Road Structure Continues to Support Society

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Keywords: Road structure, maintenance, disaster prevention/mitigation, productivity revolution

1. Introduction

Road structures, including bridges, tunnels, earthworks, and pavement, support society and make it safer, more secure and productive through the provision of the functions of roads. To support the appropriate maintenance and efficient renewal, the Road Structure Department prepared a draft of the technical standards, conducted research and a study required for its preparation, and provided technical support and transferred technologies to solve the problems that arose on-site.

For the department, fiscal 2016 was a year when the Kumamoto earthquake and various disasters and accidents occurred, and some policies were actively promoted. In this article, we would like to explain the circumstances surrounding road structures, NILIM activities, and future prospects from three viewpoints: maintenance of infrastructure; disaster prevention, mitigation, and crisis management: and a revolution in productivity.

2. Maintenance of Infrastructure

Since fiscal 2014, visual inspections have been regularly conducted on the five types of road structures, including bridges and tunnels, from a proximity distance. The NILIM has also been developing a variety of elemental technologies and promoting measures to use them in order to implement on-site maintenance cycles on these structures, in other words, inspections, diagnoses, execution, and recording. As for inspections, we are studying ways to apply new technologies to improve the reliability and rationalization of inspections based on data from regular inspections. For execution, or specifically repair and reinforcement, we are introducing a method of selecting measures that are suitable for the cause and status of deformation, as well as the partial factor design method that lets us design on the basis of the strength of the actual materials used and the planned in-service period.

For the structures, no regular inspection guidelines were set in fiscal 2014; however, inspection guidelines were established for pavement in October 2016 and for small accessories, including traffic signs, in March 2017. The NILIM prepared a draft of the guidelines and is studying methods of maintenance depending on the condition of the pavement and the life-extending effect of maintenance techniques, for example.

