Report by Research Committee on Corrosion Evaluation and Protection for Steel Bars in concrete (338 Committee) – Second Term –

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The research committee on corrosion evaluation and protection for steel bars (rebars) in concrete (the 338 Committee) was established in September 2007 as a sub-committee under the Japan Society of Civil Engineers' Concrete Committee. The research committee's first term ended successfully in 2009 and was followed by a second term (Oct. 2010 to Sep. 2012).

During the second term, three working groups (WGs) were set up and charged with the following research tasks:

(1) To establish a framework for a durability verification method for concrete structures suffering from deterioration by chloride attack (WG1 coordinated by Dr. Tsuyosi Maruya);

(2) To establish a method for predicting the remaining service life of existing concrete structures in a chloride-attacking environment (WG2 coordinated by Dr. Masaru Yokota);

(3) To evaluate the protection and repair effectiveness of surface protection methods and electrochemical corrosion protection methods against rebar corrosion and to develop a selection system based on quantitative performance evaluation (WG3 coordinated by Prof. Takao Ueda).

As a result of the committee's activities during this second term, the following outcomes were achieved:

(1) A summary was compiled of information effective for the establishment of a durability verification method for concrete structures, including research results relating not only to corrosion initiation and corrosion rate on rebars in concrete, but also to corrosion crack initiation in concrete. Furthermore, a future strategy for a durability verification system for concrete structures in a chloride environment was proposed (see Figure 1).

(2) Based on additional information obtained about concrete rebar corrosion using non-destructive methods, a technique for predicting the remaining service life of maintained concrete structures under chloride attack was discussed. The technique is intended to be applicable to structures in the initiation or propagation periods of chloride attack. Based on measured corrosion rates of rebars in concrete as well as on temperature and chloride ion content at cover concrete depth, a method for estimating the annual average corrosion rate during the propagation period was proposed (see Figure 2).

(3) Focusing on surface protection methods and electrochemical corrosion protection methods, design methods for predicting the extended life that such repairs achieve were investigated through evaluation of the upgraded performance obtained and subsequent degradation. With regard to surface protection methods, a connection chart of factors causing damage to surface

coating materials was proposed to predict the durability of coating materials in various situations. As for cathodic protection, a method of predicting the anode system's durability based on probability theory was developed. On the basis of these achievements, the system for selecting suitable repair methods for concrete structures under chloride attack, as proposed in the first term of the committee, was improved by the addition of the LCC concept (see Figure 3).

These various investigations and the results they yielded were summarized in the form of a committee report entitled “Concrete Engineering Series 99: State of the art report on corrosion evaluation and protection for steel bars in concrete” published in October 2012.

