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Fatigue Assessment of Ultra-Deepwater Pipelines

Adedayo OYENIYAN^{1,a}, Ayodeji OLAMIDE^{1,b*}, and Abdeldjalil BENNECER^{1,c}

¹Faculty of Arts, Science and Technology, The University of Northampton, Northampton, NN1 5PH, UK

^aadedayo.oyeniyan17@my.northampton.ac.uk, ^bayodeji.olamide@northampton.ac.uk,

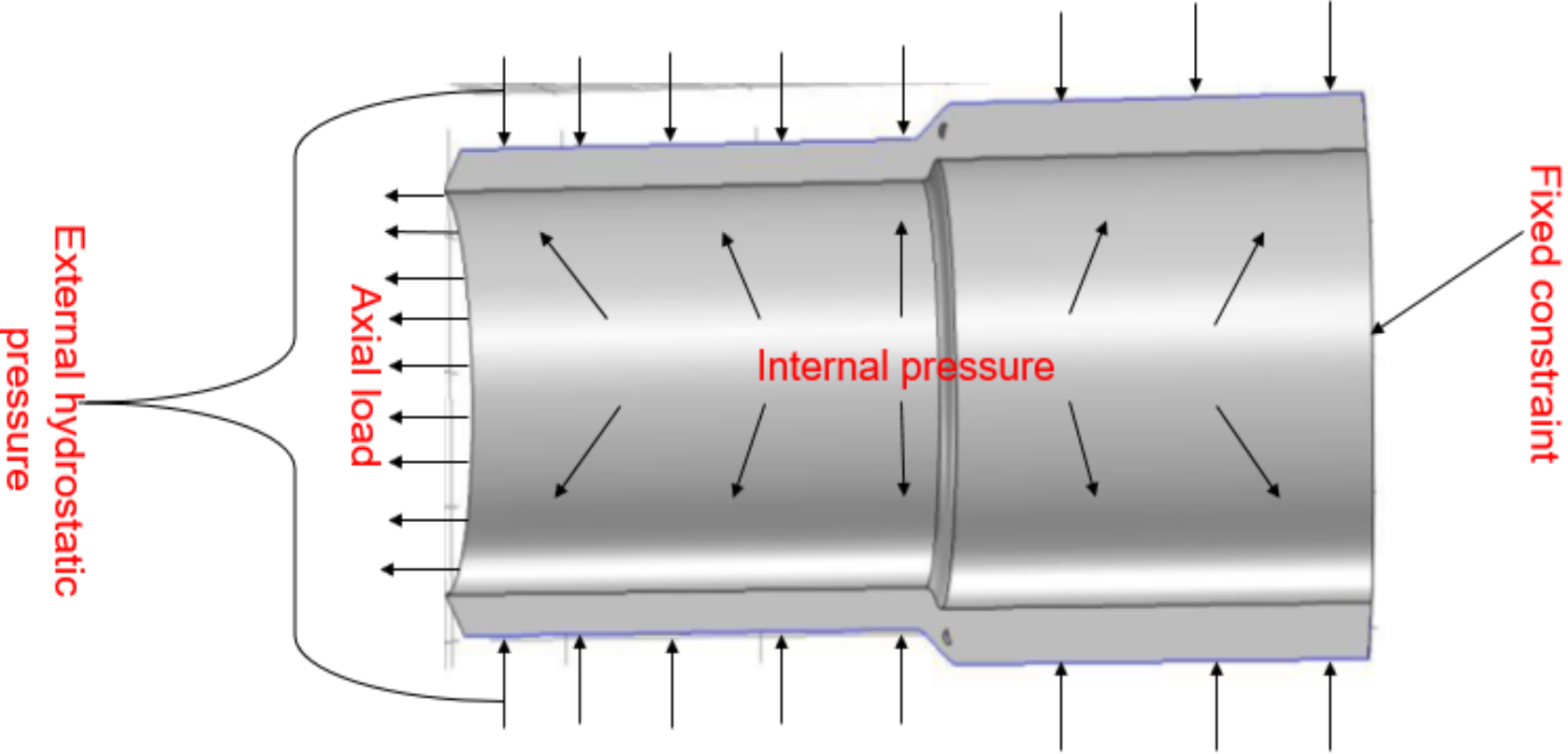
^cabdeldjalil.bennecer@northampton.ac.uk

*Corresponding author

Introduction

- Low-cycle fatigue analysis is carried out on a misaligned pipeline with lack of fusion defect.
- In addition to the large bending stress in the local area of misalignment, the presence of weld defects such as lack of fusion can lead to high stress concentration at the weld region.
- Elastoplastic analysis with kinematic hardening is used to obtain the stress and strain distributions for the fatigue evaluation due to localized yielding.
- It is important to assess the fatigue response of the welded pipelines with respect to the defect type and loading conditions.

