# R&D of Improvement for More Advanced and Efficient Road Structure Maintenance using Monitoring Technology

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## Objective

Although a lot of monitoring technologies are developed, a maintenance manager cannot choose pertinent technologies for bridge maintenance, since the practical specifications are not standardized.

To make the maintenance cycle more sophisticated and more efficient, propose guidelines to introduce the most advanced monitoring systems for bridge management.

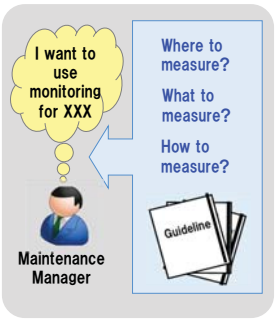

## Subject

- Survey maintenance managers' needs for monitoring technologies.
- Examine the relationship between measurement data, and damage or deterioration detected from conducting experiments.
- Develop scenarios for introducing monitoring technologies to bridge maintenance, and make guidelines for monitoring systems.

Achieve more advanced and efficient bridge maintenance through the introduction of monitoring technologies by guidelines for maintenance managers.

## Examples of expected usage

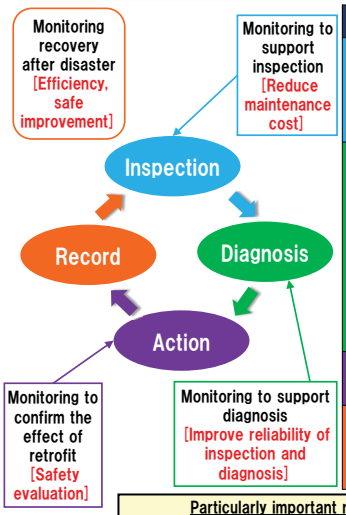
- Improve the efficiency of inspection works by monitoring data.
- Improve the accuracy of inspections of areas that are difficult to access, by introducing monitoring.
- Improve safety by introducing monitoring to damaged structures.
- Confirming the effects after repairs and reinforcement through monitoring.




## RAIMS (Research Association for Infrastructure Monitoring System)

Chief Director: TERUHIKO YODA
Emeritus Professor of Waseda University

*Listed in random order




| Classification | Objectives of maintenance manager | Objectives of monitoring |
|---|---|---|
| Monitoring to support inspection | Avoid overlooking deterioration | Understand the section where some kind of abnormality occurred |
| | Reduce inspection time and cost | Understand the range where soundness has been confirmed |
| Monitoring to support diagnosis | Action to prevent further deterioration | Understand when it has reached the point where preventive maintenance measures should be taken. |
| | Prioritize actions | Obtain quantitative data to conduct an objective evaluation |
| | Maintain the service status | Check if it has reached the point where traffic restrictions or road closures should be carried out |
| Monitoring to confirm the effects of retrofit | Confirm appropriateness of the method of retrofit | Confirm the effectiveness and durability of the measures |
| Monitoring recovery after disaster | Shorten time to open to traffic (expressway) | Understand the section where the risk of bridge collapse is predicted |
| | Detecting dangerous sections (ordinary roads) | |

**Particularly important needs for maintenance manager**
- Improve efficiency of hands-on visual inspections
- Support the inspection of areas which are difficult to approach, such as an overpass
- Monitor bridges that need repairment but cannot do immediately
- Monitor important regional short span bridges at low cost

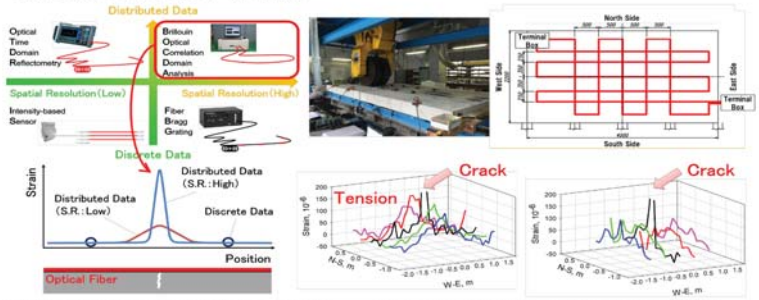
## On-Site Monitoring of Salt Attack

### On-site test

Monitoring of salt attack such as corrosion of re-bar in the reinforced concrete (RC) and prestressed concrete (PC) bridges by the sensing devices.


## Crack Detection by Optical Fiber

By distributed strain data by optical fiber sensor with high spatial resolution, it is possible to detect the occurrence of a tiny crack, and identify the position, and confirm the crack opening.



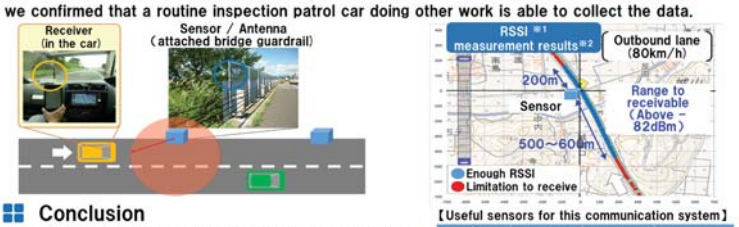

Conceptual Diagram of Crack Detection by Optical Fiber

Example of Crack Detection by Truck Wheel Traveling Test

## Evaluate wireless communication methods (Patrol collection type monitoring)

### Abstract

Focused on a technology that wirelessly collects sensor data using a car running at 80km/h, we confirmed that a routine inspection patrol car doing other work is able to collect the data.







【Useful sensors for this communication system】

| Sensor | Collection method | Data | Amount of data |
|---|---|---|---|
| Eigenfrequency Meter | Constant (Once an hour) | Eigenfrequency (3D) | 6byte/time |
| Strain Meter | Constant (Once an hour) | Deflection (1D) | 2byte/time |

### Conclusion

- Collecting sensor data in range of 200~300m across the sensors on an expressway.
- The quantity of collected sensor data by one passage is about 8,000 byte※3 (3-week data) in case of single sensor, and about 3,000 byte/sensor (8-day data) in case of multi-sensors.

※1 Received Signal Strength Indicator ※2 Retouching the map of Geospatial Information Authority of Japan. ※3 Based on 16 byte/h

## The following Videos are introduction pictures of the test site

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SIP Cross-ministerial Strategic Innovation Promotion Program

Infrastructure Maintenance, Renovation and Management