The Measurement and Control of Cable Tensile Forces in Cable-Stayed Bridge using Laser Vibrometer

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Summary

Currently, indirect measurement using dynamic data from cable is widely used measuring the natural frequency of cable from the accelerometer attached to the surface and convert the data into tensile force. However, it sometimes requires many hazardous works such as attaching the device on the surface of cable, writing it with data logger, etc, which could hinder the safety of workers in the middle of cable.

New measurement system(laser vibrometer tension measuring system, LVTMS) using wireless laser-vibrometer is developed to eliminate the unsafe works and adjust the cable tension force as well. Through the LVTMS, field engineers are able to figure out the cable tension force in no time while standing on the field. In addition, the result by the previous method is to be compared. As a result, the LVTMS is proved to be accurate and reliable

Keywords: cable force; indirect measurement; wireless; LVTMS; laser-vibrometer; control.

1. Introduction

The cable force of cable supported bridges is one of the most important factors since it reflects not only the structural stability of cables but also the overall quality of construction. During the erection of cable-stayed bridge, many field measurements have to be performed using various devices such as cable tension meter, accelerometer, displacement meter, tilt meter, stress meter, etc. Among them, the measurement of cable forces is the most importance because they reflect for the overall safety and the quality of the bridge. But, it is difficult to predict the structural displacements and the cable forces by erection simulation analysis because cable-stayed bridge has the characteristics of a slender, flexible and nonlinear behavior. The cable forces have to be adjusted for the reduction of estimation errors in section modulus, dead load, fabrication and installation during the construction. And the cable forces and deck elevations are required to be precisely adjusted for structural integrity when the construction is complete.

Currently, the vibration method using dynamic data is widely used for field measurement of cable tension force during the construction of cable-stayed bridge. The vibration method is estimating cable force by measured natural frequencies of cable from the accelerometer attached to the surface. Although attaching the device on the cable surface and wiring it with data logger when the bridge deck is not yet finished could hinder the safety of workers, most of the field engineers estimate the cable force by the vibration method due to its simplicity.

In this study, therefore, new measurement system (laser vibrometer tension measuring system, LVTMS) using wireless laser-vibrometer is developed to eliminate the unsafe works and adjust the cable tension force as well. Through the LVTMS, field engineers are able to figure out the cable tension force in no time while standing on the field. In addition, the result by the previous method is to be compared. As a result, the LVTMS is proved to be accurate and reliable.

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