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IDI QUARTERLY

Infrastructure Development Institute—JAPAN

CONTENTS

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20th Infrastructure Technology Development Award 2018

Japan Institute of Country-ology and Engineering (JICE) was established as a public interest corporation to promote construction engineering in Japan by conducting cutting-edge research and development activities.

As more incentives should be provided for construction technology researchers and research institutes to enhance the level of construction engineering more effectively, JICE commenced Infrastructure Technology Development Award with Coastal Development Institute of Technology (CDIT) under the auspices of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

Thirty-four technologies competed for the 20th Infrastructure Technology Development Award.

In principle, the applicants' technologies should have been developed within the past five years and applied to the real sites already.

As a result of examination, institutes and researchers with the following technologies were awarded 20th prizes.

The grand prize went to "Enhancement of Efficiency and Effectiveness in Maintenance and Management System by utilizing ICT".

And the three excellence prizes were awarded to "Wire Rope Barrier Systems", "Construction of large onshore wind turbine by lift up method", and "Caisson installation automation technology".

The grand prize and one of the three excellence prizes are introduced below.

For any inquiries/ comments, please contact JICE :

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Enhancement of Efficiency and Effectiveness in Maintenance and Management System by utilizing ICT

Subtitle: Innovative Maintenance and Management System for Infrastructure "i-DREAMs"

1. Introduction

In Japan, aging infrastructure that was developed during the high economic growth period has progressively deteriorated. Therefore, the number of structural damages detected from inspection work is increasing. However, there is a shortage of inspection and maintenance engineers due to a reduction of working-age population, which is one of major social issues.

Concerning the above-mentioned issues, the Metropolitan Expressway Co., Ltd. has developed an innovative maintenance and management system (i-DREAMs: intelligence-Dynamic Revolution for Asset Management system) in order to enhance efficiency and effectiveness in maintenance and management work for achieving sustainable infrastructure.

2. Maintenance and Management System for Infrastructure

As shown in Fig.1, i-DREAMs is a system that can help implement an efficient maintenance and management work by linking and integrating all relevant data and information obtained during the work processes of survey and design (DIM), construction (CIM) and maintenance (MIM).

By integrating various data obtained from each work process such as maintenance work and by utilizing 3D point cloud data for various stages of maintenance work on a Geographic Information System (GIS) platform, the system can support an efficient maintenance and management work of infrastructure.

