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AUGUMENTATION OF LIFT IN WING BY USING VARIES PASSIVE CONTROL

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ABSTRACT

Increasing of lift in airfoil is recent trends in innovative in aeronautical field. Lift increment technology may lead to mainly two types, that is active and passive methodology. Active methodology gives good results, but it leads to take a disadvantage of adding weight to the airplane. But in passive methodology does not increase the weight of the airplane. This thing leads to take our investigation in passive methodology. Passive method is nothing but the introduction of cavity in bottom surface of the airfoil. In our investigation, we took NACA 23015 airfoil at a constant speed of 60 m/s for zero, eight and sixteen degree angle of attack. This new methodology is named as triangle passive control and curved passive control. In our project we also are changing the location of passive control and to see its reaction on aerodynamic forces. The main aim of this project is to increase lift at zero angle attack with the help of passive methodology. Airfoil is generated in JAVAFOIL, and drawn in CATIA V5. Meshing and analyzing is done in ANSYS WORKBENCH and CFX.

Keywords**:** Lift, NACA 23015, passive control, cavity, airfoil

1. INTRODUCTION

An airfoil-shaped body moved through a fluid produces an aerodynamic. The component of this force perpendicular to the direction of motion is called lift. The component parallel to the direction of motion is called drag. Subsonic flight airfoils have a characteristic shape with a rounded leading edge, followed by a sharp trailing edge, often with a symmetric curvature of upper and lower surfaces. The Lift on an airfoil is primarily the result of its angle of attack and shape. When oriented at a suitable angle, the airfoil deflects the oncoming air, resulting in a force on the airfoil in the direction opposite to the deflection. This force is known as aerodynamic force and can be resolved into two components: lift and drag. Most foil shapes require a positive angle of attack to generate lift, but cambered airfoils can generate lift at zero angle of attack. This "turning" off the air in the vicinity of the airfoil creates curved streamlines which results in lower pressure on one side and higher pressure on the other. This pressure difference is accompanied by a velocity difference, via Bernoulli’s principle, so the resulting flow field about the airfoil has a higher average velocity on the upper surface than on the lower surface. The lift force can be related directly to the average top/bottom velocity difference without computing the pressure by using the concept of circulation and the Kutta-Joukowski theorem.

The method of increasing fluid mixing rates by the artificial generation of near-surface streamwise vortices has been found to be a particularly powerful technique. The vortices act to entrain high-energy flow from the undisturbed outer airstream and transport it into the low- momentum near-wall region deep inside the boundary layer [1]. An alternative to vane vortex generators is an active fluid jet vortex generator, proposed by Wallis [2]. Fluid injection via inclined and skewed (relative to the free stream flow) wall-bounded jets act to induce longitudinal vortices for flow control, instead of solid vane vortex generators. Boundary layer separation is a known problem on some modern low-pressure turbine LPT airfoils, due to the strong adverse pressure gradients created when designers impose a higher loading in an effort to improve efficiency and lower cost by reducing the airfoil count in engines. Separation bubbles, particularly those which fail to close, can result in a significant loss of lift and a subsequent degradation of engine efficiency. [5] Successful flow control results in a thin, attached boundary layer at the trailing edge of an airfoil, thereby reducing losses. The consensus of the studies listed above is that a device on the suction surface should be placed at or slightly downstream of the pressure minimum. This is a logical result, since the effects of a device farther upstream would be damped by the favorable pressure gradient, and a device too far downstream would lie under the separation bubble and be ineffective [7]. All produced similar results, found that straight trip wires were somewhat better than rows of spherical roughness elements, but only a limited number of cases were tested. Found dimples superior to other devices, presumably because the dimples produced fewer blockages than devices that protruded into the flow. Again, however, the number of cases considered was limited, and more recent evidence suggests that optimal devices should be quite small and produce minimal blockage even if they do extend into the flow [9].

