NONCONTACT DYNAMIC DISPLACEMENT MEASUREMENT USING FSF LASER

Mahito Fujii
Civil Engineer
Keisoku Research Consultant Co., Hiroshima, Japan
m-fujii@krcnet.co.jp

Shuji Umemoto
Civil Engineer
Keisoku Research Consultant Co., Hiroshima, Japan
umemoto@krcnet.co.jp

Takefumi Hara
Associate Professor
Tohoku University, Sendai, Japan
tkfm@ecei.tohoku.ac.jp

Noriyuki Miyamoto
Civil Engineer
Keisoku Research Consultant Co., Hiroshima, Japan
miyamoto@krcnet.co.jp

Takuji Okamoto
Civil Engineer
Keisoku Research Consultant Co., Hiroshima, Japan
okamoto@krcnet.co.jp

Hiromasa Ito
Professor
Tohoku University, Sendai, Japan
h-ito@ecei.tohoku.ac.jp

Yozo Fujino
Professor
The University of Tokyo, Tokyo, Japan
fujino@civil.t.u-tokyo.ac.jp

Summary

The measurement principle employed in the Frequency-shifted Feedback Laser (FSFL) enables remote/noncontact measurement, and its accuracy is not dependent on distance. Because the maximum response frequency of the FSFL is 1000 Hz, it is a promising technology for application to high accuracy, remote/noncontact dynamic measurements. Previous static field tests of the FSFL have verified that measurement with high accuracy of 200 μm at a distance of 500 m is possible. In the present research, the authors conducted a laboratory experiment using a vibration board (natural frequency: 10 Hz), and also made dynamic measurements of bridges in service. The results verified the dynamic measurement performance of the FSFL and confirmed its applicability to bridges in service.

Keywords: FSF Laser; **s**tructual health monitoring; dynamic displacement measurement; remote; noncontact; deflection.

1. Introduction

The performance requirements of the measurement technologies used in the construction field are no less strict than those in other industries. As one example of this, Fig. 1 shows the relationship between the accuracy required in displacement measurements and the distance to the object of measurement. Accuracy S of 0.1 mm when the distance L to the object is 100 m is not a rare requirement. In this case, the accuracy demanded is $S/L = 10^{-6}$. Fig. 2 shows the relationship between vibrational frequency and vibrational displacement by type of structure. In dynamic measurements in the construction field, displacement measurements at comparatively low frequencies of 10 Hz and under are required.

The requirements for measurement technologies in the construction field are not limited simply to displacement measurement in the low frequency region and measurement accuracy. Acquisition of higher density information by a noncontact method is also required. As one such method, high expectations are placed on optical full-field measurement technology. Optical full-field measurement refers to techniques for obtaining 2- and 3-dimensional information on objects by utilizing the properties of light. In comparison with measurement methods in which sensors are installed on the object, optical full-field measurement has the following advantages.

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