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Structural Behaviour of RC ECC Beam Column Joint Subjected to Cyclic Loading

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***Abstract*: Investigate the effect of PVA fibbers on behaviors of Beam- column joint under cyclic load and investigate effect of PVA fiber's beam column joint subjected under lateral loading. To analysis a numerical model of beam column joint using 3D finite element method. As the percentage of PVA fibbers increases, the load carrying capacity increases up to 0.75% of fibers content, beyond 0.75% increases in PVA fiber's content it will not contribute increasing strength. As the percentage of fibbers increases the beam column joint sections can undergo larger deformation. In 3D FEM adding the various percentage PVA fibers in T, LVDT, L shapes of beam column joint adding fibers in the junction. on. As the percentage of fibers' increases the beam column joint sections can undergo large stress.**

***Keywords*: Beam, column, FEM.**

1. Introduction

The utmost common types of a buildings constructed are the reinforced concrete building. The new methods are improving the reinforced concrete building to banish the several damages. The practice of past upheavals has exposed that influences are the lowest and the utmost disposed part create of concrete structures opposition reverse seismic loading. Under reverse seismic loads, the concrete breakability in stiffness and clip outcomes results in an inflexible shear disaster in the contact middle part, which origins bringing up the rear the lateral load faithfulness of building element. A miscellany of approaches had been settled to achievement the reverse seismic eternity of RC BC connections and frustrate their shear tenancy miserable, amid which gum dammar immunization, toughen jacketing, grooved steel structural retrofitting and the use of FRCC material can be so-called. In addition to consolidation techniques, the creation of acquaintances with better reverse seismic performance such as mass-produced beam-column joints has been promoted.

Engineered cementitious composite as one of the utmost distinguishing brands of strain-acclimatization ECCFRCC has received universal kindness. In order to inflate the manufacturing recommendation possibility of engineering

ECCs FRCC, polyethylene fiber FRCCs have been restrained to yield FRCC ECCs protection all-strength evaluation. The mechanical properties of all-strength-grade polyethylene FRCCs engineering cementitious composites counting the compressive assets, the tensile monies and the fleece properties are presented. Above and beyond, the compressive constitutional model of all-strength-grade polyethylene Engineering Cementitious Concrete FRCCs is also proposed. Furthermore, the rinsing oomph solidity and the rupture energy under uniaxial tension is stated to prove the energy dissipation capacity of polyethylene engineering cementitious composites.

2. Objectives

Following are the objectives defined based on the literature review.

1) To investigate the effect of PVA fibres on behaviour of beam-column joint under lateral load.
2) To investigate effect of PVA fibre's beam column joint subjected under cyclic loading.
3) To analysis a numerical model of beam column joint using 3D finite element method.

3. Methodology

The following steps are used for modelling of BC joint structure in ABAQUS CAE software. The programmer used in FEA is ABAQUS CAE, which is intuitive and consider user interface through the system. Step 1: Defining the archetypal geometry Start ABAQUS CAE, and open part element by double clicking on part. a dialog box of create part appears in the dialog box. create 3D, deformable part with a wire element to represent 1 section and use approximate part size of 2000.Create box and give the dimension beam column. It can be determined that concrete harm mechanics' slant implemented in FE software can be castoff efficiently to archetypal RC beam column joint. the results give accuracy if the fine mesh requires so that aspect ratio of thew element is within acceptable range. Figure shows the default meshing of model size which is 11mm. The aspects of repair and strengthening technique adopted for RC beam column joint model under cyclic loading using nonlinear FE analysis in the cyclic loading analysis the amplitude values are created in load details and the time period as 99sec. Boundary condition for the BC joint in the extant study the uppermost and lowermost appearance of the column in X, Y and Z direction to fully

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constrain. The different material properties for nonlinear analysis, such as deformation, stress strain, are active for the analysis under cyclic loading. the increasing in percentage of the polyvinyl alcohol FRCCs as the 0.25%,0.50%,0.75%,1% and increasing load carrying capacity and the deformation of the beam column joint.

Table 1
Material properties

S. No.	Materials	Parameter	Properties
1	Concrete and steel	Concrete strength	30 MPa
2		Yield strength of steel	420 MPa
3	PVAFRCC composite system	Elongation (%)	6
4		Density (kg/m^3)	1300
5		Fibre length (mm)	6
6		Fibre diameter	0.039
7		Ultimate tensile strength (MPA)	1620
8		Modulus of elasticity (Gpa)	42.8
9		Poisson's ratio	0.25

A. Modelling and Analysis

Modelling and analysis of the beam column joint is carried out using FE software (Abaqus CAE).

