

Supergen



Offshore
Renewable
Energy

Damage tolerant hybrid composites for safer and higher performance composite offshore wind turbine blades

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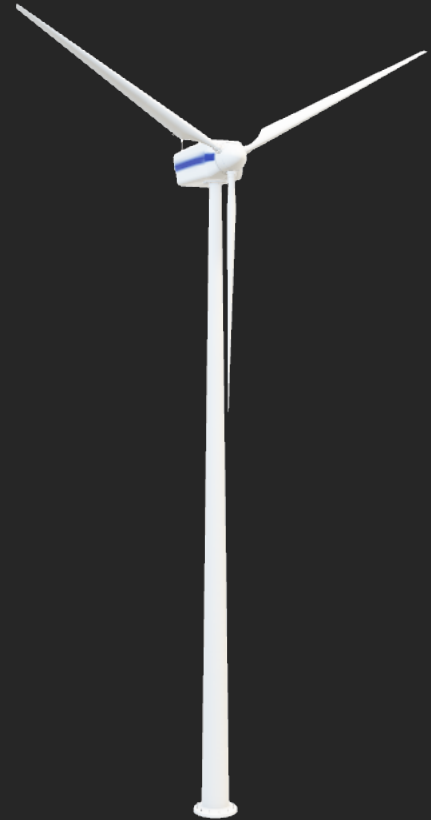


UNIVERSITY OF
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Problem



Source:
<https://www.nbcnews.com/mach/science/world-s-tallest-offshore-wind-turbine-will-tower-over-some-ncna853596>



Source:
<https://www.rechargenews.com/wind/new-failure-for-flagship-ge-wind-turbine-as-cypress-blade-breaks-in-germany/2-1-1138840>

Background

Previous models have been generated to assess pressure distribution from a 2D CFD models coupled with BEMT.

