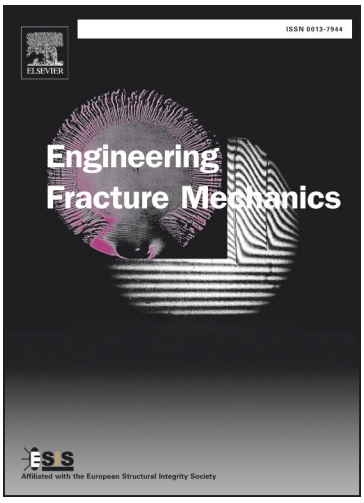

Investigation on the strain capacity of girth welds of X80 seamless pipes with defects

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Investigation on the strain capacity of girth welds of X80 seamless pipes with defects

1. Abstract

An experimental and numerical study has been carried out on the strain capacity of girth-welded X80 pipes subject to displacement-controlled conditions. The focus of this research is fracture limit state. This paper contains details of small-scale and full-scale experiments on X80 line pipe specimen containing girth welds and different initial defect dimensions in order to understand their fracture behaviour. The effect of internal pressure on strain capacity is also investigated through full-scale bending tests. Extensive accompanying Finite Element Analysis has been carried out with a focus on weld overmatch combined with Heat Affected Zone. The analysis results are compared with experimental results and the current Engineering Critical Assessment procedures.

Keywords: X80 steels; J-integral; R-curve tests; Crack growth; Pipelines

2. Nomenclature

API	American Petroleum Institute
BM	Base Metal
CMOD	Crack Mouth Opening Displacement
CTOD	Crack Tip Opening Displacement
DIC	Digital Image Correlation
ECA	Engineering Critical Assessment
EDM	Electronic Discharge Machining
HAZ	Heat Affected Zone
ID	Internal Diameter
NSSMC	Nippon Steel and Sumitomo Metal Corporation
OD	Outer Diameter
SENB	Single Edge Notch Bend
SENT	Single Edge Notch Tension
SMYS	Specified Minimum Yield Strength
WCL	Weld Centre Line
WM	Weld Metal
WPS	Welding Procedure Specification
Y/T	Yield to Tensile Ratio
ε_{ave}	Average Nominal Strain
Δa	Crack extension

3. Introduction

Internal and external pressures applied to an offshore pipeline can be extremely high as governed by wellhead and hydrostatic pressures. Hillenbard et al. /1/ showed that for pipes with