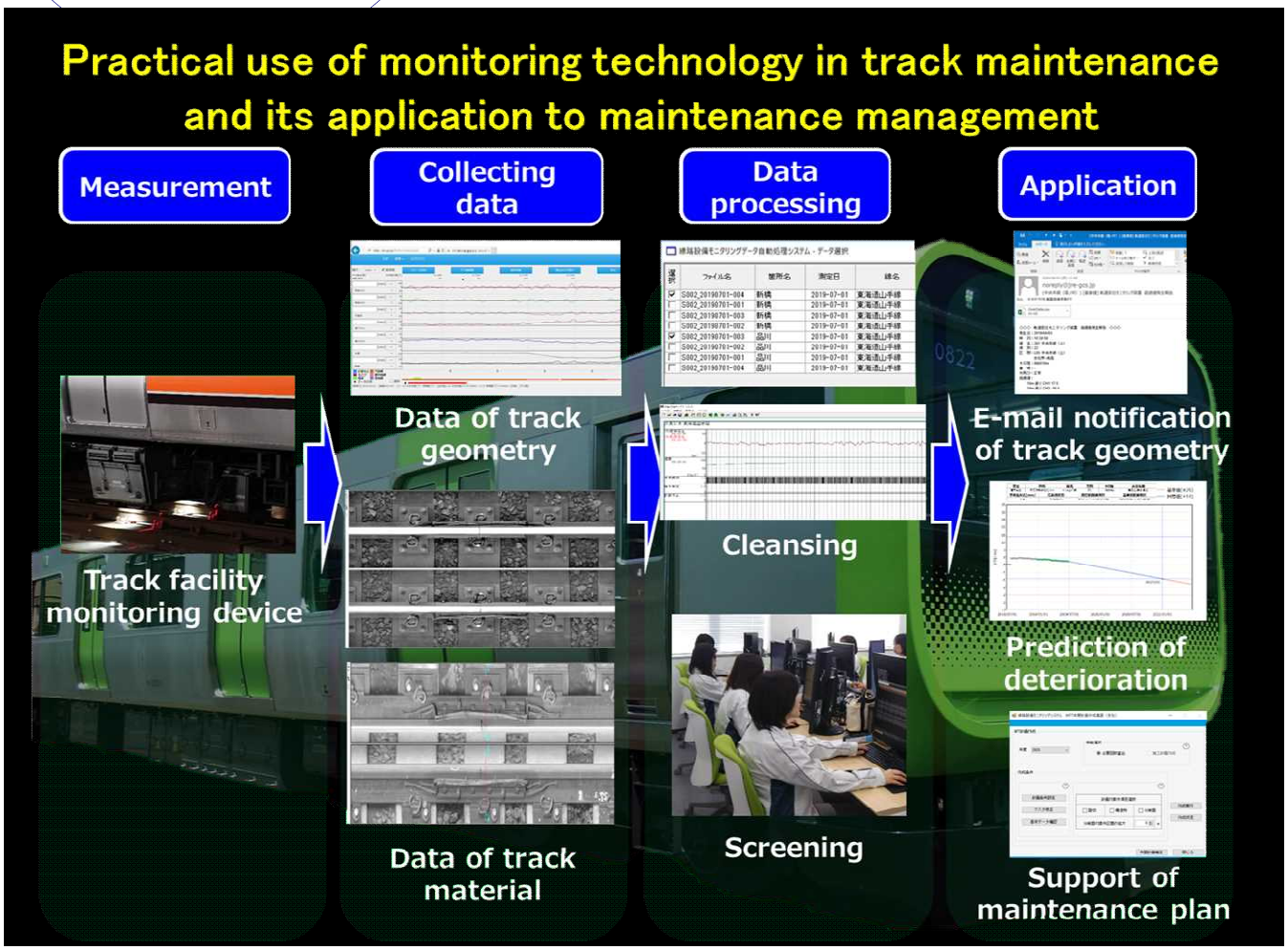
December 2019 No.86
Japanese Infrastructure Newsletter

IDI QUARTERLY

Infrastructure Development Institute—JAPAN



CONTENTS

Infrastructure Development Institute – Japan (IDI)
Plaza Edogawa-bashi 3F. 1-23-6, Sekiguchi, Bunkyo-ku, Tokyo, 112-0014, JAPAN
Tel: +81-3-5227-4107 Fax: +81-3-5227-4109 E-Mail: idi17@idi.or.jp Website: http://www.idi.or.jp/en/

21st Infrastructure Technology Development Award 2019

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).

