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Abstract

Strain-based design is often necessary for pipelines experiencing displacement-controlled loading. For onshore pipelines, the high longitudinal strains are often associated with soil movement such as seismic activity, slope instability, frost heave, and mine subsidence, etc. For offshore pipelines, displacement-controlled loading can occur during pipe laying. The specifications for linepipes and their girth welds have a much more profound influence on the integrity of the pipelines under displacement-controlled loading than would be the case under load-controlled loading. In fact, certain aspects of material specifications that are beneficial for load-controlled loading may be detrimental for displacement-controlled loading.

This paper starts with a discussion of the relevance of plastic collapse criteria for strain-based design. The significance of yield strength definition and its impact on weld strength mismatch are reviewed. The review focuses on modern low carbon micro-alloyed TMCP steels and their welds. The effects of heat-affect-zone (HAZ) softening and hoop stress on tensile strain capacity are analyzed in depth. The paper concludes with summary discussions that address several aspects of strain-based design. The complex nature of the problems requires additional work to achieve quantitative near-optimum strain-based design of pipelines.

Keywords

Pipeline, Strain-based design, Tensile strain capacity, Linepipe specification, Welding procedure qualification