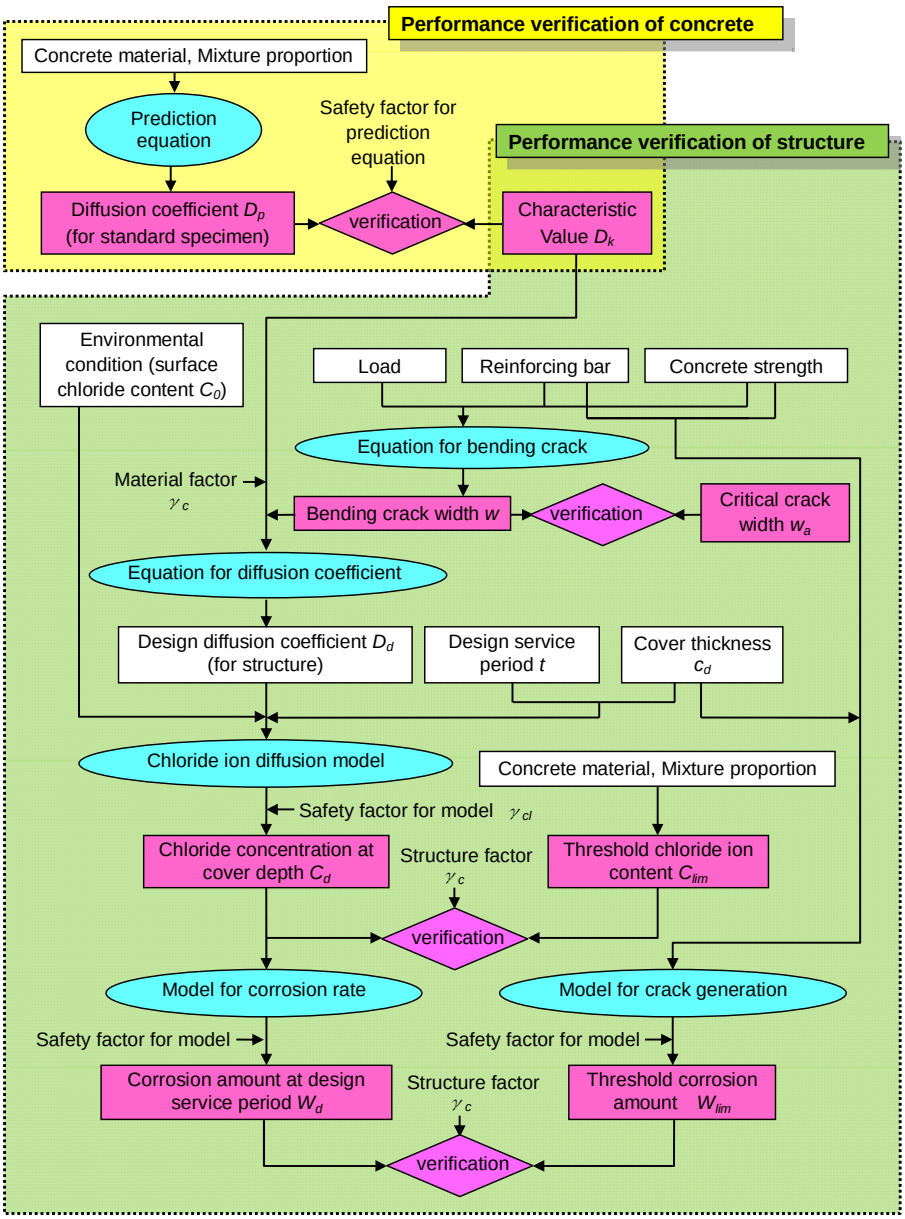

Fig. 1 Concept of performance verification of concrete structures under chloride attack

