Seismic Retrofitting of Beam-Column Joints in RCC Buildings Using Jacketing Techniques Along With Cross Bars

J. Premalatha , N. Lakshmipriya

Abstract: ***An analytical study on seismic retrofitting of a reinforced concrete Beam-column joint was performed using FEM modeling . The main objective of this study is to increase the shear capacity and load carrying capacity of the structures using retrofitting techniques. In this study, the retrofitting was done by jacketing methods like carbon fibre reinforced polymer sheets (CFRP), Glass fibre reinforced polymer mesh, Sisal fibres along with crossed bars are carried out using the ANSYS Workbench. The wrapping of beam column joint was done by single, double, triple layer of CFRP, GFRP and Sisal fibres with different thickness. During the analysis one end of the column were fixed. Cyclic loading was applied at the free end of the cantilever beam in Beam-column joint and Fixed load was applied at the top of the column. The load is applied up to the ultimate load to obtain the fatigue failure. This report discusses about the performance of the retrofitted beam column joint; and was compared with the conventional specimen.***

Keywords: Beam-column joint, CFRP, GFRP, Sisal fibres, Jacketing techniques

I. INTRODUCTION

Beam column joints are the most vulnerable portion in a reinforced concrete frame subjected to seismic forces. Fibre Reinforced polymer (FRP) composites are used nowadays for retrofitting of the beam column joints in order to avoid demolition and subsequent rebuilding of RC structures.CFRP is a composite materiel made up of various carbon fibres and thermosetting resins can be effectively used as the confinement for beam column joints by using wrapping techniques. Thus the seismic performance of RC beam column joints can be improved. Glass Fibre Mesh is used where two materials with different coefficient of expansion come together (Joints of Masonry, RCC etc.,). Fibre glass reinforced polymer composite has only isotropic elasticity. cheaper than carbon fibre, it is stronger than many metals by weight and can be molded into complex shapes.

Sisal is a species of Agave consists of stiff fibres and used for production of variety of products. Sisal fibre reinforced composites have high impact strength and comparable tensile and flexural strength, when compared to other lignocellulosic fibers.Additional cross bars provided at the beam column joints in inclined direction, which are connected to the shear reinforcement will enhance the shear strength and stiffness and prevent the degradation of joints by preventing the formation of cracks. A beam column joint model with less stirrups and additional X-bars is used to exhibit equivalent or maximum strength

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II. OBJECTIVE

The main objective of this project is to strengthen and upgrade the seismically affected RC buildings to a more seismic resistance building and to increase it's load carrying capacity at the beam-column joints using jacketing technique and with cross bracings.

A. Specifications of Beam-column joint

Columns were designed for axial loads along with uniaxial bening moment . The beam was designed as a cantilever beam. Figure 1 shows the dimensions of the column, beam and reinforcement details.

