Boundary Layer Bypass Transition on a Flat Plate Induced by Periodic Wake Passage affected Pressure Gradients(Effects of Free-Stream Turbulence)

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1. Introduction

This paper deals with the investigation of wake-disturbed boundary layer on a flat-plate model with an elliptic leading edge, which is subjected to favorable and adverse pressure gradients. Main focus of this paper is on how the free-stream turbulence affects the transitional behavior of the boundary layer induced by periodic wake passing.

2. Experiments

Fig.1 shows system for the measurement of wake-disturbed boundary layer. Detailed measurements using a single-hot wire probe are performed on bypass transition. A spoked-wheel-type wake generator is used to generate periodic wakes. Free-stream turbulence intensities are controlled with three types of turbulence grids.

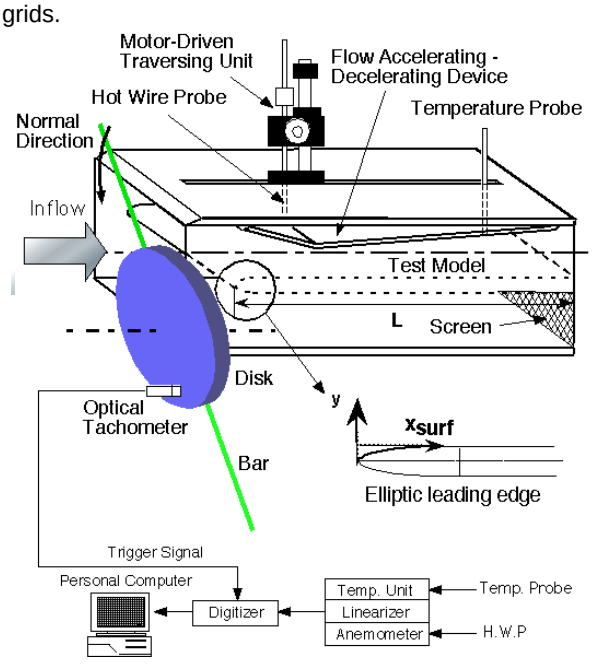

Fig. 1 System for the measurement of-wake-disturbed boundary layer

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3. Results and conclusions

Reynoldes number ($Re_{in} = 1.4\times10^{6}$) and Strouhal number ($S = 2.15$) characterized wake-disturbed unsteady flow field around the test model. Fig. 2 shows that time-averaged energy dissipation thickness rapidly rose on the region where the adverse pressure gradient was imposed. The free-stream turbulence was dominant in the bypass transition in comparison with the periodic wake passage higher than that induced by periodic wake passage for inlet free-stream turbulence cases.

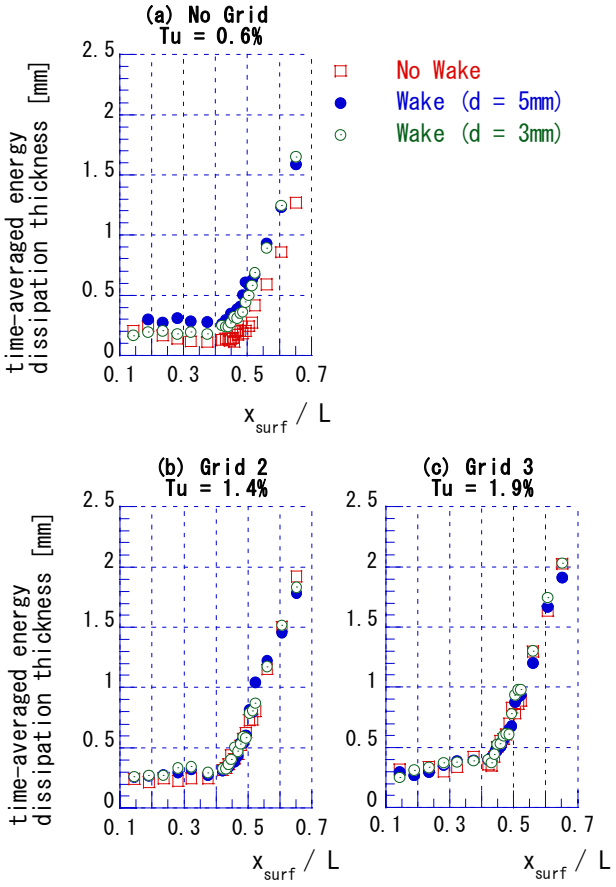

Fig. 2 Time-averaged energy dissipation thickness affected the free-stream turbulence ((a):No Grid, (b):Grid2, (c):Grid3)