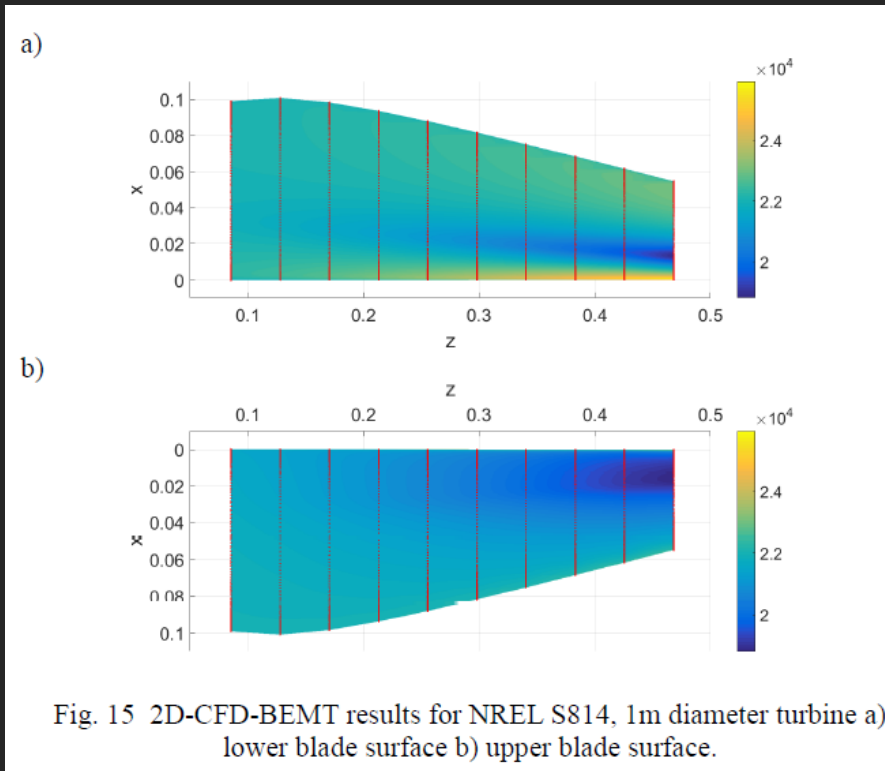
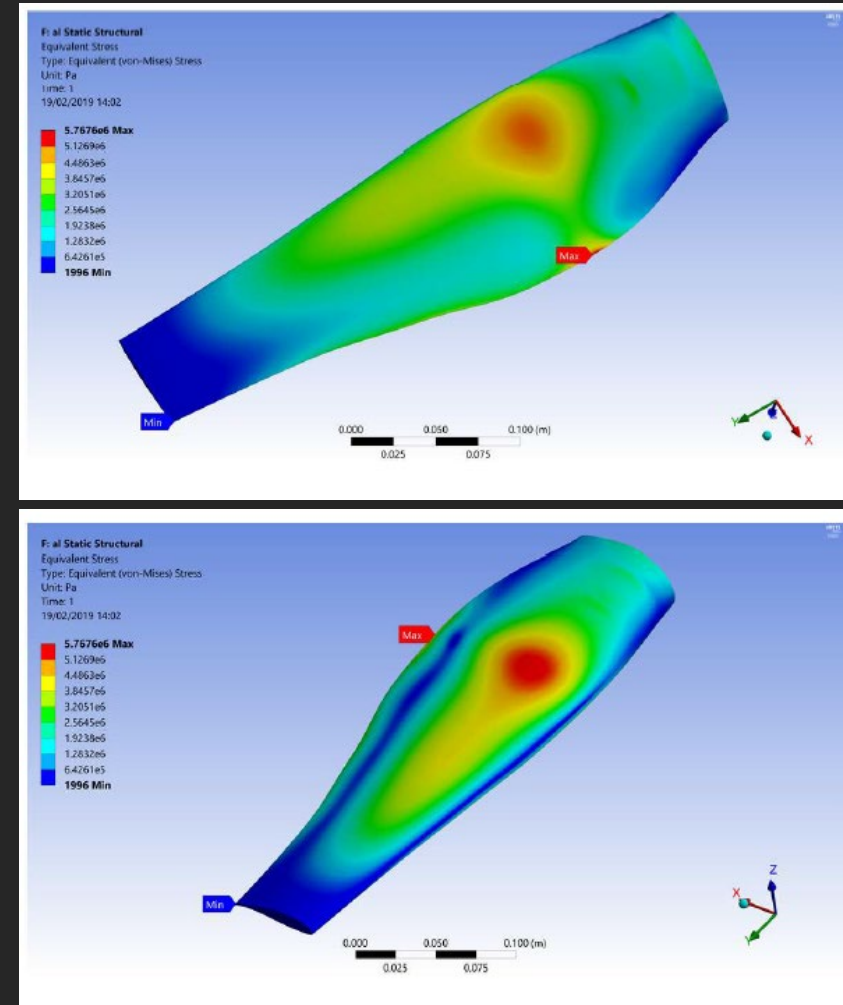


