Project title	Triblade rotor blades, preparatory project
Project number	TG2-21
Organisation	Winfoor AB
Project leader	Rikard Berthilsson
Other participants	Chalmers
Report for	2015-07-01 – 2016-03-27
Participating companies	Marstrom Composite

Project description

In this preparatory project we have analyzed the Triblade technology and planned for a subsequent R&D project to be run within SWPTC.

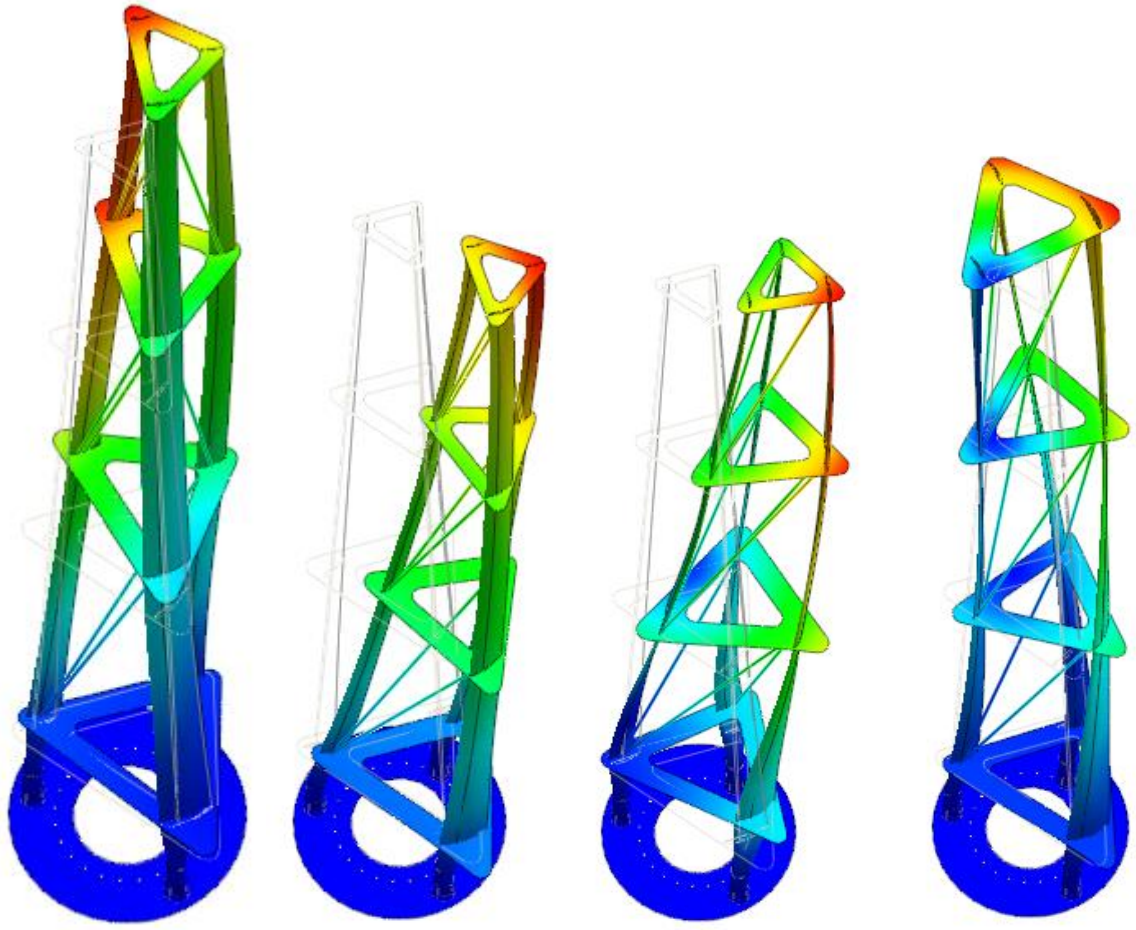
The preparatory project tasks are

1. Analyze the possibility to run a R&D project for Triblade within SWPTC. Identify interested consortium partners.
2. Define the scope for the R&D project: Fluid mechanics in 2D and 3D, noise, vibrations, turbulence, optimization, structural analysis, dimensioning and design of members and joints, hub connection, static and dynamic loads, buckling, fatigue, production development, prototyping, wind tunnel tests, pilot installation, literature studies.
3. Perform initial studies on selected tasks, run wind tunnel tests on existing prototype, analyze possible production techniques, prototyping cost estimation.
4. Complete a proposal for the R&D project: resources, budget, time plan, work packages, deliverables, and goals.

