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Review on Analysis of RCC beam, Column Joint and RCC Shearwall using FRP strengthening on Ansys Software

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Abstract: After occurrence of recent earthquakes in the most of world parts, scientific committees for reducing natural disasters and research centers declared based performance design, investigation faults, retrofitting, rehabilitation, new researches are related to strengthening of structures, notice performance, importance of structure, surface of earthquake levels, considering economic and feasibility. One of streningthening method of RC frame is using FRP laminates. Beam and column where intersects is called as joint or junction. The different types of joints are classified as corner joint, exterior joint, interior jointetc. on beam column joint applying quasi-static loading on cantilever end of the beam. and study of various parameters as to be find out on corner and exteriorbeam column joint i.e. maximum stress, minimum stress, displacement and variation in stiffness of beam- column joint can be analyzed in Ansys software (FEM Software) RC shear walls are considered one of themain lateral resisting members in buildings. In recent years, FRP has been widely utilized in order to strengthen and retrofit concrete structures. Significant experimental research has been conducted over the past three decades on hysteretic behavior of beam-column joints of RC frames under cyclic displacement loading. The various research studies focused on corner and exterior beam column joints and their behavior, support conditions of beam-column joints. Some recent experimental studies, however, addressed beam-columnjoints of substandard RC frames with weak columns, poor anchorage of longitudinal beam bars and insufficient transverse reinforcement. the behavior ofexterior beam column joint is different than the corner beam column joint.
Keywords: Beam, column, corner, exterior, joint, quasi-static **etc.**

I. INTRODUCTION

Concrete structural components exist in buildings andbridges in different forms. Understanding the response of these components during loading is crucial to the development of an overall efficient and safe structure. Different methods have been utilized to study the response of structural components. Experimental based testing has been widely used as a means to analyze individual elements and the effects of concrete strength under loading. While this is a method that produces reallife response, it is extremely time consuming, and the use of materials can be quite costly. The use of finite element analysis to study these components has also been used. Reinforced concrete (RC) shear walls areconventional structural elements incorporated in seismic regions to improve the strength and rigidity of structures against lateral loading (earthquake and wind forces). Limitation of lateral deformations along with minimizing damage to structural/non-structural components are the main advantages of RC shear walls owing to the significant inplane stiffness. Unfortunately, early attempts to accomplish this were also very time consuming and infeasible using existing software and hardware. In recent years, however, the use of finite element analysis has increased due to progressing knowledge and capabilities of computer software and hardware. It has now become the choice method to analyze concrete structural components. The use of computer software to model these elements is much faster, and extremely cost-effective. To fully understand the capabilities of finite element computer software, one must look back to experimental data and simple analysis. Data obtained from a finite element analysis package is not useful unless the necessary steps are taken to understand what is happening within the model that is created using the software. Also, executing the necessary checks along the way is key to make sure thatwhat is being output by the computer software is valid. By understanding the use of finite element packages, more efficient and better analyses can be made to fully understand the response of individual structural components and their contribution to a structure as a whole.

Design and detailing of beam-column joints inreinforced concrete frames are critical in assuring the safety of these structures in earthquakes. Such joints should be designed and detailed to Preserve the integrity of the joints sufficiently to develop the ultimate strength and deformation capacities of the connecting beams and columns; Prevent excessive degradation of joint stiffness under seismic loading by minimizing cracking of the joint concrete and by preventing the loss of bond between the concrete and longitudinal beam and column reinforcement; andPrevent brittle shear failure of the joint It has recently been reported that the beam column joints. failures observed in 1980 Assam earthquake, 1985 Mexico, 1986 Salvador, 1989 Loma Prieta and 2000 in India. It is recognizing that Beam-Column Joints can be critical reason in RC frames design for in elastic response to severe seismic attack. As a consequence, seismicmoments of opposite signs are develop in columns above and below the joints and at the same time beam moment reversal across the joints. A horizontal andvertical shear force whose magnitude is many timeshigher than in the adjacent beams and columns developed at the joint region. If not design for, joint failure can result.

This project is a study of reinforced concrete beam- column joint using finite element analysis to understand the response of reinforced concrete beams due to transverse loading. The objective of this Study is toinvestigate and evaluate the use of the finite element method for the analysis of reinforced concrete beam. A mild-steel reinforced concrete beam with flexural and shear reinforcement was analyzed to failure and compared to experimental results. A calibration model using a commercial finite element analysis package (ANSYS) was set up and evaluated using experimental data. A mild-steel reinforced concrete beam with flexural and shear reinforcement was analyzed to failureand compared to experimental results to calibrate the parameters in ANSYS for later analyses.

