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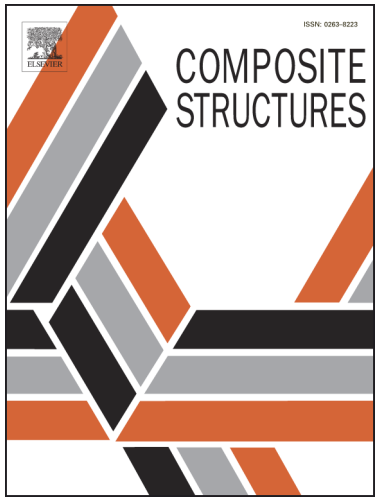

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ACCEPTED MANUSCRIPT

3D FINITE ELEMENT MODELING OF CIRCULAR REINFORCED CONCRETE COLUMNS CONFINED WITH FRP USING PLASTICITY BASED FORMULATION

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ABSTRACT

Strengthening reinforced concrete (RC) columns with external confining devices such as FRP wraps or steel tube is widely used in construction. By using external confining devices, both the strength and ductility of RC columns are significantly improved. However, numerical modelling to predict the capacity of strengthened RC columns is limited and often oversimplified. One of the biggest challenges in numerical modelling is to deal with unequal dilation between the concrete inner core (enclosed by both transverse steel and FRP wraps) and the concrete outer core (between the transverse steel and FRP wraps). Inaccurate modelling on the concrete dilatant behavior can lead to incorrect strength prediction. Sophisticated constitutive models which are able to model concrete dilation and robust modelling techniques are required. In this paper, three-dimensional non-linear finite element analysis (3D-NLFEA) of circular RC columns confined with conventional steel stirrups and FRP wraps is presented. In the FEA, the initial stiffness method with Process Modification (acceleration technique) is used to solve the equilibrium forces in the global solution. The constitutive model is based on the plasticity formulation proposed by the authors, which can capture the effective lateral modulus $\left(E_{\mathrm{L}}\right)$ of the confining devices. This lateral modulus is obtained by observing the principal incremental stresses and strains at each element gauss point. It

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