



Aalborg Universitet

AALBORG UNIVERSITY
DENMARK

Distribution of Defects in Wind Turbine Blades

Toft, Henrik Stensgaard; Branner, Kim; Sørensen, John Dalsgaard

Published in:
EWEC 2009 Marseille

Publication date:
2009

Document Version
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Toft, H. S., Branner, K., & Sørensen, J. D. (2009). Distribution of Defects in Wind Turbine Blades. In *EWEC 2009 Marseille: Europe's premier wind energy event, Parc Channot, Marseille, France 16-19 March 2009* The European Wind Energy Association.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- ? Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- ? You may not further distribute the material or use it for any profit-making activity or commercial gain
- ? You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

ID: 188

TRACK: SCIENTIFIC TOPIC: Reliability, Materials & lubrication

DISTRIBUTION OF DEFECTS IN WIND TURBINE BLADES

Henrik Stensgaard Toft (Aalborg University, Department of Civil Engineering, Denmark)

Kim Branner, Denmark (1) John Dalsgaard Sørensen, Denmark (2)

(1) Risø-DTU (2) Aalborg University and Risø-DTU

Local defects in the form of e.g. delaminations and wrinkles in wind turbine blades seem to have a significant influence on the load carrying capacity. The prediction of type, number, position and size of the individual defects will for this reason be crucial in future blade design, where this information can be used to study critical positions and sizes of defects. The influence of defects on the load carrying capacity is quantified by comparing calculations for blades with and without defects. Additionally the information obtained from NDT methods during quality control are used to update the probability for defects.

Calculation of the load carrying capacity for wind turbine blades have been widely studied during the last decades leading to more refined finite element calculations and failure criteria's. However, there still seems to be a significant difference between the measured and calculated load carrying capacity for full-scale blades.

The difference in load carrying capacity can to some extend be caused by physical variations in the material properties. However, local defects in the blade which are due to minor or gross variations in the manufacturing process, seem to have a significant influence on the load carrying capacity. The local defects occurring during the manufacturing process are often delaminations which are areas of poor or no bonding between adjacent plies and wrinkles which often are caused by poor stretching of the fibers. These local defects can in some cases increase in size during service because the blade is exposed to cyclic loading and extreme load cases.

In this paper is proposed a model for the number and distribution of local defects in a wind turbine blade. First a model is described based on the assumption that defects occurs randomly and are independent of each other. Next the model is improved to take into account that local defects often occur in clusters ? where several defects are located close to each other. The individual defects are also attached information about there type, size etc.

Based on the proposed model is number, position and size of local defects in a wind turbine blade simulated and used as input parameters for calculation of the load carrying capacity. For a few selected cases the load carrying capacity is calculated and the results are compared to calculations of a ?perfect? blade which does not contain any defects.

After manufacturing a wind turbine blade is quality controlled in order to secure that the blade does not contain any critical local defects. The quality control is often performed by visual inspection assisted with other Non Destructive Testing (NDT) methods such as infrared and ultrasound scanning. However, these testing methods are not perfect and the reliability has to be modelled probabilistically by Probability Of Detection (POD) curves. In this paper is it described how information obtained by NDT can be used for updating the probability distribution of defects by Bayesian methods and how the load carrying capacity can be updated dependent of the quality of the NDT.