Evaluation of Buoyancy Weight Ratio in Submerged Floating Tunnel Under Hydrodynamic Loads. A Case Study of Seribu Islands

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Summary

This study is purposed to obtain the smallest internal forces acting on the SFT structures due to the effect of Buoyancy Weight Ratio (BWR). The numerical investigation was carried out using SAP2000 to simulate the model of SFT structures under various BWR values. Values of BWR were intently selected greater than 1.0 in order to preserve the structures afloat. In this study, the BWR were modified from 1.1 to 1.9 with the increment of 0.1. In addition, other parameters i.e. angle of inclination of cable (AIC) of 36° with initial tension of 26.1 kN was applied. Hinged support was also given as the boundary condition of the SFT structures. The results showed that the BWR of 1.3 and 1.4 exhibited the most effective configuration for AIC of 36° and initial tension of 26.1 kN. This is due to the smallest axial force, stress, and deflection occurred in the structure.

Keywords: Submerged floating tunnel; buoyancy weight ratio; numerical modelling; hydrodynamic load.

1. Introduction

Submerged floating tunnel (SFT) is a type of bridge that immersed at a certain level under the surface of the water system. The system of SFT is similar to the principle of Archimides' Law which is regularly consisted in a tubular shaped and restrained by moored system in the most cases. The SFT is also made up by cables or tethers connected to the seabed [1]. Due to the principle of Archimedes' Law, the SFT structure will be attached by the buoyant force. The weight design of SFT should be less than the buoyant force in order to keep the structure remains floating. Furthermore, cable support on the SFT structure should be maintained in a proper condition to, so the structure will not sustain the excessive distortion [2].

The SFT structure compete with other conventional bridges regarding the volume of work and job sequence. On the environmental aspect, the SFT also has the advantages. The manufacturing process is done through fabrication segmentally. Hence, the work can be carried out at the factory to minimize the disruption in the construction area. As showed in Figure 1, it can be seen that the construction cost of tunnel segment unit will not increase even if the total length of SFT increases. As the matter of fact, the SFT can be said more profitable to be applied in the water with a long-span compared to a conventional bridge. Based on the advantages, the SFT structure is supposed to replace the conventional bridge in order to connect the two mainland's which are divided by a strait, lake, and river [3], [4]. In addition, SFT is one of the solutions to create a reliable connection system between continents in the future [5], [6].

Another advantage comes from the removal of the structural element. SFT is a bridge structure without piers. The piers are substituted by cables for stabilization. The position of the cable

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