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Telescopic Wing

Vaidant Trivedi
Student (Aerospace Engineering)
Chandigarh University
vaidant.trivedi27@gmail.com

Dushyant Singh
Student (Aerospace Engineering)
Chandigarh University
singhdushyant2989@gmail.com

Bhawna Pal
Student (Aerospace Engineering)
Chandigarh University
iambhawnapal123@gmail.com

Pawan Kumar
Student (Aerospace Engineering)
Chandigarh University
pawanmanak777@gmail.com

Prashant Shrivastava
Student (Aerospace Engineering)
Chandigarh University
prashant58259@gmail.com

ABSTRACT
In this paper we will describe what actually is the idea of variable wing span and its advantage. Since, wing is the most important part of an aircraft that produces lift and satisfies the purpose of the aircraft, that is, to fly. By keeping in mind, the importance of wing, we worked on the idea to reduce the wing span while the plane is in cruise condition and hence reduce the lift produced while cruising. Also, with increased number or aircrafts, there engenders the problem of space in hangers, so this idea will also help in reducing the problem of confined spaces by reducing the area of the wings.

Keywords
Wing span, aircraft wings, lift generation, occupied space reduction.

1. INTRODUCTION
Wings are the most crucial element of an aircraft. It is the only component of an aircraft that enables it to fly through air. Wing have two surfaces, the upper surface and the lower surface. When aircraft is moving through air, the velocity at its upper surface is high as compared to the velocity at the lower surface. Due to this, the pressure difference is generated on the upper and lower surface of the wing. As the pressure moves from higher to lower pressure values, the aircraft experiences a resultant force that is further resolved into two components, that are lift and drag.

There are further different components that are inscribed under the wing surface. These components are, spars, ribs and stringers, that will be discussed under further sections.

1.1 Wing Terminology
A wing consists of sections that alter the resultant lift and drag of the wing. Those factors affecting the lifts are discussed in this section. Figure.1 shows the wing anatomy.

1.1.1 Leading Edge
As the name suggests, the leading edge is the front edge of the wing. The moving air comes and stops at the leading edge. This stagnated air, the further bifurcates and goes to upper and lower sides of the wing. For better understanding, refer to figure.1.

1.1.2 Trailing Edge
The trailing edge is the back side of the wing. The air from upper and the lower surfaces meet at the trailing edge. For better understanding, refer to figure.1.

1.1.3 Leading Edge Radius
The leading edge is kept curved. The arc of the leading edge is kept of some radius depending upon the purpose of the aircraft. The radius of the circle that connects the upper and lower surfaces is called the leading-edge radius.

1.1.4 Chord line
The cord line is the straight line that connects the leading edge and trailing edge. The length of the chord is calculated as the distance between leading edge and trailing edge measured horizontally.

1.1.5 Camber
Camber is the line that joins the mid points of the line between the upper and lower surface at every point. In short, the camber is the line that divides the wing into two equal parts. The camber is one of the main factors that affect the lift produced by a wing.

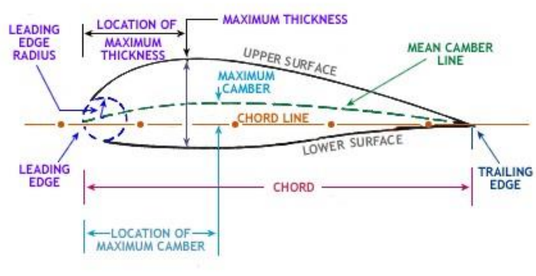

Figure.1 Wing terminology.

2. Wing
The wing was designed to supports the idea of variable wing span. The wing was divided into three parts. These three parts

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had, a stationary wing, and two movable wings. All of the three wings were designed according to the coordinates of NACA 4412 airfoil.

The figure.2 shows the wings layout and design. The wing to the extreme right will be stationary and the others will be movable. The shape of the stationary wing was kept same, whereas, the shape of the movable wings were slightly altered so as to fit the wings inside the stationary wing at the moment they retract.

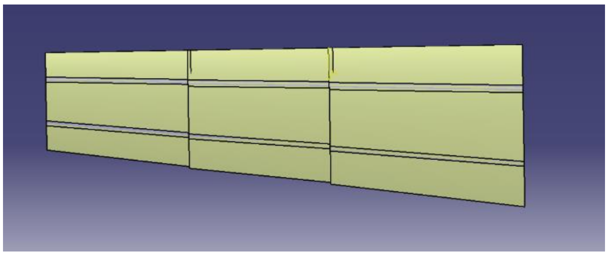

Figure.2 Wing design (top view)

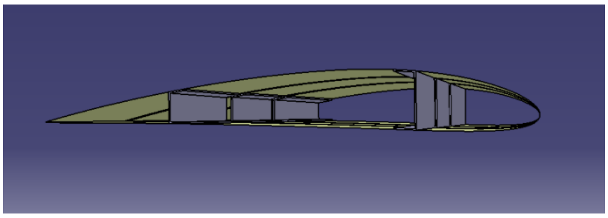

Figure.3 Wing design (side view)

3. SPARS

The spars of the telescopic wing design were designed to fit the spars of movable wing inside the main stationary wing spars. The spars were designed of "C" shape to support the retractability of the wings. This Spar is fit inside the fuselage which further extract toward the variable wing as the wing extract. In the following photo it shows the spars from the different view and also shows the retracted spars.

