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Effect of corrosion on load carrying capacity and buckling behavior of locally corroded offshore tubular members

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Abstract

This paper presents the results of an investigation into numerical modeling of locally corroded tubular members. A parametric finite element approach was used in order to simulate the behavior of corroded tubular members. In order to validate the numerical model, the results were examined against available experimental records. The dimensions of tubular members were taken from SPD 12A offshore jacket platform.

The parametric approach associated with regression analysis led to derive a semi-empirical formula for predicting load carrying capacity as a function of corrosion dimensions.

The corrosion pattern used was defined by the depth, length, width and location of damage. In this study it is focused on the effect of some parameters that have not been addressed yet.

The effects of corrosion dimension were assessed and it was shown that location of corrosion has great effect in the form of reduction of ultimate strength. In cases with severe corrosion damages, the occurrence of local buckling plays an important role on deformation of damaged region.

1. Introduction

Tubular members are the most commonly used structural elements in offshore structures. Their advantages are isotropic performance under axial compression, low drag resistance, and easy handling during construction. They are often subjected to compressive, accidental and fatigue loads. Figure 1 shows a typical offshore platform and its tubular members.

Corrosion of metallic structures due to existence in corrosive marine environment is inevitable. The corrosion can take place in shapes of uniform or local damages. As a result of material loss and changing mechanical properties of corroded region, the load carrying capacity of damaged member decreases. The damaged structural elements must meet the strength requirements and withstand design loads during their expected lifetime. The importance of this issue becomes clear where the damaged structure is expected to have adequate level of reliability. This necessitates full knowledge of residual stress of damaged elements.

The corrosion can take place in the forms of global corrosion and local corrosion. The global corrosion is a kind of corrosion that causes a uniform loss of material. The local type can be defined as the damage confined to a region. In this study a local corrosion damage is modeled. The corrosion pattern used in this study is a common type of local corrosion named as corrosion 'patch'. Although the other forms of corrosion such as uniform one may exist over the surface of aged tubes, it often occurs in the form of locally restricted damages. The major difference between overall and local corrosion is that in locally corroded tubes, transverse deflections of tube under axial compression is likely to increase and therefore the stability of tube is affected.