



Crack Widths Close to the Reinforcement

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Summary

Currently used design methods predict that the crack widths at the concrete surface increase significantly with concrete cover. Requirements concerning limitation of crack widths therefore makes it difficult to use large concrete covers, which otherwise is desirable to reduce the corrosion of reinforcement. For this reason it would be more relevant to limit the crack width in the vicinity of the reinforcement bars. In this paper experimental studies to investigate how concrete cover affects the crack width at the reinforcement level are presented. Axially loaded concrete prisms with central reinforcement bars and beams loaded with bending moment are tested with a method making it possible to measure crack widths near the reinforcement. Concrete cover, bar diameter and concrete quality are varied. The test results show that the crack width close to the bar is only to a limited extent affected by concrete cover, bar diameter and concrete quality. Three-dimensional, non-linear FE-calculations are also performed to understand the mechanisms determining the properties of a crack.

Keywords: Beam, concrete, corrosion, crack width, durability, FEM.

1. Introduction

One of the most important factors governing durability of concrete structures is reinforcement corrosion, and to prevent degradation associated with it, it is desirable to use large concrete covers. As long as the concrete close to the reinforcement bars is unaffected by carbonation and no chlorides reach the steel the risk of corrosion is very low. The time of carbonation and chlorides to reach the reinforcement is proportional to the square of the concrete cover [1]. A doubling of the cover therefore increases the time until corrosion starts with a factor of four.

Structural codes usually require that crack widths at the concrete surface shall be limited, among other things to prevent corrosion of reinforcement. If the concrete cover is increased, some currently used design methods, such as that given in Eurocode 2 [2], will predict that the crack widths at the concrete surface increase significantly. Therefore, requirements concerning limitation of crack widths make it difficult to use large concrete covers, unless the total amount of crack reinforcement is increased significantly.

Current design practice for crack control only considers crack widths at the concrete surface. With respect to the risk of corrosion, the crack width in the vicinity of the reinforcement bars should be more relevant. Test results by a number of researchers [3]-[7] show that the surface crack widths are of the order twice the crack width close to the bar surface for normal thicknesses of concrete