Multi-Scale and Multi-Chemo-Physics Analysis Applied to Fatigue Life Assessment of Strengthened Bridge Decks

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ABSTRACT

At present, a wide variety of methods are available for strengthening non-conforming highway bridge decks in service [1]. Each method with its unique characteristics has proved effective in testing for improving fatigue durability. No studies have yet been made to the knowledge of the authors on the changes in fatigue life depending on the degree of damage to the deck at the time of strengthening.

Cases have recently been reported of damage to strengthened decks due to time-based deterioration following the strengthening [2]. The evaluation of strengthening and the verification of the applicability of the strengthening method are therefore urgently required. The authors conducted numerical analysis and suggested that the damage to decks strengthened by attaching steel plates might be attributable to the expansion of gel produced by the corrosion of reinforcing bars in existing decks [3], and noted the possibility of insufficient strengthening effect being achieved depending on the damage condition of the existing deck.

In this study, changes in fatigue life are considered by varying the condition of damage at the time of strengthening done by each deck strengthening method, using a nonlinear finite element method of direct path integral method type [4]. In relation to the liquid water captured between cracks, changes in and movement of pressure due to the opening and closing of the crack are considered to examine the changes in structural response of the strengthened deck and deterioration of fatigue life. Decks with different damage conditions at the time of strengthening are used to consider the applicability of strengthening methods from a viewpoint of durability.

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