Vibration-based long-term scour monitoring for an in-service railway bridge

K. Yoshitome[1], C.W. Kim[2], Y. Goi[3], S. Kitagawa[4], M. Shinoda[4], H. Yao[4], Y. Hamada[5]

[1]Gradutae student, Dept. of Civil and Earth Resources Eng., Kyoto University, Kyoto 615-8540, JAPAN
[2] Corresponding author, Professor, Dept. of Civil and Earth Resources Eng., Kyoto University, Kyoto 615-8540, JAPAN, kim.chulwoo.5u@kyoto-u.ac.jp, +81-75-383-3421.
[3]Assistant Professor, Dept. of Civil and Earth Resources Eng., Kyoto University, Kyoto 615-8540, JAPAN
[4] Fuji Electric Co., Ltd. Tokyo 191-8502, JAPAN,
[5]Structural Engineering Office, West Japan Railway Company, Osaka 532-0011, JAPAN

ABSTRACT

This study is intended to discuss feasibility of a long-term scour monitoring for an in-service railway bridge utilizing microtremor monitoring by means of remote sensing. In the context of the structural health monitoring, vibration-based approach might be a promising technique for the scour monitoring of railway bridges, as it is well known that changes in the vibration characteristics of the railway bridge pier under scour is obvious. Japanese railway companies make decisions on occurrence of scour utilizing change in a target frequency of piers empirically. The empirical criterion is 20% decrease in the target frequency. Therefore, the impact test on the railway bridge pier to identify changes in frequencies has been adopted as a promising scour detection method in Japan. However, the impact test is a laborious and time-consuming method, and is inapplicable for the real time monitoring to make a proper decision on the train operation control during heavy rains. This study investigates feasibility of vibration-based scour monitoring as an alternative method for the impact test. A railway bridge with high potential of scour was monitored utilizing a smart sensing unit which includes functions of vibration measurement, data processing and remote control. The target frequency was slightly decreased under high water level. However, the decreased frequency recovered once the water level decreased. It demonstrated lower chance for occurring scour as the vibration characteristics of the monitoring pier keep constant. It also encourages the use of the proposed sensing unit and microtremor measurement for scour monitoring.

Keywords: ambient vibration; long-term monitoring; railway bridges; remote sensing; scour monitoring; system identification