

Modeling of a Radio Controlled Plane with Analysis of Lift Generation Using Ansys Fluent

K.Rajesh Kumar, D.Sreenivasulu Reddy

Abstract: Abstract - Aircraft are important, because they carry people and goods quickly to great distant places, over all types of terrains. From the only last century we were all certain that the aircraft flies. The basic forces that are associated with the flight are the Lift, Drag, Thrust and Weight. We are clear with the Thrust is created by the fly motors because of the response powers produced by fumes gases and is given by Newton's third law and Due to the consistency of air when aircraft travels through air we have Drag over the aircraft and any item having mass will have Weight due to earth's pull. But we are not clear how the Lift is generated which is most important of the four forces acting on aircraft. There are two different ways of clarifying the lift generation on wing. One is the numerical description which is depicted by utilizing course ideas and the other is the physical depiction of lift. Despite the fact that we have numerous physical portrayals of lift does not fulfill in all conditions. Thus we demonstrated an airplane with cambered aerofoil alongside the investigation is made in Ansys Fluent that how the lift is created which is the verification for the Actual physical depiction of lift.

Index Terms: Lift, Drag, coanda effect and RC (Radio Controlled).

I. INTRODUCTION

A radio controlled aircraft has all the dynamic attributes which are available in genuine aircraft. RC Air crafts can be utilized to convey some mass of little esteem or additionally use by defence specialist by applying a covert agent camera on it. RC flying machine is additionally utilized by R&D division so as to check the achievability of any design.

A. Basic Components

1. The fuselage
2. The wings
3. Aileron
4. Flaps
5. Rudder
6. Horizontal stabilizer
7. Vertical stabilizer
8. Elevator
9. Tail
10. Power plant

11. Landing gears

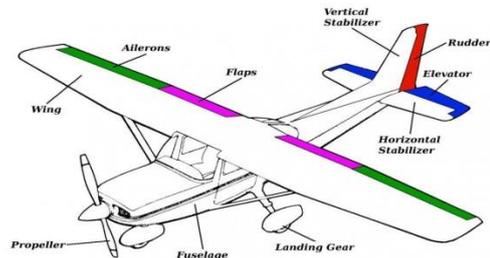


Fig 1: Basic components of plane

B. Basic Four Forces

There are four forces associated with the aircraft. These forces, illustrated are lift, weight, thrust, drag. In case of flat and straight height the entire lift on the aircraft is always same to its weight. We say net lift because, for a conventional 1 airplane design, the horizontal stabilizer pulls down, Giving Extra weight on wings. Drag is same to the thrust generated by engine, when lift is generated by air friction and work done.

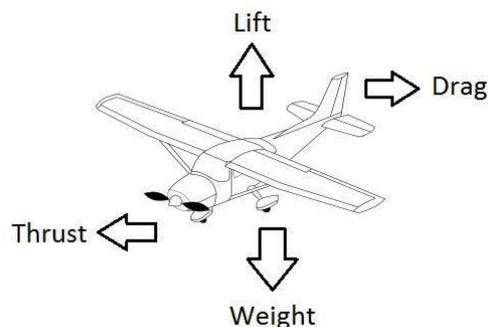


Fig 2: Basic forces of plane

Table 1: Flight condition and its effects

Aircraft Condition	Effect
When Thrust is greater than Drag	Aircraft Accelerates
When Weight is greater than Lift	Aircraft Falls
When Drag is greater than Thrust	Aircraft Slow
When Lift is greater than Weight	Aircraft Rises

C. Axis Of Aircraft

1. Vertical Axis
2. Lateral Axis
3. Longitudinal Axis

Manuscript published on 30 January 2019.

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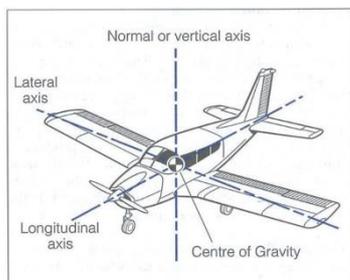


Fig 3: Axis of an aircraft

D. Aerofoil Technical terms

For delivering better lift in air, a shape like aerofoil is considered. Aerofoil has different shapes with different cross sections. Aircraft wings are manufactured by selecting different aerofoil. Prime Specifications are selected by the designers for their requirement.

