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Theoretical Analysis of Mechanical Vibration for Offshore Platform Structures

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Abstract : A new class of support structures, called periodic structures, is introduced in this paper as a viable means for isolating the vibration transmitted from the sea waves to offshore platform structures through its legs. A passive approach to reduce transmitted vibration generated by waves is presented. The approach utilizes the property of periodic structural components that creates stop and pass bands. The stop band regions can be tailored to correspond to regions of the frequency spectra that contain harmonics of the wave frequency, attenuating the response in those regions. A periodic structural component is comprised of a repeating array of cells, which are themselves an assembly of elements. The elements may have differing material properties as well as geometric variations. For the purpose of this research, only geometric and material variations are considered and each cell is assumed to be identical. A periodic leg is designed in order to reduce transmitted vibration of sea waves. The effectiveness of the periodicity on the vibration levels of platform will be demonstrated theoretically. The theory governing the operation of this class of periodic structures is introduced using the transfer matrix method. The unique filtering characteristics of periodic structures are demonstrated as functions of their design parameters for structures with geometrical and material discontinuities; and determine the propagation factor by using the spectral finite element analysis and the effectiveness of design on the leg structure by changing the ratio of step length and area interface between the materials is demonstrated in order to find the propagation factor and frequency response.

Keywords : vibrations, periodic structures, offshore, platforms, transfer matrix method
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