II. PROBLEM STATEMENTS

Earthquakes are one of the most feared natural phenomena that are relatively unexpected and whose impact is sudden due to the almost instantaneous destruction that a major earthquake can produce. Severity of ground shaking at a given location during an earthquake can be minor, moderate and strong which relatively speaking occur frequently, occasionally an rarely respectively. Design and construction of abuilding to resist the rare earthquake shaking that may come only once in 500 years or even once in 2000 yearsat a chosen project site even though life of the building itself may be only 50 to 100 years is too robust and also too expensive. Hence, the main intention is to make building earthquake-resistant that resist the effect of ground shaking although it may get damaged severely but would not collapse during even the strong earthquake. Thus, the safety of people and contents is assured in earthquake-resistant buildings. This is a major objective of seismic design codes throughout the world.

The performance of structures in earthquakes indicates that most structures, system and components, if properly designed and detailed, have a significantcapacity to absorb energy when deformed beyond their elastic limits. Experience with the behavior of reinforced concrete beam-column joints in actual earthquakes is limited. To fully realize the benefits of ductile behavior of reinforced concrete frame structures,instabilities due to large deflections and brittle failure ofstructural elements must be prevented under the most severe expected earthquake ground motions..

Investigation of the behaviour of FRP retrofitted reinforced concrete structures has in the last decade become a very important research field. In terms ofexperimental application several studies were performed to study the behaviour of retrofitted beams and how various parameters influence the behaviour. The effect of number of layers of CFRP on the behaviour of a strengthened RC beam was investigated. They tested simply supported beams with different numbers of CFRP layers. The specimens were subjected to dead load and horizontal forces. The results showed that the load carrying capacity increases with an increased number of layers of carbon fibre sheets. The model of RC building shown in plan was developed in ANSYS software.

III. OBJECTIVES

The experimental investigation carried out for evaluating the seismic response of RC wide beam- column joints under cyclic load and for exploring the potential of improving the seismic performance of the same joints without introducing significant changes in the design and construction practices.

The primary objectives of this project can be summarized as follows:

1) To identify the RCC beam, column joint and RCC shear wall.
2) To study of various parameters as to be find out on corner and exterior beam column joint in Ansys software.
3) To study of reinforced concrete beam using finiteelement analysis to understand their load-deflection response.
4) To Analysis of RCC beam, column joint using FRP strengthening in Ansys software.
5) To Analysis of RCC shear wall using FRP strengthening in Ansys software.

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IV. LITERATURE REVIEW

The strength of beam-column junction plays a very important role in the strength of the structure, here the literature survey is carried out to have the information about the Loading applied to the beam-column joint.

Kuang J.S. and Wong H. F. [2] Reversed cyclic- load tests are carried out on full-scale reinforced concrete (RC) exterior beam–column joints, which are fabricated to simulate those in as-built RC framed buildings designed to BS 8110. Emphasis of the study is placed on the effects of the types of beam bar anchorageand location of laps in column reinforcement on the seismic behavior and shear strength of RC exterior joints subjected to simulated earthquake load. Shear strength of a beam–column joint predicted by the criterion of initial diagonal cracking is highly dependenton the level of axial loads applied on the column; this model gives very good correlations with all the test datain this study. overall structural safety, especially forreinforced concrete beam–column joints.

Ha G.J and Cho .C.G [12] Lack of ductility in high-strength concrete members raises serious concerns for overall structural safety, especially for reinforced concrete beam–column joints. In the current study, experimental research was performed to improve the seismic strength and performance of reinforced highstrength concrete exterior beam–column joints undercyclic load reversals. A new design approach for beam–column joints was introduced using advanced reinforcement details. Specimens of reinforced high-strength concrete beam–column joints weremanufactured based on the new design method developed from the concept of a moving beam plastic hinge using anchor-type intermediate bars and advanceddetails of doubly confined closed stirrups in the beam near the joint, and tested for comparison with specimens designed using the conventional approach. The newly developed design approach minimizeddamage and considerably improved the structural performance of beam–column joints under cyclic load reversals. The manufactured joints were expected to be effective in improving the weakness in induced by the brittleness of high-strength concrete in reinforced high- strength concrete beam–column joints.

