

Fatigue Analyses in Fixed Offshore Jackets using Spectral Method

Peyman. Moazen¹, Mohammad Javad Ketabdari²

1-Hormozgan University, Department of Civil Engineering

2-AmirKabir University of Technology, Faculty of Marine Technology

Abstract

Fatigue, is defined as structural failure under alternative load cycles in a long period of time. This experience is important when cyclic loads exert to the structures. In this study a model was developed to estimate fatigue life under irregular waves for fixed offshore jackets using S-N curves and Palmergen-Miner method. In this study valid codes and most authentic international regulations, such as ABS and API codes of practices were employed. The inputs to the model are wind velocity, wave spectral density and structural details including S-N curves, type of connections and welding situation in different joints. The model can estimate the fatigue life of the structure based on the worst environmental condition. A case study carried out for a typical jacket in Persian Gulf. A dynamic analysis using SAP2000 was undertaken with an exciting force extracted from a proposed spectrum for sea state of the study area. The results showed that the spectral analysis of fatigue life is more accurate than time domain analysis using zero- up crossing technique. The result of the model also shows promise for optimum design of steel offshore jacket type platforms choosing proper type of connections and high quality welding in joints.

Keywords: Fatigue life, Spectral analysis, Jacket type platforms, Palmergen-Miner rule, welded connections

1 Introduction

Wave is the most important phenomenon in the sea environment inducing considerable forces to marine structures. In fact this is the main source of structural cyclic stresses leading to fatigue fracture. Therefore, estimating fatigue life for such structures, have a particular importance for marine engineers. To estimate the fatigue life it is required to determine several transfer functions. First one is a transform from wave profile to force in time or frequency domain. Second one is a transform of dynamic forces to stresses in structural elements. Finally a transform is required to give fatigue life using concentrated stresses.

2 Wave loading

To determine the fatigue life in a marine structure it is required to estimate the wave loading to the structure. Therefore providing realistic information about the waves properties in the desired location is the first stage in this study. Wave spectrum is a useful tool to simulate the free surface profile for seas and oceans. Different research groups tried to propose wave spectrums for different seas based on long term field studies using wave buoys. some of these standard wave spectra are JONSWAP, Pierson Moskowitz and Bretshnieder Spectra. For Persian Gulf in south part of Iran the available field measurements are not adequate to be able to propose an original wave spectrum. However a few researchers tried to propose a modified spectrum to above mentioned spectra using limited available data. A modified model to

1 M.Sc. Graduated in Marine structures

2 Assistant Professor