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Development of Probability Distribution Models for Degree of Bending (DoB) in Chord Member of Tubular X-Joints under Bending Loads

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Abstract : Fatigue life of tubular joints in offshore structures is not only dependent on the value of hot-spot stress, but is also significantly influenced by the through-the-thickness stress distribution characterized by the degree of bending (DoB). The DoB exhibits considerable scatter calling for greater emphasis in accurate determination of its governing probability distribution which is a key input for the fatigue reliability analysis of a tubular joint. Although the tubular X-joints are commonly found in offshore jacket structures, as far as the authors are aware, no comprehensive research has been carried out on the probability distribution of the DoB in tubular X-joints. What has been used so far as the probability distribution of the DoB in reliability analyses is mainly based on assumptions and limited observations, especially in terms of distribution parameters. In the present paper, results of parametric equations available for the calculation of the DoB have been used to develop probability distribution models for the DoB in the chord member of tubular X-joints subjected to four types of bending loads. Based on a parametric study, a set of samples was prepared and density histograms were generated for these samples using Freedman-Diaconis method. Twelve different probability density functions (PDFs) were fitted to these histograms. The maximum likelihood method was utilized to determine the parameters of fitted distributions. In each case, Kolmogorov-Smirnov test was used to evaluate the goodness of fit. Finally, after substituting the values of estimated parameters for each distribution, a set of fully defined PDFs have been proposed for the DoB in tubular X-joints subjected to bending loads.

Keywords : tubular X-joint, degree of bending (DoB), probability density function (PDF), Kolmogorov-Smirnov goodness-of-fit test
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