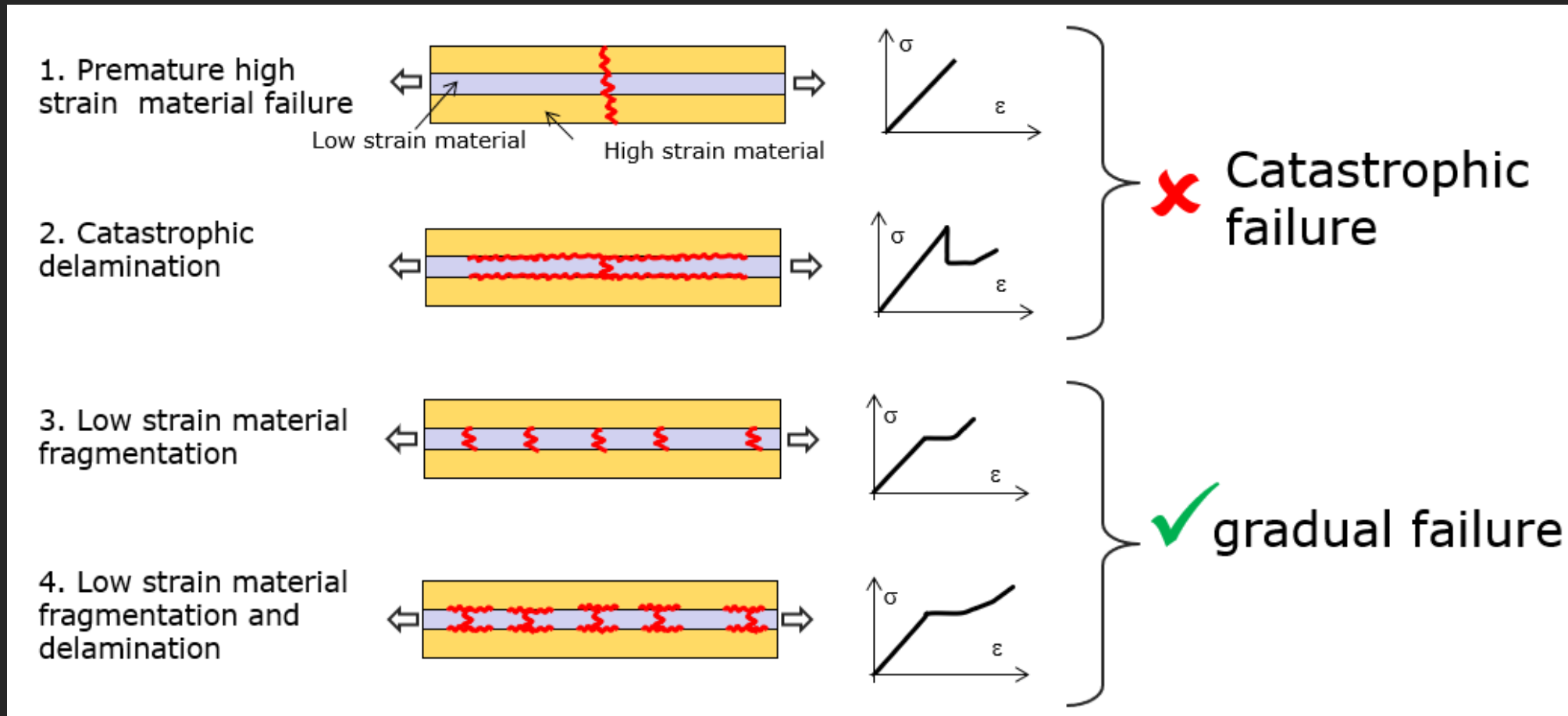
Fig. 15 2D-CFD-BEMT results for NREL S814, 1m diameter turbine a) lower blade surface b) upper blade surface.



Assessment of loadings for a thermoplastic tidal stream turbine blade using ANSYS.

Background

Composites damages may develop in 4 different ways:



Objectives

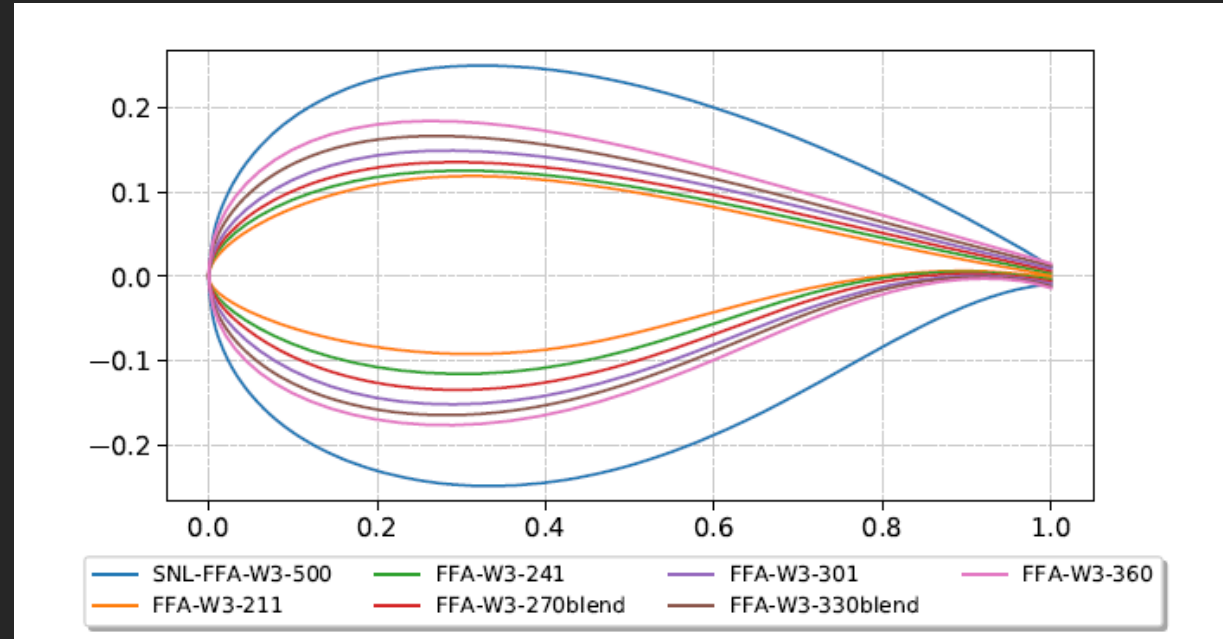
Design a hybrid composite material to reinforce the root or sections of a wind turbine blade.

