鋼とコンクリートの複合桁の耐久性評価と維持管理手法に関する研究

Form 3

Abstract

Title: A Study on Durability Evaluation and Maintenance Method for Steel-concrete Composite Girders

(鋼とコンクリートの複合桁の耐久性評価と維持管理手法に関する研究)

With aging, preflex beam bridges undergo concrete cracking and degrade as the cracks propagate and deteriorate due to repeated service load application and exposure to humid and saline environment. The objective of this study firstly is to evaluate concrete cracking, changes in prestress, and consequent changes in sectional properties as the preflex beam undergoes deterioration in its concrete casing under cyclic loading. Fatigue strength and failure behavior of non-load bearing rectangular shear ribs welded to lower flange of preflex beams are also investigated. Furthermore, the thesis also investigated structural behavior of pre-cracked beams repaired by bonding CFRP sheets with multiple configurations to propose an efficient method for retrofitting the deteriorated members. The experimental study for investigating behavior of the preflex beam included two specimens of the same details, of which one was preflexed and the other was a conventional non-preflexed specimen. To study fatigue behavior of the shear ribs, fatigue test coupon specimens with different weld end patterns and beam specimens were cyclically tested up to failure. Addressing the repair mechanism of the deteriorated beams, total of nine beams; one sound, one pre-cracked without repair, and seven pre-cracked beams repaired by different configurations of bonded CFRP sheets, were tested by four-point bending test up to failure.

The study concluded that changes in the concrete crack width can be used to fairly estimate changes occurring in the neutral axis location, rebar stress, and steel-lower-flange stress of the preflex beam under cyclic loading. The study also concluded to minimize crack width, prestress loss, and changes in sectional properties of the girder, closer spacing for shear ribs welded to the lower flange can be helpful. However, the number of cracks would be larger.

Results of the fatigue tests of the shear ribs show that regardless of the weld end pattern, the weld joint of the shear rib qualifies for JSSC-D class fatigue strength.

It was observed that use of CFRP sheets for repairing pre-cracked RC beams improved structural behavior of the damaged beams. Use of inclined CFRP sheets at the beam ends for shear, was helpful to avoid shear failure of the repaired beams prior to the CFRP sheets failing under flexure in the midspan. It is concluded that a combination of bottom-bonded and side-bonded CFRP sheets up to heights at which the steel reinforcement is located inside the composite beams could be used as an efficient method for repairing pre-cracked beams provided that proper anchorage or shear repair techniques are used.

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