Dynamic Characteristics of Seohae Cable-stayed Bridge Based on Results from Long-term Structural Health Monitoring

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Summary

This paper presents the long-term dynamic characteristics of a cable-stayed bridge where installed the SHM (Structural Health Monitoring) system. Modal parameters such as natural frequencies and mode shapes were identified from the modal analysis using the three-dimensional finite element model. The modal parameters of the developed baseline model have a good correlation with those identified from field ambient vibrations. By the analysis of correlations between the measured natural frequencies and temperatures, it was found the natural frequency was in linearly inverse proportion to the temperature. Mode shapes were extracted from the TDD (Time Domain Decomposition) technique for ambient vibration measurements. Finally, these results demonstrate that the TDD technique can apply to identify modal parameters of large-scaled bridges.

Keywords: cable-stayed bridge; structural health monitoring; time domain decomposition; vibration; temperature effect.

1. Introduction

Recently, many long-span cable-supported bridges, such as the Seohae bridge (2000), the Youngjong bridge (2000) and the Kwangan bridge (2003), have been constructed in Korea. These are equipped with structural health monitoring systems like the Tsing Ma, Kap Shui Mun, and Ting Kau bridges in Hong Kong, which are examples of the best-equipped bridges.

To monitor the structural response and evaluate the performance of the Seohae cable-stayed bridge, an integrated structural health monitoring system, called the Seohae Structural Health Monitoring System (SSHMS), has been developed by the Highway and Transportation Technology Institute in 2000. More than 180 sensors, such as anemometers, accelerometers, inclinometers, strain gauges, temperature sensors, and so on, were placed in locations where the structural behaviors were thought to be well known. From the completion of the bridge in 2000, the bridge's structural behaviors are being extensively monitored now.

One of the structural health monitoring methods is based on vibration measurements. Vibration-based monitoring can apply to assess the condition of the whole structure or detect damage in elements. Vibration-based methods can be applied intermittently or continuously. In most large-scaled bridges all over the world, intermittent vibration tests have been performed to identify the dynamic characteristics [1]. There were few bridges being continuously monitored for identifying the dynamic characteristics. In case of the Seohae cable-stayed bridge, a continuous vibration-based monitoring had applied to the SSHMS uniquely. Then, modal parameters - primarily lowest natural frequencies - have been stored up over 6 years. Algorithm to extract mode shapes in real time developed recently and will be applied to the SSHMS soon.

This paper, with a brief description of the bridge and the SSHMS, presents the dynamic characteristics of the structure, specially focusing on the long-term variations of the dynamic

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