Bing Li, Yiming Wu, and Tso-Chien Pan [4] described the development of finite element model for interior beam-wide column joints. The global behavior and the principal stresses of the interior beam-wide column joints discussed in detail and the results are compared with the author"s experimental results. The calculated results indicated the global behavior of the joint simulated to correlate and well within the experimental observations. The effects of several critical design parameters on the joint behavior are explored by means of finite element models

Vladmir Guilherne Haach, Ana Lucia Home De Cresce El Debs, Mounir Khalil El Debs [1] This paper investigates the influence of the column axial load on the joint shear strength through numerical simulations. The numerical study is performed through the software ABAQUS, based on Finite Element Method. A comparison of the numerical and experimental results is presented in order to validate thesimulation.

The results showed that the column axial load made the joint more stiff but also introduced stresses in the beam longitudinal reinforcement. A more uniform stress distribution in the joint region is obtainedwhen the stirrup ratio is increased. Furthermore, some tension from the top beam longitudinal reinforcement isabsorbed by the stirrups located at the upper part of the joint. This paper gives the affect of stirrup ratio to exterior beam-column joints where the beam is loaded monotonically

Hegger Josef,Sherif Alaa and Roeser Wolfgang[8] here authors have carried out Monotonic tests on beam-column joints which showed the failure of the connection can either be in the beam(bending failure) or inside the joint(shear and bond failures).The behavior of exterior beam-column joints is different from that of interior connections. The model has been calibrated using a database with more than 200 static load tests. The reported test results as well as test resultsfrom the literature were used to study the behavior of exterior and interior beam-column connections. The shear strength of an exterior beam-column connection decreases with increasing joint slenderness.

Murty.C. V. R, Durgesh C. Rai, K. K. Bajpai, and Sudhir K. Jain [14] described an experimentalstudy of beam-column joints in frames common in pre- seismic code/gravity-designed reinforced concrete (RC)frame buildings. Exterior RC joint sub assemblages are studied with four details of longitudinal beam bar anchorage and three details of transverse joint reinforcement. All these specimens showed low ductility and poor energy dissipation with excessive shear cracking of the joint core.

Uma. S. R. and Meher Prasad. A [8] discussedthe general behavior of common types of joints in reinforced concrete moment resisting frames. Themechanisms involved in joint performance with respect to bond and shear transfer are critically reviewed and discussed in detail.

The factors impacting the bond transfer within the joint appears to be well related to the level of axial load and the amount of transverse reinforcements in the joints. The parameters that affect the shear demand and shear strength of the joint are explained. The design of shear reinforcement within thejoint and its detailing aspects are also discussed.

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V. RESEARCH METHODOLOGY

The proposed work is planned to be carried out in the following manner,

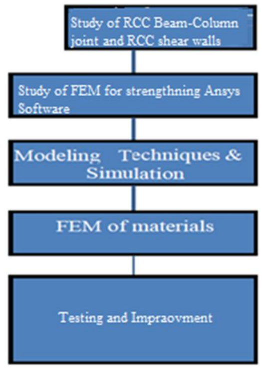


Fig.1. Planning of work

A. Criteria For The Desirable Performance Of Joints In Ductile Structures Designed For Earthquake Resistance

1) The strength of the joint should not be less than the maximum demand corresponding to development of thestructural 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 the inelastic range.
2) The Capacity of the column should not be jeopardized by possible strength degradation within the joint. The joint should also be considered as an integral part of the column.
3) During moderate seismic disturbances, joints should preferably respond within the range.
4) Joint deformations should not significantly increase story drift.
5) The joint reinforcement necessary to ensure satisfactory performance should not cause undue construction difficulties.

B. Performance Criteria

Because the response of joints is controlled by shear and bond mechanisms, both of which exhibit poor hysteric properties, joints should be regarded as being unsuitable as major sources of energy dissipation. Hence the response of joints should be restricted essentially to the elastic domain. It is of particular importance to ensure that joint deformations, associated with shear and particularly bond mechanisms, do not contribute excessively to overall story drifts. When large diameter beam bars are used, the early break downof the bond within the joint may lead to story drifts in excess of 1%, even before the yield strength of suchbars is attained in adjacent beams. Excessive drifts may cause significant damage to non structural components of the building, while frames respond within the elastic domain. By appropriate detailing, to be examined subsequently, joint deformations can be controlled.

C. Shear Strength

Internal forces transmitted from adjacent members tothe joint as shown in fig. result in joint shear forces in both the horizontal and vertical directions. These shear forces lead to diagonal compression and tension stressesin the joint core. The latter will usually result in diagonal cracking of the concrete core. The mechanism of shear resistance at this stage changes drastically.

