Behaviour of Beam Column Joint With Frp Under Cyclic Loading

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Abstract- *In this investigation, four full-scale beam-column section joint sub assemblages were tested under cyclic loading. The examples were built to speak to corner joints of moderately reinforced concrete structures..Therefore, all specimens were cased using low quality of concrete and plain reinforcing bars with detailing. Two sub assemblages (Group A) included joint, beam, upper story and lower storey columns, a transverse beam and a part of slab, while the other two sub assemblages (Group B) did not include the transverse beam and slab. One specimen from each group was tested as reference specimens, while the remaining one specimen from each group was tested after the joints were retrofitted using carbon FRP sheets. The point of the examination was both to explore the impact of FRP retrofit of beam column section joints and the impact of transverse beam and slab on the conduct of reference joints and retrofitted joints. The test results were evaluated in terms of damage development, failure patterns and hysteretic behavior characteristics, such as degradation of strength and stiffness, and energy dissipation. At the end of the study, significantly better performance was obtained for the FRP retrofitted specimens, both in terms of shear strength of the joint and energy dissipation during loading cycles. It should be noted that special attention was paid for the retrofit method to be practically applicable.*

Keywords- Beam, column, joint, FRP, Cyclic loading.

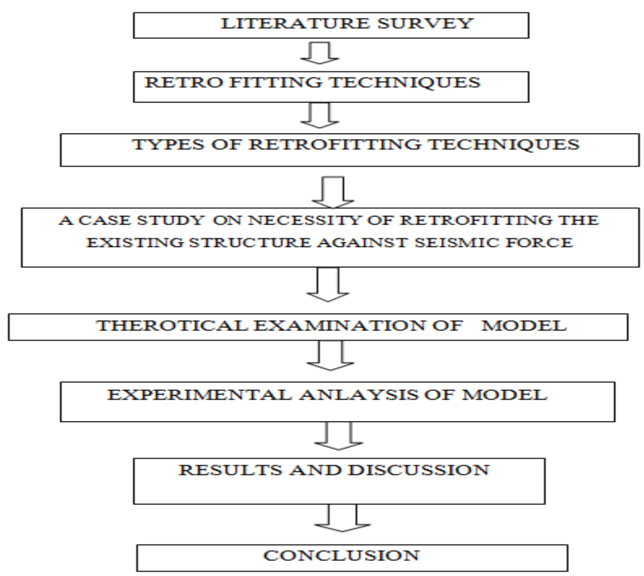
I. INTRODUCTION

Earthquakes have uncovered the powerlessness of existing reinforced concrete beam column joints to seismic stacking. Concrete jacketing and steel jacketing were the two common methods adopted for strengthening the deficient reinforced concrete beam column joints. This type of retrofitting results in substantial increase in the cross-sectional area and the self-weight of the structure, more over the retrofitted joints have poor resistance for weather attacks and are labour intensive. Another method has developed as of late which utilizes fiber reinforced polymer (FRP) sheets to fortify the beam-column joints which have various positive qualities, for example, straight forwardness to install, immunity to corrosion and high strength. The simplest way to strengthen the joints is to wrap fibre sheets in the joint region in two orthogonal directions.

1.1 OBJECTIVE

1. Seismic performance of the original joint and the repaired and retrofitted joint are extracted from their capacity backbone curves and compared.
2. To improved the ability of FRP and concrete working together to resist the joint shear forces.
3. To prepare finite element models using ANSYS WORKBENCH for given section.

II. METHODOLOGY



2.1 REINFORCED CONCRETE JACKETING-

The main purpose of jacketing is to increase the load carrying capacity of the structural elements against the lateral load. A considerable increase in ductility and stiffness of the section can be obtained depending on the type of jacketing (Vaghani, 2014). There are many methods of jacketing of damaged structural elements. most common technique is Reinforced Concrete Jacketing (RCJ). In this method the existing member is wrapped with concrete, reinforced with longitudinal steel and ties or with fabric wire. There are three methods of RCJ namely beam jacketing, column jacketing and beam column joint jacketing. The main benefit of RCJ is it increases the shear and flexural capacity and easy to construct. Because of that it is most used techniques of retrofitting all over the world and several kinds of research work has been done on the utilities of RCJ. Researchers have concluded that using of RCJ increases flexural and shear strength of existing sections. Karayannis, Chalioris& Sirkelis (2008) experimentally investigated and addressed a new type of RC jacket for external beam-column joint damaged by seismic excitations. This experimental program has 10 exterior beam column joints (Figure 1) investigated under constantly increasing cyclic loads, then retrofitted with of. The dissipated hysteretic energy area measured in terms of the area of the full load–deformation envelopes of the original beam–column joints is compared with the hysteretic energy dissipation of the retrofitted specimens.

