Analysis of deterioration characteristics of road bridges based on road bridge periodic inspection data

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1. Purpose of the study

The establishment of an action program and individual facility plans is called for in view of reliably and efficiently securing infrastructure functions, etc., at the Inter-Ministerial Liaison Committee on the promotion of measures to cope with the aging of the infrastructure. It is expected that the extent of damage is kept track of by performing periodic inspections, and data related to maintenance is collected and accumulated for analysis and utilization for the purpose of mid- to long-term maintenance. Although it is desirable that data is acquired, accumulated, and analyzed by each administrator, such analysis and utilization have limitations because the amount of accumulated data is small and the quality of data is not uniform. However, for road bridges managed by the central government, objective and detailed records of status from periodic inspections have been collected and accumulated since 2004. Comprehension of deterioration characteristics is considered possible by organizing such records as statistic data of changes over time.

Thus, in this research, in order to comprehend the characteristics of any deterioration, statistical analysis of deterioration characteristics of each member according to various conditions, such as its erection environment and planar position and the like, was conducted using the data accumulated so far through inspections of road bridges managed by the central government.

2. Inspection data based statistical deterioration characteristics analysis

In the periodic inspections of central government managed bridges, 26 types of damage and evaluations of the extent of damage at each site classified into the maximum of five classes from a to e (condition is worse on progression towards e), with respect to each evaluation element subdividing each member, are recorded in the inspection record. From this record, the transitions of the extent of damage within five years of the same element are aggregated to calculate the Markov transition probability matrix. Such data organization was carried out for corrosion and deterioration of the anticorrosive function of the main steel girders, cracking and peeling off/rebar exposure of main concrete girders, cracking of concrete slabs, and cracking of concrete substructures. Analyses of the deterioration characteristics were carried out for a total of 272 patterns of conditions, to which conditions thought to be associated with different deterioration characteristics, such as erection environment, structure type, and planar position, of members have been added and combined.

Based on the Markov transition probability matrices, the state transition trend was estimated only from the changes over time of the state of damage since put into service, and the state probability distribution and the deterioration curve were generated (Fig. 1). In (3) in Fig. 1, a state probability distribution according to planar positions (end portion / intermediate portion) of the member is generated, taking the corrosion of the main steel girder as an example. Such a comparison reveals that the number of years taken until 50% of the entire elements reach the extent of damage d or worse is clearly smaller at the end portion. In Fig. 1 (4), the number of years to reach each class of extent of damage is acquired and plotted together with the quantified extent of damage. A deterioration curve was generated by approximating this by a multiple of functions. The drawing illustrates that the difference in approximated functions is represented by the difference in the number of years to reach each expected value.

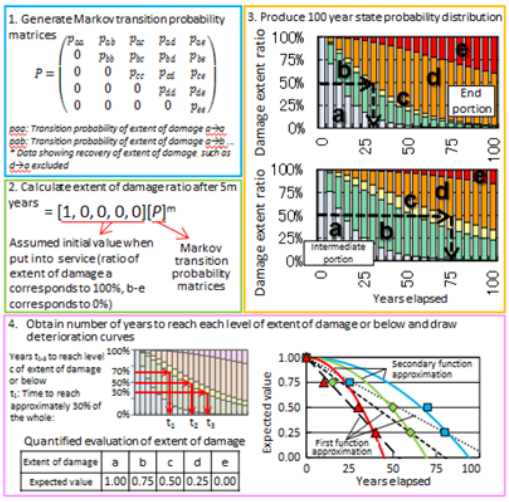

Fig. 1 Flow of creation of state probability distribution and deterioration curve (example of steel main girder corrosion)

3. Summary

In this research, such analytical results are compiled as a collection of data, and it is expected that it will be utilized going forward as reference material for mid- to long-term maintenance.