NUMERICAL ANALYSIS OF HYDROELASTIC EFFECT ON SHIP STRUCTURAL RESPONSE

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ABSTRACT: In the last years very large floating structures (VLFS) are continuous appearing in the waters of developed coastal cities under different layouts like floating airports, floating bridges, floating storage facilities, mobile offshore structures and even for habitation. Their size is growing up rapidly and the structure become more and more flexible and prone to wave induced vibrations. In case of relatively “soft” floating bodies the springing phenomenon can appear and it represents a steady state dynamic response produced at the resonance case associated with first few structural natural frequencies excited by wave actions. For large floating structures using the classical rigid body seakeeping analysis and modelling the hydro-structure interface by the transfer of the pressure is not sufficient and hydroelastic coupling is necessary to solve the interaction between the surface waves and the rigid-elastic body. This paper is concerned with the importance of analysing the influence of hydroelastic vibratory response on structural fatigue damage for VLFS. The hydro-structure analysis was performed using HOMER software by coupling 3D potential flow code for hydrodynamics and 3D FEM structural model of a very large floating structure. The modal superposition method is used, which means that the total structural response is represented by a series of eigenvalue structural modes pre-calculated by the 3D-FEM structural software. By defining additional boundary value problems for radiation potential associated with dry structural modes the coupling with hydrodynamics model is performed. By resolving the interaction between the surface waves and the floating elastic body the hydroelastic response is obtained. Top-down technique was used to determine the influence of the hydroelastic effect called springing on structural fatigue damage of several fatigue details. In order to clearly evaluate the influence of springing on the overall ship structural response the total structural response is decomposed into quasi-static and dynamic part.

INTRODUCTION

Nowadays, many countries with long coastlines start to create vast and valuable land from the sea. In order to protect the environment a better solution than land reclamation is to use very large floating structures. Some advantages of very large floating structures comparing to traditional land reclamation method are:

• possibility to relocate, remove or expand;
• construction is cheaper, faster and easier;
• can be installed near the shore as well as rather far into open sea;
• are environmental friendly;
• availability of interior spaces.

During the years very large floating structures have been used for a variety of purposes like floating bridges, floating energy bases, floating storage facilities, floating entertainment facilities, floating container terminals/docks, floating airports/cities, floating wind/solar plants, etc.

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