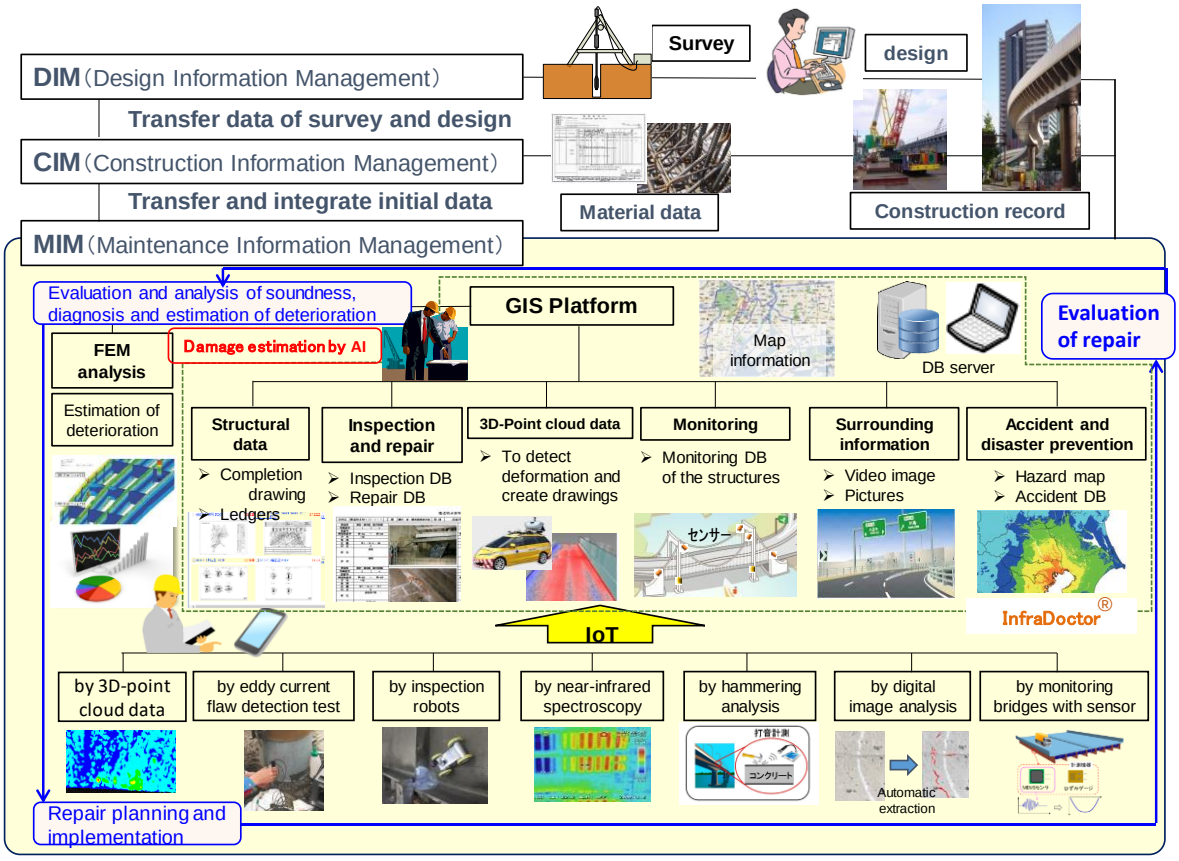

Figure 1 Overall concept of i-DREAMs

3. Core Technology of i-DREAMs and its Advantages

3.1 Site Condition Survey from the System

By using Mobile Mapping System (MMS) as shown in Fig.2, 3D point cloud data and omnidirectional video image can be efficiently measured while moving on highway without requiring work zone traffic control such as road closure, thus making it possible to survey the site condition on the GIS platform. The coordinates of each point cloud have an equivalent accuracy with that obtained from a conventional on site surveying. As shown in Fig. 3, it is possible to accurately measure the dimension of an arbitrary designated part such as road width. It is expected that the required lead time can be reduced up to 1/10 compared with that of a conventional method.

Figure 2 Mobile Mapping System (MMS)

Figure 3 3D Dimensional measurement (road width)

3.2 Creation of 2D and 3D CAD Drawing

The system is equipped with a function to automatically extract outline, planar or curved surface of structures from 3D point cloud data. By this method, 2D or 3D CAD drawings can be easily created for structures without initial as-built drawings or structures that have individual drawings but without integrated drawings as a whole, as shown in Figs. 4.

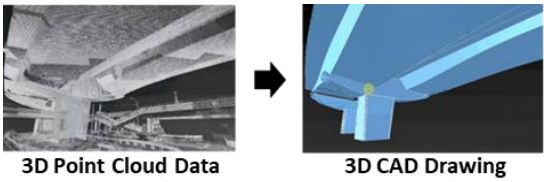

Figure 4 3D Drawing creation

3.3 Simulation in 3D Work Space

As shown in Fig. 5, a function that enables a dynamic simulation of any construction machine in the work space of 3D point cloud data by using the tool of 3D model of construction machine prepared beforehand was developed. As a result, it is possible to confirm in advance the selection of heavy construction / inspection machinery that is suitable for the actual site condition, the arrangement position, and the interference with surrounding structures. Hence, it is possible to provide work safety and to minimize any rework in the field work.

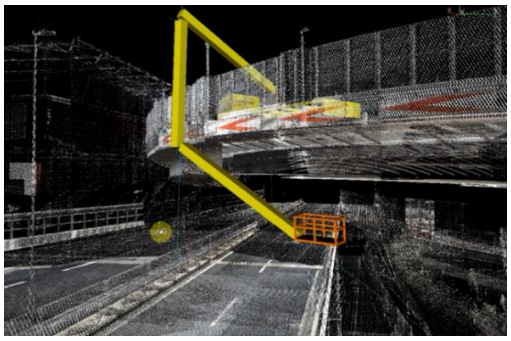

Figure 5 Simulation of construction machinery (example of bridge inspection vehicle)

4. Conclusion

The measured 3D point cloud data by MMS without any necessity of work zone traffic control can be efficiently utilized in maintenance and management work. This can significantly reduce the time required for work zone traffic control, thus leading to a decrease in social and economic losses due to such traffic control.

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Wire Rope Barrier Systems

1. The Background and Turning Point of the Technology Development

On non-divided two-lane expressways, head-on-collisions have been a safety issue. The feasibility of installing median strips, which requires road widening, has been limited because of high costs. An example of guard fence installation along the division line of a narrow road was seen in the case of a 2 + 1-lane road system adopted in Sweden. However, we found that the Swedish system did not conform to the guard fence installation standards of Japan; therefore, we started developing a new type of wire rope barrier system.

