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RESEARCH ARTICLE - MECHANICAL ENGINEERING

Frequency Domain Long-Term Efficiency of Viscous Damper in Jacket Platforms Under Random Wave Load

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Abstract Various types of controlling mechanisms have been investigated to decrease vibrations of different structures, and in many cases, the reliability has been increased with respect to conventional methods of structural optimization. Among them, using passive viscous damper is one of the useful methods to control structure response due to environmental loads. Hence, in this study, the effect of viscous damper on vibration control of jacket platform (case study oil platform SPD2 and Resalat) exposed to wave loads is investigated, and with the sea state, long-term performance of damper to reduce the structural response is introduced for the first time the more suitable than the responses in an especial case. To keep up this purpose, the platform is modeled by finite element method, and wave spectra are radiated to it. Spectral analysis is adopted to investigate the structural response of the jacket platform equipped with viscous dampers, and also, conventional arrangements of dampers are analyzed to acquire optimal one. Then, the economically optimal arrangement of damper is determined. The novelty of this paper is that the results based on the sea states recorded in the long term help one find the optimal arrangement of damper.

Keywords Jacket · Long term · Viscous damper · Wave

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1 Introduction

Using controlling mechanisms to optimize the performance of existing platforms by improving vibrational behavior may be an effective solution that eliminates expensive structural repair operations and strengthening of components under sea loads. Since offshore platforms are subjected to repetitive wind and wave loads during their lifetime, fatigue damage is considerably important. The design experiences of fixed offshore platforms show that in regions with low seismic risk like Persian Gulf that the intensity of waves in critical sea states is not far from normal states, fatigue damage is a determinative factor, and therefore, reducing structural response, e.g., amplitude of displacement by controlling methods, has a considerable effect on increasing the lifetime of the structure. The average lifetime of offshore platforms is about 25 years, and many of the structures in the aforementioned region have exceeded their design lifetime, and since from economical point of view, the continuation of activity of a platform is often preferred to install a new one; it again emphasizes on importance of using controlling mechanisms to decrease structural response. The first investigation on the subject dealt with controlling vibrations of offshore platforms was performed by Vandiver and Mitone [1]. They indicated that liquid sloshing in tanks located on topside of the platforms has a significant effect on the period and damping characteristics of platform. Their analysis shows that storage tanks with low frequency placed on topside offshore platform increases dynamic response of platform. In addition, by choosing correct geometry for these tanks the jacket platform response could be reduced and these liquid storage tanks can behave as a damper [1]. Lee and Reddy suggested that sloshing of liquid has energy absorbing characteristics that can be used to decrease dynamic response of the jacket platform. They used finite element method to model the platform

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Since, in one area, different sea states occur with various probabilities, ignoring these effects can lead to inefficient and uneconomical design of control system. So in this study, several different configurations of viscous dampers investigated in long term of sea states. The results showed that the performance of dampers may change if we consider only a specific wave state.

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