

Effects of Fatigue Damage on Bond Behavior between Corroded Rebar and Concrete

Yunpeng ZHANG

Mr.

Tongji University

Shanghai, China

zh_yunpeng@tongji.edu.cn

Doctoral student who studies on bond behaviour between corroded steel bars and concrete with fatigue damage

Weiping ZHANG

Prof. Dr.

Tongji University

Shanghai, China

weiping_zh@tongji.edu.cn

Research interests are life-cycle design and maintenance of engineering structures, and structural performance enhancement

You HU

Mr.

Tongji University

Shanghai, China

4645857051@qq.com

Master who studied on bond deterioration between corroded steel bar and concrete under repeated loading

Contact: zh_yunpeng@tongji.edu.cn

1 Abstract

Bond degradation due to rebar corrosion and fatigue loading may affect the serviceability and even safety of reinforced concrete (RC) bridges. 15 specimens confined with stirrups were cast for eccentric pull-out tests, and 12 of them were corroded with the target mass loss of 0.03 by the impressed current method. Monotonic pull-out tests were conducted on three corroded and three uncorroded specimens. Wavy descending branch was found in bond stress-slip test curves of uncorroded specimens attributed to stirrup confinement, however it disappeared in those curves of the corroded specimens due to the corrosion loss of rebar transverse ribs. Based on the tested monotonic bond strength, the other nine corroded specimens of different fatigue damages were obtained through repeated loading with different levels and cycles before undergoing monotonic pull-out tests. It is observed that the relative slip increases with a gradually decreasing rate as the loading cycles increase. The monotonic tests of specimens with fatigue damage show that the bond strength increases to a certain value and then decreases with the increase of fatigue loading cycles. Moreover, the higher the loading level is, the fewer cycles are needed to reach the maximum bond strength. In addition, the peak slip corresponding to bond strength decreases with the increase of fatigue loading cycles.

Keywords: bond behavior; corroded rebar; fatigue damage; splitting failure.

2 Introduction

Bond behavior between rebar and concrete guarantees the cooperative work of the two materials, and it has a significant influence on the mechanical properties of RC structures. Due to the relatively harsh service environment, rebar corrosion is more likely to occur in RC bridges, which produces a deterioration of structural performance. The deterioration of corroded structural properties is not only due to the degradation of material properties, but also due to the degradation of bond behavior between corroded rebar and concrete.

The bond behavior of corroded rebar was investigated by many researchers [1]. When rebar is corroded slightly, the bond strength increases because of the increased confining action and interfacial friction induced by the expansive stress of corrosion products. With the propagation of corrosion, the corrosion products expansion induces the cracking of concrete cover; the corrosion loss of rebar transverse ribs reduces the mechanical interaction between rebar and concrete; the loose corrosion products accumulate to form a weak layer at the interface; the above reasons can

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