2. The Technological Features

The wire rope barrier system consists of highly ductile wire ropes and relatively low-strength posts. The barrier system resists the impact of vehicle collision by mainly using the tension of the wire rope. The main feature of this barrier system is that the impact of a colliding vehicle is absorbed by the wire rope, and another feature is that this barrier system can be installed along a narrow center strip of the road because the ropes are stretched through the vertically aligned holes of thin posts. Installation and removal of this facility is easy; therefore, it is advantageous to apply this facility to narrow-width roads. To reduce the installation width, the ends of the wire ropes are aligned along the center line.

3. Range of Application of the Technology

This technology is installed as a median division facility mainly for two-lane roads.

4. Effectiveness of the Technology

When this facility is installed as a median facility on a non-divided two-lane road, it prevents head-on-collisions and reduces the number of casualties in vehicles involved in accidents caused by vehicles that drift into the opposite lane. Furthermore, the degree of injuries of the occupants of the vehicles that collide with the median facility is reduced because of the impact absorbing characteristics of the wire rope. There are two aspects to the cost reduction from installing the wire rope barrier systems: one is the reduction due to its lower construction cost than those for other types of guardrails, and the other is the reduction in the cost for road widening due to this barrier system requiring only 9cm for the installation width. The turnbuckles installed with intervals of about 200m is able to be removed without any machinery and the posts are able to be removed when the tension of the wire rope is released. These two features enable the road administrator to make an opening in the guardrail anywhere desirable at the time of an accident or other emergency. The time required for repairing this guardrail is short. Repair for the ordinary damage caused by a vehicle collision only requires replacement of the damaged posts.

Photo 1 Installed posts (left) and the end part (right)

Photo 2 Removal of posts and installation of opening

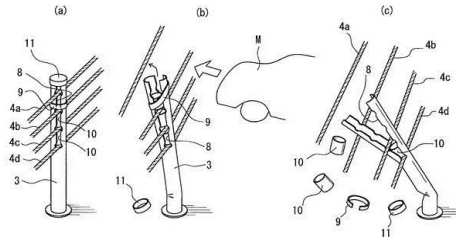

Fig. 1 The mechanism that works during a vehicle collision

Photo 3 Crash test (left: passenger car; right: large vehicle)

5. The Social Importance and Technical Applicability

Head-on-collisions on a non-divided two-lane expressway tend to be severe—they are often fatal. The social importance of preventing head-on-collisions on non-divided two-lane expressways is high because vehicle occupants who are not at-fault are involved in such accidents. In 2015, the Board of Audit of Japan recommended the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and Nippon Expressway Companies to examine improving safety measures, including the installation of median facilities in order to solve problems of fatal accidents on the temporary tow-lane sections of expressways. In 2016, the MLIT announced that the ministry would start examination on the safety measures against head-on-collisions on two-lane expressways by experimentally replacing the currently used rubber-pole median facilities with wire rope barrier systems. In 2017, East, Central and West Nippon Expressway Companies experimentally installed wire rope barrier systems on a total of about 113km of road sections on 12 routes. As of May 2018, the number of accidents caused by vehicles that drifted into the opposite lane decreased from 45 cases before installation to one case. The number of fatal accidents decreased from 7 cases to zero, and the number of injury accidents decreased from 6 cases to zero. In June 2018, the MLIT announced that the ministry, based on this examination, would start full-fledged installation of wire rope barrier systems on the temporary two-lane sections under construction or repair.

6. Installation Records

- 2015: 17km on Obihiro-Hiroo Expressway
- 2017:70.2km on Doto Expressway, Hokkaido Expressway, Akita Expressway, Ban-Etsu Expressway, and Nihonkai-Tohoku Expressway
- 2017: 4.4km on Tokai-Kanjo Expressway, Maizuru-Wakasa Expressway, and Kisei Expressway
- 2017: 38.7km on San-in Expressway, Hamada Expressway, Matsuyama Expressway, and Higashi-Kyushu Expressway

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Photo 4 Installation on a temporary two-lane

Photo 5 Example case that prevented a head-on-collision (Source: MLIT website)

About IDI and IDI-quarterly

Infrastructure Development Institute (IDI)-Japan is a general incorporated association operating under the guidance of Ministry of Land, Infrastructure, Transport and Tourism of Japanese Government.
IDI provides consulting services for mobilizing International Assistance to developing countries, promoting international exchange of information and human resources, and supporting globalization of project implementation systems targeting both developed and developing countries in the field of infrastructure.

IDI has been publishing the free quarterly journal “IDI Quarterly” since1996 for the purpose of introducing information relating to public works and construction technologies developed in Japan to foreign countries. We have distributed the journal to administration officials in more than 90 countries around the world by e-mail.

It is highly appreciated if you would send us your opinions, impressions etc on the articles.
We are also welcoming your specific requests on articles to pickup for the following Quarterly issues.