AEROFOIL DESIGN AND BOUNDARY LAYER TRANSITION FLOW STUDIES AT SUBSONIC SPEEDS FOR A TYPICAL TRANSPORT AIRCRAFT

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Abstract

Reliable computational aerodynamic prediction of airfoil drag, maximum lift and the effect of Reynolds number continue to be a challenge to aerodynamicists, using large computer programs and memory resources even today. Design of an aerofoil for an efficient wing is presented here for the typical transport aircraft which is being developed. Flow around five digit NACA23015 aerofoil was investigated at three distinct Reynolds numbers viz, 2×10^6, 10×10^6 and 20×10^6 typical to small and medium size transport aircrafts for various angle of incidences up to stall. This paper provides insights into the geometry shape design of an aerofoil taking into consideration the effect of Reynolds number on overall efficiency i.e. the lift to drag ratio of an aerofoil. Further the paper provides some aspects of prediction and comparison of the movement of transition point for free transition flow at specific Reynolds numbers. Extensive use is made here of the open source XFOIL. With its analysis and excellent interactive inverse design capabilities for low speed single element aerofoil, the design of the aerofoil has been studied with respect to lifting characteristics, drag characteristics and pitching moment. The results are compared with those of the classical NACA 23015 aerofoil and another NASA Natural Laminar Flow (NLF) aerofoil. The comparative numerical studies using the XFOIL has shown some promising results of the modified aerofoil for use on the aircraft under design.

Keywords: Aerofoil Analysis, Inverse Design, Transition Flow, Free Transition, Natural Transition