The spar of the stationary wing was designed in such a way that it can accommodate the other spars of the movable wings in it while the wing is retracting. Spars is the most crucial component of a wing. The spar transfers the load from the wing to the fuselage. The spar deals with the whole weight of the wing.

In a wing, there are two spars that shares the load with each other. Those spars are known as, the front spar and the rear spar. Here, we have kept the design of both the spars same. For the optimum load distribution, the spars were designed to be at the quarter chord and third quarter chord positions, that is, at 25% and at 75% of the length of the chord.

The figure.3 shows the design of the spars.

Figure.4 Spars design

4. RIBS

Ribs are the components that take the load from the stringers and transfers this load to spars. Ribs are the frames that supports the stringers on them and take the loads from them. We have designed a different shape of ribs. Due to the movable wings, the use of conventional ribs was not possible here.

This rib frame is attached inside skin of the fixed wing. When the wing is retracted then the variable wing takes the position under the frame. This frame further helps the wing to maintain its aerofoil shape. The gap between the frame is for rollers and stringers so they can slide smoothly. Variable ribs exactly fit under the frame so it doesn't get deformed. And there will be no clearance gap between frame and variable ribs. This is the main part which support or helps the wing in to maintain the shape of aerofoil. And provide strength to the outer wing.

Figure.5 shows the possible sketches of the ribs that we have designed. The

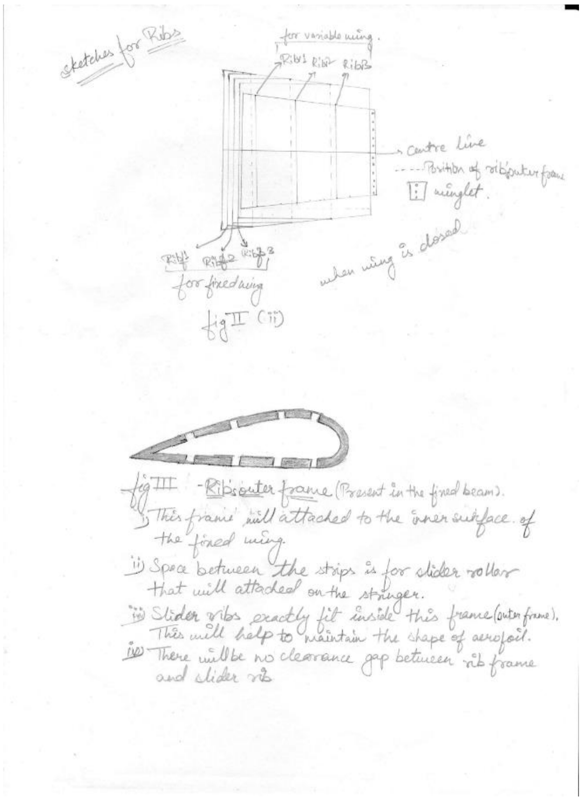

Figure.5 Ribs sketches

5. STRINGERS

The stringers are the component that transfers the load to ribs. The pressure load that is experienced by the wing surface, is absorbed and further transferred through stringers. The stringer also helps in maintaining the airfoil shape throughout the wing.

The stringers were made of the "L" shape, as usual. These stringers were attached to the surface at different points at the upper and lower surface. We used total of eight stringers in our design.

Figure.6 shows the stringer design. The stringer design in the stationary and movable wing is kept same. The red color stringer is the stringer of the stationary wing and the other, grey colored wing is that of the movable wing.

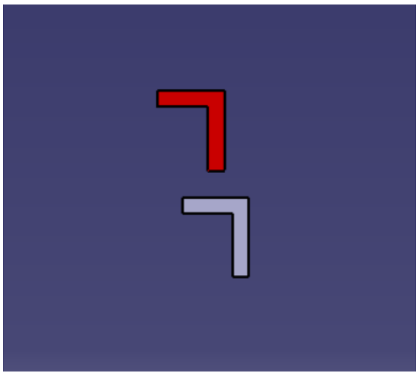

Figure.6 Stringers

6. CONCLUSION

The variable wing is hereby the better idea than the conventional wings. As, at the time of cruising, we have less requirement of lift, so we can change the wing span of the aircraft and hence, we can reduce the lift. And when we need to change the altitude, either ascend or descend, we can extract the wing for better maneuverability and we can land safely.

The secondary thing is, the conventional wings are very big and occupy lot of space when they are in the hangers. Using variable wing span will reduce this problem of space. The space occupied by an aircraft will be much less than usual as we have retracted our wings and decreased the wing span. So now, there will be no problem in accommodating the aircraft and the hanger can accommodate more planes than it usually can.

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