Seventeen technologies competed for the 21st 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 21st prizes.

The grand prize is "Practical use of monitoring technology in track maintenance and its application to maintenance management".
And the two excellence prizes are "The Automatic Placement System of Dam Concrete", and "Rapid Removal Technology for Replacing Reinforced Concrete Decks of Composite Girder Bridges".

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

Any inquiries/ comments please contact to JICE :
Homepage: http://www.jice.or.jp/
(Japanese version only)
E-Mail: webmaster@jice.or.jp

Practical use of monitoring technology in track maintenance and its application to maintenance management.

Establishment of maintenance method using a track facility monitoring device.

1. Background of the technology development and its opportunity

There are two primary purposes. The first is to introduce Condition Based Maintenance (CBM) to track maintenance. We have been carrying out regular measurements using special inspection vehicles and improving based on the results, yet it was challenging to introduce CBM from various conditions. The second is to increase maintenance productivity. Inspection of the track's condition is mainly conducted by a visual inspection. Due to its structural characteristics and other factors, it requires experienced staff with skillful techniques, thus improving productivity is an urgent issue.

2. Technical contents

Japan's first technology that can monitor the condition of the track was developed and successfully put into practical use. Track maintenance work is generally divided into maintenance of track geometry and replacement of track materials. However, the track facility monitoring device (photo1 and photo2) mounted in the commercial trains can be used to measure track geometry and track material conditions remotely to improve inspection efficiency and quality and delivered optimization of repair plan. Also, a monitoring center was established, and the development of new data processing technology, standardization of processing operations, system development, and establishment of inspection and maintenance methods for equipment was obtained.

Photo1 Track geometry measurement device

Photo2 Track material monitoring device

3. Technical coverage

50 lines of JR East (Yamanote Line, Keihin Tohoku Line, Ohu Line, Tohoku Line, Uetsu Line, etc.)

4. Technical performance

(1) In addition to visualizing the track deterioration status (Fig.1 and photo3) and estimating the time of repair (Fig.2), an e-mail notification (Fig.3) will be sent when an emergency repair is necessary. Therefore, the repairs can be made promptly.

