Faculty Engineering Technology
Program Sustainable Energy Technology

UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

S. Lamboo

will give a presentation, entitled:

Bend-Twist Coupling for Tidal Turbine Blades

Date: Friday October 7, 2016

Time: 13:00

Room: Horst Building OH111

Summary:
In the continued search for sources of renewable energy, tidal energy has been receiving an increased amount of attention over the past decade. As tidal currents depend on the movement of the earth, moon, and sun they are very predictable, which is a benefit of tidal energy over alternative renewable energy sources such as wind energy and solar energy. To compete with other energy sources, however, the cost-of-energy of tidal energy has to be reduced. Tidal energy is a young renewables industry, but much can be learned from the wind energy industry since there are many similarities between tidal turbines and wind turbines.

Relative to wind, tidal currents have a large energy density, implying that a lot of energy can be harvested using turbines with a rotor diameter that is small compared to that of wind turbine rotors. The high energy density also has as consequence that the loads on the turbine rotor is high. Many conventional methods for load reduction for wind turbines rely on active systems or moving parts, like blade pitching systems. These solutions are less favourable in a submarine environment due to possible component failure or blockage, which would require expensive offshore maintenance. Therefore for tidal turbines passive load reduction methods have been investigated as alternative solutions. Bend-twist coupling was identified as one of the most promising concepts.

Bend-twist coupling is a passive method used to control the forces on turbine blades, airplane wings, and helicopter rotors. It makes use of the forces on the structure to induce a controlled change in geometry. When tailored correctly the geometric deformations can be used to decrease the angle of attack of a blade section, thereby decreasing the hydrodynamic force. A decrease in hydrodynamic force can be used to reduce loads or improve energy production, both of which have a beneficial effect on the overall cost-of-energy. Bend-twist coupling can be achieved by tailoring either the structural or geometrical design of a turbine blade, requiring no additional components, and thereby keeping the number of components that that can fail to a minimum.

In this thesis the feasibility of using bend-twist coupling for the tidal turbines of Tocardo International BV has been investigated. Blade Element Momentum (BEM) software has been used to study the stationary and dynamic effects of bend-twist coupling on loads and energy production. The results show that fatigue loads can be significantly reduced, keeping energy production nearly unaffected or even slightly higher, depending on the degree of deformations. To determine the full extent of the achievable deformations a detailed structural design would be required, which was beyond the scope of the present study. Investigation of the structural feasibility, however, indicates that small amounts of deformations are expected to be achievable with no major issues concerning the manufacturability and stability of the rotor.

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