

Effect of cross flow on aerodynamics of a commercial airplane

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Summary

This paper analyzes computationally the flow field for the full geometry model of a commercial passenger airplane, Boeing747-400. The geometric dimension of an airplane was acquired by means of the reverse engineering technique adopting the photo scanning measurement. The steady three-dimensional viscous compressible flow field was calculated when the airplane cruises under side flow. The basic computational conditions were considered as the same to those of Boeing 747-400's cruising state, i.e., the atmospheric condition at 13 km above the sea level and Mach number of 0.85. The boundary conditions are the same that the freestream with side flow approaches to the aircraft. And the pressure conditions are set on the all remaining boundaries. The high Reynolds turbulence model is used, and the flow characteristics around the aircraft are discussed. Aerodynamic forces according to the Mach number and the angle of attack were analyzed; in addition effects of side flow on force and moment coefficients were described. When the rage of Mach number of crossflow is between 0 and 0.3, lift and drag coefficients were remarkably decreased and increased, respectively starting from cross flow Mach number 0.118; the former decreases nearly 50% and the latter increases nearly 56% as comparison with the cruising condition.

keywords: Aerodynamic force and moment, Cross flow, Full configuration, Transonic flow, Pressure coefficient

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