Bridge Displacement Monitoring using Acceleration Measurement and Development of Efficient Bridge Management System

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Abstract

In this study, the concept of an efficient bridge management system focused on monitoring bridge displacements, was proposed for maintaining numerous bridges of municipal government in Japan. In order to monitor displacement easily, a displacement estimation method using measured acceleration data was proposed. The applicability of the proposed method, then, was verified through the field measurement using the prepared and weighed loading truck. The management system was proposed, and its application scenario using the developed system and measurement device, was also introduced for further actual operations in municipal government districts.

Keywords: acceleration measurement, displacement estimation, structural health monitoring, bridge management system

1 Introduction

Numerous civil infrastructures, which were constructed during the rapid economic growth of Japan, have been aged over time ahead of the world, and so much attention has been paid to the maintenance of infrastructures. There are over 700 thousand bridges in Japan and almost 70% of the total bridges is managed by the municipal government districts.

In addition, Japan's population has gradually shrunk to the date and the government finances are severely constrained because of falling tax revenues. Therefore, municipal governments are facing lack of financial and human resources, as well as technical knowledge on structures. Hence, it is essential to manage as many bridges as possible with the least cost and effort.

It is important to measure bridge displacement since it can be used to ensure the applicable limit of bridges. Moreover, displacement is directly related to the stiffness of bridges, and therefore bridge displacement can be used to understand the tendency of how existing bridges deteriorate by monitoring changes of bridge displacements induced by the known weight of the loading truck [1]. Also, displacement would be an index which is easy to understand for administrators without knowledge on structural engineering.

In this study, by considering the implementation cost and applicability of displacement measurement in field measurements, an acceleration based displacement monitoring system was proposed. By the proposed method, displacement can be estimated from one acceleration sensor. It enables measurement of the bridge displacements which can be easily compared to the measurement by contact displacement sensor. The field measurement of the loading tests using the prepared loading truck was conducted for the target bridge to measure displacements and accelerations. From the results of the field measurement, estimated

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