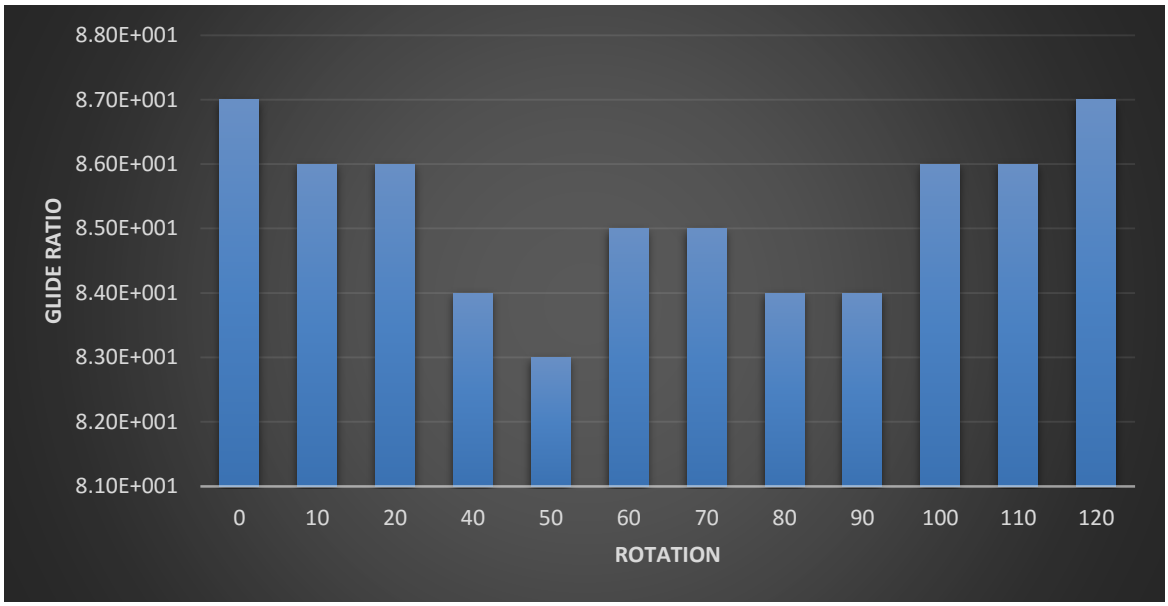
Results

All tasks of the preparatory project have been completed. A draft proposal for an R&D project has been written and can be found as APPENDIX 1. The consortium partners are Winfoor and the fluid mechanics department at Chalmers. It has however proven to be difficult to find an acceptable setup of the project such that it can be co-financed by SWPTC.

Within the preparatory project we have done initial studies of the aerodynamic and structural properties of Triblade through CAD modelling and FEM simulations. We have also done initial studies on production development. The structural analysis includes analysis of buckling, stress concentration, and vibrations. The aerodynamic analysis was carried in the software Openfoam and is so far limited to static 2D analysis only. As a result, a draft model for Chalmers test wind turbine at Hönö has been completed and analysed.



The first four buckling modes of Triblade for Chalmers test turbine.



Glide ratio of Triblade as a function of the angle between the three blade configuration of Triblade and the relative wind direction. The figure shows that the glide ratio changes only marginally with the relative wind direction.

A wind tunnel test was done at Chalmers wind tunnel. A model of a section of a Triblade that has previously been tested at the wind tunnel was tested again but with a different method. The test showed that the diagonal struts affects the flow of the air significantly, especially at the middle of the model where the struts cross each other. The conclusion is that we should use thinner and as few struts as possible. For additional wind tunnel tests we should also consider using a smaller model since we had boundary effects from the close proximity between the model and the wind tunnel walls.

A prototype of a joint between two sections of a blade was made by Marstrom. The prototype uses a telescopic connection for joining the blades which has been analysed and tested for loads. The telescopic concept for joining blade parts shows promising results and has potential for a modular design of Triblade that can be manufactured and transported in section for later assembly.

Outside the scope of the preparatory project, a pilot installation has been completed. For the pilot we have manufactured a rotor comprising three 3.6 m long Triblades. The rotor diameter is 7.4 m and it has been installed and tested at Nordic Folkecenter in Denmark. A video of the test can be found at https://vimeo.com/154300292 using the password: greenpower. The power output of this first pilot is in accordance with expectations, peaking at 8.5 kW at 13 m/s.

Fulfilment of SWPTC's goals

The preparatory project and subsequent R&D project will contribute to

- Lowering mass of rotor blades.
- Increase the performance of wind turbine
- Increase knowledge on wind turbine components and systems

Deviations from project plan

The preparatory project was completed behind time schedule, but otherwise according to plan.

Publications

None

External activities

None