

# To Appropriately Create and Efficiently Maintain Road Structures

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*(Key words) Road structure, maintenance, required performance, periodic inspections, technical support*

### 1. Introduction

The deterioration of road structures provided in a short period during and after the high economic growth period has become a severe problem throughout Japan. In Japan, there are about 700,000 road bridges and about 10,000 road tunnels nationwide, and it is predicted that the number of road structures reaching their 50th year since construction will rise sharply, so it is necessary to appropriately maintain road structures while holding down costs in the face of a declining population and falling birth rate. In order to appropriately maintain road structures, it is important to go through the maintenance cycle that consists of inspection, diagnosis, countermeasure, and recording, and it is necessary to build a procedure for doing so. To stabilize the people's livelihoods and stimulate regional economies, it is also necessary to efficiently and effectively create road structures with superior durability with limited budgets. One method of doing this is to use new structure types or materials, but in order to use these new technologies properly, it is necessary to ensure the safety and durability of the structures that are built.

The Road Structures Department prepares drafts of technological standards for bridges, tunnels, earth structures, and pavement etc., conducts surveys and research these require, gives technical guidance and consultation regarding troubles that occur in the field, and nurtures technologists with specialized knowledge in order to give technological support for appropriate maintenance and efficient creation of road structures through links with the headquarters of the Ministry of Land, Infrastructure, Transport and Tourism and other concerned organizations.

### 2. Appropriate maintenance of road structures

Road managers are obligated by law to perform direct visual inspections of bridges and tunnels once every 5 years, and periodical inspections began in July of last year. The Road Structures Department actively prepared drafts of periodic inspection rules that stipulate the minimal periodical inspection methods and recording items in cooperation with MLITT head office. There is an urgent need to establish methods of designing repair work and retrofitting, because it is predicted that in the future, the number of structures requiring repairs and retrofitting will soar as measures taken in response to results of inspections and diagnoses. It is necessary to systematize

the maintenance of earth structures and pavements that are not the object of periodical inspections. The Road Structures Department is, therefore, mainly conducting the following research.

#### 1) Bridges

A non-destructive investigation method to survey state of internal damage that requires diagnosis of bridges where deformation has been externally confirmed, a design method to evaluate traffic characteristics and degrees of damage etc. based on partial factors, and that can evaluate load bearing capacity of bridges damaged as shown in Photo 1 and the effectiveness of repairs and retrofitting countermeasures.



Photo 1 Damaged bridge

#### 2) Tunnels

Analysis of damage cases and of repair and retrofitting cases, effects of repair and retrofitting countermeasures, and methods of evaluating these effects.

#### 3) Earth structures

Abstracting and evaluating locations vulnerable to disaster, rational inspection methods to lower risk, effectiveness of countermeasures to repair and retrofit damaged earth structures.

#### 4) Pavement

Maintenance methods suitable for the type of pavement and state of pavement, lifetime extension effects of patching and similar maintenance work methods.

The department is also analyzing the results of inspections of bridges, tunnels and other structures that are periodically inspected and researching ways to perform more reliable inspections more efficiently. And to establish a management method for systematic maintenance and renewal of road structures under budget constraints, the department is also researching the basic

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concepts of asset management and common comprehensive management indexes for structures.

### 3. Efficient creation of road structures

In order to use new structure types and materials to build structures that are extremely safe and reliably durable, it is necessary to establish a design method that clarifies the performance a structure should ensure and that can rationally evaluate the characteristics of the structure type and the performance of the materials. And to lower the future burden of maintenance, it is important to ensure quality during design and construction considering durability and ease of maintenance, and necessary to reflect knowledge obtained by analysis of inspection results in design and construction. The Road Structures Department is, therefore, mainly conducting the following research.

#### 1) Bridges

A partial factor design method that permits consideration of acting load or safety allowance of materials etc., which are the foundations of performance verification methods to replace the past allowable stress design method, and a method of evaluating durability of bridges with complex stress conditions based on an analysis method.

#### 2) Tunnels

A method of setting the design load and verifying the performance for a case where the analysis method is used to design a tunnel where the standard tunnel support pattern cannot be applied to the design of a tunnel support structure because the overburden is small or the geological condition is bad.

#### 3) Earth structures

Design and construction method to clarify design load and required performance and to ensure required performance in order to permit the performance required of a structure as large as that shown in Photo 2 and a structure with a new type.



Photo 2 Large scale embankment

#### 4) Pavement

Applicability of concrete pavement with durability higher than that of asphalt pavement

The department is also researching concepts of safety performance that must be required to prevent harm to the

public, safety allowance setting methods and methods of securing safety even for members other than principal structures.

### 4. Personnel training and technical guidance and consultation

As technical support for administrators, in addition to preparing drafts of technical standards, the department trains technologists with specialized knowledge and gives technological guidance and consultation in response to requests from road managers.

Regarding the training of technologists, the department cooperates by preparing training texts and dispatching instructors to give practical training and instruction at workshops and training sessions that contribute to nurturing and boosting the technical skills of technical personnel working on administrative duties, including not only Ministry of Land, Infrastructure, Transport and Tourism regional development bureau employees who maintain road structures, but those in local governments.

In the field of technical guidance and consultation, the department provides support by giving technical consultation and field guidance concerning disasters, serious accidents, malfunctions, and technical review and assessments etc. that require expert knowledge such as interpreting advanced standards and so on, and by participating in meetings. In FY2014 in particular, in addition to giving technical consultation as in the past, the department sent employees to the Ministerial Jurisdiction diagnosis of three bridges in Japan done by the Road Maintenance Technology Group formed by employees of regional development bureaus as a measure to support local governments. Through participation in Ministerial Jurisdiction diagnosis, they performed a field survey as a member of a Road Maintenance Technology Group and contributed to providing technical advice to local governments.