



Effect of Strand Corrosion on Corrosion-induced Cracking of PC Structures

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Abstract

A model for corrosion-induced cracking in prestressed concrete (PC) structures was developed in this study. The prestress and geometric properties of the strand have been incorporated into the prediction. Corrosion-induced cracking in PC structures was predicted based on the three stages: micro-crack formation, cover cracking initiation, and crack width growth. Five PC beams were designed and accelerated toward corrosion-induced cracking. Observing the strands supported visual evidence of pitting corrosion and crevice corrosion. The proposed model has been verified by the experimental results and this work presents the effects of parameters on corrosion-induced cracking. The results show that prestress has an adverse effect on corrosion-induced cracking. Prestress leads to a decrease in the critical corrosion loss at the three stages. The critical corrosion loss of strand at the three stages increases with the increase of the concrete tensile strength and concrete cover, while it decreases with the increase of the strand diameter and rust expansion ratio. The movement of corrosive liquid between crevices could lead to corrosion extension along the beam length and could accelerate the corrosion rate of the strand. Slight corrosion loss would induce the cover cracking of PC structures due to the effects of prestress and diameter of strand.

Keywords: prestressed concrete structures; corrosion-induced cracking; crack width; Strand corrosion.

1 Introduction

Chloride-induced steel corrosion had been identified as being one of the most prolific deterioration mechanisms in the concrete structure, which seriously affects the serviceability and durability of the concrete structure [1]. The corrosion of prestressing strand subjected to the high level of stress is very complex, it is more severe than the corrosion of the ordinary steel in the concrete structure [2, 3]. The volume expansion of corrosion products could induce the concrete cover cracking, which is called the corrosion-induced cracking. The cracking of the concrete cover induces harmful effects on prestressed concrete (PC) structures. Not only

does the cracking degrade the capacity of the concrete structure, but also it accelerates the process of corrosion [4]. The progress of corrosion cracking provides a channel for harmful substances into the structure, and then accelerates the corrosion of prestressing strand, which could be deteriorated the capacity and the durability of concrete structure [5]. Prediction of the corrosion loss to concrete cover cracking has an important significance in evaluating the service life of corroding PC structures.

The durability of concrete structure can be deteriorated by the corrosion-induced cracking. A considerable number of studies have been undertaken on corrosion-induced cracking of