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Remote Control Aeroplane

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Abstract: **-- A RC Plane is a small flying machine that is controlled remotely by an operator on the ground using a hand held radio transmitter. The transmitter communicates with a receiver within the craft that sends signal to the servos which move the control surfaces based on the position of joystick on the transmitter. Government and Military organisations are also using RC aircraft for experimentations, gathering weathering readings and even using them as spy planes.**

I. INTRODUCTION

The aircraft is dihedral wing having the wing span of 35.43cm and length of 23.62cm. The fuselage is built using bulkheads and formers are made of spruce ply and Balsa wood. An electric propulsion unit nylon propeller of size 10*4.5 is driven by a Lithium polymer battery of 2200 mAH. Adequate sizing of tail have been established for proper handling and control of the aircraft..

II. ENVIRONMENTAL CONSIDERATION

Change in altitude from home location to the competition location and its corresponding change in wind gust and air density should be accounted in the design of plane. The aerodynamic characteristics of the aircraft were studied at home location (Bangalore, India) under average condition . Demand for air transport is continually growing and, if this demand is to meet with all the attended benefits, society must also accept the cost (noise, pollution, climate change, risk, resource use etc.). While it is not possible to make aviation sustainable in the very long term, much can be and is being done to improve aviation sustainability.

Assembly and Subassembly

1) After the wing, fuselage and empennage is fabricated the assembly begins with the wing, Ailerons are installed at the trailing edge of the wing with the help of adhesive tapes and control horns are then screwed to the ailerons. The servo slots are then made on both sides of the wing with the help of balsa spar such that the servo remains intact and the servo is then fixed with the help of screws, cyanoacrylate is applied to the joints to give a firm grip. Pushrods are used to connect the controlhons to the servo arm.

SETTING OF SERVO OVER THE WINGS FIXING OF STBILIZER

2) Grooves are machined into the horizontal stabilizer, the vertical stabilizer have a series of notches and tabs to add rigidity to the joint and to allow easy alignment of both the stabilizers. The horizontal stabilizer is then attached to the

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vertical stabilizer in an inverted T formation and glued using industrial grade cyanoacrylate while adequate care was taken to maintain perpendicularity and to avoid unwanted aerodynamic and stability issues. The elevators are then attached to the horizontal stabilizer with the help of adhesive tapes and control horns are screwed to the elevators.

3) Motor is fixed to the mount of the fuselage using nuts and bolts. Propeller is connected to the motor shaft with the help of safety nut. The servo slot is made on the right wall of the fuselage at 4.52 inch from the end, the servo is then screwed and glued with cyanoacrylate.

4) The empennage is then fixed at the top end of the fuselage with cyanoacrylate. One end of the pushrod is connected to the servo arm of the fuselage and other to the controlhons of the elevator.

5) The wing is secured with rubber bands to the mounting rods of fuselage such that the wing can be removed and replaced at will. **Rubber bands for wings**

Fixing of tail over fuselage

III. TESTING

For testing, the insulation and connection of all the wires was checked. The transmitter was turned on and the shunt plug was connected. The throttle was tested for sufficient thrust and control system for proper trim to stabilize the plane. Then the prototype without payload was hand launched according to the inputs from the pilot with initial angle of attack and velocity. After successful landing, the payload was increased after every flight, till the plane cannot take-off to check the maximum weight. After ten successful flights the plane was made to crash at very high speed to analyze the extent of the damage.

Manufacturing

After the final design was selected, the manufacturing started using balsa wood. The ribs and the bulkheads cut-outs were obtained using CNC laser cutting machine. The ribs used had slots for the spar attachments and for the carbon fibre rod. Wing was fabricated using cyanoacrylate at the rib, spar and sheeting interfaces. Wing was then covered with the ultra coat using iron. The off side of the film has an adhesive which sticks to the balsa wood upon heating. First the ultra coat is placed over the balsa then heated using iron, due to the heat the adhesive melts and sticks to the balsa which keeps the balsa in its position as well as increases its strength. The team experienced some problems while covering the cambered side of the wing which was overcome by using cyanoacrylate at the rib and ultra coat surface and then ironed to give the wing an airfoil shape.

