Synopsis

Thesis Title : EVALUATION OF JOINT SHEAR STRENGTH OF REINFORCED CONCRETE BEAM COLUMN SUB-ASSEMBLAGES FOR SEISMIC RESISTANCE

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Recent earthquakes have caused devastating effects on the infrastructures. Most of the existing reinforced concrete structures are decades old, and were designed and detailed for gravity loads only. Performance of these structures under seismic events is extremely vulnerable and needs to be assessed before taking any protective measure to improve human safety.

It is evident from the previous earthquakes that the beam-column joint regions are the critical regions of reinforced concrete structures. During an earthquake, these joints are subjected to shear forces of large magnitude which make them to fail in brittle fashion. There is an urgent need to evaluate the shear strength of these beam-column joints to ensure safety under seismic loading. In view of this, it is required to develop efficient methodology to predict their behaviour and understanding of the failure mechanisms that occur in the joints.

Number of models such as empirical models, spring models, and analytical models were proposed by the researchers to evaluate the beam-column joints behaviour and to predict their shear strength. The softened strut and tie model and modified rotating angle softened truss model which are capable of incorporating the force equilibrium, strain compatibility and constitutive relations of cracked reinforced concrete are employed in the present study to predict the shear strength of the exterior- and interior-joints of beam-column sub-assemblages. Based on the softened strut and tie model and modified rotating angle-softened truss model concepts, formulations and MATLAB programs are developed in this study for the evaluation of shear strength of the beam-column joints and to understand the influence of different parameters on shear strength and failure mechanisms of sub-assemblages.

Using the programs developed in the present study, the effect of concrete compressive strength, diagonal strut angle, the area of horizontal tie bars and vertical steel (intermediate bars of column reinforcement), and column axial load on the joint shear capacity is assessed. From the studies carried out in the present work, conceptual phenomenon of failure type with various set of parameters for a beam-column joint is brought out. The key findings of the present study will be helpful to arrive at the design procedure of the joints to ensure the desired failure mechanism.

The focus of the present work is to bring out a robust and efficient mathematical model for evaluation of the shear strength of the RC joints, which can be used as a tool to assess the available strength hierarchy of beam-column sub-assemblage and to provide information for design of suitable and adequate strengthening scheme, if required, for critical component of deficient structures.