The influence of residual stresses on the structural integrity of renewable energy marine structures.

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Introduction

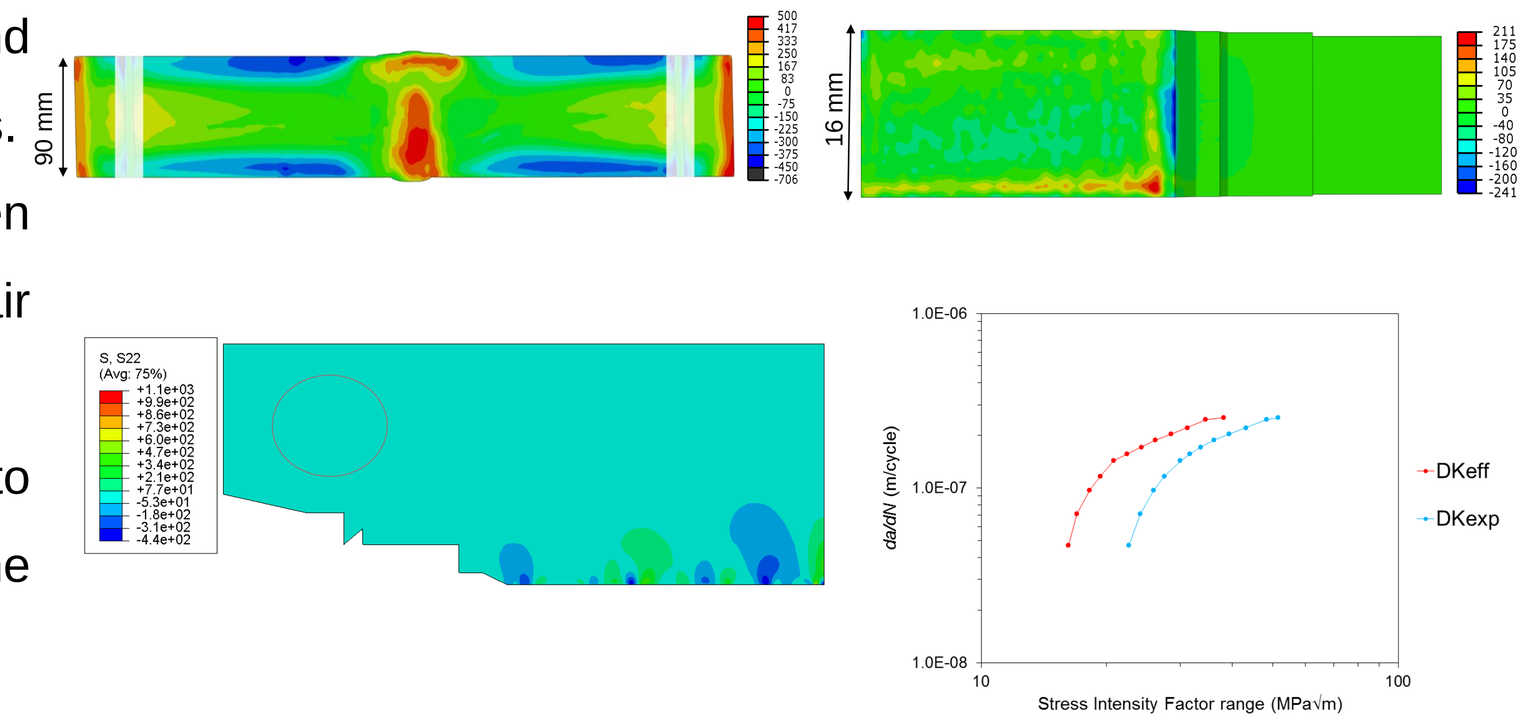
A significant challenge in the offshore wind industry is to provide a reliable assessment of the remaining life of offshore wind turbine monopile support structures, which has subsequent impacts on the levelised cost of energy. An important area that needs to be investigated to improve the current best practice is the influence of residual stresses on fatigue crack initiation and propagation at monopile weldments.

Aims and objectives

The aim of this project is to develop new fatigue crack growth curves for offshore wind monopile weldments by measuring and accounting for residual stresses around the weld region. This study involves numerical simulations and experimental testing on C(T) specimens extracted from monopile weldments.

Results and discussion

- Residual stress profiles in C(T) specimens have been measured and compared with full-scale welded plates.
- Fatigue crack growth tests have been conducted on C(T) specimens in air and seawater.
- 2D FEA simulations were performed to model fatigue crack growth in the presence of residual stresses.



Conclusions

- A framework has been developed to account for residual stresses in the fatigue crack growth behaviour of offshore wind turbine monopile weldments.
- Residual stresses show beneficial and damaging effects on the fatigue crack growth behaviour of the examined material depending on their magnitude (-100 to +100 MPa in C(T) specimens) and direction.

Future work

- Residual stress measurements and fatigue tests will be performed on large-scale monopile weldments to examine the size effect on fatigue crack growth behaviour of monopiles.
- A 3D FEA model will be developed for numerical analysis.

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