Development of inspection and monitoring technology for preventive control of infrastructure

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1. Introduction

Infrastructure has played a primary role as the foundation for industrial expansion and was intensely created during a period of high economic growth more than fifty years ago. Now this aging infrastructure is a concern due to an increasing threat of accidents and the potential results of natural disasters upon it that could affect society as a whole, in addition to increasing maintenance costs and reconstruction expense.

To adequately confront our aging infrastructure in the future, we must change into an investment-minded society that designs and builds extended life constructions. For that purpose, in place of reactionary measures used to address present damage, we must implement strategic maintenance and control techniques based on preventive maintenance thinking to attempt to reduce total costs through long-lived facilities. This includes regularly inspecting and diagnosing structures to determine the root cause of failures, and implementing countermeasures before critical defects occur to prevent accidents and disasters from impacting a society that faces a rapidly increasing risk from aging infrastructure.

In this research, we have identified inspection methods applicable to various types of construction in order to change from simply "seeing what is visible" to "observing what we need to observe," as described below:

I. Inspection and diagnosis technology on hidden portions of construction
II. Inspection and diagnosis technology for variations of constructions that are visually difficult to evaluate

2. Outline of research and development

Ⅰ. Development of inspection and diagnosis technology for visually difficult portions of the construction

① Inspection and diagnosis technology for buried and covered portions through nondestructive inspection

With a goal of developing nondestructive inspection and diagnosis technology and evaluation standards for visually difficult portions, such as buried and covered portions of concrete in civil engineering constructs, we have developed prototypes for placement inside an auscultation system. Through nondestructive inspection, structural endoscopes and wall face detectors running over outer walls are able to determine actual performance of structures.

② Inspection and diagnosis technology on visually difficult portions through images and data

With the goal of developing inspection and diagnosis technology and evaluation standards for visually difficult portions, such as the interiors of sewer pipes or subfloors of constructions that cannot be approached directly through image and data technology, we have implemented a performance verification test using a prototype screening method of TV camera investigation for road-caving prediction and deterioration diagnosis of wooden subfloor materials.

Ⅱ. Inspection and diagnosis technology for variations of constructs that are visually difficult to evaluate

① Inspection diagnosis technology for leaking constructs using infrared

With the goal of developing inspection and diagnosis technology and evaluation standards to quantitatively understand wet portions of dikes that are difficult to detect with current methods that use infrared ray thermo sensors, we have implemented a performance verification test using an infrared ray thermo sensor in an actual river dike.

② Monitoring of structural subjects and variation of detection methods through positional measurement

Utilizing position identification technology through GPS and road management cameras, we have developed and implemented a performance verification test in the field on actual bridges. The inspection and monitoring technology and evaluation standards will allow us to capture accidental and critical variations of structural subjects such as bridges, swiftly and simply.

3. Future planning

We are planning to develop inspection and diagnosis technology and evaluation standards for portions and variations of structural objects that are difficult to see, up until now making evaluation visually difficult. Additionally, we will establish a multi-purpose evaluation method and evaluation standard for inspection and monitoring results and implement them as swiftly as possible.