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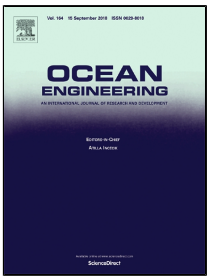

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An Unified Formula for the Critical Force of Lateral Buckling of Imperfect Submarine Pipelines

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Abstract: Unburied submarine pipelines might buckle laterally under the conditions of high temperature and high pressure. As an important design parameter of submarine pipelines, the lateral buckling critical force (LBCF) is affected by the maximum amplitude, wavelength, shape of the initial imperfection, and etc. However, the exact relationship between the LBCF and the initial imperfection shape is not clear at present. In this paper, the lateral buckling behaviors of submarine pipelines with different initial imperfection shapes are studied using 3D finite element (FE) analysis. A parametric study is conducted and the characteristic parameter of the initial imperfection shape is found. It is the characteristic parameter that makes the LBCF greatly affected by the initial imperfection shape. A unified formula is proposed to reveal the exact relationship between the LBCF and the initial imperfection shape. An application of the unified formula is carried out and the results show the accuracy of the unified formula.

Keywords: Lateral buckling; Critical force; Unified formula; Imperfection shapes

1. Introduction

Submarine pipelines play a significant role in offshore and deep water oil/gas transportation systems. As offshore oil/gas development shifts towards deep water, submarine pipelines operating under high temperature and high pressure (HTHP) become more common. Considerable axial force will be produced in the submarine pipelines because of HTHP. Once the axial force reaches to a certain value, global buckling of submarine pipelines occurs. This certain value is referred to as critical force. Because of the expensive costs of burying a pipeline and the difficulties and troubles in detection and maintenance afterwards (Tianfeng and Xianhong,

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