- 1) Evaluate loadings of a realistic wind turbine blade.
- 2) Assess hybrid materials using testing machines assessing tensile, compressive and bending moments.
- 3) Evaluate the hybrid composite materials in terms of blade damage tolerance in a four-point bending test



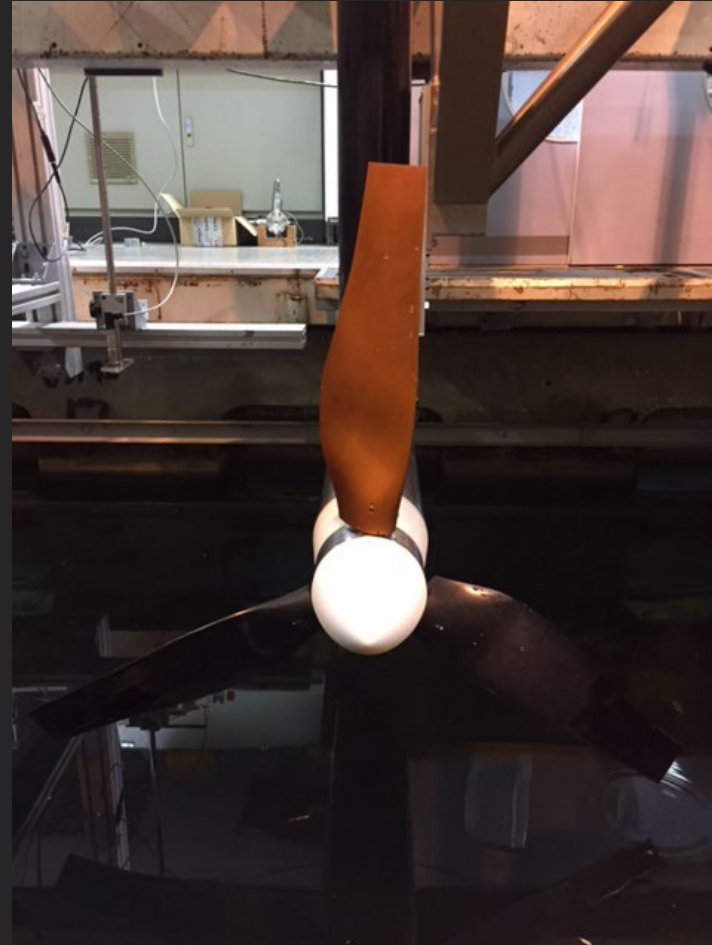
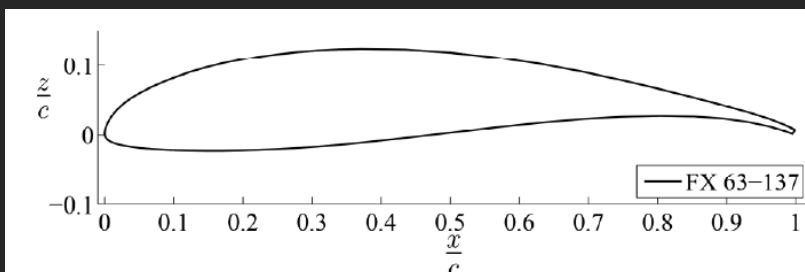
Methodology

- Horizontal axis wind turbine
- 3 bladed
- 15 MW wind turbine
- 117 m blade length
- Designed C_p 0.489
- Designed C_t 0.799



Methodology

- Horizontal axis tidal stream turbine
- 3 bladed
- Tidal stream turbine prototype
- 0.3 m blade length
- Designed C_p 0.42
- Designed C_t 0.82



Murray, R., Fu, S., Ordonez-Sanchez, Truba, K., O'Doherty, T., & Johnstone, C, 2019
Ordonez-Sanchez, S., Allmark, M., Porter, K., Ellis, R., Lloyd, C., Santic, I., O'Doherty, T. & Johnstone, C., 2019

A vertical red fiber optic cable bundle is the central focus, showing individual fibers and some dark spots. The background is a blurred laboratory environment with a perforated metal panel and various equipment.