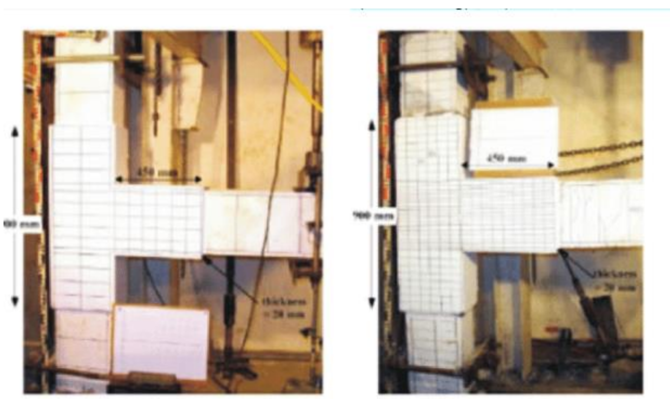


Fig.1 Application of RC jacketing to beam-column joint (Karayannis et al 2008)

The comparison of the seismic performance between the original and the retrofitted specimens indicated that all the retrofitted joints using the proposed jacketing with light reinforcement exhibited significantly enhanced behavior with respect to the original specimen. The available structural system geometry and the building mass were not modified, and therefore the dynamic characteristics of the structure remain practically without effected.

Chalioris & Pourzitidis (2012) applied self-compacting RCJ technique to shear damaged reinforced concrete beam. The thickness of the jacket is 25 mm andit wrapped the bottom part of the beam and the vertical side as well (U shaped jacket). The steel reinforcement of the jacket consists of small diameter mild steel longitudinal rebar and U-shaped stirrups. They have observed that the load bearing capacity and the overall structural performance of the jacketed beams was improved with respect to the starting tested specimens. Marlapalle, Salunke& Gore (2014) described the effectiveness of RCJ of beams and columns as per IS15988:2013. Author also mentioned the disadvantages of RCJ technique such as the available space is reduced due to the increase of section and a large amount of dead mass is added and the duration of implementation is very slow.

Ansys Inc. is an American public company based in Canonsburg, Pennsylvania. This company develops and used to solve many engineering problems based on markets finite element analysis software. The software creates simulated analytical models of structures, electronics, or machine components to get strength, toughness, elasticity, temperature distribution, electromagnetism, fluid flow, and other attributes. Without building test products or conducting crash tests, to determine how a product will function with different specifications ansys is used..For example, Ansys software may simulate how a bridge will hold up after years of traffic Ansys Workbench software is mostly used software for problem simulations which is one of the company's main products. Basically Ansys operators break down larger structures into small parts that are each modeled and can be tested individually. A user may start by defining the dimensions of an object, and then adding weight, pressure, temperature and other physical properties. Finally, the Ansys software simulates and analyzes movement, fatigue, fractures, fluid flow, temperature distribution, electromagnetic efficiency and other