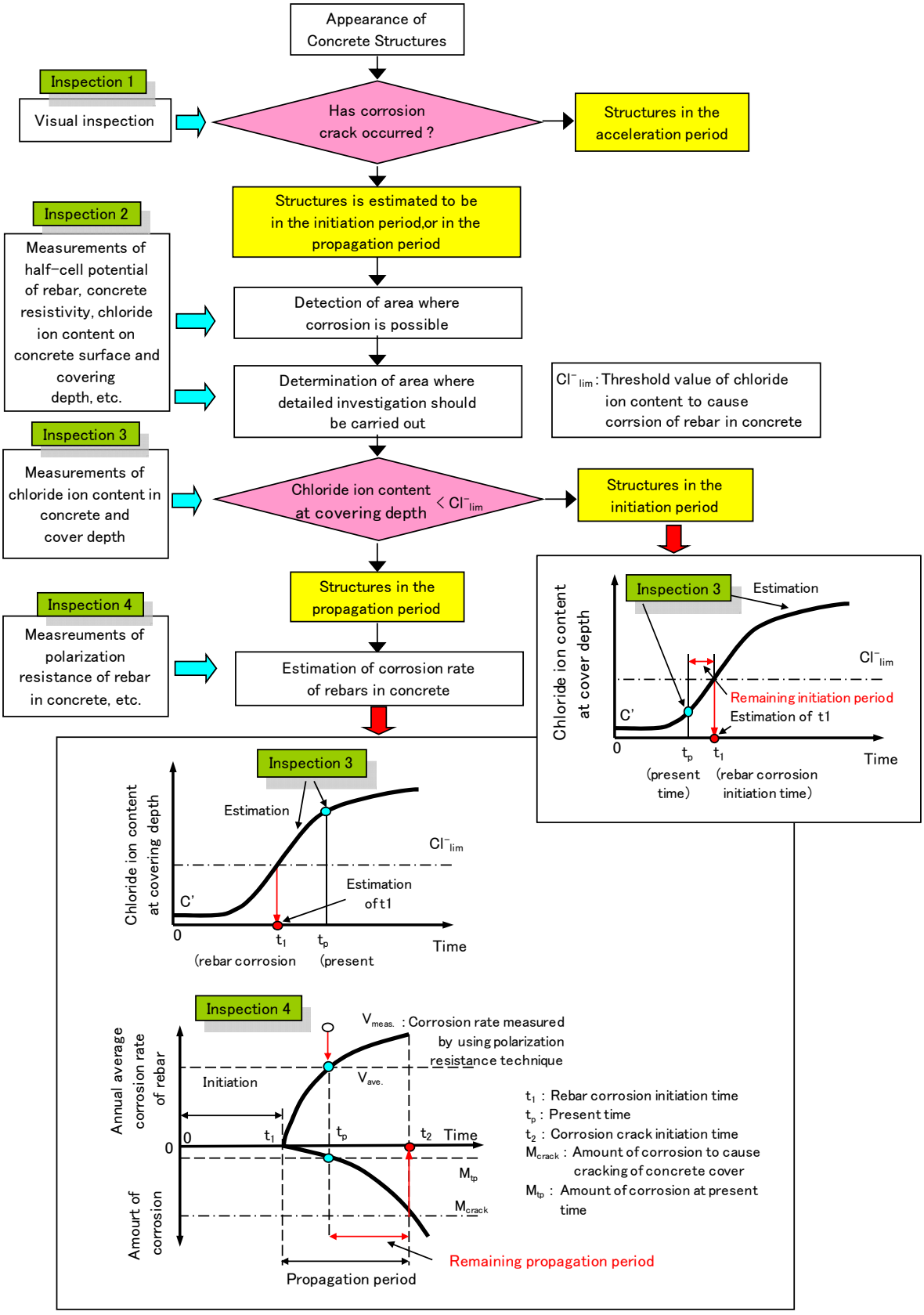

Fig. 2 Outline of prediction method for the deterioration of existing maintained structures under chloride attack

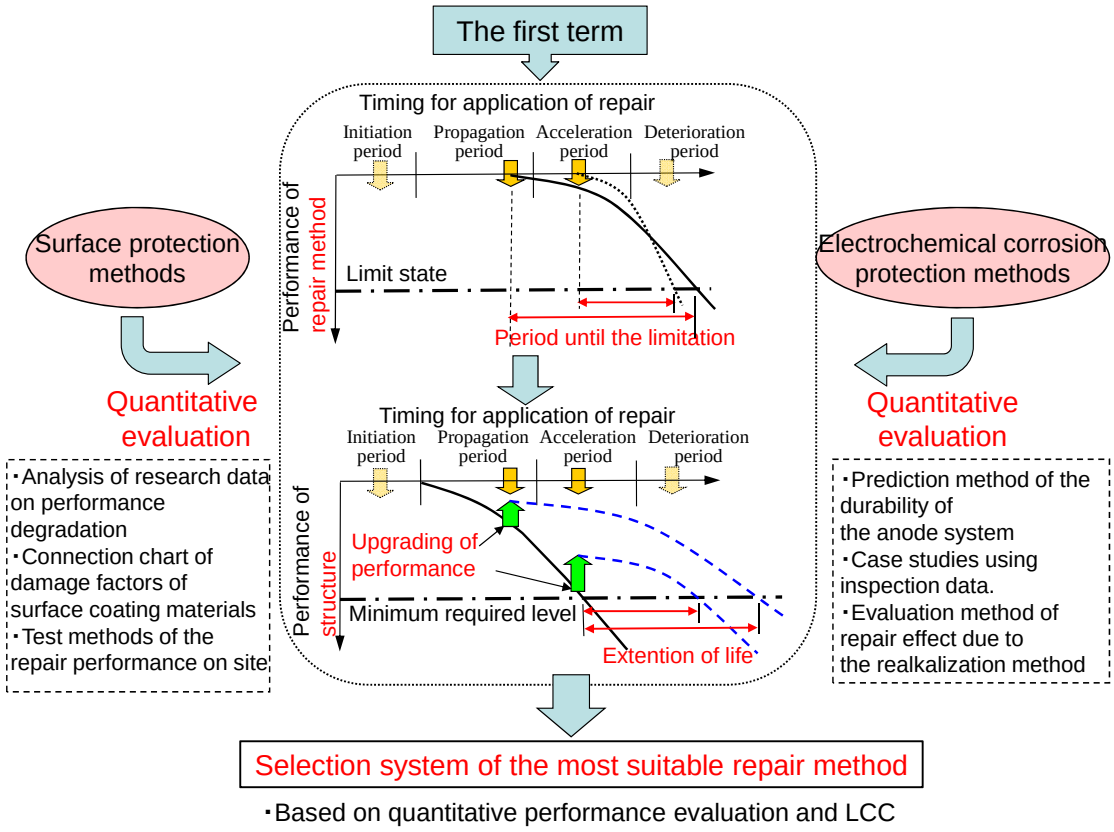

Fig. 3 Concept of selection system for concrete structure repairs based on quantitative evaluation of life extension