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STRESS CONCENTRATION FACTOR ANALYSIS FOR UNIPLANAR TUBULAR DKT-JOINTS AND PROPOSING PARAMETRIC EQUATION FOR SCF DISTRIBUTION

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ABSTRACT

Despite the frequent use of tubular DKT-joints in offshore structures, no parametric equation is available for determining the distribution of stress concentration factors (SCFs) along the brace-chord intersection of such joints. In the present paper, the effect of non-dimensional geometrical parameters and brace-to-chord inclination angle on the distribution of SCFs along the weld toe of tubular DKT-joints under the balanced axial loads is studied. Thereafter, a parametric equation is proposed for predicting the distribution of SCFs along the 360° spatial curve of weld toe. The proposed equation satisfies the acceptance criteria recommended by UK Department of Energy, and consequently can reliably be used for design purposes.

Keywords: *Offshore Structures, Fatigue, Fracture Mechanics, Tubular DKT-joint, Parametric Equation, Stress Concentration Factor (SCF).*

INTRODUCTION

In order to meet the demands of energy requirements, many offshore platforms have been installed all over the world for exploration and exploitation of oil and gas reserves from hydrocarbon reservoirs below the seabed. In the construction of offshore platforms, steel circular hollow sections (CHSs) have been extensively used in the industry because of their high strength-to-weight ratio, non-directional buckling and bending strength, and low wave resistance. In a tubular joint, circular hollow members (tubulars) are connected by welding the prepared end of the brace members onto the surface of the chord member. Fig. 1 shows a tubular DKT-joint with the three commonly named locations along the brace-chord intersection: saddle, crown toe and crown heel, and the geometrical parameters for chord and brace diameters D and d, and the corresponding wall thicknesses T and t. Tubular joints in offshore structures such as jacket templates and jack-up rigs are subjected to cyclic wave loading and are thus susceptible to fatigue damage. Design against fatigue and periodic in-service inspections are necessary in order to ensure their safety and integrity. In order to assess the approximate fatigue life of offshore structures, the Stress-Life (S-N) curves are frequently adopted by researchers. In this method, the number of loading cycles that the structure can sustain before failure is estimated from the corresponding hot spot stress (HSS) range. The hot spot stress range can be determined from a parameter called the stress concentration factor (SCF). The SCF is the ratio of the local surface stress to the nominal direct stress in the brace. The structural discontinuity at the brace-to-chord intersection regions incurs a large amount of stress concentration.

During the last 40 years, a significant number of papers have been published on stress concentrations in tubular steel joints with CHS members. Some researchers proposed