Model Definition



| Property | Value | Unit |
|---------------------------|---------|-------|
| Young's Modulus (E) | 207GPa, | Pa |
| Poisson's ratio (nu) | 0.3 | 1 |
| Density | 7850 | Kg/m3 |
| Initial yield Stress | 450MPa | Pa |
| Kinematic Tangent Modulus | 80GPa | Pa |

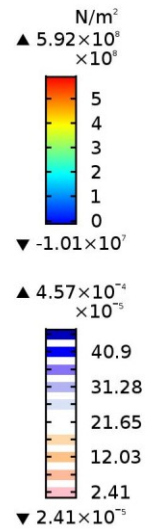
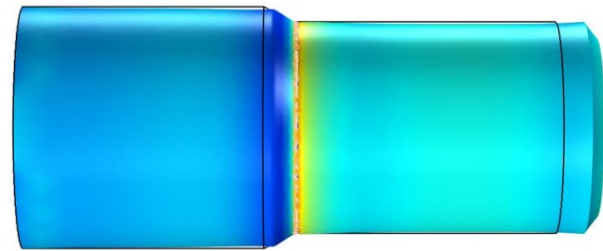
Model Definition (continued)

- Outer boundary of the pipe is subjected to an axial pressure of 162.5 MPa having a sinusoidal variation with time.
- Time is not used explicitly in the problem.
- Load is modelled as a function of a parameter, “para”, and load history is traced with a parametric solver.

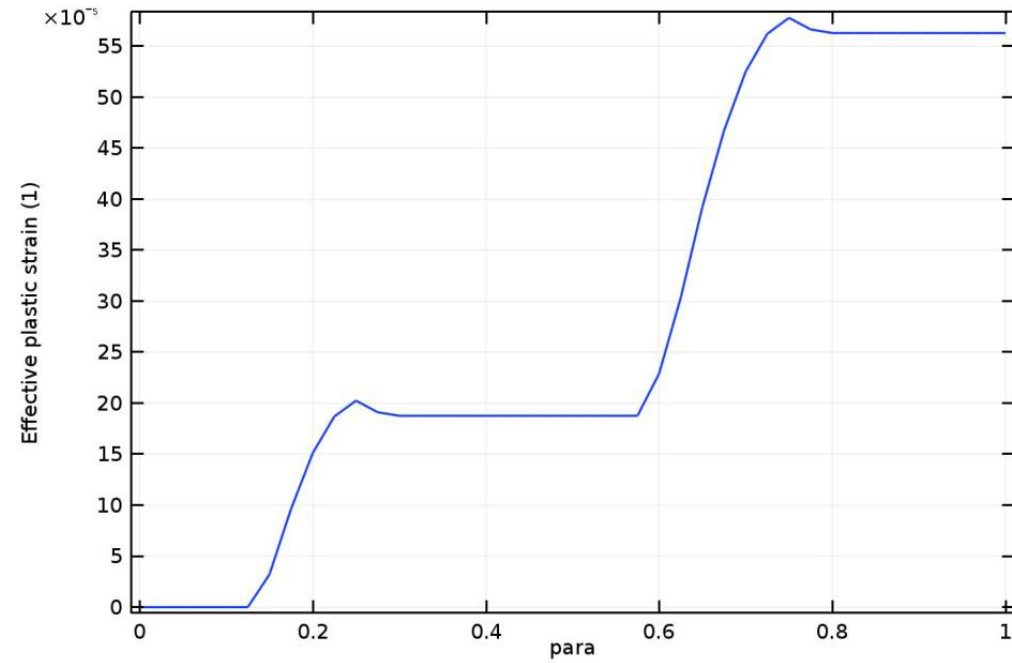
$$\text{i.e. } F_A = -162.5 \text{ [MPa]} * \sin(2 * \pi * \text{para})$$

