CAPACITY ANALYSIS OF RCC FRAME STRUCTURE WITH AND WITHOUT INFILL WALLS

NALKARI NEHA, AJITH KUMAR DEY
M.Tech Student, Associate Professor
Dept of Civil Engineering
Sree Dattha Institute of Engineering and Science,Hyderabad

ABSTRACT

A beam-column joint is a very critical zone in reinforced concrete framed structure where the elements intersect in all three directions. Joints ensure continuity of a structure and transfer forces that are present at the ends of the members. In reinforced concrete structures.

During the past four decades, significant amount of research has been conducted to investigate the behavior of RC beam-column joints. These joints are studied due to its critical influence on the overall behavior of RC moment-resisting frames subjected to seismic loads . However, there is a lack of data and test results still exists on such connections when they are totally reinforced with FRP reinforcement. Nevertheless, none of the available FRP codes or guidelines provides any recommendations on the seismic design of the moment-resisting frames reinforced with FRP.

In this study, behavior of exterior R.C beam-column joint was investigated according to FEMA 356 with a macro model using SAP 2000 using nonlinear pushover analysis procedure. The analysis included 2D model using one dimensional elements. Moreover, the 2D model was extended to investigate the behavior of CFRP retrofitted exterior beam- column joint. Group of modeling have 5 specimens with different area of

CFRP. The study results showed that the failure in this case occurs in the beam when the joint and 25% from column are rehabilitated with CFRP.

For the purpose of analysis of large scale structures, behavior of framed ten multi-storey structure was investigated according to FEMA 356 with a macro model using SAP 2000 using the nonlinear pushover analysis procedure in order to withstand seismic lateral force applied on building. Moreover, the 3D model was extended to investigate the behavior of CFRP retrofitted frame building.

I.INTRODUCTION

A beam-column joint is a very critical zone in reinforced concrete framed structure where the elements intersect in all three directions. Joints ensure continuity of a structure and transfer forces that are present at the ends of the members. In reinforced concrete structures, failure in a beam often occurs at the beam-column joint making the joint one of the most critical sections of the structure. Sudden change in geometry and complexity of stress distribution at joint are the reasons for their critical behavior. In early days, the design of joints in reinforced concrete structures was generally limited to satisfying anchorage requirements. In succeeding years, the behavior of joints was found to be dependent on a number of factors related with their geometry; amount and detailing of reinforcement, concrete strength and loading pattern. The requirements Criteria for the desirable performance of joints can be summed up as: (Park. R & Paulay.T, 1975).

(i) The strength of the joint should not be less than the maximum demand corresponding to development of the structural plastic hinge mechanism for the frame. This will eliminate the need for repair in a relatively inaccessible region and for energy dissipation by joint mechanisms, which, as will be seen subsequently, undergo serious stiffness and strength degradation when subjected to cyclic actions in thein elastic range.

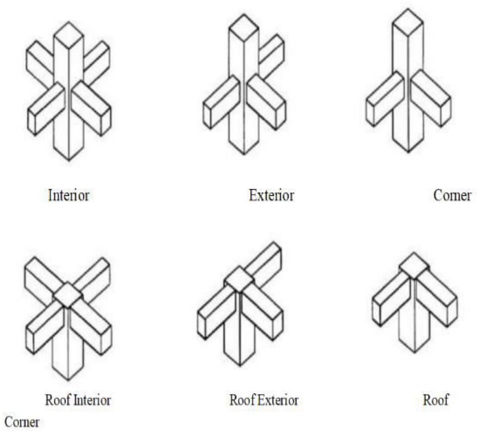
(ii) The capacity of the column sh5 ould not be jeopardized by possible strength degradation within the joint. The joint should also be considered as an integral part of the column.

(iii) The joint reinforcement necessary to ensure satisfactory performance should not cause undue construction difficulties.

BEAM COLUMN JOINT

The functional requirement of a joint, which is the zone of intersection of beams and columns, is to enable the adjoining members to develop and sustain their ultimate capacity. The joints should have adequate strength and stiffness to resist the internal forces induced by the framing members. The joint is defined as the portion of the column within the depth of the deepest beam that frames into the column. In a moment resisting frame, three types of joints can be identified viz. interior joint, exterior joint and corner joint.