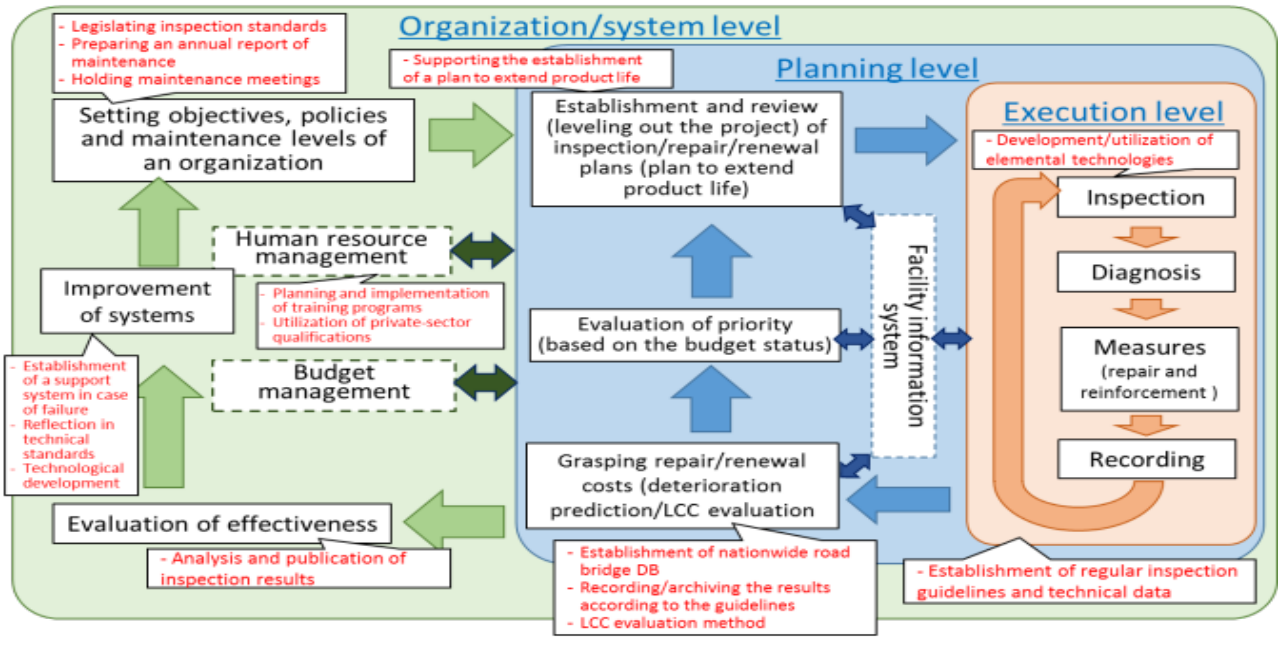

Figure 1: NILIM's approach to the maintenance cycle and road structures

As for maintenance of infrastructure, we need to make efforts at the execution level, at the planning level as the road management authority, and at the organizational and system level to realize the policies as shown in Figure 1. As indicated in red in the same figure, the NILIM is making a variety of efforts in liaison with the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), including support for establishing a plan to extend product life, planning and implementation of training programs, analysis and publication of inspection results, and the establishment of a support system in case of failure. Some of them are introduced in the Trend and Results of Studies.

Table 1 Damage on road structures by the Kumamoto Earthquakes and the measures taken

Structure	Damage by the Kumamoto earthquakes and the measures implemented
Bridge 	-Bridges with rocking bents fell. -> Promoting reinforcement of existing bridges and reflecting necessary structural improvements in the standards - Damage from the collapse of slopes -> Reflecting improvements necessary for the deformed slopes in the standards -> Studying improvements necessary in the planning/design stage - Damage to the anchor parts of a vibration control damper -> Reflecting the supportive information about the component-fixing parts in the standards - Sagging or inclined foundation in an earthquake -> Developing a policy on the anti-seismic strengthening of the foundation and studying a damage evaluation method. -> Studying the analysis method of the behavior of the ground when an earthquake happened and the total bridge system
Tunnel 	- Concrete lining fell. -> Informing road management authorities on the supportive information used in tunnel planning, investigation, design, construction, and maintenance stages
Earthwork 	- Embankment collapsed on slant and weak foundation ground -> Informing road management authorities on the supportive information required for embankments - Damage to earthworks and from the fall of rocks is observed in many places along the roads for emergency transportation. -> Studying a checking system for seismic capacity appropriate to the function of a road
Disaster prevention system	- Grasping the damage at night or in the mountains -> Restudying the information needs in case of a disaster -> Developing a system to grasp the status of damage

3. Disaster Prevention/Mitigation and Crisis Management

The Kumamoto earthquakes in April 2016 caused immense damage to road structures. The types of structures, damage, and measures implemented are shown in Table 1. The NILIM supported the restoration of damaged structures and communicated technical supportive information to road management authorities via the MLIT. This is expected to be reflected in the technical standards when they are revised in the future. We will research the improvements necessary for deformed slopes and liaise with the Laboratory for the Restoration from the Kumamoto Earthquakes Project established in April 2017.

In fiscal 2016, Japan experienced many disasters, including torrential rain in Hokkaido and Iwate, the fall of rocks in Shimane, and heavy snow in Tottori, in addition to the earthquakes in Kumamoto. Accidents that occurred during the execution of projects include the fall of a bridge girder and cave-in of a tunnel both during construction. To respond to these disasters and accidents, we liaise with the Public Works Research Institute and participate in site investigations and committees.

To respond to such earthquakes, torrential rain, and accidents, we intend to develop technologies for measures before and after disasters, which would be used by road management authorities.

4. Productivity Revolution

In order to improve productivity, the NILIM is trying to introduce the i-Construction initiative. As for road structures, we are developing standards that reflect the information we have acquired and are promoting research in the rationalization of earthwork and pavement projects using ICT technologies and a way to use precast components to improve productivity in the use of concrete.

We are also accelerating the development and implementation of new technologies as part of an infrastructure maintenance revolution. We support NETIS of the predetermined theme type (where new technologies sought) through examination of the performance requirement for technologies and concrete verification methods as well as the collection and classification of the results.

In order to introduce new materials and various types of road structures, performance codes are preferable to specification codes as technical standards. For this purpose, we are revising and converting the technical standards for road bridges into the partial factor design method that specifies performance, and we are promoting research for this purpose. As for tunnels, earthwork, and pavement, we are going to clarify the performance requirements for structures and study the possibility of systemization of the design and execution method to assure the satisfaction of requirements.