Short communication

Probabilistic evaluation of initiation time in RC bridge beams with load-induced cracks exposed to de-icing salts

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A B S T R A C T

In this study, a reliability-based method for predicting the initiation time of reinforced concrete bridge beams with load-induced cracks exposed to de-icing salts is presented. A practical model for predicting the diffusion coefficient of chloride ingress into load-induced cracked concrete is proposed. Probabilistic information about uncertainties related to the surface chloride content and the threshold chloride concentration has been estimated from a wide review of previous experimental or statistical studies. Probabilistic analysis to estimate the time to corrosion initiation with/without considering the effect of the load-induced cracks on the chloride ingress into concrete has been carried out. Results of the analysis demonstrate the importance of considering the effect of the load-induced cracks for correct prediction of corrosion initiation in RC bridge beams exposed to chlorides.

The initiation time depends on various factors including the surface chloride content, the rate of penetration of chloride ions in concrete, the depth of the concrete cover, as well as the threshold chloride concentration. Numerous models for ‘perfect’ and uncracked concrete developed from Fick’s second law of diffusion [1] have been used to predict the initiation of chloride-induced reinforcement corrosion in concrete in the past decades [e.g., 2–10]. The influence of the rate of penetration of chloride ions in concrete due to the presence of cracks and its effect on the time to corrosion initiation have been also investigated in some recent researches [11–13]. However, all the previous models are developed within a deterministic framework. Because there is significant uncertainty associated with the factors related to the chloride ingress into concrete, it might be more appropriate to use a probabilistic approach to predict the initiation time.

In order to account for various sources of uncertainty and considering the problem of chloride ingress and corrosion initiation in RC structures in probabilistic terms, many probabilistic approaches and techniques are recently proposed for the evaluation of initiation time [14–19]. However, these applications using probabilistic approaches have been generally limited to the sound concrete without considering crack effect. Since the occurrence of visible macro-cracks is inevitable for RC structures under service loads, the influence of cracks on the time to corrosion initiation should be taken into account.

The main objective of this study is to present a reliability-based method for predicting the initiation time of RC bridge beams with load-induced cracks exposed to de-icing salts. A practical model for predicting the diffusion coefficient of chloride ingress into load-induced cracked concrete is proposed. Probabilistic information about...