2. COMPUTATIONAL WORKS

Airfoil is generated by using **JAVAFOIL** software, which is transferred to **CATIA V5.** Airfoil is coded as **NACA 23015,** which is a five digit one. In this research work, NACA 23015 airfoil is going to change some different models. 1st model is the basic **NACA 23015** model is analyzed with 0,8 and 16 degrees of angle of attack. 2nd model is the basic **NACA 23015** model is analyzed with 0,8 and 16 degrees of angle of attack with the curved passive control under bottom surface of the airfoil in 25% of chord. 3rd model is the basic **NACA 23015** model is analyzed with 0,8 and 16 degrees of angle of attack with the curved passive control under bottom surface of the airfoil in 50% of chord. 4th model is the basic **NACA 23015** model is analyzed with 0,8 and 16 degrees of angle of attack with the curved passive control under bottom surface of the airfoil in 75% of chord. 5th model is the basic **NACA 23015** model is analyzed with 0,8 and 16 degrees of angle of attack with the triangle passive control under bottom surface of the airfoil in 25% of chord. 6th model is the basic **NACA 23015** model is analyzed with 0,8 and 16 degrees of angle of attack with the triangle passive control under bottom surface of the airfoil in 50% of chord. 7th model is the basic **NACA 23015** model is analyzed with 0,8 and 16 degrees of angle of attack with the triangle passive control under bottom surface of the airfoil in 75% of chord. Then the model was meshed in ICEM CFD. Finally, it was analyzed in ANSYS CFX.

3. RESULTS & DISCUSSIONS

In this chapter, we discuss about the final results obtained from the solver and CFX post.

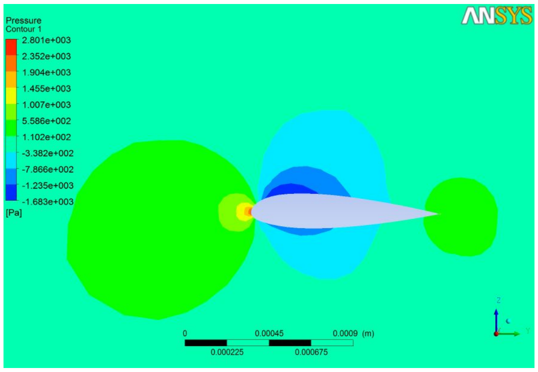

FIG 1 Pressure contour for airfoil with zero deg AOA

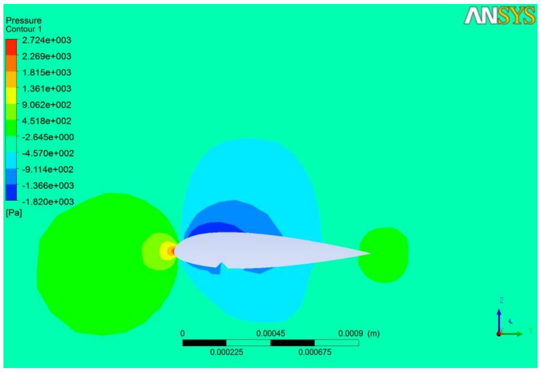

FIG 2 Pressure contour for airfoil with 0 deg AOA with triangle passive control at 25% of chord

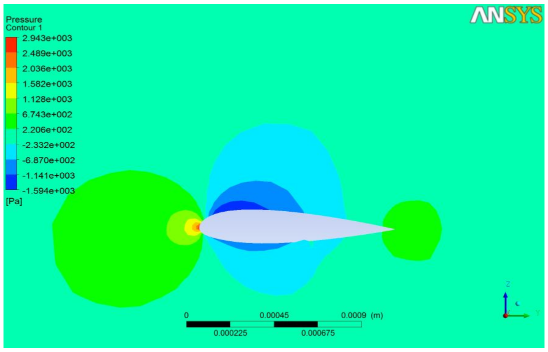

FIG 3 pressure contour for airfoil with 0 deg AOA with with triangle passive control at 50% of chord

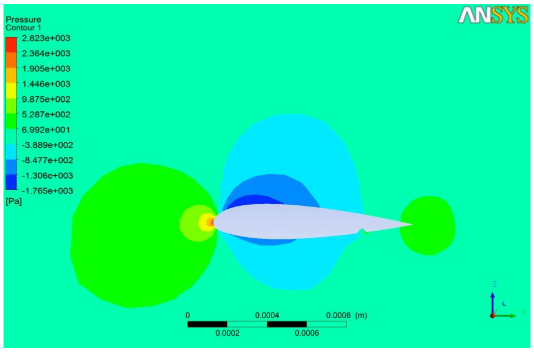

FIG 4 pressure contour for airfoil with 0 deg AOA triangle passive control at 75 % of chord

