Engineering Assessment Method for Anchorage in Corroded Reinforced Concrete

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Abstract

There is an increasing need for reliable methods to assess load-carrying capacity and remaining service life of existing infrastructure. Several previous research projects have resulted in a verified, simple 1D model for assessment of anchorage in corroded reinforced concrete structures. Previous verification has involved both experiments and detailed 3D NLFE analyses. To further develop the 1D model it needs to be extended to comprise more practical situations. In order to facilitate an efficient extension procedure in the future, the size of 3D NLFE model that is required to capture the bond behaviour between corroded reinforcement and concrete is investigated. Beam-end models and models of sub-sections were studied, and the results in terms of bond stress and crack pattern were compared. Preliminary results indicate good agreement for some situations; however for some cases a section model seems to overestimate the capacity.

Keywords: corrosion, bond, concrete, reinforcement, nonlinear FEA

1 Introduction

Corrosion of steel reinforcement is the most common cause of deterioration in concrete bridges [1]. Many existing bridges are damaged with corrosion induced cracks or even spalling of concrete cover. Furthermore, the deterioration is believed to accelerate due to climate change thus more severe damage can be expected in the future [2]. The demand on load-carrying capacity of bridges is nevertheless increasing over time. There is therefore a growing need for reliable methods to assess the load-carrying capacity and remaining service-life of existing infrastructure.

Corrosion of reinforcement reduces the cross sectional area of reinforcing bars, and thereby their capacity and ductility. Furthermore, the volume expansion of corrosion products eventually cracks the concrete cover and adversely affects the bond between the reinforcement and concrete; this results in an inadequate anchorage capacity and may cause abrupt failure of the structure. The effect of corrosion on the bond capacity can be modelled using detailed three-dimensional nonlinear finite element (3D NLFE) models, e.g. [3]. These models are also capable of capturing cracking and spalling of the concrete, but wide practical applications are limited since 3D NLFE analyses require large resources in terms of time and competence.

In order to utilize the knowledge gained from previous research in engineering practice, there is

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