Experimental study on effect of corrosion-induced cracking on bond property between deformed steel bar and concrete

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Summary

In order to investigate the influences of cover cracking due to corrosion expansion on the bond behaviour between the reinforcing bar and concrete, the pullout test on the bonding specimens with deformed steel bar was designed. The strain gauges were fixed in the interior of deformed steel bars. The accelerated corrosion tests by applying a constant electrical current to the bars by a power supply were used to compare the results that experienced in real RC structures. The reinforcement strains at various positions in bonding specimens with various corrosion-induced cracking widths are obtained. The present study analyzes the effect of corrosion cracking width on strain of reinforcement at different positions. As a result, the bonding stresses at various positions between the reinforcement and concrete are obtained. This paper also develops the relationship between the corrosion cracking width and bonding stress between reinforcement and concrete. The experimental results show that for the specimens with the narrow crack the peak bond stress mainly appears near region of the loading end, however for the specimens with the wide crack the peak bond stress is close to the free end.

Key words: bridge engineering; corrosion; corrosion- induced cracking; bond stress; pullout test

1. Introduction

The corrosion of reinforcement is one of the most important causes of failure and of significant damage of reinforced concrete bridges. The corrosive products results in volume expansion of the steel bar and then concrete cover cracking for RC member under aggressive environments. Corrosion of reinforcing steel affects the bond strength in a reinforced concrete member or structure to such an extent that serviceability failure occurs.

Some researches on bond properties between corroded reinforcing steel and concrete have been conducted. The bond behaviour of reinforced concrete elements, including the ultimate bond strength, free-end slip and failure modes in precracking, cracking and postcracking stages were studied by Almusallam et al [1]. Also, the effect of crack widths and the rib profile degradation for various degrees of corrosion on the bond strength were evaluated. Berto et al [2] discussed several topics (i.e. cracking, reduction in steel cross-section, bond degradation, etc.) by focusing on the effects of corrosion on bond behaviour. A coupled mechanical-environmental damage model is used to simulate the deterioration of concrete (i.e. cover cracking and reduction of mechanical properties); the effects of corrosion on bond behaviour were dealt with using two different approaches. Some researchers considered the maximum bond strength and the bond rigidity as a function of reinforcement corrosion rate to investigate the relationship between degree of reinforcement corrosion and bond properties based on the pullout test and finite element method [3]. The load-slip curves and relationship between corrosion rate and bond stress were established

https://doi.org/10.2749/222137810796062914