Ribs and Spars ***Attachment of Rib and Spar***

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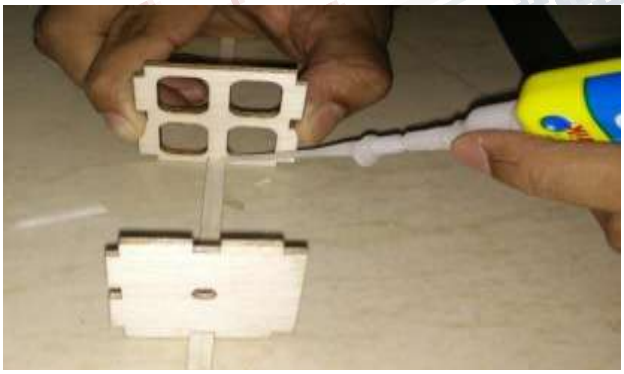
Application of Ultra coat

For proper distribution of loads truss structure was decided for fuselage and empennage instead of solid structure. In total four bulkheads are used for the fuselage, the first bulkhead for the mount, second and third bulkhead includes the payload bay and the fourth bulkhead at tail end of the fuselage. The bulkhead for the motor mount was made up of 0.196 inches thickness plywood and the rest of the bulkheads are made up of two sheets of 0.0787 inches thickness attached with cross grain to give fuselage the strength and rigidity. The bulkheads was provided slots for the spars attachments and lightning holes to reduce the weight and the passage of wires. The bulkhead, spar and sheeting interface were fixed using cyanoacrylate



Spacing of Bulkheads ***Fixing of Bulkheads***

The mounting rods on the fuselage are made up of carbon fiber to reduce the weight. The mounting rod position depends upon the placement of the wing, the two rods are kept at 4.72 inches from each other and are placed at 4.13 inches from themoter mount. The rod is fixed using cyanoacrylate and is placed near the bottom surface of the fuselage such that the payload bay is not disturbed.

Mounting Rods for Wing

Slabs were introduced at the inner bottom surface of the fuselage to attach female Velcro to which electronic components and payload is attached. The control surface was cut from 0.078-inch thickness balsa sheets and slots were made for controlhons attachments. The controlhons were slide into the slots, screws and cyanoacrylate was then applied. The covering for fuselage was done with ultra coat to give it a proper finish.

The horizontal and the vertical stabilizer were fabricated using balsa spars of thickness 0.197 inches. The joints were glued using cyanoacrylate and a covering of ultra coat was given to both the stabilizer. The final aircraft is

Formulae used

$L=0.5\rho V^2 SCl$ … Lift equation

$D=0.5\rho V^2 SCd$ … Drag equation

$VHT=LSHT/CSW$ …….....Horizontal Tail Coefficient

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$VVT = LSVT/CSW$ .....Vertical Tail Coefficient
$n = L/W$ ..... Load Factor
$V = \sqrt{2L\rho}$ ..... Velocity
$M = V/A$ .....Mach Number
$Re = \rho VL/\mu$ ..... Reynolds Number

IV. CONCLUSION

We have put forward a design document for a RC aircraft designed and manufactured to participate at SAE Aero Design 2017 . The team has met all the specifications laid down by the rulebook. The team has achieved the required objectives by testing the aircraft over numerous real time flight test which further allowed us in construction of desired aerodynamic characteristics, and proved helpful in creating an aircraft with good performance by efficiently planned use of limited resources available to our best level. The aircraft has been designed by keeping in mind the compactness of the structure. The best design & configuration was selected for the various parts of the aircraft structure and was optimized based on the flight test results and other requirements. The team feels confident to push the aircraft to its peak performance margins and provide a tough and a healthy competition to the teams who are visiting SAE Aero Design 2017.