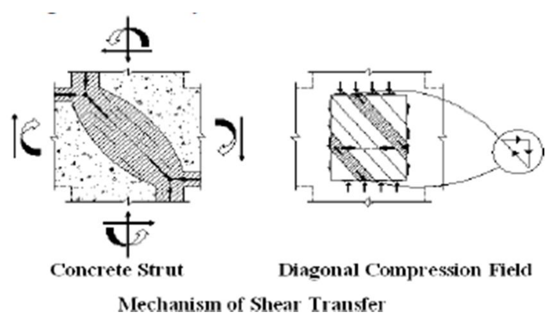


Fig.2 Shear Mechanism

Some of the internal forces, particularly those generated in the concrete, will combine to develop a diagonal strut. Other forces, transmitted to the joint coreform beam and column by means of bond, necessitate a truss mechanism.

When the joint shear reinforcement issufficient, yielding of the hoops will occur. Irrespective of the direction of diagonal cracking, horizontal shear reinforcement transmits tension forces only. The inelastic steel strains that may result are irreversible. Consequently, during subsequent loading, stirrup ties can make a significant contribution to shear resistance only if the tensile strains imposed are larger then those developed previously. This then leads to drastic loss of stiffness art low shear force levels, particularly immediately after a force or displacement reversal.

D. Bond Strength

At exterior column the difficulty in anchoringa beam bear of full strength can be overcome readily by providing a standard hook. At interior columns, however, this is impractical. Some codes require that beam bars at interior beam-column joints must pass continuously that bars may be anchored with equal ifnot greater efficiency using standard hooks within or immediately behind an interior joint.

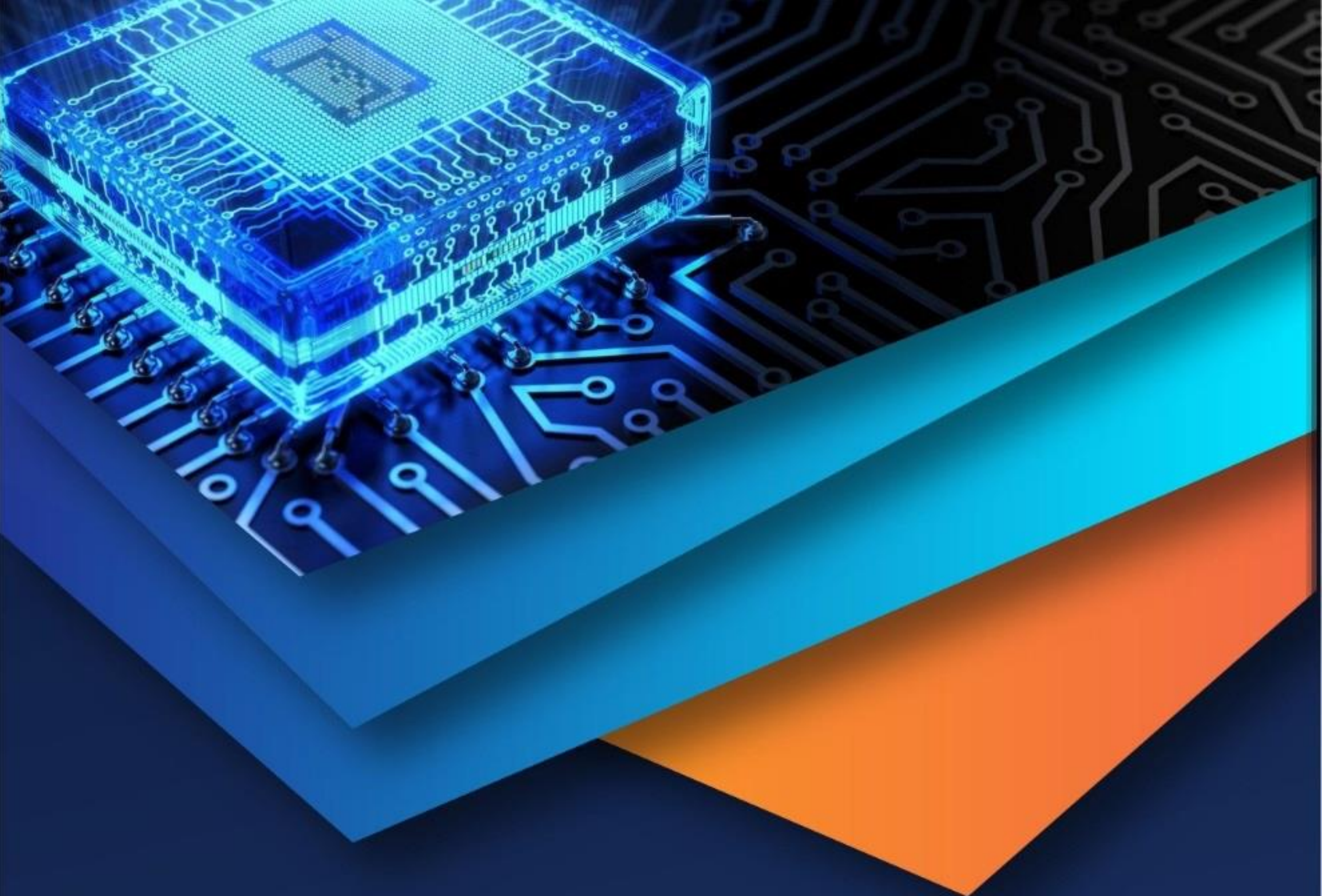
The fact that bars passing through interior joints are being "pulled" as well "pushed" by the adjacent beams, to transmit forces corresponding to steel stresses up to the strain hardening range in tension, has not as a rule, been take into account code specifications until recently. In most practical situationsbond stresses required to transmit bar forces to the concrete of the joint core consistent with plastic hinge development at both sides of the joint, would be very large and well beyond limits considered by codes for bar strength development. Even at moderate ductility demands, a slip of beam bars through the joint can occur. A breakdown of bond within interior joints does not necessarily result in sudden loss of strength.

