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THE EFFECT OF COMBINING TWO PAPER PLANE MODELS ON THE FLIGHT OF THE NEW MODEL A STUDY ON THE CHANGE IN FLIGHT LENGTH OF A PAPER PLANE

Rian Shah

Research Scholars Program, Aditya Birla World Academy, Mumbai, India.

ABSTRACT

The present study includes folding each of the two paper planes and understanding their aerodynamics and whether these effects have any change on their individual flight. To take it forward, I conducted an experiment wherein these two paper planes namely the ring plane shaped like a flying tube and the convectional paper plane are merged together thereby increasing the efficiency of the flight. Together, the paper planes merge the two concepts of Laminar Flow and increase in the lift due to the Coanda Effect. After the completion of this experiment, the combination of aerodynamic principles leads to an improvement in the flight distance. The measurement was caried out by determining the line of best fit and then comparing the results with it. To conclude, the elimination of the useless forces using different methods helps to increase the flight method.

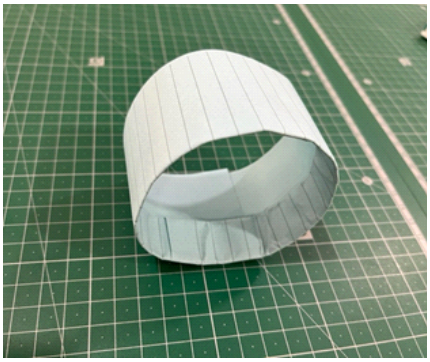
KEYWORDS: Ring plane, Laminar Flow, Coanda Effect, Flight method.

There are many aerodynamic factors which change the effectiveness of the flight in an aeroplane or simply a paper plane. Such factors include:-

1. Increase in the area of wings for better wing loading
2. Centre of gravity
3. Dihedral Effect on the plane by changing the dihedral angle
4. The material used to make the plane (different types of paper)
5. Drag
6. Thrust
7. The number of layers caused due to folds
8. The Glide Ratio

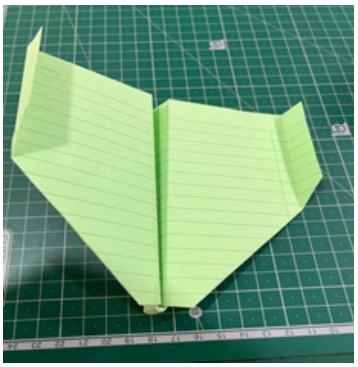
Ways to reduce negative forces obstructing the flight of a paper plane:
Some simple ways of reducing the negative forces- such as drag, gravity, and air turbulence-are by reducing the number of folds used to make the plane, increasing the lift, and changing the dihedral angle respectively. Although these are some of the easy methods of doing so, the combination of different models of planes, each holding a specific characteristic which helps for a good flight, can be an effective way to increase the efficiency as per the experiment conducted by me .

Tube Plane (1):
The Tube Plane is a special kind of paper plane shaped like a tube as the name suggests. The main characteristic of this particular model is its ability to reduce drag and increase the lift. To do so, it spins along its imaginary centre of gravity, at the centre of the ring, thus causing uplift by swirling the air through it causing a propulsion effect. This uplift is caused due to the boundary layer effect. The air travelling is pushed downward because of its curved shape. The factor which pushes the air along the surface is called the Coanda Effect (the cause due to which air travels along the shape of a moving body and follows its path in that direction). All of these factors make it an excellent glider but the drawback being that it doesn't travel a longer distance than the standard paper plane. According to the experiment conducted, it could only reach a distance of 7 meters (when thrown on a flat plain without a slope) before crashing down.



(1)

Standard Paper Plane (2):
The standard paper plane, capable of flying a longer distance compared to the tube plane, has a very bad lift thus causing it to not being able to glide for a longer time. Since it has a glide ratio of around 7.5:1 which is not efficient for hovering in air for a longer period of time. The average distance travelled by it is around 11 meters (when thrown on a flat plain without a slope) as recorded during experimentation conducted by me. Despite having a bad glide ratio and distance, specific modifications can help maintain the dihedral angle which in turn provides stability to the plane. Making larger wings helps to increase the wing ratio and helps to reduce the effect of gravity on the plane by capturing more air and thus gliding in the air. One way to increase the lift is to bend the back of the wing in order to tilt the nose of the plane in an upward direction and thus increasing the altitude. To conclude, the standard paper plane causes a lot of drag and hence reduces the ability of the other factors, which help in better flight, causing it to only retain the property of slicing through the air to an average distance without any glide.



(2)

The combined Tube and Standard Paper Plane (3):
This particular model is the main component of the research conducted. The combination of these models produce amazing results, increasing the overall flight duration, distance, stability ,and glide ratio. The tube plane is built under the standard plane thus facilitating the qualities of both the planes into one. However, the question is that, "Does it actually incorporate the individual properties of both the planes into one ?". The answer to that is a NO. The tube plane spins around its imaginary axis, but when joined together the plane cannot spin along with it because if it does then the equilibrium is disturbed and the plane will crash down. This is when the combination of forces take place. The tube wants to turn and does turn but only 180 degrees and soon as it reaches the 180 degree mark, the dihedral angle of the wings bring the plane back into position and thus two half rotations simulate one complete rotation hence giving the plane a good amount of lift. Simultaneously, the standard paper plane continues to show its property of flying long distances. Thus the combination of the lift by the tube plane and the distance given by the standard plane helps it to fly through an enormous distance of 19.5 meters on an average along with good stability. Extra lift is given to the plane by folding the back edge of the wing in an upward direction to push the nose of the plane up and thus lifting it higher. This is caused due a better laminar

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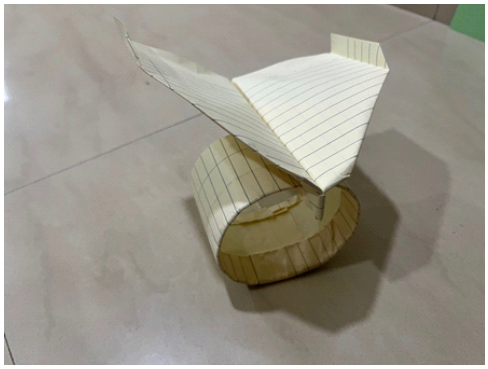
flow. The speed also increases due to the Coanda Effect when air travels in the shape of a swirl through the tube hence acting like a propeller. The height of the plane remains high enough through the entire flight, it regains some height after the parabolic fall thus increasing its flight duration and distance.



(3)

Comparison Chart

Model	Average Distance	Height After 2 Seconds	Height After 5 Seconds	Height After 10 Seconds
Tube Plane	7m	4ft	2.5ft	0.5ft
Standard Plane	11m	3ft	2ft	0ft
Combined Model	19.5m	5ft	3ft	2.5 ft Due to increase in lift after parabolic fall

**Calculated using a line of best fit obtained using a fourth simpler paper plane to get approximate values.*

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