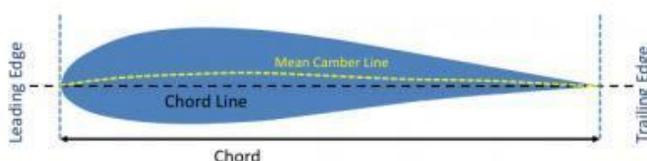


Fig 4: Aerofoil terminology

Chord line is a line joining the leading and trailing edges;

Leading edge is the one which hits aerofoil first;

Trailing edge is the one which hits aerofoil last;

Chord is length between the trailing edge and leading edge;

Mean camber line is a line connecting trailing edge and leading edge;

Lengthy distance between chord line and mean chamber line is called **Mean camber**

The length between lower surface and upper surface is called **Maximum thickness**

E. Coanda Effect

The coanda impact needs to with the twisting of liquids around an article. For the forces and pressure related with low-speed flight air is consider a liquid as well as an incompressible liquid

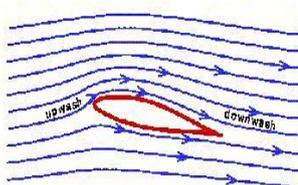


Fig 5: True airflow on a wing with lift, indicating up wash and downwash

When there is a interface between air and water it starts to neglect that area of connection. In reality, the water glass is hold at one end and water in that glass instead of moving down it folds the glass is called coanda effect. We can see that newtons first law shows shear is some energy is pushing these liquid to up. Which give some kind of stickiness. Viscosity of air is less and enough for air particles to adhere the surface. The speed between air atoms and surface is zero. At the surface liquid has little velocity.

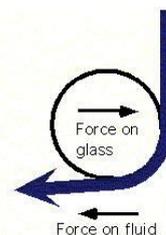


Fig 6: Coanda effect

Since the liquid close to the surface has an adjustment in velocity, the liquid flow is bent towards the surface. Except if the curve is excessively tight, the liquid will pursue the surface. The air volume of wing is stoped the wing is called the "boundary layer".

II. LITERATURE REVIEW

Literatures indicates that the Turbulence models utilized in a large portion of the business CFD programming treat the boundary layer around the aerofoil as completely turbulent and henceforth the lift forces are over anticipated and displaying of stream change from laminar to fierce gives precise investigation results . A portion of the written works and have reasoned that three dimensional CFD analysis results will give good prediction of stalled aerodynamics as the turbulence is purely a three dimensional phenomena. Literature works and have communicated that Mentors Shear Stress Transport turbulence model is giving acceptable results in the post stall region.

III. RADIO CONTROLLED PLANE

A. Major Components Used In The Radio Controlled Aircraft

1. PROPELLERS
2. MOTOR
3. ESC(ELECTRONIC SPEED CONTROL
4. RECEIVER
5. SERVO MOTOR
6. CONNECTING WIRES
7. TRANSMITTER
8. COROPLAST
9. GLUE GUN
10. LANDING GEARS

B. CONNECTING THE ALL COMPONENTS

Ensure when you connect anything to the receiver that you push in the servo leas with the goal that the darker wire (negative) faces AWAY from the content on the receiver.

1. Interface the battery and esc
2. Channel 3 is lead by ESC servo on beneficiary. Connect to channel 3.
3. Esc to the engine. interface the three wires in any capacity. you can change this later
4. binding the receiver to transmitter
5. So you have everything snared, except when you turn on the transmitter, nothing happens well this is on the grounds that you haven't bound the receiver to the transmitter

6. Binding the receiver
7. Receiver should bound to transmitter, we can control when this transmitter is not connected to receiver.

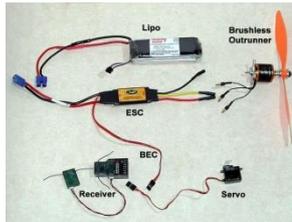


Fig 7: Connections of all electronic parts

1. Battery slot is connected to the bind plug .
2. From ESC power connector is connected.
3. On the receiver a red light is located which shall be blinking.
4. Holding down the bind switch, turn on yours's transmitter.
5. After certain time lapse if you find the red light stop flashing, then the bind is established successfully.

