Behavior of Partially Earth Anchored Cable-Stayed Bridge Considering Construction Phase and Operational Phase

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Summary

In this study, the behavior of a cable-stayed bridge with a partially earth anchored cable system was studied both for the construction phase and for the operational phase. The recently constructed 3-span cable-stayed bridge with a usual self anchored cable system in Korea was modified into a partially earth anchored cable system. According to the FCM construction method, the construction sequence analysis was performed to find optimal cable stressing forces. Effects of the systems with partially earth anchored cables were examined by comparing the self anchored cable system.

The behavior of the partially earth anchored cable-stayed bridge in the operational phase was investigated. The live load analysis was carried out according to the Korean vehicle class. Also, the response spectrum analysis for the seismic load and the buffeting analysis for the wind dynamic load were carried out. From these results, it is shown that the partially earth anchored cable-stayed bridge increases the resistant capacity against the service loads.

Keywords: cable-stayed bridge, partially earth anchored cable system, construction sequence analysis, live load, dynamic load

1. Introduction

Cable-stayed bridges have been known as an economical solution for bridges with span lengths between 150m and 500m. Some papers reported that cable-stayed bridges are most economical for span lengths between 150m and 360m [1]. Nowadays, cable-stayed bridges with a main span length of over 1000m are under construction owing to the development of a high strength materials and advanced technology. Because the inclined cables of cable-stayed bridges increase compressive forces in the girder as a span length becomes longer, a buckling problem in the girders can take a place. So, a reduction of compressive forces is needed to increase the main span length of cable-stayed bridges. To reduce compressive forces in the girder, the cable-stayed bridge with a partially earth anchored cable system was conceptually proposed by Gimsing [2]. This study adopted a partially earth anchored cable system in order to show the feasibility and effect of partially earth anchored cable system for long span bridges.

To show the effects of a partially earth anchored cable-stayed bridge, an existing cable-stayed bridge was modified into a partially earth anchored cable-stayed bridge by changing the boundary conditions of cables and supports. A 3-D finite element model was applied to simulate a constructional phase and an operational phase. Through a parametric study, the optimal number of partially earth anchored cables was determined for the example bridge and the efficiency of a system with partially earth anchored cables was examined by comparing the self anchored cable system. Also, effects for a live load and a dynamic load were examined. From these results, it was shown that the cable-stayed bridge with a partially earth anchored cable system increases the resistant capacity against service loads and dynamic loads.

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