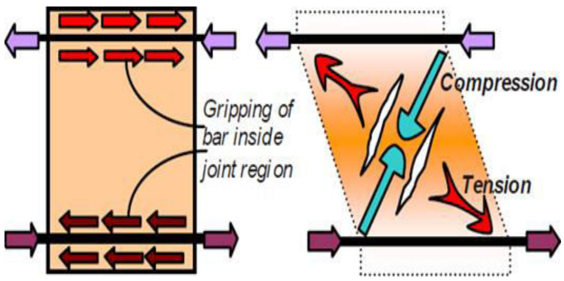
When four beams frame into the vertical faces of a column, the joint is called as an interior joint, When one beam frames into a vertical face of the column and two other beams frame from perpendicular directions into the joint, then the joint is called as an exterior joint, When a beam each frames into two adjacent vertical faces of a column then the joint is called as a corner joint.



Beam-Column Joints are Special as their constituent materials have limited strengths, the joints have limited force carrying capacity. When forces larger than these are applied during earthquakes, joints are severely damaged, Repairing damaged joints is difficult, and so damage must be avoided. Thus, beam-column joints must be designed to resist earthquake effects.

EARTHQUAKE BEHAVIOUR OF JOINTS

Under earthquake shaking, the beams adjoining a joint are subjected to moments in the same (clockwise or counter-clockwise) direction , Under these moments, the top bars in the beam-column joint are pulled in one direction and the bottom ones in the opposite direction , If the column is not wide enough or if the strength of concrete in the joint is low, there is insufficient grip of concrete on the steel bars In such circumstances, the bar slips inside the joint region, and beams lose their capacity to carry load. Further, under the action of the above pull-push forces at top and bottom ends one diagonal length of the joint elongates and the other compresses . If the column cross-sectional size is insufficient, the concrete in the joint develops diagonal cracks .



Diagonal cracking , crushing of concrete can be prevented in Joints. Mostly, for this large column size is the most effective. Another way is providing steel ties also known as stirrups.

Aims of research

The primary tasks of the current study are to:

1. Construct macro models using the pushover analysis procedure for a exterior beam-column joint able to predict the overall behavior, capacity and the modes of failure.

2. Studying the behavior of a CFRP retrofitted exterior beam-column joint constructing a macro model using the pushover analysis procedure in order to predict its overall behavior, capacity and the modes of failure.

3. construct a model of ten-multi-story structure using the pushover analysis procedure able predict its overall behavior. Safety of construction members against earthquake and its mode of failure

4. studying the need of using retrofitting withstand the equivalent static force calculated by response spectrum analysis for the building by retrofitting only the first story then, retrofitting two stories and so on, and predict the overall behavior for each case until the capacity of building

reach the safe zone against the earthquake.

II. LITERATURE REVIEW

During the past four decades, significant amount of research has been conducted to investigate the behaviour of steel-reinforced beam-column joints. These joints are studied due to its critical influence on the overall behaviour of RC moment-resisting frames subjected to seismic loads. Hanson and Connor (1967) [9] had conducted the first experiment on exterior beam column joints reinforced with steel. Since then, many researchers have been involved in studying the behaviour of the beam- column connections through analytical models and experimental tests. These researchers were able to provide knowledge on how beam column joints work and what are the main parameters that affect their performance , However, there is a lack of data and test results still exists on such connections when they are totally reinforced with FRP reinforcement. Nevertheless, none of the available FRP codes or guidelines provides any recommendations on the seismic design of the moment-resisting frames reinforced with FRP.

BACKGROUNDThe performance of beam-column joints has long been recognized as a significant factor that affects the overall behavior of reinforced concrete (RC) framed structures subjected to large lateral loads.

The first design guidelines for reinforced concrete beam-column joints were published in 1976 in the U.S. [2.1] and in 1982 in New Zealand [2.2]. Buildings constructed before 1976 may have significant deficiencies in the joint regions.

