

# Girth Weld Reinforcement Case Study: A Numerical and Experimental Approach

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Girth welds joining pipes/components of dissimilar wall thicknesses exhibit higher stress concentrations at the wall thickness transition region, significantly affecting their fatigue performance and limit load capacities. In addition, the presence of flaws in these welds exacerbate the stress concentration, potentially further degrading their performance. Therefore, when flaws are detected in girth welds, assessment and remediation becomes critical to ensure safe operation.

This paper discusses a case study that utilized numerical and experimental methods to assess the performance of girth welds when the pipe segment is subjected to high strain - low cycle axial loads that result from environmental forces. Additionally, the effectiveness of girth weld reinforcements such as steel sleeves, composite wraps, or a combination of both are examined to evaluate the benefits to the fatigue life.

Numerical analyses involved simulating a typical girth weld using finite element (FE) models to assess the localized stresses and stress concentration factors, with and without reinforcements. Various scenarios were examined, including different wall thickness transition ratios, material mismatches, and repair installation pressures, aiming to evaluate the effectiveness of repairs in reducing stresses and enhancing the fatigue life of the weld.

Testing encompassed sub-scale, small-scale, and full-scale tests aimed at validating the performance of the girth weld with and without reinforcements. Sub-scale and small-scale testing results were coupled with the numerical analyses results to design and execute the full-scale test, which simulated the real-life behavior of the girth weld in the field.

The paper discusses the details of the numerical and testing methods and demonstrates the effectiveness of the reinforcements in improving the fatigue life of girth welds.

KEYWORDS: Girth Welds, Geohazard, Fatigue, Numerical Analysis, Experimental Testing, Pipe Reinforcement, Steel Sleeve, Composite Repair, FEA, Full-Scale Testing

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