Fatigue damage propagation in unidirectional glass fibre reinforced composites made of a non-crimp fabric - DTU Orbit (15/12/2018)

Fatigue damage propagation in unidirectional glass fibre reinforced composites made of a non-crimp fabric

Damage progression in unidirectional glass fibre reinforced composites manufactured of a non-crimp fabric subjected to tension-tension fatigue is investigated, and a quantitative explanation is given for the experimentally observed stiffness degradation. The underlying damage-mechanisms are examined using three distinct microscopic analyses, and the transverse crack density is measured. It is documented that the stiffness loss in fatigue is directly related to fibre fractures in the load-carrying axial fibre bundles, initialised by interface debonding and cracking in the transverse backing bundles. A simple stiffness spring model validates the stiffness loss observed. A fatigue damage scheme is presented, which suggests that damage initiates due to failure of the backing bundle causing a stress concentration in the axial load carrying fibres. This stress concentration, along with fretting fatigue, gives rise to axial fibre fractures and a loss of stiffness, eventually leading to final failure. The uniqueness of the present work is identification of the mechanisms associated with tension fatigue failure of unidirectional non-crimp fabrics used for wind turbine blades. The observed damage mechanisms need further attention and understanding in order to improve the fatigue life-time of unidirectional glass fibre reinforced non-crimp fabrics.

General information
State: Published
Organisations: Department of Wind Energy, Composites Mechanics and Materials Mechanics, University of Delaware
Contributors: Hansen, J. Z., Brøndsted, P., Gillespie Jr., J. W.
Pages: 2711-2727
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Journal of Composite Materials
Volume: 48
Issue number: 22
ISSN (Print): 0021-9983
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.57 SJR 0.555 SNIP 0.898
Web of Science (2017): Impact factor 1.613
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.42 SJR 0.528 SNIP 0.803
Web of Science (2016): Impact factor 1.494
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.4 SJR 0.573 SNIP 0.876
Web of Science (2015): Impact factor 1.242
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.44 SJR 0.612 SNIP 1.188
Web of Science (2014): Impact factor 1.173
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.45 SJR 0.625 SNIP 1.186
Web of Science (2013): Impact factor 1.257
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.21 SJR 0.599 SNIP 1.239
Web of Science (2012): Impact factor 0.936
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Original language: English
Keywords: Fatigue damage, Glass fibre reinforced composite, Fibre fracture, Microscopy, Stiffness degradation, Non-crimp fabric
DOIs:
10.1177/0021998313502062
Research output: Research - peer-review › Journal article – Annual report year: 2013