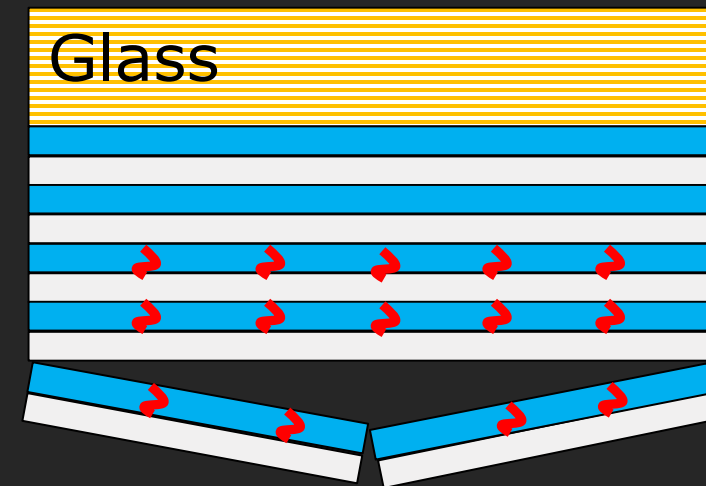
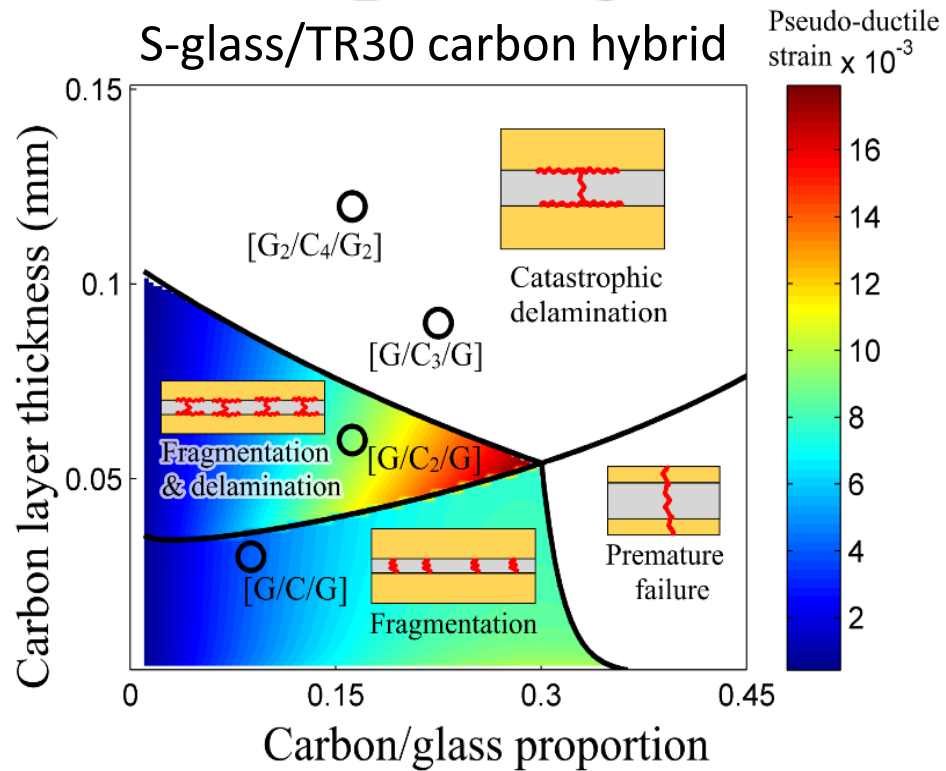
Experimental procedure

Gradual brush-like failure in bending

A simple and accurate damage mode map tool for optimal UD hybrid configurations.



G Idarraga G, M Jalalvand, M Fotouhi, J Meza, MR Wisnom MR, 2015



Fragmentation of the inner low strain carbon fibre material



Thank You



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