IV. MODELLNG OF A RADIO CONTROLLED PLANE

A. Modelling Of Radio Controlled Plane In Catia

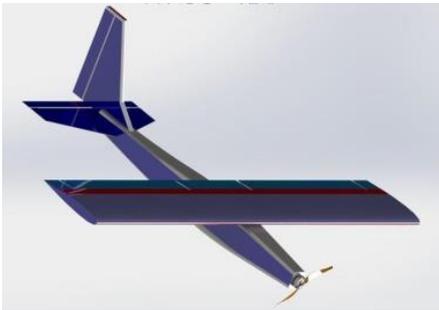


Fig 8. Modelling in Catia

Note: This general rule is more applicable for rectangle shaped wings, and do not apply that for odd shaped or delta shaped wings.

V. ANALYSIS THAT SUPPORTS THE ACTUAL THEORY OF LIFT

Open the ansys application
By going to the ansys workbench

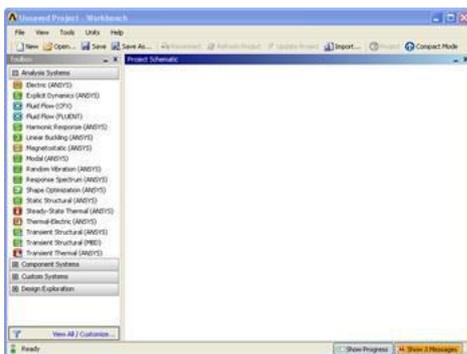


Fig 9 : Ansys window

Before entering work bench we defined it by parameters we required as a load the fluid flow

Firstly we create the geometry structure of the product by importing from catia are any other design software's and we

create the surface from the edges which gives a detailed view

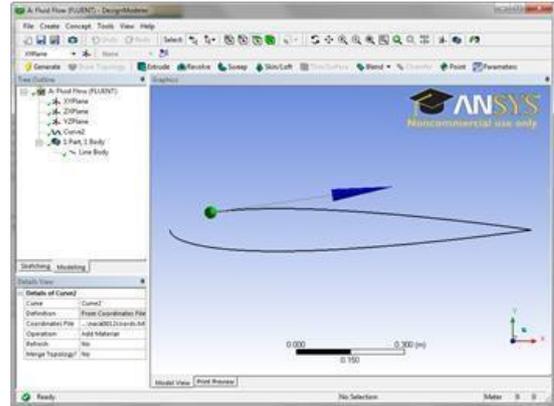


Fig 10: Import file from Catia

Later we create a new coordinates system by ucs command in order to generate a new sketch locate the point at the centre and by using centre by arc method create arc and by Considering two points that is, one on the vertical axis above the origin and other on the same axis below the origin, we can create end points of arc . drawing the tangent lines, we acquire the section You should end up with the following and by creating the quadrats we do the same procedure to obtain the exact dimensioned component

A. Meshing the surface

First, we will apply a mapped face. To view meshing toolbars, click on mesh. In mesh toolbar, select mesh controls > mapped face meshing. Be cautious and check if face selection filter is selected.

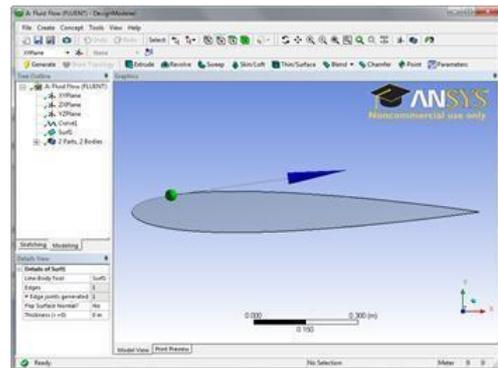


Fig 11: Aerofoil design

Details View	
Details of Plane4	
Plane	Plane4
Sketches	0
Type	From Coordinates
<input type="checkbox"/> FD11, Point X	1 m
<input type="checkbox"/> FD12, Point Y	0 m
<input type="checkbox"/> FD13, Point Z	0 m
<input type="checkbox"/> FD14, Normal X	0 m
<input type="checkbox"/> FD15, Normal Y	0 m
<input type="checkbox"/> FD16, Normal Z	1 m
Transform 1 (RMB)	None
Reverse Normal/Z-Axis?	No
Flip XY-Axes?	No
Export Coordinate System?	No

