

Case study

Reheat Cracking Test Specimen

Test specimens are used in the civil nuclear industry to investigate the susceptibility of stainless steels to reheat cracking at high temperature. With an understanding of the cracking susceptibility more accurate life calculations can be conducted. A new test specimen design was proposed, in the form of a ring weld. Frazer-Nash Consultancy was asked to optimise the specimen design so that macro cracks would be produced when soaked at high temperatures within several thousand hours.

TEST SPECIMEN DESIGN

A new test specimen design was required which would be easy to fabricate and which would facilitate NDT. The test specimens will be used in a programme of thermal exposure tests, which will monitor the development of creep damage and reheat crack initiation in both the weld metal and HAZ material. The tests will be accompanied by detailed FE analyses simulating the fabrication/welding procedures, thermal exposure and development of reheat crack initiation damage.

KEY PARAMETERS INVESTIGATED

In order to maximise reheat cracking, several different parameters were investigated. These were the radius of the ring weld, thickness of the specimen, amount of fill in the weld groove, pass sequence and an offset repair weld. The residual stresses and creep damage for each parameter were assessed, allowing two geometries to be selected, one which maximised the creep damage in the weld material and one which maximised the creep damage in the HAZ material.

While this study was to maximise the residual stresses and creep damage, the same principles could easily be applied to minimise residual stresses and distortions for other applications.

OUTCOMES

Significant cost and time was saved for the customer since the modelling work carried out by Frazer-Nash resulted in an optimised design without resorting to an expensive and time consuming trial and error experimental approach. The simulation work also confirmed the viability of achieving the project requirements before a single piece of metal was cut.

Following on from this work, test specimens will be manufactured to the specifications defined by Frazer-Nash.

In parallel to a programme of testing and residual stress measurements, Frazer-Nash are to carry out a more detailed analysis of the ring weld for further studies and validation supported by residual stress measurements.

Client

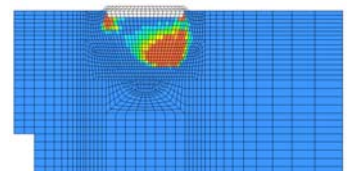
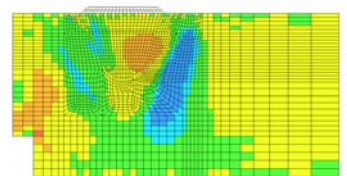
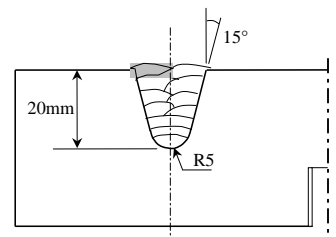
British Energy Generation Ltd.

Business need

Design test specimens to investigate the susceptibility to reheat cracking

Why Frazer-Nash?

Frazer-Nash expertise in welding simulation is one of the most advanced in the world.



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