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Hydrodynamic analysis of the submerged floating tunnels under irregular waves

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Abstract

Many concepts of the submerged floating tunnels, which consists of floating tunnel segments and mooring systems, have been continuously suggested for the new-type transportation system. Although the SFTs show structural effectiveness and economic efficiency compared to the conventional oversea transportation structures such as oversea bridges and underwater tunnels, there is still no real construction example due to lack of sufficient researches about hydrodynamic behavioural characteristics with rational global performance analysis methodologies. For designing the main structural members such as floating tunnel segments, mooring lines, and anchor systems, the engineer should apparently know the behavioural characteristics of the SFT under the design environmental loading conditions first. Because the SFT moored at the pre-defined underwater location with specific draft is affected by waves and currents, the submerged floating structure shows significant dynamic responses continuously. Therefore, rational hydrodynamic analysis should be conducted in order to evaluate the global performance of the SFT and calculate the structural responses such as motion, internal forces, and stresses under the governing design loads. In this paper, the methodology of rational global performance analysis is suggested based on time domain hydrodynamic analysis. Using the method, significant dynamic characteristics of the submerged structures under the irregular waves are studied.

Keywords: submerged floating tunnel; hydrodynamics; offshore; time-domain analysis; structural dynamics; fatigue; mooring

1 Introduction

In general, oversea grand bridges, underwater tunnels or precast immerged tunnels are considered as transportation systems for land connection. Although the conventional transportation systems have been mainly constructed and operated, there is still construction period and cost issues related with underwater foundation construction of offshore piles, piers, sheets as well as underwater excavation work. A submerged floating tunnel (SFT), consists of floating tunnel and mooring systems, was firstly suggested as the new-type oversea transportation systems in order to overcome those offshore construction difficulties. [1] The pre-fabricated segments of tunnels and mooring systems can be delivered and erected at the construction site without heavy underwater

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