Fig 12: C – Mesh domain setup

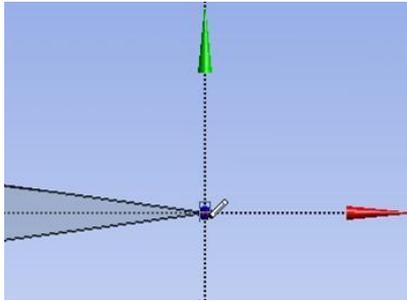


Fig 13. Point at trailing edge

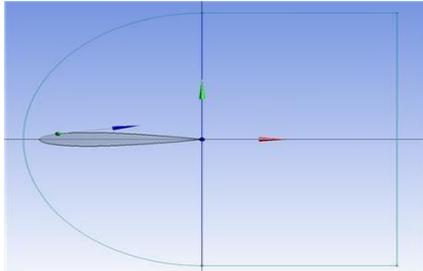


Fig14. Dimensions of the domain

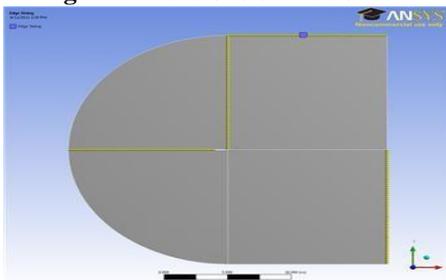


Fig15. Selecting of edge

After the selection of edges in a detailed view of the geometry apply. Next, select the type and have to change the number of divisions to 50. Click the behaviour as hard. Go for the mesh to have bias, so the first bias to be selected as bias and give 150 as the edge sizing Bias Factor

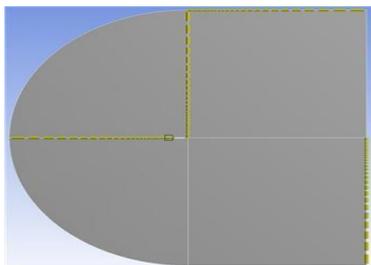


Fig 16. Edge sizing

We have to make confirmed that the edge divisions is important to this point are biased towards the mesh centre. After the selection of the type > Number of Divisions, and change Number of Divisions to 100. Select hard < behaviour Now we will not select for bias.

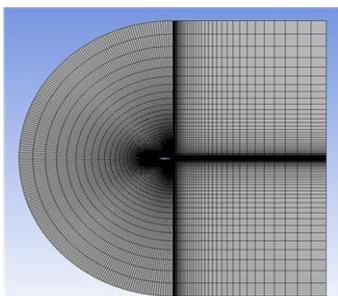


Fig 17. Mesh

Now will dole out names to a portion of the edges to make making limit conditions for the work simpler. For pre analysis step we check the conditions. Gulf is having blue, outlet is with red, white is with aerofoil at the center. Now prepare the segment that has to be named. Edge choice apparatus/is selected.

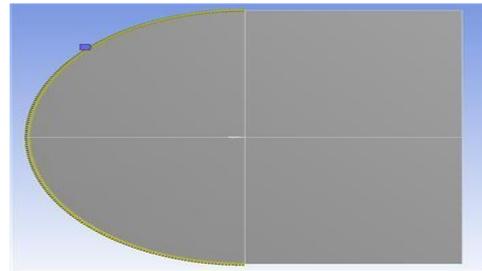


Fig 18. Number of divisions

At present two vertical edges are selected on the extreme right half of the work. To create named selections make the right snap. The edge outlets are to be named.

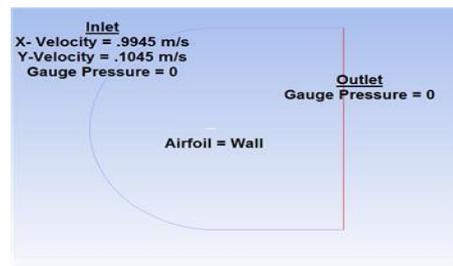


Fig 19. Inlet and out let of domain.

From the above image select the edges that compare to the delta of the stream as characterized by the above image.. Once more, right snap and select Create Named Selections and this time name the choice delta. We finally name the choice aerofoil for the two edges prefeed. Finally, the meshing is done and we are ready to apply the various loads

VI. RESULTS AND VADILATION

A. Static Pressure

A pressure can be distinguished for each point in a body of liquid, paying little heed to whether the liquid is in movement. Pressure can be estimated utilizing an aneroid, bourdon tube, mercury column, or various other methods.

