
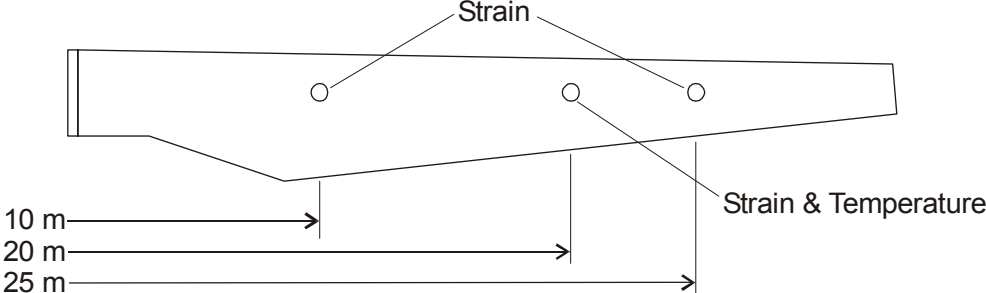


Wind Turbine Blade Monitoring and Control

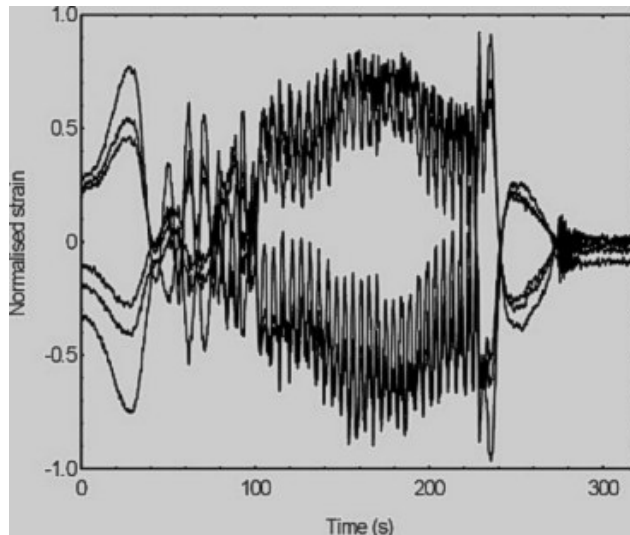
Project	Development and test of a WEC blade load monitoring system for condition monitoring and pitch control.
Client	Enercon GmbH
Date	2002 - 2004
Location	Emden, Germany
Sensors	SmartPatch
Attachment	Internal blade surface mount
Interrogator	OFSSSI
Images	 <p>Multi megawatt turbine (c/o Enercon GmbH)</p>
Results	<p>The three 33-m blades of an Enercon™ wind energy converter were fitted with FBGs for strain and temperature measurement. Two of the blades had arrays of three strain and one temperature sensor on the tension side and the third had three additional strain gratings in the compression side.</p>  <p>Locations and types of FBG in the wind turbine blades. Distances are measured from the centre of the hub.</p>

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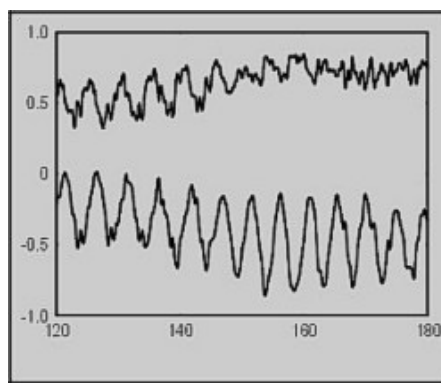
Results

The blade was made in two halves, with the fibres being laid on the internal surfaces of the two sections, tacked in place with cyanoacrylate adhesive and covered with a single layer of 0/90° glass cloth, impregnated with a low-temperature curing epoxy resin. Epoxy resin was applied to the two halves of the blade, which were then clamped together and held at 80°C for 8 hours.

The instrumented blades were initially loaded statically in the laboratory to test the performance of the sensors and were then installed on an E-66 wind turbine in Emden, Germany. Data were gathered as the turbine was in operation. The example below is of data from the third blade, equipped with six strain and one temperature FBG, as the turbine was rotating and generating electricity. During the first 100 seconds, the pitch of the blades was adjusted as the turbine started to spin up to speed, then for the next 120 seconds, the blades were rotated at a constant speed. The periodic variation of strain with rotation at 0.2 Hz, due to the blade's own weight, is clearly superimposed on the aerodynamic load. Finally, the rotor was braked and the blades moved into their locking position. The inset figure shows small fluctuations within each period of rotation.



Strains recorded from six FBG sensors in an operational wind turbine blade.



Outputs of sensors at 25 m in compressive and tensile faces.

Work under this project at Enercon is ongoing and further data are restricted.

Further information

Withheld