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Finite Element Analysis of Beam – Column Joints Reinforced with GFRP Reinforcements

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Abstract

Glass Fibre Reinforcement Polymer (GFRP) reinforcements are currently used as internal reinforcements for all flexural members due to their resistance to corrosion, high strength to weight ratios, the ability to handle easily and better fatigue performance under repeated loading conditions. Further, these GFRP reinforcements prove to be the better alternative to conventional reinforcements. The design methodology for flexural components has already come in the form of codal specifications. But the design code has not been specified for beam-column joints reinforced internally with GFRP reinforcements. The present study is aimed to assess the behaviour of exterior beam-column joint reinforced internally with GFRP reinforcements numerically using the ABAQUS software for different properties of materials, loading and support conditions. The mechanical properties of these reinforcements are well documented and are utilized for modelling analysis. Although plenty of literature is available for predicting the joint shear strength of beam-column joints reinforced with conventional reinforcements numerically, but no such study is carried for GFRP reinforced beam-columns joints. As an attempt, modelling of beam-column joint with steel and with GFRP rebars is carried out using ABAQUS software. The behaviour of joints under monotonically increasing static and cyclic load conditions. Interpretation of all analytical findings with results obtained from experiments. The analysis and design of beam-column joints reinforced with GFRP reinforcements are carried out by strut and tie model. Strut and Tie models are based on the models for the steel reinforced beam-column joints. The resulting strut and tie model developed for the GFRP reinforced beam-column joints predicts joint shear strength. Joint shear strength values obtained from the experiments are compared with the analytical results for both the beam-column joints reinforced with steel and GFRP reinforcements. The joint shear strength predicted by the analytical tool ABAQUS is also validated with experimental results.

Keywords: Reinforced Concrete; Beam-column Joint; GFRP Reinforcements; Failure Mechanism; ABAQUS; Strut and Tie Model.

1. Introduction

Recent developments in *concrete composites* have resulted in several new products which aim to improve the strength, stability and Serviceability of the concrete structures. In general, the structural system comprises of *structural elements* (load-carrying, such as beams and columns) and non-structural elements (such as partitions, false ceilings, doors). The function of the structural elements is to resist efficiently the action of gravity and environmental loads, and the serviceability of the structure without significantly disturbing the geometry and integrity. In the viewpoint of simplified analysis as one-dimensional skeletal elements such as beams, columns, arches, truss elements or two-

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