Inspection, Monitoring, and Maintenance of Infrastructure Systems in a Life-cycle Context: Emphasis on Bridges

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Summary

This paper provides a brief overview of the inspection, monitoring, and maintenance scheduling for civil infrastructure systems within the context of life-cycle management under uncertainty. Various methods for determining the optimum life-cycle inspection, monitoring and repair times and types, as well as the impact of such activities on the total life-cycle cost, are discussed in detail. Sources of uncertainty and the objectives of the life-cycle assessment and management are also presented. Additionally, the integration of these activities with other modules of the general life-cycle management framework responsible for the performance prediction and updating is also discussed. The presented approaches are capable of handling, individually or simultaneously, various deterioration mechanisms such as earthquake effects, fatigue, and corrosion. The role of probabilistic performance indicators including reliability and redundancy is also highlighted. The key achievements in developing the optimization schemes specifically formulated for bridges are discussed.

Keywords: Life-cycle management; inspection planning; maintenance; monitoring; fatigue; corrosion; optimization; uncertainty.

1. Introduction

Within the last decade, major developments in the field of infrastructure management of deteriorating structures have been achieved. Additionally, the parallel advancements in the computational capabilities enabled complex system- and network-level simulations and optimization problems to be solved. This led to more robust life-cycle management approaches that can accurately predict the structural performance under uncertainty and identify the optimal life-cycle interventions (e.g., inspection, monitoring, and maintenance actions) schedule. In these approaches, information about the damage initiation and propagation is collected and the time-variant structural performance under uncertainty is predicted. Performance indicators such as the reliability index, redundancy, risk, and robustness are integrated within the optimization problem. Each of these performance indicators provides a deeper insight into a certain structural property that can be beneficial for the life-cycle management aspects. The predicted performance profile is next

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