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Base Pressure Control using Quarter Rib at Mach 1.3: A Comprehensive CFD Analysis

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Abstract

The study of base pressure and its control is an important research area in the transonic speed when the flow undergoes a sudden change in area. The turbulent flow in a separated region is still a crucial area of research due to the advent of space shuttles and high-performance military aircraft, and turbulent flow in transonic and supersonic flow is a thrust area for researchers. This paper focuses on base pressure control with sudden expansion at Mach 1.3 for an area ratio of 4.84. The flow field inside the duct is controlled through a passive control in the form of quarter ribs of radii 1 mm, 2 mm, 3 mm, and 4 mm for various duct lengths in the range from $L = 1D$ to $6D$ for nozzle pressure ratios in the range from 3 to 11. Results show that a 1 mm rib is not adequate, and rib radii 2 mm, 3 mm, and 4 mm are effective in raising the base pressure values, and this rise in the base pressure continues till the duct length $L = 1D$ to $4D$. There is a marginal reduction in base pressure for the duct lengths $L = 5D$ and $6D$ due to the ineffectiveness of the back pressure. © 2025, Semarak Ilmu Publishing. All rights reserved.

Author Keywords

Base pressure; L/D ratio; Mach number; nozzle pressure ratio; sudden expansion

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