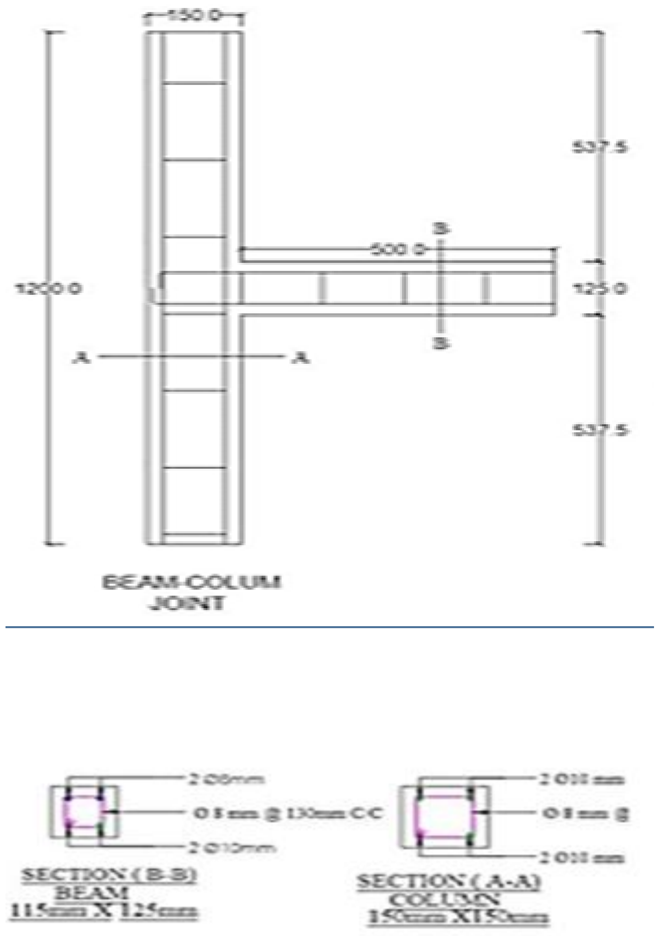

Figure 1. Beam column reinforcement details

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The flow chart represents the details of FRP wrapping, types of FRP wrappings, grade of concrete and the thickness of different layers like single, double, triple. The three types of FRP wrappings are CFRP (carbon fibre reinforced polymer sheet), GFRP (Glass fibre reinforced polymer mesh), Sisal fibres

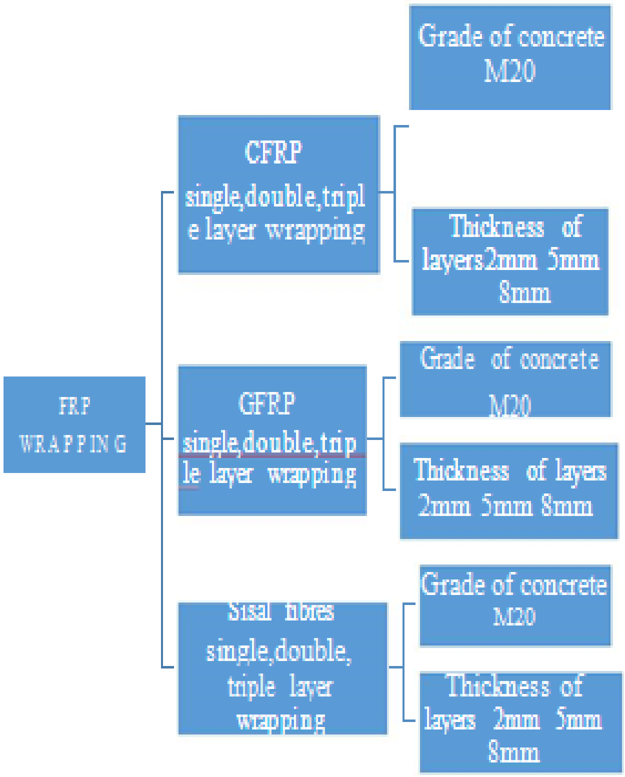

Figure 2 flow chart of modeling using FRP wrapping

B. Modelling and meshing

In modeling phase, connections and properties for the materials are the important parameters were the connections create the bond strength between concrete and steel. Geometry of Beam-column joints are shown below Figure 2 to Figure 5).

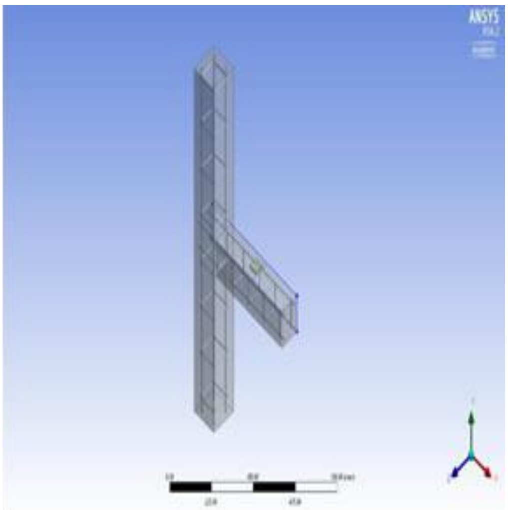

Figure 2. The geometry of the Beam-column joint with wrapping of sheets in different layers and angle of inclination

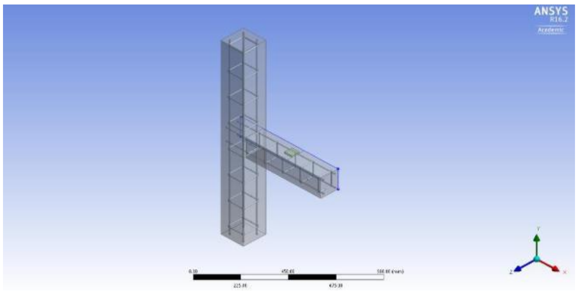

Figure 3.

