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Flatback Airfoil Wind Tunnel Experiment

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Abstract

An experimental investigation of blunt trailing edge or flatback airfoils was conducted in the University of California, Davis Aeronautical Wind Tunnel. The flatback airfoil was created by symmetrically adding thickness to both sides of the camber line of a baseline airfoil, while maintaining the maximum thickness-to-chord ratio of 35%. Three airfoils, with geometries based on the baseline airfoil, of various trailing edge thicknesses (0.5%, 8.75%, and 17.5% chord) are discussed in this report. In the present study, each airfoil was tested under free and fixed boundary layer transition flow conditions at Reynolds numbers of 333,000 and 666,000. The fixed transition conditions, used to simulate surface soiling effects, were achieved by placing artificial tripping devices at 2% chord on the suction surface and 5% chord on the pressure surface of each airfoil. The results of this investigation show the blunt trailing edge airfoils reduced the well-documented sensitivity to leading edge transition for thick airfoils. The nominally sharp trailing edge airfoil, with trailing edge thickness of 0.5% chord, performed well under free transition conditions, but the lift characteristics deteriorated significantly when the flow was tripped at the leading edge. As the trailing edge thickness was increased, the effect of leading edge transition diminished, that is, the airfoil lift performance became increasingly similar for free and fixed transition. The flatback airfoils yield increased drag coefficients over the sharp trailing edge airfoil due to an increase in base drag. To address the base drag increment, six different trailing edge devices were investigated for the airfoil with 17.5% chord trailing edge thickness at a Reynolds number of 333,000 under tripped flow conditions. Several of the trailing edge devices caused significant reductions in base drag.