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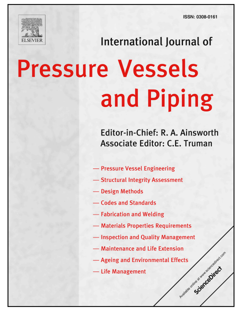

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Buckling of Internally-Pressurized Spiral-Welded Steel Pipes under Bending

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ABSTRACT

The mechanical behaviour of spiral-welded large-diameter steel pipes is simulated, with the purpose of defining their bending deformation capacity against local buckling. The steel pipes are candidates for hydrocarbon onshore pipeline applications with diameter-to-thickness ratio D/t equal to 53 and 69, and are subjected to longitudinal bending under internal pressure levels ranging from zero to 75% of the nominal yield pressure. Initial geometric imperfections are considered in the form of short-wave axial wrinkles and girth weld misalignment, whereas residual stresses are taken into account as computed from a special-purpose finite element simulation of the spiral bending process, which also accounts for both de-coiling process and hydrotesting. The sensitivity of critical bending curvature on the level of internal pressure is examined, the value of buckling wave length is discussed and the effects of hydrotesting after spiral forming on structural performance are also investigated. Finally, the value of critical bending curvature is compared with analytical and empirical equations, widely used in pipeline design applications. The results of the present study determine the main parameters affecting the buckling deformation capacity of large-diameter spiral welded pipes in a strain-based design framework, and indicate that these pipes can be used in demanding pipeline applications, such as in geohazard areas.

INTRODUCTION

Large-diameter steel pipes, produced through the spiral-welding manufacturing process, are extensively used in large-diameter onshore pipelines for the transmission of energy (hydrocarbon) or water resources. In geohazard areas, ground movements caused by tectonic fault movement, ground

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