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Flow Direction Control using Circular Cylinder with Multi-slotted Tangential Blowing

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Extended Abstract

Jet technologies are sometimes used for boundary layer control, including the stall control of wings [1]. Studies been conducted on circulation control wings (CCW), which utilize jet sheets to generate more lift [2]. A CCW generates a high lift by blowing out jet sheets tangentially from slots on the negative-pressure side of the wing and increasing the circulation around the wing by utilizing the Coanda effect on the curved surface of the wing. The simplest form of a CCW is a circular cylinder with tangential blowing, and the lift can be controlled without changing the geometry by adjusting the momentum of the jet sheet [3].

However, as most studies have focused primarily on the lift force characteristics, the knowledge necessary to apply circular cylinders with tangential blowing to the directional control of the already existing flow, such as in ductless ventilation, is lacking [4]. In particular, the effect of the number of slots on the deflection characteristics of the flow remains largely unexplored [5].

In this study, two types of circular cylinders with tangential blowing single-slot and double-slot were used to control the direction of the main jet, and their fundamental flow characteristics were elucidated. The double-slot type is expected to exhibit a self-cooling function similar to that of film cooling. The effects of the momentum coefficient C_μ, the slot installation angle θ_j, and the eccentricity of the columns with respect to the main jet ε on the jet deflection characteristics were mainly discussed through flow visualization and velocity measurements. The Reynolds number in this experiment was constant at 2.7×10^4.

The main results were that the deflection characteristics of the main jet applying the single- or double-slot types are different for identical momentum coefficients C_μ. The jet deflection characteristics do not depend significantly on the eccentricity of the installed cylinder ε in the single-slot case, whereas in the double-slot case, the flow characteristics differ significantly depending on the eccentricity of the installed cylinder ε.

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