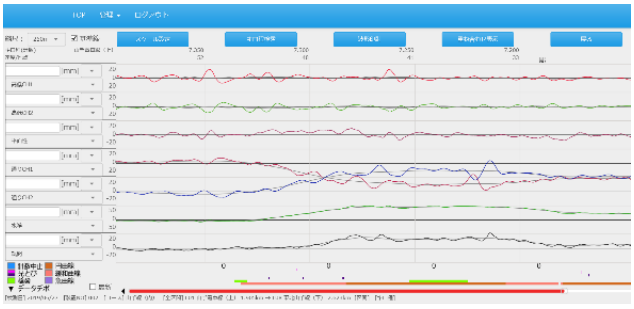


Fig.1 A chart generated by the track geometry monitoring device

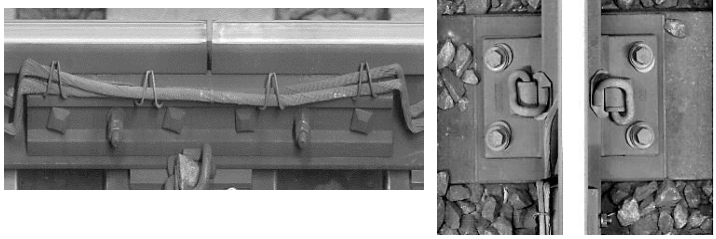


Photo3 Images from the track material monitoring device

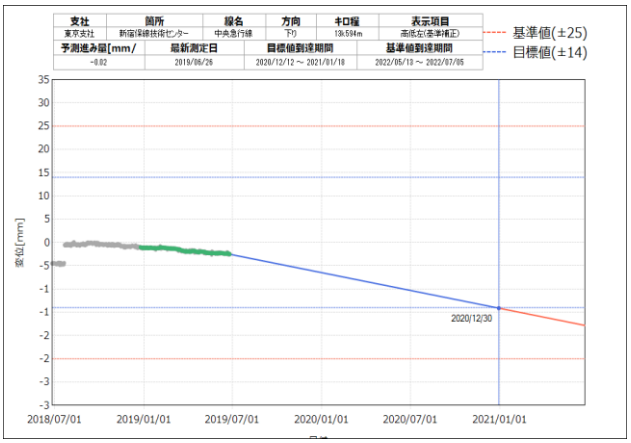


Fig.2 The deterioration prediction for the track geometry

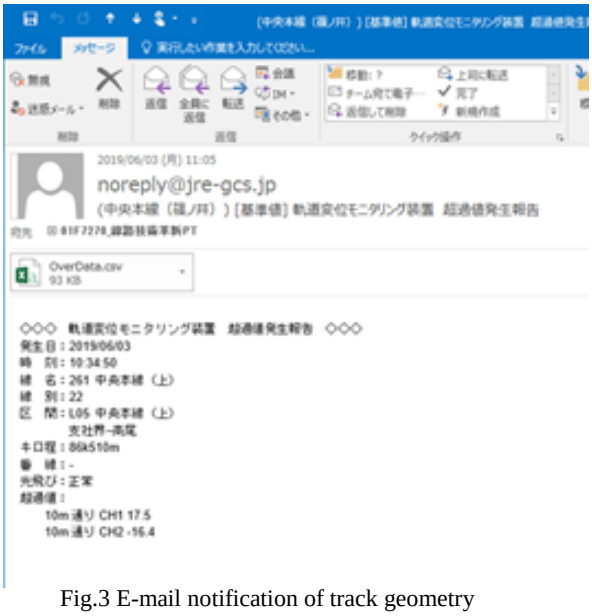


Fig.3 E-mail notification of track geometry

(2) The visual inspection can be made 12 times more efficient from "once a week" to "once every three months," and established an efficient visual inspection method by operators (Photo4) without relying on skilled engineers.

Photo4 An efficient visual inspection method by engineers

(3) Optimization of the operation plan for large repair machines can be made using a high-frequency track geometry data. Since the operation results can be automatically evaluated, it is now possible to assist in the selection of repair methods.

5. Social implication and development

The track maintenance industry is also facing a labor shortage, and our company needs to improve productivity by around 20% over the next 20 years. Furthermore, the social demand for safety and stability of railways is increasing, and the social implication of this technology is significant. In the railway business, the role of the track maintenance department to maintain the track is essential. Also, there is enough potential to be utilized by many domestic and foreign operators. In terms of technology, advanced development can be expected through the application of artificial intelligence technology.

6. Implementation results

26 lines of JR East (Yamanote Line, Keihin Tohoku Line, etc.), as of December 2018.

Technology Developer: East Japan Railway Company／
Japan Railway Track Consultants Co.,Ltd
Joint Developer: Railway Technical Research Institute
／Kawasaki Heavy Industries,Ltd／
Hitachi High-Tech Fine Systems Corporation／
JREAST information Systems Company
E-mail: yoshida-tatsuya@jreast.co.jp
TEL: +81-3-5334-1244
FAX: +81-3-5334-1191

Automatic Placement System of Dam Concrete

Completely Automatic Production of Dam Concrete, Conveyance, and Placing

1. Background and Impetus for the Technology Development

In the construction of a concrete gravity dam, the concrete placing cost accounts for about 60% of the dam body construction cost. Therefore, we believe that rationalization of the work will contribute greatly to increasing productivity.

Also, in this construction work, the works of production, conveyance, and placement of the concrete are repeated from tens of thousands of times to hundreds of thousands of times.

Conventionally, concrete placement work required many skilled operatives because the work proceeded according to the following procedure.

1) The placement engineer will give an instruction to start placing at the concrete placement site.

2) Mixing concrete with the specified mixing composition and quantity.

3) Take a mixed concrete into a concrete bucket on the transfer car which provided underneath the concrete batching plant.

4) The crane operator conveyances the concrete bucket on the transfer car to the placing site using a crane.

5) The signal operator on the dam body lower the concrete bucket after the engineer in charge confirming the surrounding area.

In particular, aerial cableway crane operation requires experience and skill, so at present when there is a large turnover rate of skilled construction labors, it was considered important that substituting practiced technical skills through automatize.

