

# COLLOQUIUM

In accordance with article 4.6.8 of the SSNS-wb.

Group: Engineering Fluid Dynamics

As part of his MSc thesis assignment

**Maarten Paul van der Laan**

will give a presentation, entitled:

## **Numerical Simulation of Flow around Wind Turbine Blade with Vortex Generators**

**Date:** Thursday, December 23, 2010

**Time:** 14:00h

**Room:** N109



### **Summary:**

Wind turbine blades often suffer from flow separation in the root section. This part of the blade is thick in order to keep the structural stresses and strains, caused by the large root bending moment, below the allowed level. To delay flow separation flow control devices can be used. Presently for wind turbine blades mainly vortex generators (VG's) are applied. VG's are passive flow control devices that delay flow separation by generating stream-wise vortices that add momentum to the boundary layer on the blade.

Finding the optimal design for VG's and their location on the blade is not an easy task. Wind tunnel experiments of blades with VG's can provide useful information but are time consuming and expensive. Numerical simulations of the VG design employing computational fluid dynamics (CFD) are relatively fast, although representing the geometrical details of VG's in a grid results in large grids that lead to a substantial computational effort. Therefore in the present study a model of the VG, due to Bender, Anderson & Yagle (BAY) has been utilized. The BAY model represents the effects of the presence of the VG on the flow using a volumetric force distribution. However, the BAY model requires calibration using data from numerical simulations of the flow around the geometrically fully represented VG configuration.

The first step in the present study investigates in detail the calibration of the BAY model applied to VG's positioned on a flat plate. The second step is considering the configuration of a row of VG's positioned on an extruded aerofoil, for which the effect of VG's on flow separation has been investigated numerically. Using the results from the flat-plate VG-configuration calibration of the BAY model, a parametric study of different VG designs has been carried out. Finally, the flow around one of the VG designs for the extruded aerofoil has also been numerically simulated with the VG's geometrically fully represented. Comparison of results of this numerical simulation with the results from the same configuration with the BAY model for the VG's show that the BAY model is a very useful model that leads to a significant reduction of the required computational time.

### **Assessment committee:**

Prof.dr.ir. H.W.M. Hoeijmakers (chairman)  
Dr.ir. J.M. Cnossen (SBT) (mentor)  
Dr.ir. E.T.A. van der Weide (mentor)  
Dr.ir. J.B.W. Kok  
Ir. J.J. Slot

### **Chairman:**

November 23, 2010