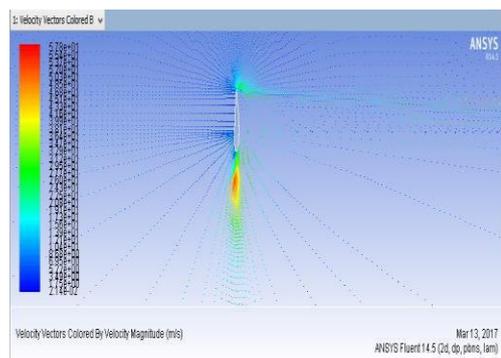


Fig 20. Velocity vector

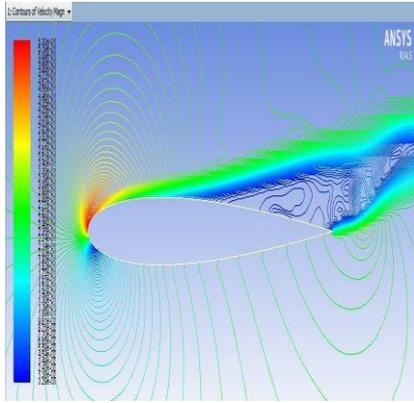


Fig 21. Contours of velocity magnitude

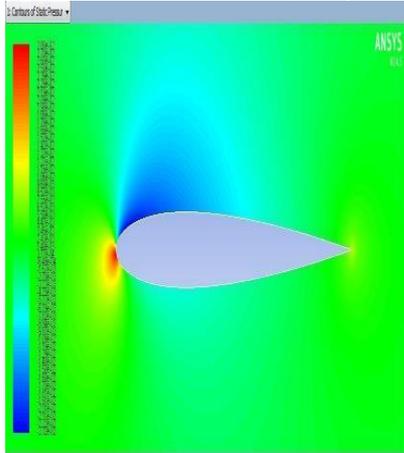


Fig 22: Contours of static pressure

B. Stream Lines

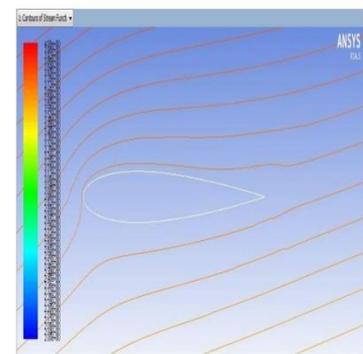
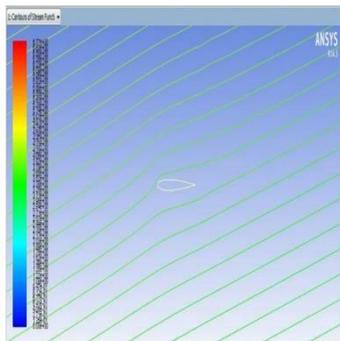


Fig 23: Contours of stream lines

1. Path traced by stream line is found by massless particle moving with the flow.
2. Velocity is tangent to stream line at every point
3. Mass does not cross stream lines

C. Convergence

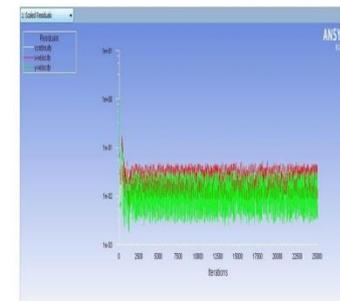
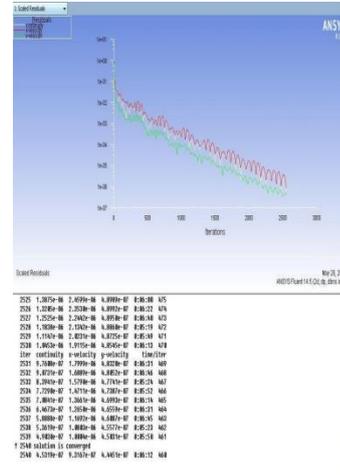