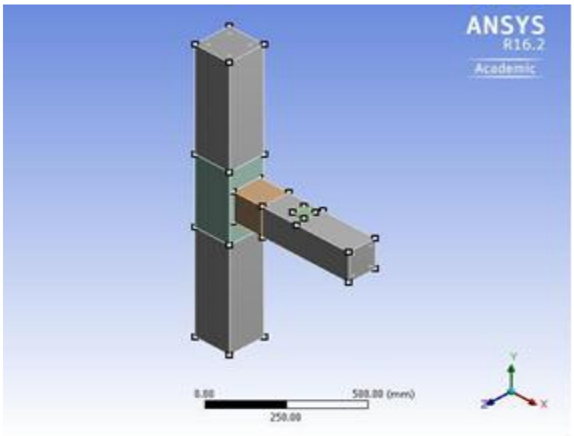

Figure 4.

Axial load was applied on the beam column joint and the ultimate load capacity of the joint is found out from FEM analysis.

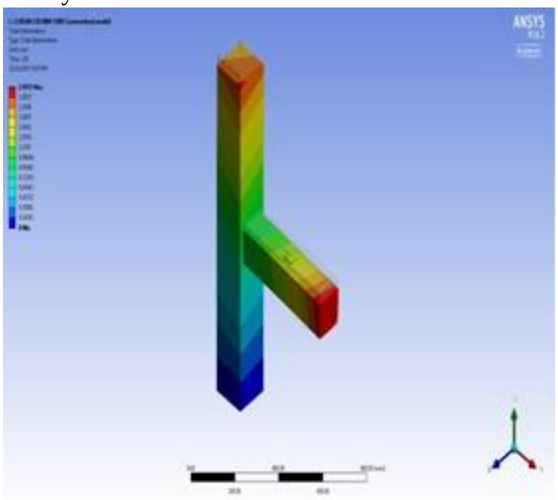

Figure 5

Shear stress, force tending to cause deformation of a material by slippage along a plane or planes parallel to the imposed stress.

C. Load and deflection value

Table 1 shows the relationship deflection, and Ultimate load for different specimen and the stiffness values are shown in Figure 6.

S.NO	SPECIMEN	No.of layers	Thickness (mm)	Ultimate Load (kN)	Deflection (mm)
1	Conventional	-	-	380	67.613
2	Conventional with cross bars	-	-	395	59.028
3	CFRP	1	3	389	59.205
4	GFRP	1	3	385	67.188
5	Sisal Fibres	1	3	383	68.125
6	CFRP	2	5	401	58.677
7	GFRP	2	5	394	67.305
8	Sisal Fibres	2	5	389	67.602
9	CFRP	3	8	418	58.015
10	GFRP	3	8	403	66.449
11	Sisal Fibres	3	8	396	66.012

Table 1 Ultimate loads for various retrofitting technique

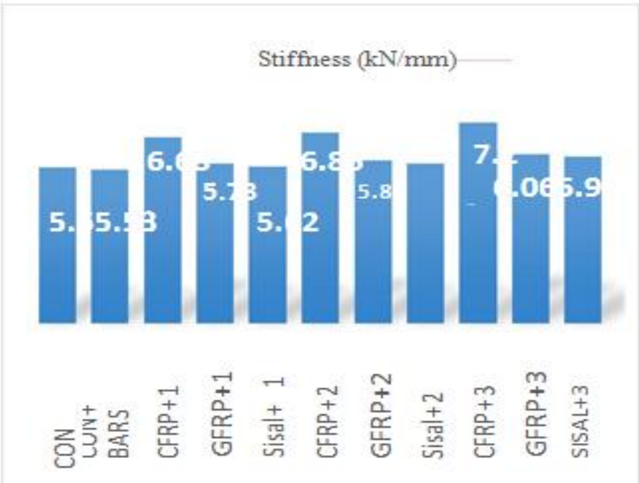

Figure 6. Stiffness (kN/mm) values for various Models

III. CONCLUSION

According to the analytical study and FEM modeling of RCC Beam-column joint with CFRP, GFRP, Sisal fibres wrappings along with cross bars using ANSYS software described in this study, the following conclusions are drawn

1.The FEM modelling of RCC Beam-column joint with FRP wrapping along with cross bars was developed using ANSYS software.

2.The Ultimate load carrying capacity is increased up to 15% after the utilization of the FRP wrapping.

3.Significant increase in strength was observed with increase in thickness of the FRP sheets.

4.When compared with the conventional beam column joint, its stiffness was increased by providing CFRP wrapping.

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