Program Advanced Technology University of Twente.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his Bachelor assignment

Marijn Sanders

will give a presentation, entitled:

On Boundary Layer over a Flat Plate

Date: Friday July 11, 2014

Time: 10:00

Room: **Horst Building Room Z.109**

Summary:
The properties of the boundary-layer over a flat plate have been investigated analytically, experimentally and numerically employing XFOIL. With the theory from Blasius and von Kármán, the boundary-layer over an infinitesimally thin flat plate have been investigated analytically. A finite-thickness plate, designed to behave aerodynamically as a flat plate, with a Hermite polynomial leading edge and a trailing edge corresponding to the last 70% of a NACA 4-series airfoil section, has been analyzed with XFOIL and has been investigated mounted at zero angle of attack in the Silent Wind Tunnel of the University of Twente.

Initial measurements have been performed to obtain the drag force and velocity profile in the boundary layer. The drag force was measured with load cells and the velocity profile was determined with a Pitot tube and a single-wire Hot Wire probe (55P11) at various Reynolds numbers. The measurements indicate a delayed transition from laminar to turbulent flow at a Reynolds number around $Re_{crit}=3\cdot10^6$ instead of the expected $Re_{crit}=5\cdot10^5$. Leading-edge turbulence strips were also applied in order to investigate the drag force and the transitional boundary layer.

The found delayed transition is unfavorable for further research on the influence of surface roughness on transition because of the maximum velocity achievable in the Silent Wind Tunnel. Since the turbulence level of the Silent Wind Tunnel is relatively low (approximately 0.25%), other possibilities have been investigated on the cause of the delayed transition. Results of numerical simulations using XFOIL indicated that a small change in the streamwise pressure gradient can delay transition substantially. Therefore, additional measurements have been performed on the streamwise pressure gradient in the Silent Wind Tunnel. These results revealed a streamwise pressure gradient in the Silent Wind Tunnel which is amplified when the plate is installed in the wind tunnel and may have been the cause of the delayed transition.

Assessment committee: **Chairman,**

Prof.dr.ir. H.W.M. Hoeijmakers (Mentor/Chairman)
Dr. H.K. Hemmes (External Member)
Ir. R. Kommer (mentor)

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