2.2 MODELLING OF BEAM COLUMN JOINT IN ANSYS

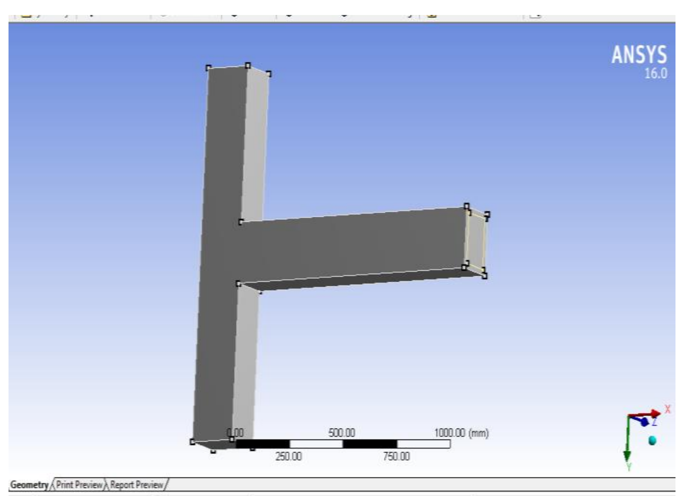


Fig 2.: LOADING CONDITION

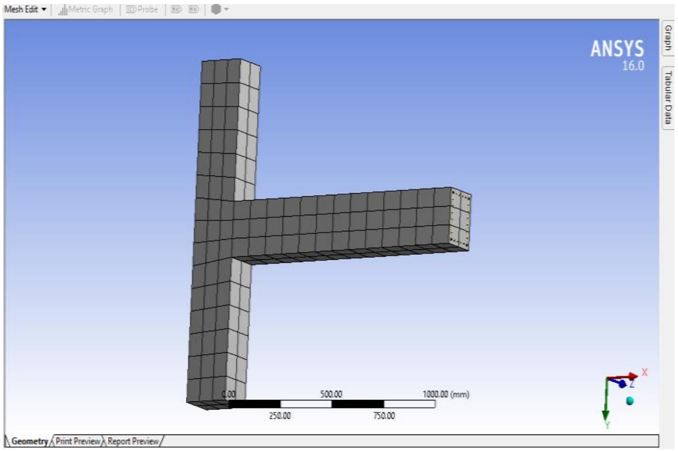


Fig 3: FINITE ELEMENT MESH

III. RESULTS

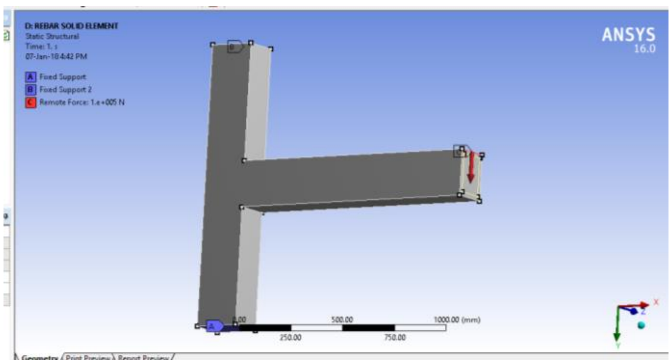


Fig 4 STATIC STRUCTURAL STRESSES

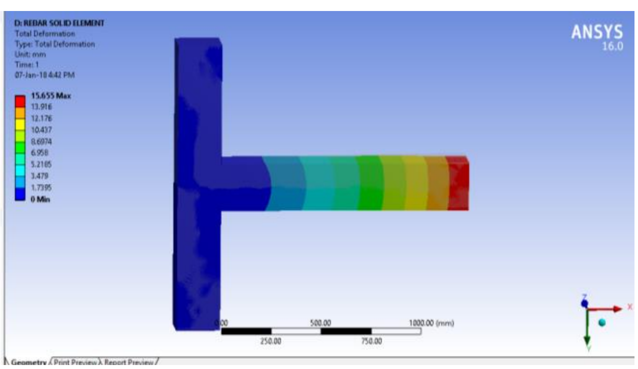


Fig 5: TOTAL DEFORMATION

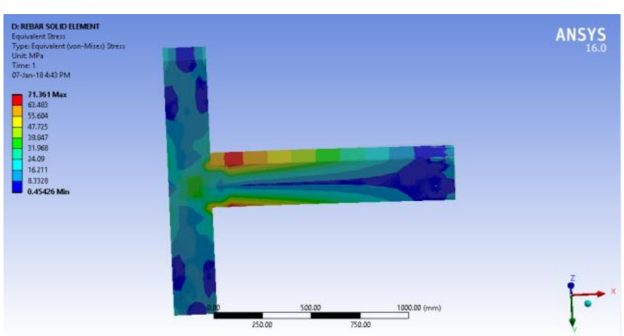


Fig 6: EQUIVALENT STRESS

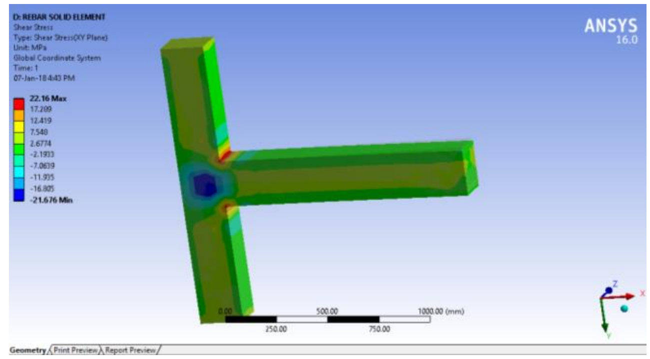


Fig 7: SHEAR STRESS

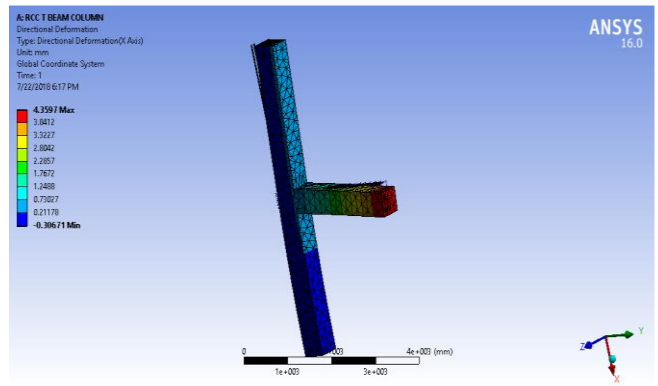


Fig 8: DIRECTIONAL DEFORMATION

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Table 1: Results for 50KN Loading

SR NO.	RCC beam column	PRECAST beam column
Total Deformation (mm)	0.11175	0.0949875
Equivalent Stress (KN/mm^2)	1.9729	1.676965
Shear Stress (KN/mm^2)	2.8298	2.40533
Directional Deformation (mm)	3.45	2.37

IV. CONCLUSION

4.1 Surface bonded GFRP sheets can be used as an effective retrofit technique for RC Structures.

4.2 The GFRP-retrofitted specimen, with a single layer of GFRP in each direction, resisted twice the lateralforce resisted by the existing structure.

4.3 GFRP sheets prevent diagonal shear failure and improved the shear capacity.

4.4 The load carrying capacity of the retrofitted structure is comparatively higher than the normal structure.

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