World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:10, No:06, 2016

Comparison between Experimental and Numerical Studies of Fully Encased Composite Columns

Authors : Md. Soebur Rahman, Mahbuba Begum, Raquib Ahsan

Abstract : Composite column is a structural member that uses a combination of structural steel shapes, pipes or tubes with or without reinforcing steel bars and reinforced concrete to provide adequate load carrying capacity to sustain either axial compressive loads alone or a combination of axial loads and bending moments. Composite construction takes the advantages of the speed of construction, light weight and strength of steel, and the higher mass, stiffness, damping properties and economy of reinforced concrete. The most usual types of composite columns are the concrete filled steel tubes and the partially or fully encased steel profiles. Fully encased composite column (FEC) provides compressive strength, stability, stiffness, improved fire proofing and better corrosion protection. This paper reports experimental and numerical investigations of the behaviour of concrete encased steel composite columns subjected to short-term axial load. In this study, eleven short FEC columns with square shaped cross section were constructed and tested to examine the load-deflection behavior. The main variables in the test were considered as concrete compressive strength, cross sectional size and percentage of structural steel. A nonlinear 3-D finite element (FE) model has been developed to analyse the inelastic behaviour of steel, concrete, and longitudinal reinforcement as well as the effect of concrete confinement of the FEC columns. FE models have been validated against the current experimental study conduct in the laboratory and published experimental results under concentric load. It has been observed that FE model is able to predict the experimental behaviour of FEC columns under concentric gravity loads with good accuracy. Good agreement has been achieved between the complete experimental and the numerical load-deflection behaviour in this study. The capacities of each constituent of FEC columns such as structural steel, concrete and rebar's were also determined from the numerical study. Concrete is observed to provide around 57% of the total axial capacity of the column whereas the steel I-sections contributes to the rest of the capacity as well as ductility of the overall system. The nonlinear FE model developed in this study is also used to explore the effect of concrete strength and percentage of structural steel on the behaviour of FEC columns under concentric loads. The axial capacity of FEC columns has been found to increase significantly by increasing the strength of concrete.

Keywords : composite, columns, experimental, finite element, fully encased, strength
Conference Title : ICCSEE 2016 : International Conference on Civil, Structural and Earthquake Engineering
Conference Location : Toronto, Canada
Conference Dates : June 13-14, 2016