Member report Number: 1103/2018

Industrial Member Report Summary – Key Findings for Industry

Finite Element Analysis of Selected Welded Wide Plate Tests

TWI Development of Industry Standards

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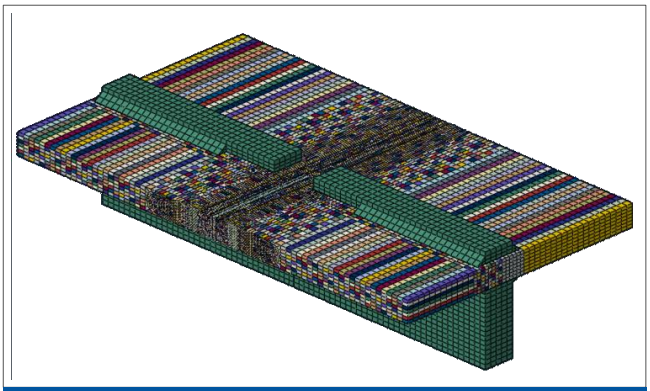
Industrial need

Finite element analysis (FEA) can provide increased accuracy in engineering critical assessment (ECAs) compared with the explicit equations and formulae in procedures such as R6 and BS 7910, allowing a reduction in conservatism. This work uses FEA to re-assess wide plate tests previously assessed using R6 and BS 7910, to demonstrate how modelling can improve the accuracy of a fracture assessment.

Key Findings

- The eigenstrain method allows residual stresses to be introduced into the finite element model.
- Optimised limit loads are a powerful method. With FEA this method:
  - Accounts for weld strength mismatch, and can be applied when the geometry is not covered by solutions in BS 7910;
  - May improve the limit load solution and reduce conservatism present in the BS 7910 solution.
- FEA can significantly improve the accuracy of an ECA, bringing assessment points closer to the failure assessment curve.
- However, in this case, it was not possible to bring the assessment point all the way to the curve. This may reflect uncertainty in the value of fracture toughness.



Every element in the model used a unique material definition (indicated by different colours)

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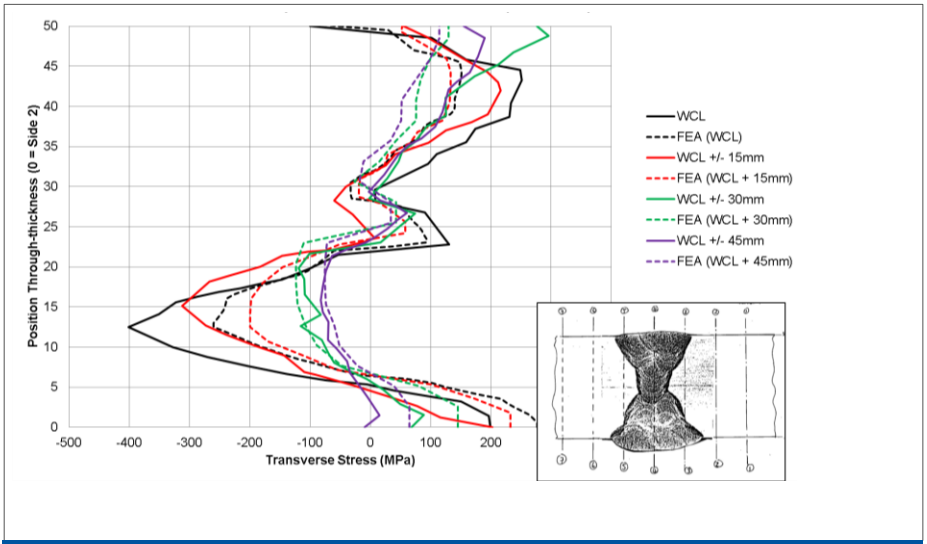

Comparison of transverse welding residual stresses in the model (dashed lines) and measurements (solid lines) at various locations