EFFECT OF ANGLE OF ATTACK ON AERODYNAMIC FORCES OF SYMMETRICAL AND UNSYMMETRICAL AIRFOIL USING WINDTUNNEL

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ABSTRACT

Wind tunnels are primary devices and tools that enable researchers to the study of experimental aerodynamics which includes flow of air and the forces and interactions of air over the objects of interest. Wind tunnels enable aerodynamic investigation to evaluate the influence of wind past solid objects. In the present study, a typical low speed, subsonic wind tunnel is used to find the effect of angle of attack on lift and drag forces of a symmetrical and asymmetrical airfoils. Angle of attack (AOA) is the angle between the relative velocity between air and airfoil and the chord of air foil. The wind velocity inside the test section is 28.2 m/s. It was found experimentally that for an unsymmetrical airfoil, as angle of attack increases from -15° to 15°, co-efficient of lift, $C_L$, increases and reaches a maximum value of 0.74 at 15°. Coefficient of drag, $C_D$, decreases with increase in angle of attack and remains constant at a value of 0.08 between 0° to 5° and reaches a value of 0.11 at critical angle of attack. In case of symmetrical airfoil, critical angle of attack was found to be 10° with maximum $C_l$ at 0.62. $C_D$ decreased with angle of attack up to 5° and showed little change of $C_D$ between 0° to 5° and there was increase in $C_D$. The aerodynamic forces depend on pressure distribution over airfoil which varies with angle of attack. The upper surface of unsymmetrical airfoil experienced boundary layer separation due to adverse pressure gradient while lower surface experienced favourable pressure gradient and hence no boundary layer separation at -10° to -5° AOA. As $C_D$ is increased to +10°, favourable pressure gradient occurred at upper surface while lower surface met with adverse pressure gradient at +10°. In case of symmetrical airfoil, at -5° to -10° adverse pressure gradient occurred at upper surface while lower surface met with favourable pressure gradient. As AOA is increased, there is no boundary layer separation on both surfaces due to favourable pressure gradient. At +10°, lower surface of symmetrical airfoil met with adverse pressure gradient.

KEYWORDS: Windtunnel, Aerodynamic forces, Lift, Drag, Angle of attack, Critical angle, Adverse pressure gradient, Favourable pressure gradient

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