Development and Practical Application of Prestressed Concrete Bridge Rating Expert System

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Summary

The author has been developing a practical Bridge Management System that is referred to as the Japanese Bridge Management System (J-BMS) for existing concrete bridges. This paper introduces a newly developed bridge management system for the prestressed concrete (PC) bridges (J-BMS PC version) which integrated with the PC bridge rating expert system (PC-BREX). The proposed system is able to predict the deterioration process of the existing PC bridge superstructure components as well as assess a broad array of optional corrective strategies. The system also has the capability to search and retrieve from a J-BMS database system(J-BMS DB), the necessary information, carry out suitable analyses to arrive at some recommendations that would help users to optimize their decisions based on engineering aspects, cost and economic issues and bridge management policies. A comparison of the results of applying the system to some actual in-service PC bridges with a special designed survey form to experts shows that optimal maintenance planning as well as bridge rating can be predicted accurately by using the system.

Keywords: lifetime management system; prestressed concrete bridge; J-BMS DB; bridge rating expert system (BREX); practical application.

1. Introduction

The author has been developing a practical Bridge Management System that is referred to as the Japanese Bridge Management System (J-BMS) integrated with the Concrete Bridge Rating Expert System (BREX) that can be used to evaluate the serviceability of existing concrete bridges. J-BMS is composed of three subsystems, namely, J-BMS Data Base System (J-BMS DB), Bridge Rating Expert System (BREX) and Maintenance Plan Optimization System (MPOS)[1][2][3]. The J-BMS uses multi-layered neural networks to predict deterioration processes in existing concrete bridges, construct an optimal maintenance plan for repair and/or strengthening measures based on minimizing life-cycle cost and maximizing quality, and also estimate the maintenance cost. In this system, the Genetic Algorithm (GA) technique was used to search for an approximation of the optimal maintenance plan. The J-BMS subsystems were developed at different points in time and no compatibility had been established. In order to solve the problem, the J-BMS subsystems were integrated and a version of J-BMS for prestressed concrete bridges (J-BMS PC version) was developed in this study. Verifications from diverse viewpoints are, however, required before practical system implementation. Numerous data obtained in the inspections of an actual bridge were input to PC-BREX and the diagnostic results were closely verified. For consideration, variances were identified according to the structural type, input method and inspector, and points to be improved and problems were organized.

2. Configuration of J-BMS

The configuration of J-BMS is shown in Figure 1. The figure shows J-BMS functions corresponding to the steps of the bridge management flow. As the steps of the flow, (i) bridge

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