TABULATION FOR LIFT AND DRAG FOR ALL AIRFOILS

SL	NAME	% OF PAS CONTR	ANGLE ATTAC (DEGR	LIFT (N	DRAG (
1	NACA 23015	NO	0	0.000758	0.000443
2	NACA 23015	NO	8	0.005468	0.00074
3	NACA 23015	NO	16	0.00762	0.00157
4	TRIANGLE PASSIVE CONT	25	0	0.000817	0.000486
5	TRIANGLE PASSIVE CONT	25	8	0.005628	0.000753
6	TRIANGLE PASSIVE CONT	25	16	0.008069	0.00139
7	TRIANGLE PASSIVE CONT	50	0	0.000778	0.000430
8	TRIANGLE PASSIVE CONT	50	8	0.005575	0.000693
9	TRIANGLE PASSIVE CONT	50	16	0.008438	0.00136
1	TRIANGLE PASSIVE CONT	75	0	0.000845	0.00044
1	TRIANGLE PASSIVE CONTROL	75	8	0.005654	0.00071
1	TRIANGLE PASSIVE CONT	75	16	0.007653	0.00145
1	CURVED PASSIVE CONT	25	0	0.000932	0.00048

1	CURVED PASSIVE CONT	25	8	0.005782	0.00071
1	CURVED PASSIVE CONT	25	16	0.008120	0.00275
1	CURVED PASSIVE CONT	50	0	0.000912	0.00046
1	CURVED PASSIVE CONT	50	8	0.005586	0.00076
1	CURVED PASSIVE CONT	50	16	0.008086	0.00281
1	CURVED PASSIVE CONT	75	0	0.000784	0.00046
2	CURVED PASSIVE CONT	75	8	0.005517	0.00071
2	CURVED PASSIVE CONT	75	16	0.008096	0.00281

4. CONCLUSIONS

From the above project investigations, we will derive the words of conclusion to our investigations. In this project investigation goes under the different cases for NACA 23015 airfoil for 0, 8 and 16 degrees. At the same time we took new methodology like passive control over the above mentioned airfoil and above the mentioned angle of attack. The new methodology is taking passive controls in bottom surface of the airfoil.

This new kind of passive control at 25% of chord gives lift augment, to make our project interestingly changing the passive control location at various positions to 50% and 75 percentage.

For 0 degree angle of attack, passive control at 25% gives more lift than 7% in triangular passive control at the same the circular passive control gives 22.9% increment in the lift.

For 8 degree angle of attack, passive control at 25% gives more lift than 2.5% in triangular passive control at the same the circular passive control gives 5.8% increment in the lift.

For 16 degree angle of attack, passive control at 25% gives more lift than 5.7% in triangular passive control at the same the circular passive control gives 6.5% increment in the lift.

For 0 degree angle of attack, passive control at 50% gives more lift than 2.6% in triangular passive control at the same the circular passive control gives 20.3% increment in the lift.

For 8 degree angle of attack, passive control at 50% gives more lift than 2.01% in triangular passive control at the same the circular passive control gives 2.19% increment in the lift.

For 16 degree angle of attack, passive control at 50% gives more lift than 10.6% in triangular passive control at the same the circular passive control gives 6.03% increment in the lift.

For 0 degree angle of attack, passive control at 75% gives more lift than 11.4% in triangular passive control at the same the circular passive control gives 3.4% increment in the lift.

For 8 degree angle of attack, passive control at 75% gives more lift than 3.4% in triangular passive control at the same the circular passive control gives 1% increment in the lift.

For 16 degree angle of attack, passive control at 75% gives more lift than 1% in triangular passive control at the same the circular passive control gives 6.1% increment in the lift.

From the above results we may conclude that each part of the passive control airfoil be played an important role in their specific cases.

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