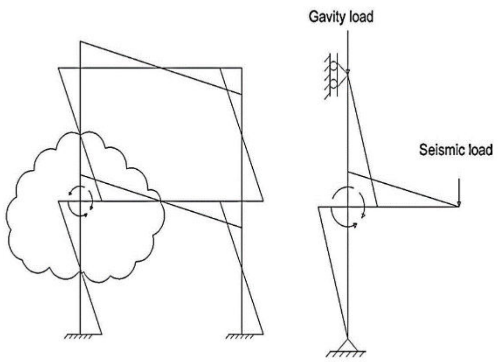
Especially since the 1985 Mexico earthquake, a considerable amount of research has been devoted to identifying the critical details of nonseismically designed buildings as well as to developing methods of strengthening. Through their reviews of detailing manuals and design codes from the past five decades and their consultation with practicing engineers .

Committee 352 [2.4] reads: “These joints need to be studied in detail to establish their adequacy and to develop evaluation guidelines for building rehabilitation. Methods for improving performance of older joints need to be studied. Scarce information is available on connection repair and strengthening"

III. Non Linear Analysis of Exterior RC beam column joint

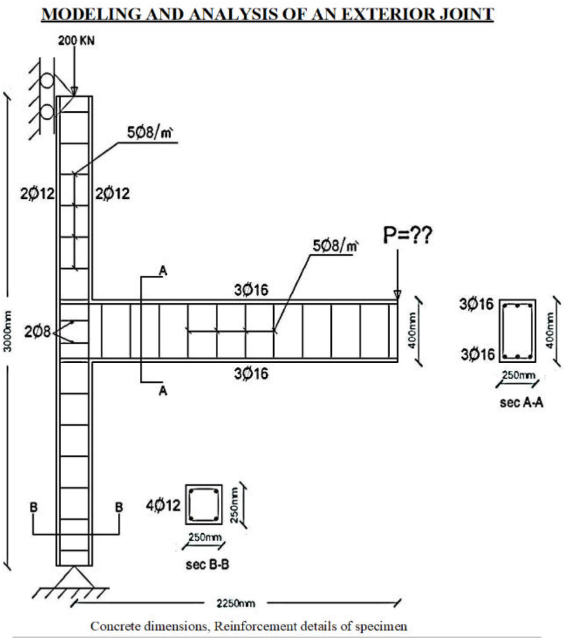
The local response of beam–column joints is not considered for the seismic analysis of multistory reinforced concrete (RC) frame structures, where these critical regions are typically assumed as rigid. Studies that incorporate the local effect of the joints in the seismic analysis of multistory RC frame structures are limited. Identifying the main disadvantages of the analytical models that have been proposed so far, a behavioral model is developed for the simulation of the local inelastic response of exterior RC beam–column joints in multistory RC frame structure.

As existing theoretical and experimental study of the joints are not perfect, especially the Seismic performance, it is difficult to make a comprehensive evaluation of the performance of the joints



OBJECTIVE

The main objective is to make modeling of a specimen of an exterior RC beam column joint using SAP2000 program according to FEMA356 to get the capacity of joint, max displacement and its mode of failure due to cyclic load P.



Concrete dimensions, Reinforcement details of specimen

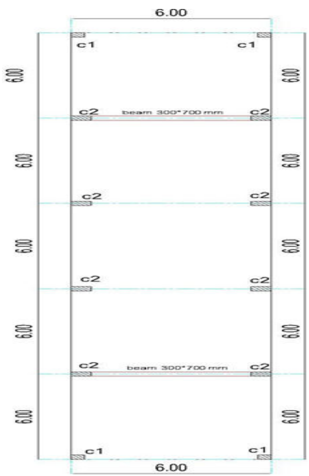
IV.CASE STUDY

OBJECTIVE

The main objective of the present chapter is to explanation the behavior and capacity of the frame under the study. Also survey influence use (CFRB) in repairing the external beam column joint under seismic load.

