determining total deformation and safety margins. The impact load was divided into 20% and 80% between the nose and main gears.

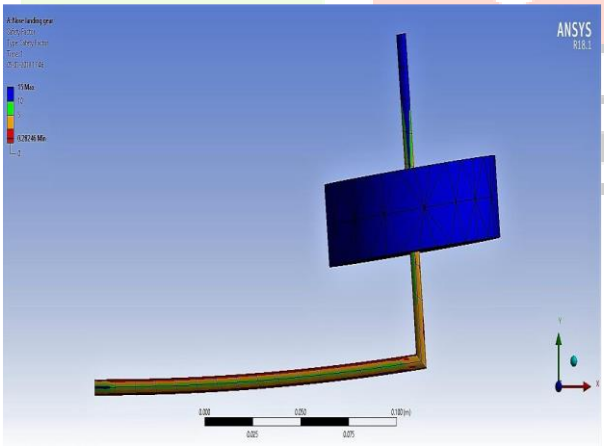


Fig. 5 Landing Gear Analysis

VI. FABRICATION

Material selection

The material selected for manufacturing our aircraft is balsa wood and aero ply since the aircraft is designed to carry high payload. Both the materials are lighter in weight and thus the overall weight of the aircraft can be reduced automatically. The material has high strength to weight ratio through which the high payload can be carried. An aluminium rod is used for supporting the wing of the aircraft. Landing gears of aircraft are manufactured using the material stainless steel. All other components of our aircraft is manufactured using balsa sheets and aero ply.

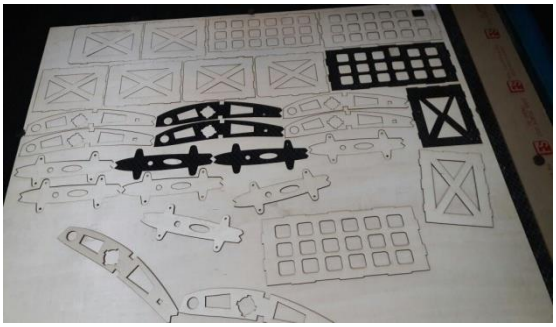


Fig. 4 Laser cutting of various components

Fig.4 represent the Various components were cut through laser cutting from 2mm and 3mm thickness balsa sheets

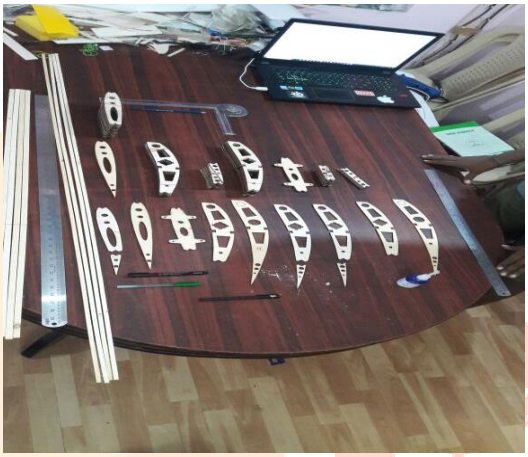


Fig. 5 Main Wing And Tail Stabilizers Ribs

The Fig.5 represents the assembling of main wing and tail stabilizer ribs.

Fig.6 Construction of RC Plane

The Fig.6 represents the assembling of main wing and fuselage body.

VII. CONCLUSION

Thus our team has designed, fabricated and tested a remote controlled airplane for SAE Aero Design West Competition 2018 as per the guidelines and regulations.

REFERENCES

[1] Pradyumna S V et.al, "Design, Fabrication & Analysis of a High Winger Conventional Tail Radio Controlled Airplane" International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015.

[2] A. Noth and R. Siegwart, "Design of Solar Powered Airplanes for Continuous Flight" Eidgenossische Technische Hochschule Zurich, Autonomous Systems Laboratory, December 2006.

[3] Moumen Idres et.al, "Design, Fabrication and Flight Testing of a Surveillance UAV" Advanced Materials Research Vol 1115 (2015) pp 450-453 (2015) Trans Tech Publications, Switzerland Submitted: 2015-01-09 Accepted: 2015-03-26.

[4] Manas Kumar Padhi, "Micro-Turbine Generator System", Department of Electrical and Electronics Engineering, 0501209277.

[5] John Rajadas et.al, "Design, Fabrication and Testing of a Novel UAV as a Multi-Year Capstone Project" American Society for Engineering Education, 2007, Page 12.

[6] Ang Eng Ling, "Design and Manufacturing of Generic Unmanned Aerial Vehicle Fuselage Assembly (Payload Bay, Empennage, Wheel Assembly and Wing box) Via Low Cost Fibre Glass Molding Process" Universiti Tunku Abdul Rahman, 13 April, 2012.

[7] RicNepal Chandra Chattopadhyay and Kamrul Hasan Khan, "Design, Analysis and Fabrication of Experimental Aircraft: A Challenge for Pioneers" Proceedings of the World Congress on Engineering 2013 Vol III, WCE 2013, July 3 - 5, 2013, London, U.K.

[8] Fayssal Hadjez and Brahim Necib, "Stress Analysis of an Aircraft Fuselage with and without Portholes using CAD/CAE Process" Hadjez and Necib, J Aeronaut Aerospace Eng 2015, 4:1.

[9] Bento Silva de Mattos et.al, "Considerations about Forward Fuselage Aerodynamic Design of a Transport Aircraft" 42nd AIAA Aerospace Sciences Meeting and Exhibit,5 - 8 January 2004, Reno, Nevada.

[10] David Lesnewski et.al, "Aircraft Empennage Structural Detail Design" NASA-CR-195486, 421S93ADPT2-2, April 15, 1993 NASA-CR-195486) Aircraft Empennage Structural Detail Design (Embry-Riddle Aeronautical Univ.)56 p.

.