



Corrosion effect on compatibility between prestressing strand and concrete

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Abstract

This present study investigated effects of the strain compatibility between strands and concrete on the flexural behavior of corroded post-tensioned beams. First, eight post-tensioned beams with bonded strand were designed and subjected to accelerated corrosion to different strand corrosion degrees, and the load deflection response and the ultimate strength were discussed based on the flexural test. Next, a compatibility coefficient was introduced to quantify the inconsistent compatibility between corroded strand and concrete. The influence of strand corrosion on the compatibility coefficient was discussed. Finally, an analytical model was proposed to predict the ultimate strength of the post-tensioned beams with corroded strand. The model was verified with different experimental results.

Keywords: prestressed concrete; corrosion; bond performance; compatibility; flexural strength.

1 Introduction

The prestressed concrete structures corroded easily in the erosion environment, leading to safety accident [1-2]. Corrosion not only reduces the section area of strand, but also degrades the mechanical properties of materials [3-7]. The volume expansion of corrosion product will induce the cracking of concrete cover and reduce the bond performance between strands and concrete, adversely affecting the carry capacity of structures [8-9]. There are about 30 bridge collapse accidents caused by strand corroded over the world during 1950-1977. Another 10 accidents were also reported in America during 1978-1982. It is estimated that corrosion related maintenance and repairs for concrete infrastructure cost around \$100 billion per annum in the world [10]. It is necessary to predict the bearing capacity of the corrosion affected prestressed concrete structures.

Some studies have been performed to investigate the mechanical property degradation of corroded strand, and several useful conclusions have been obtained. Corrosion also degrades the capacity of structure. Rinaldi et al. [1] found that the corrosion of prestressing strand is more sensitive to mechanical property degradation than that of the ordinary steel. Li et al. [10] concluded that pitting corrosion decreased the tension capacity and the ultimate strain of strand. However, a little work was performed on the residual behaviours of corroded post-tensioned (PT) concrete beams, especially on the deteriorated bond performance and the strain compatibility between the corroded strands and concrete.

The bond performance degradation will change the compatible strain between corroded strand and concrete. Many studies have been performed to investigate the strain compatibility between corroded ordinary steel and concrete [11]. The compatibility coefficient has also been introduced to quantify the incompatible strain between the