Results

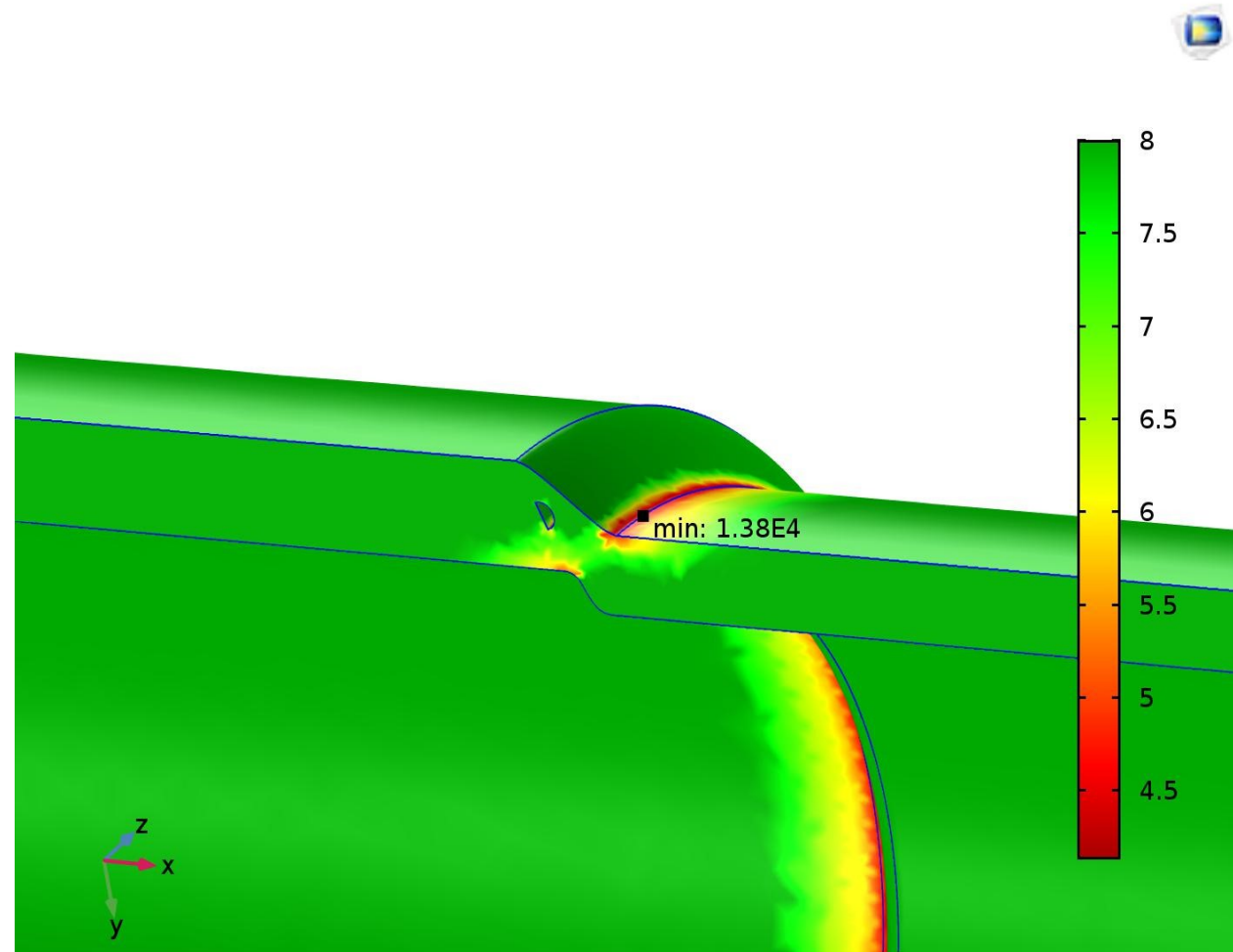
para(11)=0.25 Surface: von Mises stress, Gauss-point evaluation (N/m²)
Contour: Effective plastic strain (1)



Point Graph: Effective plastic strain (1)



Results (continued)



Conclusion

- Accurate fatigue assessment can reduce unnecessary replacement of pipelines thereby saving costs.
- A maintenance approach can be determined to extend the lifespans of pipelines containing defects.