EFFECT OF PASSIVE DAMPERS ON DYNAMIC RESPONSE OF FIXED OFFSHORE PLATFORMS SUBJECT TO SEA SPECTURM

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ABSTRACT

Fixed offshore platforms are subjected to various loads. One of the most important loads is due to waves. To ensure the safety of the platform and to reduce the down time to a minimum, the displacement of the platform must be kept in a certain limit. In this regard, a new technique uses passive dampers. Instead of decreasing the amplitude of motion by increasing the stiffness of the structure, passive dampers increase the damping of the system to limit the amplitude of the response. In this research the effect of passive dampers on the response of a fixed platform subjected to waves is studied and the application of two kinds of passive dampers (viscous and viscoelastic dampers) is considered. It is observed that the additional dampers add substantial damping to structure and thus favorably control the response of platform structure.

KEYWORD

Damper, Jacket, Passive control, Energy dissipation devices.

INTRODUCTION

Fixed offshore platforms have been used for decades to exploit oil from sea bottom. These platforms are subjected to vibrations due to wave excitations. Whenever the wave frequency is close to natural frequency of the structure resonance could happen. This phenomenon cause an increase in the amplitude of motion and may cause damage to the structure. In addition to resonance, steady vibration of the platform caused by wave over its working life may result in fatigue in some parts of structure.

The technology of using dampers to suppress response to wind and earthquake has been used in structures built on land for a numbers of years. However, this technology has rarely used in offshore structures.

When the structure is subjected to wave its dynamic equation of motion can be written as follows (Patel, 1989):

$$[M]\{\ddot{x}\} + [C_s]\{\dot{x}\} + [K_s]\{x\} = \{F\} \quad (1)$$

Where $[M]$, $[C_s]$, $[K_s]$ are mass, damping and stiffness matrices, respectively, $[x]$ is displacement vector and $\{F\}$ is the vector of excitation forces caused by fluid-structure interaction. The forces vector $\{F\}$ is estimated by Morison's equation. It can be written as the sum of an inertia force and a drag force as follows:

$$\{F\} = 0.5C_d[A_P]\{|\dot{u} - \dot{x}|(\dot{u} - \dot{x})\} + \rho C_i[V]\{\ddot{u}\} - \rho(C_i - 1)[V]\{\ddot{x}\} \qquad (2)$$

In Eq. (2), $\lfloor A_p \rfloor$ is the projected area matrix, $[V]$ is volume matrix, $\{\dot{u}\}$ is time dependent flow velocity, and C_d and C_i are drag and inertia coefficients, respectively. If the diameter of structural element is small the inertia coefficient can be considered as the sum of an added mass coefficient and a Froud-kryloff coefficient.

The governing equations of a fixed jacket platform is obtained by substituting for $\{F\}$ from Eq. (2) into Eq. (1). If dampers are installed in the structure, the damping term of the equation must