■土木系■（構　造）

Flexural Strengthening of Corrosion-damaged RC Bridge Piers Using Ultra-High-Performance Concrete Layers: An Experimental Study

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OBJECTIVES

Since bridges are important components of social infrastructure, it is necessary to restore the structural performance of RC piers damaged by corrosion without changing their original geometry. As a repair method for deteriorated RC piers, a cross-section repair method was selected in which the cover concrete was removed and reinforced with UHPC layers containing steel fibers. The purpose of this study was to verify the effectiveness of this method through experiments with combined axial and reverse cyclic loading.

OVERVIEW

The experimental investigation included five single-shaft RC bridge piers. The details of the specimen can be seen in Figure 1. Case 1 was a reference or sound specimen. Case 2&3 underwent an average of 10% rebar corrosion, Case 4&5 underwent an average of 15% rebar corrosion. Case 3&5 was strengthened with 50 mm thick UHPC layers. The 28-day compressive and tensile strength of UHPC was 143 MPa and 13.7 MPa, respectively, and the 28-day average compressive and tensile strength of the normal concrete was determined as 25 MPa and 1.7 MPa, respectively. After the fabrication and curing of the test specimens, the accelerated corrosion test was carried out. Corrosion damage was limited to a height of 600 mm from the footing surface. The concrete covers in the corroded area were replaced with UHPC layers. The specimens were subjected to reversed cyclic loading with an axial force of 160 kN. After the application of axial force, the specimens were subjected to reversed cyclic loading with a drift ratio from 0.25% to 8%. Experimental results i.e., envelope curves of applied load vs displacement, ductility, and stiffness degradation are shown in Figure 2.

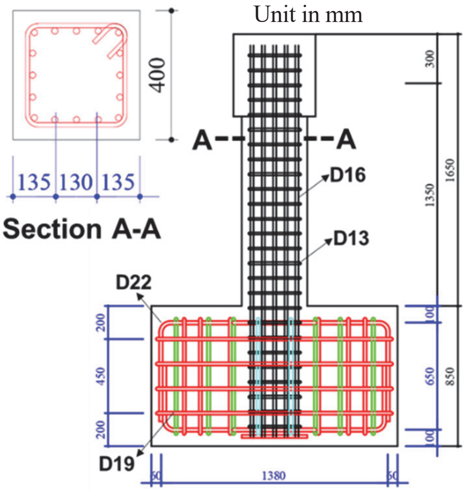

Fig 1: Specimen details

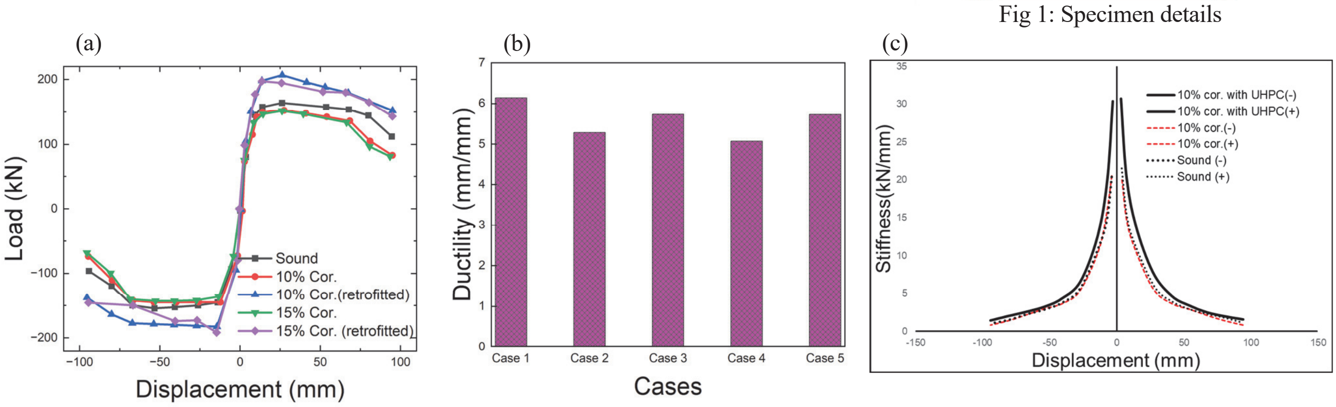

Fig 2: Experimental results (a) backbone curve (b) ductility (c) stiffness degradation

RESULTS

The experimental outcomes showed that reinforcement corrosion considerably reduced maximum load-carrying capacity (MLC). The MLC of the specimen with 15% rebar corrosion was decreased by 9.2%, compared to the reference specimen as can be seen in Figure 2(a). However, the 15% corroded specimen strengthened with UHPC layers displayed superior structural performance, the MLC was increased by 24% compared to the sound specimen. The ductility of Case 2&4 was reduced by 14% and 17% when the specimens were subjected to 10% and 15% rebar corrosion, respectively. Interestingly, ductility was reduced by only around 7% in the corroded specimens retrofitted with UHPC layers as shown in Figure 2(b). The magnitude of the stiffness decreased with the increase in deflection as can be seen in Figure 2(c). It can be noted that the corroded specimens strengthened with UHPC layers demonstrated remarkably higher stiffness than the sound and corroded specimens. For example, at the deflection level of 3.5 mm, the specimen with 10% rebar corrosion with UHPC layers demonstrated more than 33% higher stiffness than the sound specimen and the specimen with 10% rebar corrosion.

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