

## Ⅵ - 67 Classification System for Inspection of Concrete Bridges

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In last few decades, in most developed countries, maintenance of existing road systems is being given more emphasis as the expansion of construction of new facilities started to slow down. Since maintenance budgets are always limited, this involves setting priorities and defining maintenance strategies based on the real condition of each bridge determined by periodic inspection.

Management systems are therefore necessary for a systematic determination of present needs for maintenance, rehabilitation and replacement of bridges, and to predict future needs. Management systems can also be a tool to provide guidance in the effective use of designated funds and therefore can help with rational maintenance decisions.

### Maintenance system

Objective of maintenance system is identification of potential maintenance activities. The first step in a reliable maintenance procedure is to carry a through investigation of structure defects and damages.

The main aims of the investigation include the identification of the cause of the damage, determination of the extension of the damage, and determination of materials properties, in order to assess the safety and serviceability of the structure, and to provide recommendations on remedial and preventive measures, and to estimate the cost of repair or replacement.

### Site inspection

The purpose of site inspection is to identify structure defects. In the past, most of the inspections were performed in a random fashion as problems aroused at any particular site. This approach frequently proved costly because by the time the bridges were inspected major deterioration had occurred. Consequently, the methods of setting inspection plans based on periodic visits to each bridge and using preventive repair were instituted. However, inspections are sometimes made by personnel who lack sufficient field experience and sometimes different evaluations of the same situation obtained. Therefore is it clear the need for standardization.

### Classification system

A classification system of damages and defects is proposed. Damages and defects of concrete bridges are classified in groups according to a functional- positional criteria as shown in Fig. 1. This classification was made trying to avoid redundancy and at the same time trying to include the damages and defects likely to be found in concrete bridges. The damages and defects were roughly divided according to their similarity, common cause or proximity in order to make it easier to use the list of damages and defects.

#### Damage classification of concrete bridges

- A. Concrete elements
- B. Reinforcement/cables
- C. Foundations/abutments/embankments
- D. Bearings
- E. Joints
- F. Wearing surface/water tightness
- G. Water drainage
- H. Secondary elements

Fig.1 Damage classification of concrete bridges

Possible causes of these defects are classified more or less chronologically as shown in Fig. 2.

The diagnosis methods that may be employed to detect or analyze are also classified according to the technique employed as shown in Fig. 3. Relationship between defect and causes, diagnostic methods can be obtained by correlation matrices.

Causes classification	
-CA.	Design errors
-CB.	Construction errors
-CC.	Natural aggressive factors
-CD.	Man-caused aggressive factors
-CE.	Environmental actions
-CF.	Natural accidental actions
-CG.	Man-caused accidental actions
-CH.	Lack of maintenance
-CI.	Changes from initially planned used

Fig.2 Defects possible causes classification

Diagnosis method classification	
-MA.	Direct visual observation
-MB.	Mechanical techniques
-MC.	Potential difference measurements
-MD.	Chemical indicators
-ME.	Magnetic techniques
-MF.	Ultrasonic and electromagnetic tech.
-MG.	Electrical methods
-MH.	Acoustic techniques
-MI.	Radioactive methods
-MJ.	Thermic methods
-MK.	Load test

Fig.3. Diagnosis Methods classification

### Defect rating

Interpreting the results of a condition survey requires knowledge and experience. After detailed analysis of all available information, the causes of the damage and the source are confirmed, and also the extend of damage in the individual members of the structure is outlined.

The damage members of the structure may be classified according to their condition. This is necessary for planning a repair scheme. Therefore a rating system is helpful to select the high priority defects. The rating criteria in the system takes into account rehabilitation urgency, importance to the stability of the structure, and volume of traffic affected.

To prioritized activities, the defects are grouped according to the number of points assigned to each one. Each defect classification is included in one of the priority actions groups: maximum, high, medium, low or minimum priority.

The application of this simple system will provide a picture of the damaged structure as a whole and the severity of the problem at hand.

For the maintenance procedure one must act first upon the bridge that has the defect that the management authorities feel can be economically repaired with the same equipment and workmanship.

### Conclusion

A classification system for inspection is proposed as a first step in a maintenance system. In order to standardize, damages and defects likely to be found in concrete bridges are classified, and in the same way are classified the possible causes and diagnosis methods. Correlation is established among defects and the other items. Defects are rated, and finally classified into priority action groups. This system will provide a view of the damage structure.

### References

1. Routine Maintenance of concrete bridges. ACI committee 345
2. Draft recommendation for damage classification of concrete structures. RILEM 104- DDC, materials and Structures, 1994, 27.