NONLINEAR BEHAVIOUR OF CORRODE RC COLUMNS UNDER CYCLIC LOADING

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ABSTRACT

A new modelling technique is developed to model the nonlinear behaviour of corrosion damaged reinforced concrete (RC) bridge piers subject to cyclic loading. The model employs a nonlinear beam-column element with multi-mechanical fibre section using OpenSees. The nonlinear uniaxial material models used in the fibre section account for the effect of corrosion damage on vertical reinforcing, cracked cover concrete due to corrosion of vertical bars and damaged confined concrete due to corrosion of horizontal tie reinforcement. An advanced material model is used to simulate the nonlinear behaviour of vertical reinforcing bars that accounts for combined impact of inelastic buckling and low-cycle fatigue degradation. The basic uncorroded model is verified by comparison of the computation and observed response of RC columns with uncorroded reinforcement. This model is used in an exploration study of recently tested reinforced concrete components to investigate the impact of different corrosion models on the inelastic response of corrosion damaged RC column.

INTRODUCTION

Many structures in regions of high seismicity are also exposed to corrosive environments. Corrosion of reinforcing steel is the most common reason for the premature deterioration of RC structures. In the recent years several researchers have put significant efforts to study the seismic vulnerability and fragility analysis of corroded RC bridges (Gosh and Padgett 2010, Alipour et al. 2011). They have investigated the effect of reinforcement corrosion on the behaviour and response of RC bridges subject to seismic loading through nonlinear fibre-based finite element analysis. However, they have used very simple uniaxial material models to model the impact of corrosion on stress-strain behaviour of reinforcing steel. Moreover, in most cases the corrosion damages has only been limited to the reinforcing bars (only considering an average reduced area or reduced yield strength) and the impact of corrosion on confined concrete, ductility and reduced low-cycle fatigue life is ignored. Recent experimental testing (Ou et al. 2011, Ma et al. 2012) shows that corrosion can significantly diminish the strength and drift capacity of RC elements (e.g. beams and columns). Therefore, material deterioration due to corrosion must be considered in assessing the earthquake vulnerability of