EP/L014106/1

SUPERGEN Wind Hub

Deliverables:

D.5.2.1 Report on design of 3D structural woven T-joints, concepts that can be explored for large WT blades

D5.2.2 Report on use of optical fibres for damage monitoring in woven composite laminates

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Delivery date:	23/5/18		
Distribution list:	Management Committee		

Sponsored by:

Dec17 **- D.5.2.1** Report on design of 3D structural woven T-joints, concepts that can be explored for large WT blades

The Northwest Composites Centre at University of Manchester has developed 3D finite element models (stress and failure analysis) in the effort to better understand and design 3D structural woven composite T-joints, a critical structural element in a wind turbine blade. The EPSRC-funded Henry Moseley X-ray Imaging Facility has been used for capturing the textile geometry details and damage evolution due to static and fatigue loading. The numerical simulations are in good agreement with observations and measurements.

The deliverable for D.5.2.1 is provided in the form of the following journal publications presented at national and international conference events:

1. Wang, Y and Soutis, C. A 'finite element and experimental analysis of composite T-joints used in wind turbine blades', The 8th world conference in 3D fabrics and their applications, 28-29 March 2018, Manchester UK
2. Wang, Y and Soutis, C. 'Fatigue behaviour of fibre-reinforced composite T-joints', Conference Proceedings, 12th International Fatigue Congress, 27th May to 1st June, 2018, Poitiers France.
3. Wang, Y and Soutis, C. 'Fatigue behaviour of composite T-joints in wind turbine applications', Applied Composite Materials, 24(2), (2017), 461-475.
4. Saleh, M.N., Wang, Y., Yudhando, A., Joesbury, A., Potluri, P., Lubineau, G. and Soutis, C. 'Investigating the potential of using off-axis 3D woven composites in composite joints', Applied Composite Materials, 24(2), (2017), 377-396.

Dec17 – **D5.2.2** Report on use of optical fibres for damage monitoring in woven composite laminates

During the fabrication process and especially the cure and post-cure cycle, followed by cooling, residual stresses can develop in fibre reinforced plastics that in combination with mechanical loading (flexural bending) could lead to premature resin cracking, fibre-matrix interfacial de-bonding and eventually fibre breakage, which leads to final failure. Optical fibres, embedded during the fabrication process of the composite component (plate, pipe) have successfully captured the thermal strains developed during the curing and cooling cycle in addition to damage monitoring when loaded in 3 and 4-point bending. Measured data were correlated to Acoustic Emission results. This effort will lead to the development of a real time structural health monitoring system.

Deliverable D5.2.2 is provided by the following journal publications, presented at national and international conference events.

1. Chandarana, N., Soutis, C. and Gresil, M. 'Passive and active monitoring for defect detection and quantification in composites', SPIE Smart Structures and Non-Destructive Evaluation, Denver, USA, 2018.
2. Chandarana, N., Soutis, C. and Gresil, M., 'Damage detection in composite pipes during mechanical three point bending', 11th International Workshop on Structural Health Monitoring, Stanford University, USA, 2017
3. Chandarana, N., Soutis, C. and Gresil, M., "Early damage detection in composites by acoustic event monitoring", 12th International Conference on Advances in Experimental Mechanics, Sheffield, UK, 2017.
4. Chandarana, N., Soutis, C. and Gresil, M., 'Early damage detection in composites during fabrication and mechanical testing', Materials, 10(7), (2017), 685.
5. Chandarana, N., Lansiaux, H., Soutis, C. and Gresil, M. 'Characterisation of damage tubular composites by acoustic emission, thermal diffusivity mapping and TSR-RGB projection technique', Applied Composite Materials, 24(2), (2016), 525-551.