Towards the Establishment of Asset Management Methods for Road Bridges

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1. Introduction

During this period when road structures are steadily aging, considering the degree of damage and the predicted decline of investment capacity, maintenance must become more efficient, requiring the creation of data based scientific maintenance to advance road asset management. Road bridges managed by the national government are, under the provisions of Manual for Periodic Inspections of Bridges (Draft) (March 2004), given a direct visual inspection for the first time within 2 years after the beginning of service and periodically every five years afterwards. The second inspections will soon be carried out. The NILIM is conducting research based on detailed and multi-faceted analysis using vast data which has been accumulated from these inspections.

2. Optimization of the inspection system

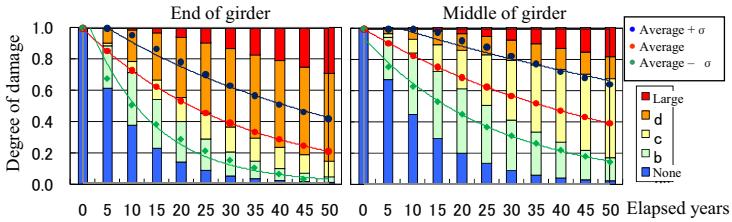
Periodic inspections are performed by directly examining the entire bridge and all of its members every five years. If the correlation of the characteristics of the occurrence and progress of damage and related factors can be clarified, it will be possible to do these inspections more efficiently by optimally combining inspection items and frequency for the bridge and each of its members. Changes of two inspection results performed on the same location of the same bridge will be analyzed by damage, by member, by type of bridge, and by bridge erection environment in order to achieve this greater efficiency.

Inspections are primarily visual, so the state inside members cannot be clarified unless symptoms appear on the surface. Specified inspections including non-destructive inspection methods are required to compensate for this weakness. In order to narrow the locations and the time of the specified inspections, the correlation between the characteristics of steel member fatigue cracking etc. and related factors and the relationship between the damage and the bridge's performance are being researched.

Inspections are intermittent and there are limits to their ability to catch sudden malfunctions, so the department is studying methods of detecting fatal damage by constant monitoring of change of position and risk management methods to introduce these into inspection systems.

3. Establishing road bridge management methods

The foundation of management is reducing the life cycle costs (below, "LCC") by clarifying the present state of a bridge by the above inspections, predicting its future condition, and repairing damage or retrofitting at appropriate times. The deterioration of a bridge encompasses a wide variety of forms of deterioration or damage according to the condition of each bridge, so the results of deterioration prediction are always scattered. This is an important point to remember when trial calculating LCC, so the department is developing deterioration prediction equations which provide LCC matched to the degree of reliability (see Fig. 1).



The Markov transition probability is obtained and degree of damage weighted based on changes of the results between two inspection (none 1.0 to large 0.0), and the mean value and standard deviation are calculated for each number of elapsed years (tentative value by damaged member).

Figure 1. Example of Deterioration Curve of Main Girder Corrosion on a Steel Girder Bridge

4. Future research policies

The department will link a variety of research activities with related organizations in order that engineers skillfully employ information processing technologies and other most advanced scientific methods to perform inspections optimized for each bridge, that smart maintenance systems capable of

minimizing the LCC of overall road resources and minimizing risk to road users are created, and that required performances are established for new bridges to control durability and reduce scattering in order to enhance maintainability.

[Reference] Web site of the Bridge and Structures Division (with access to related reports)
http://www.nilim.go.jp/lab/gcg/index.htm