PROBABILISTIC BASED PERFORMANCE ASSESSMENT OF A CONCRETE BRIDGE SUBJECTED TO CHLORIDE INDUCED DETERIORATION

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Abstract

Maintaining an adequate safety level in concrete bridges under gradual degradation, due to traffic and environmental actions, is not only an expensive task, but also filled with some level of uncertainty. Degradation in itself is not easily quantifiable because numerous aspects reduce the load bearing capacity of a concrete bridge. Furthermore, the effects of preventive maintenance and rehabilitation actions are difficult to predict. Chloride ion ingress is an important aspect of durability design and maintenance, especially in regions where winter salt is commonly applied for traffic safety. This paper introduces a feasible approach to analyze the effects of chloride induced deterioration on the overall safety level, which is validated by the application to a real highway bridge, which was demolished after 38 years of service. Concrete samples were extracted from this bridge and chemical analyses were performed to determine the chloride concentration profile in the concrete. Once the present chloride levels were determined, an inverse analysis of chloride ion ingress, based on the Cellular Automata technique, provided information regarding the temporal and spatial development of the chloride concentration. This data serves as basis for a probabilistic prognosis of the corrosion processes during the planned service life of the structure, which accounts for uncertainties in the experimental investigations. The prediction of non-visible degradation, e.g. reduced reinforcement area, allows the localization of critically corroded structural elements and, thus, represents the main input for a long term performance assessment. In particular, comprehensive probabilistic analyses reveal the time dependent

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reliability levels with respect to code based serviceability and ultimate limit states. The outcomes of the proposed methodology are a quantification of the current safety levels as well as a prediction of their future development with and without (preventive/corrective) intervention. Both are quintessential for cost-efficient and save maintenance management.

Although the concept of sampling and chloride ingress prognosis will be covered, the focus of this contribution lies with the incorporation of time varying chloride concentration information into the framework of nonlinear analysis and reliability assessment.