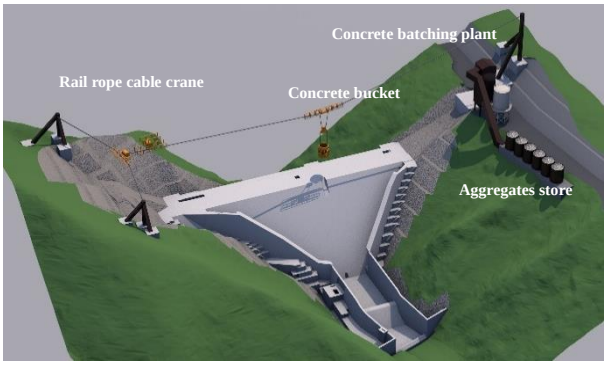


Fig. 1 Dam body and layout of concrete production, conveyance, and placement plant

2. Outline of the Technology

The objective of this technology is to greatly improve the productivity of dam construction by fully automating the series of operations from concrete production, conveyance to placement.

1) The concrete placement plan is drawing up by inputting the concrete placement areas, the mixing composition of the concrete to be placed, etc.

2) Then input the data of concrete placement plan into the system. In response, each item of plant is operated, such as the aggregates storage facilities, concrete batching plant, transfer car, concrete buckets, aerial cableway crane, etc. are linked together to repeat a series of operations fully automatically. (Fig. 1 and Fig. 2)

Previously technologies had been established for each element such as automatic operation of the concrete batching plant, automatic operation of fixed or travelling cable cranes, etc., but this technology is unprecedented technology that fully automated the series of operations by means of over the entire scheme of concrete placing.

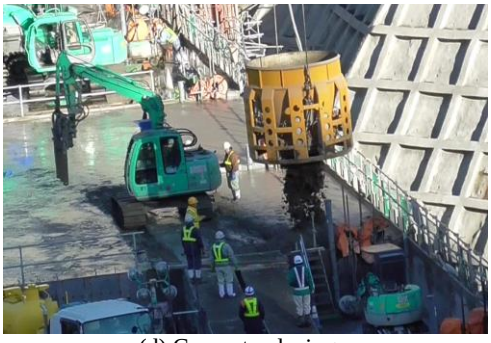
In addition, because of it has been considered difficult to perform three-dimensional control of position coordinates, such as automatic anti-swaying and landing, the aerial cableway crane has not been implemented by automation so far.

Therefore, by constructing a mechanism that links the operation control information of the aerial cableway crane with the three-dimensional position coordinates of bucket to be transported, it had become possible to control each position coordinate and established a fully automated method.

(a) Aggregates transport plant

(b) Concrete batching plant

(c) Concrete conveyance facility



(d) Concrete placing

Fig. 2 Fully automated concrete production, conveyance, and placement

3. Scope of the Technology Application

Automation of facilities related to concrete production, conveyance and placement, and an integrated system to control them has been built, so it can be applied not only to cable cranes but also to concrete dam construction work using aerial cableway types.

4. The Effect of this Technology

The effect of this technology is improved placement cycle time, cost reduction due to a reduction in placement-related skilled labors and to be cleared away the shortage of skilled labors related to placement.

In particular, it can be expected that streamlining by fully automating the operation of the aerial cableway crane that requires three-dimensional operation to improve about 10% cycle time, the number of labor required for concrete placement has been reduced to 2/3 and it will be possible to perform the operations sufficiently with unskilled labors.

5. Social Significance and Advancement

Increasing the productivity of the construction business and clearing away the shortage of skilled labors related to construction in Japan are urgent issues, necessitating the acceleration of computerized construction using ICT is required.

This is the new technology that can contribute to such requirements of society, and it consider that it has great social significance.

6. Experience of Application of the Technology

Yanagawa Dam (dam body) construction, August 2018 to November 2018

Applicant : Shimizu Corporation

Technology Developer : Norikazu Yamashita,

E-Mail : yamashita_n@shimz.co.jp

TEL : +81-3-3561-3883

About IDI and IDI-quarterly

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

IDI has been publishing the free quarterly journal called “IDI Quarterly” since1996 to introduce information related 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 also welcome your specific requests for the following Quarterly issues.