Fig 24: Scaled results

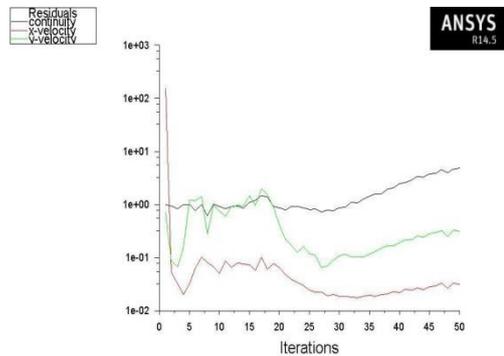


Fig 25: Normal graph of scaled results

D. Efficient Of Drag And Lift

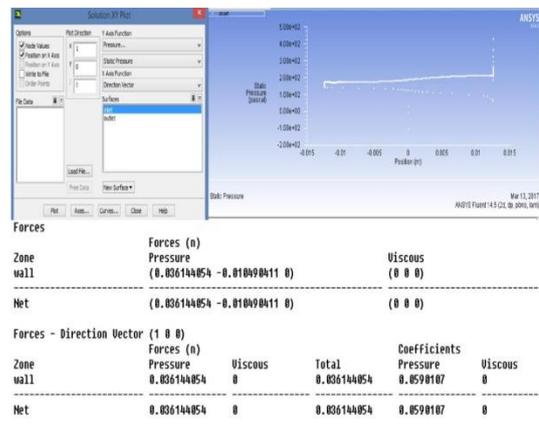


Fig26: Coefficient of lift and drag

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25000 2.3190e-02 2.8228e-02 1.7722e-02 0:00:00 0
Forces
Zone Forces (n) Viscous
airfoil Pressure (-0.0052064066 0.027278535 0) (0 0 0)
Net (-0.0052064066 0.027278535 0) (0 0 0)

Forces - direction Vector (0,3,0,0,0)
Zone Forces (n) Coefficients
airfoil Pressure Viscous Total Pressure Viscous Total
0.0019978545 0 0.0019978545 0.063921345 0 0.063921345
Net 0.0019978545 0 0.0019978545 0.063921345 0 0.063921345

Forces
Zone Forces (n) Viscous
airfoil Pressure (-0.0052064066 0.027278535 0) (0 0 0)
Net (-0.0052064066 0.027278535 0) (0 0 0)

Forces - direction Vector (0,0,3,0)
Zone Forces (n) Coefficients
airfoil Pressure Viscous Total Pressure Viscous Total
0.027278535 0 0.027278535 0.87291313 0 0.87291313
Net 0.027278535 0 0.027278535 0.87291313 0 0.87291313

2539 4.8916e-07 1.0000e-06 4.5301e-07 0:00:30 661
! 2540 solution is converged
2540 4.5193e-07 9.3216e-07 4.4451e-07 0:00:31 660

Forces
Zone Forces (n) Viscous
airfoil Pressure (-0.00018114022 0.0071525657 0) (0 0 0)
Net (-0.00018114022 0.0071525657 0) (0 0 0)

Forces - direction Vector (0,3,0,0,0)
Zone Forces (n) Coefficients
airfoil Pressure Viscous Total Pressure Viscous Total
5.731014e-05 0 5.731014e-05 0.0018329245 0 0.0018329245
Net 5.731014e-05 0 5.731014e-05 0.0018329245 0 0.0018329245

Forces
Zone Forces (n) Viscous
airfoil Pressure (-0.00018114022 0.0071525657 0) (0 0 0)
Net (-0.00018114022 0.0071525657 0) (0 0 0)

Forces - direction Vector (0,0,3,0)
Zone Forces (n) Coefficients
airfoil Pressure Viscous Total Pressure Viscous Total
0.0071525657 0 0.0071525657 0.2289141 0 0.2289141
Net 0.0071525657 0 0.0071525657 0.2289141 0 0.2289141
    
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Fig 27: Force and pressure distribution

VII. CONCLUSION

It is found that centre of gravity should be balanced 25% of chord from the leading edge. The functioning of all control surfaces we observed. From the analysis it is found that law of equal transit times and Bernoulli's theorem explanation of lift is not true, but after the analysis of the lift is developed by the wing due to Coanda effect and Newton's laws. The lift is reaction force developed by the wing.

REFERENCES

- 1 Understanding flight by David f Anderson 2e MC GRAW HILL PUBLICATIONS
- 2 Fundamentals of flight volume 1 basic aerodynamics by LALIT GUPTA & DR.O.P. SHARMA HIMALAYAN BOOK PUBLICATIONS NEW DELHI
- 3 Fundamentals of aerodynamics by JOHN D. ANDERSON JR 5 TH edition MC GRAW HILL PUBLICATIONS
- 4 Introduction to flight by JOHN D. ANDERSON JR. 6 TH edition MC GRAW HILL PUBLICATIONS
- 5 [Http:// www. Rc groups.com](http://www.Rcgroups.com)
- 6 [Http:// www. Rcdhamaka.com](http://www.Rcdhamaka.com)
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