DCAMM SEMINAR

APPLIED MATHEMATICS AND MECHANICS

FS937 1 June 2018

A DCAMM seminar No. 726 will be presented by

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The title of the lecture is

Damage mechanisms of fibre composite for wind turbine blades investigated by X-ray tomography and finite element modelling

Abstract:

Due to their high specific stiffness, strength along with their great fatigue performance, fibre composites are increasingly replacing conventional materials such as aluminium and steel in structural applications. In the case of wind turbines, the main load carrying parts are made from non-crimp fabric based fibre composites where most of the fibres are aligned in the axial direction (uni-directional). Due to the continuous rotation of the blades, fatigue loading of such materials reaches load repetitions in the range of 10^8-10^9 cycles, and thus fatigue is an important design concern. However, fatigue design methods commonly used in industry are based on approaches developed for metals despite the damage mechanisms being considerably different. To make it possible to establish new fatigue design criteria suitable for fibre composites, it is necessary to understand the damage mechanisms in depth.

Thus, the current study focused on elucidating the damage initiation and progression mechanisms of non-crimp fabric based fibre composites. Several experimental approaches were established. An ex-situ X-ray CT fatigue testing approach was established and used to monitor the development of fibre fractures in 3D during fatigue loading. Furthermore, a tension clamp solution was established for applied load during X-ray CT, increasing the visibility of the damage in the X-ray CT images. In addition, off-axis crack initiation and growth were monitored by camera and light in-situ during fatigue testing. Finally, finite element modelling was carried out to study the effect of the real fibre bundle structure by extracting the 3D geometry from X-ray CT images. By monitoring the damage initiation and progression it was found that the damage progressed in a 3D manner and that the local variation in the fibre bundle structure highly effected the initiation and progression mechanisms, which also highlighted the importance of 3D modelling. Finite element modelling was carried out based on the real fibre 3D bundle structure obtained from X-ray CT images, and higher stresses were observed in regions where damage also was observed to initiate experimentally. The study provided significant knowledge on the fatigue damage mechanisms of non-crimp fabric based composites and took the initial step towards X-ray CT based modelling of such materials.

DATE: **Friday, 15 June 2018**

TIME: **14:00 – 15:00 incl. questions**

PLACE: **Room S01, Building 101**
DTU, Technical University of Denmark

Danish pastry, coffee and tea will be served 15 minutes before the seminar starts.

All interested persons are invited.

Niels Leergaard Pedersen