ANALYSIS OF THE INFLUENCE OF THERMAL ENVIRONMENT ON STRUCTURAL PARAMETERS FOR BRIDGE HEALTH MONITORING

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Abstract

Damping is affected by changes in the energy distribution of the structural system and can be considered as an indicator of structural deterioration. However, the temperature environment around the bridge also affects the change in damping ratio. In this study, the influences of temperature were analysed by calculating the structural parameters, from acceleration responses of a road bridge by the Natural Excitation Technique and Eigen-system Realization Algorithm method (NExT-ERA method). A solar-powered monitoring system using MEMS-type accelerometers was constructed and installed on a steel girder bridge. The structural parameters were calculated by the NExT-ERA method. Finally, the temperature influence on the structural parameters is evaluated by using the weighted average, based on the observed data.

Keywords: Bridge health monitoring; acceleration response; damping ratio; frequency; temperature influence; NExT-ERA; weighted average.

1 Introduction

Bridge Health Monitoring (BHM) has been carried out for prompt detection of structural deterioration and efficient management of structures. Typically, the vibration-based BHM identifies the structural parameters, such as damping, natural frequencies, stiffness, by inverse analysis from vibration response of bridge upper structures. Structural damping is closely related to energy balance in a whole bridge system, including supports, piers, and abutments, as well as decks, girders, and pavement. Since deterioration or damage in bridge components cause a transition of energy balance in the structure of a bridge, a change in damping would be observed. However, the damping highly varies compared to other structural parameters. The damping is also affected by external disturbances, such as ambient air temperature, traffic vehicles, as well as internal transitions of the bridge system. Authors evaluated the effects of temperature and traffic environment on structural damping in previous studies [1]. In the analysis, the natural frequencies were estimated by the power spectral density of acceleration response. A calculation method of the structural damping considering the external disturbances was constructed, based on RD method. As result, the relationship between structural damping and ambient temperature was demonstrated. However, in general, RD method can only be applied to an independent vibration mode, since a bandpass filter is used to separate the target mode. Hence, it

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