VI. CONCLUSION

In this research work a study of reinforced concrete beams using finite element analysis in order to understand the response of reinforced concrete beams due to transverse loading. The reinforced concrete beam with flexural and shear reinforcement was analyzed to failure and compared to experimental results. The various research studies focused on corner and exterior beam column joints and their behavior, support conditions of beam-column joints. Some recent experimental studies, however, addressed beam-columnjoints of substandard RC frames with weak columns, poor anchorage of longitudinal beam bars and insufficient transverse reinforcement. the behavior ofexterior beam column joint is different than the corner beam column joint.

REFERENCES

[1] Barr, P.J. (2008). "Comparison of prestress losses for a prestress concrete bridge made with high performance concrete", J. Bridge Eng., ASCE, 13 (5), 468-475.
[2] Byung Hwan Oh, In Hwan Yang (2001). "Realistic long term prediction of prestress forces in psc box girder bridges", J. Structural Eng., ASCE, 127 (9), 1109-1116.
[3] Chang-Su Shim, Pil-Goo Lee, Sung-Pil Chang (2001). "Design of shear connection in composite steel and concrete bridges with precast decks", J. Bridge Eng., ASCE, 15 (3), 725-733.
[4] Dereck J. Hodson, Paul J. Barr, and Marvin W. Halling (2012). "Live-Load Analysis of Post-tensioned Box-Girder Bridges", J. Bridge Eng., ASCE, 17(4), 644-651.
[5] Gonzalo R., Angel, C. A., Gonzalo R. and Juan R.C.(2000). "Externally prestressed high strength concrete viaduct", J. Bridge Eng., ASCE, 26 (4), 337-345.
[6] IRC: 18.(2000). Design criteria for prestressed concrete road bridges (post tensioned concrete), IRC, New Delhi, India.
[7] IRC: 6. (2010). Loads and stresses, IRC, New Delhi,India.
[8] IRC:112. (2011). Code of practice for concrete bridges, IRC, New Delhi, India.
[9] IS1343.(1980). Indian Standard code of practice for prestressed concrete (First Revision), BIS, New Delhi,India.
[10] Jarret Kasan, s. m., Kent, A. H. (2011). "Redevelopment of prestressing force in severed prestressed strands", J. Bridge Eng., ASCE,16 (3), 431-437.
[11] John B. Kennedy and Mohamed H. Soliman (1987). "Temperature distribution in composite bridges" J. Structural Eng., ASCE, 113 (3), 475-482.
[12] Krishna Raju, N. (1995). Prestressed Concrete,Tata McGraw- Hill Publishing company Limited, New Delhi.
[13] Leo E. Rodriguez, Paul J. Barr, Marv W. Halling (2013). "Temperature effects on a box girder, integral abutment bridge", journal of performance of constructed facilities, ASCE, 16(7), 548-553.
[14] Raina, V.K. (1994). Concrete Bridge Practice- Analysis, Design and Economics, McGraw- Hill Publishing Company Limited, New Delhi.
[15] S. Maleki (2002). "Effect of deck and supportstiffness on seismic response of slab girder bridges", Engineering Structures, 24, 219-226.
[16] Vikash Khatri, Pramod Kumar Singh and P.R.Maiti (2012). "Comparative study of prestressedsteel concrete composite bridge of different span length and girder spacing", International Journal of Modern Engineering Research, 2(5), 3917-3922.



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