



Vehicle-based Health Monitoring System for Short and Medium Span Bridges

Ayaho Miyamoto, Risto Kiviluoma

Aalto University, Espoo, Finland

Akito Yabe

KOZO KEIKAKU Eng., Inc. Tokyo, Japan

Contact: miya818@yamaguchi-u.ac.jp

Hisao Emoto

Kouzoubutsu Clinic Ltd. Ube, Japan

Abstract

In this paper, one practical solution to the problem for condition assessment of short and medium span bridges is discussed. It uses vehicle-based measurements with a public bus as part of a public transit system. The system, named as “bus monitoring system”, is introduced along with safety indices and data analysis methods. It is shown that the bridge vibration response can be extracted from the measured vehicle response, and so called “characteristic deflection” to be calculated. Characteristic deflection is found to be relatively free from the influence of varying parameters like vehicle speed, bus overall weight and roughness of the road surface. It could therefore be used as structural performance indicator of the bridge. The system is operating in Ube-city, Japan, that is dealt as a case study.

Keywords: short and medium span bridge, long term monitoring, public bus, health monitoring system, condition assessment, damage detection, characteristic deflection, sensitivity.

1 Introduction

This paper describes on the long-term field test of a bridge health monitoring method using a public bus as part of a public transit system (called “bus monitoring system”) for short and medium span bridges[1] located on the municipal bus routes in Ube-city, Yamaguchi Prefecture, Japan conducted over a period of about four years from December 2010 to September 2014. Since the field test has been conducted for about four years, a considerable amount of measurement data has been accumulated. The data thus accumulated were utilized to evaluate the influence of fixed-bus operating conditions (external disturbance factors) such as weather, the number of oncoming vehicles, the number of persons in the vehicle and vehicle speed) on characteristic deflection. In addition to the derivation of conversion

(correction) factors based on the correlations between various bus operating conditions (external disturbance factors) and characteristic deflection carried out in previous studies[1,2] based on data accumulated over a period of about one year, newly obtained measurement data were used. Thus, by conducting an integrated study using all data accumulated over a combined period of about four years, new study results have been obtained. These results are also described in this paper.

2 Details of long-term monitoring conducted on Ube-city's bus routes

In order to develop and put to practical use a bus monitoring system for short and medium span bridges located on bus routes, it is necessary to conduct a series of studies involving a long-term field test using an in-service fixed-route bus. In