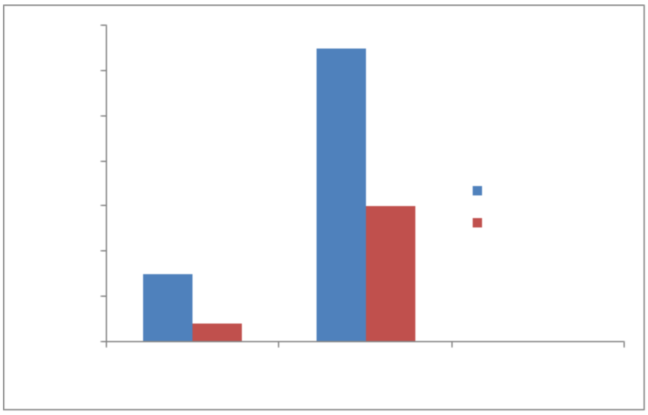
GENERAL

Residential building (30m*6m) consists of 10 floor . there are 2 frames to resist earthquakes forces with column cross section 300*700 mm and beam cross section 300*700 mm



V.CONCLUSION

	cfrp	concrete jaketing
material cost (pound)	12600	5000
labors cost (pound)	2400	60000
total cost (pound)	15000	65000
time of repair (day)	4	30



Based on the studied dimensions of the beam–column joint and the considered defects along with the proposed CFRP strengthening configuration subjected to cyclic loading, the following conclusions can be drawn

1. Web-bonded CFRP-retrofitting technique can be used to relocate the beam plastic hinging zone away from the column face in RC ordinary moment resisting frames.

2. Use of over-designed FRP-retrofitting increases the strength of the beam end so that the beam sections adjacent to the column face remain essentially elastic.

3. Use of (CFRP) transverse wrap is recommended in order to confine the retrofitted areas and reduce the shear deformation.

4. Generally, using (CFRP) as a strengthening material led to increased ultimate capacity and ductility compared to those of un- strengthened joints

5. The result showed that increasing capacity for the frame by retrofitted using (CFRP)

6. Use (CFRP) in repairing better than concrete jacketing as it take short time and lower total cost .

REFERENCES

[1] Chung, L. and Shah, S.P. (1989). "Effect of Loading Rate on Anchorage Bond and Beam-Column Joints," ACIStructural Journal, V. 86, No. 2, pp. 132-142.

[2] Hakuto, S., Park, R., and Tanaka, H. (2000). "Seismic Load Tests on Interior and Exterior Beam-Column Joints with Substandard Reinforcing Details," ACI Structural Journal, V. 97, No. 1, pp. 11-25.

[3] Murty, C. V. R., Rai, D. C, Bajpai, K. K., and Jain, S. K. (2003). "Effectiveness of Reinforcement Details in Exterior Reinforced Concrete Beam-Column Joints for Earthquake Resistance," ACI Structural Journal, V. 100, No. 2, pp. 149-156.

[4] Zhang, L., and Jirsa, J.O. (1982). A Study of Shear Behavior of RC Beam- Column Joints. PMFSEL Report No. 82-1, University of Texas at Austin.

[5] Ohwada, Y. (1977). A Study on Effect of Lateral Beams on RC Beam-Column Joints (2). Conference of AIJ, No. 61.

[6] Wong, H.F. (2005). Shear Strength and Seismic Performance of Non-Seismically Designed Reinforced Concrete Beam-Column Joints. PhD Dissertation, Hong Kong University of Science and Technology.

[7] Walker, S.G. (2001). Seismic Performance of Existing RC Beam–Column Joints. MSCE thesis, University of Washington.

[8] Alire, D. A. (2002). Seismic Evaluation of Existing Unconfined RC Beam– Column Joints. MSCE thesis, University of Washington.

[9] Hanson, N. W. and Connor, H. W. (1967). “Seismic Resistance of Reinforced Concrete Beam-Column Joint,” Journal of the Structural Division, ASCE, V. 93, ST5, pp. 533-560.

[10] Paulay, T., Park, R., and Priestley, M.J.N., “Reinforced Concrete Beam-Column Joints under Seismic Actions”, ACI Journal, Vol. 75, No. 60, 1978, pp. 585-593.

[11] Hwang, S., and Lee, H. “Analytical Model for Predicting Shear Strengths of Exterior Reinforced Concrete Beam-Column Joints for Seismic Resistance”. ACI Structural Journal, Vol. 96, No. 5, 846-858, 1999.

[12] Park R., and Paulay, T., “Reinforced Concrete Structures”, John Wiley & Sons, First Edition, 1975, pp. 769.