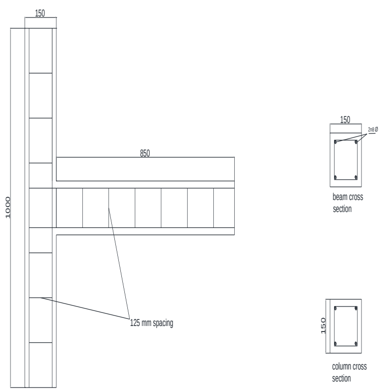

Fig. 1. T shape BC joint

Table 2
Details of the structure T shape BC joint

S.No.	Structure	Element	Details of model
1	Beam	Width	150mm
		Depth	150mm
		Span	850mm
		Top steel	2M 8
		Bottom steel	2M 8
2	Column	Width	150mm
		Depth	150mm
		Span	1000mm
		Longitudinal steel	4M 8
		Transverse spacing	120mm

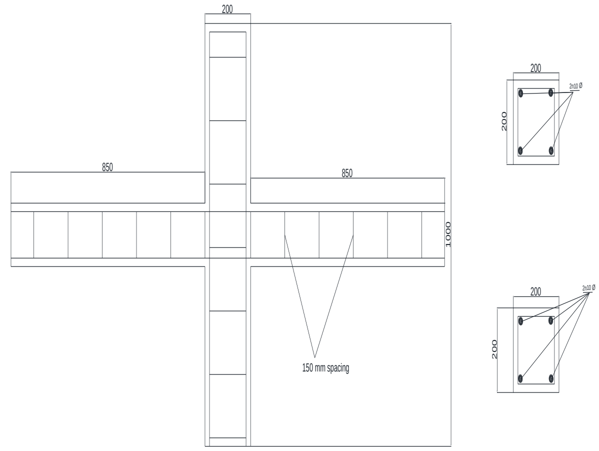

Fig. 2. LVDT shape BC joint

Table 3
Details of the structure LVDT shape BC joint

S.No.	Structure	Element	Details of model
1	Beam	Width	200mm
		Depth	200mm
		Span	850mm
		Top steel	2M10
		Bottom steel	2M10
2	Column	Width	200mm
		Depth	200mm
		Span	1000mm
		Longitudinal steel	4M10
		Transverse spacing	150mm

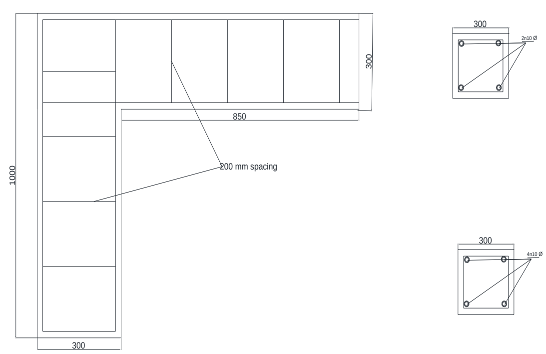

Fig. 3. L shape BC joint

Table 4
Details of the structure L shape BC joint

S.No.	Structure	Component	Details
1	Beam	Width	300mm
		Depth	300mm
		Span	850mm
		Top steel	2M20
		Bottom steel	2M20
2	column	Width	300mm
		Depth	300mm
		Span	1000mm
		Longitudinal steel	4M20
		Transverse spacing	200mm

B. Steps Adopted for Modelling

The following steps are used for modelling of BC joint structure in ABAQUS CAE software. The programmer in FEA is ABAQUS CAE, which is intuitive and consider user interface through the system.

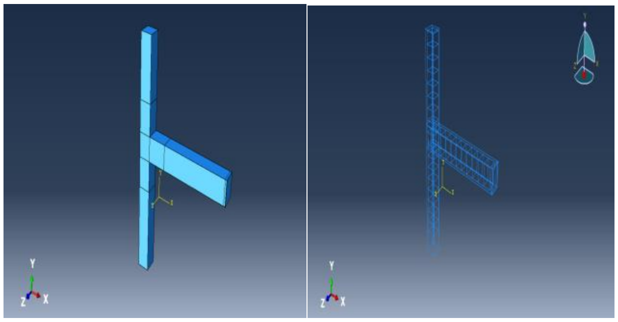

Fig. 4. PVAFRCCs composite adding in BC joint junction

From the figure 4 shows PVAFRCCs composites adding in beam column joint at the junction adding the PVAFRCCs in the material property sections and also adding other material properties. the transverse reinforcement drawn .in assembly section adding the reinforcement bars.

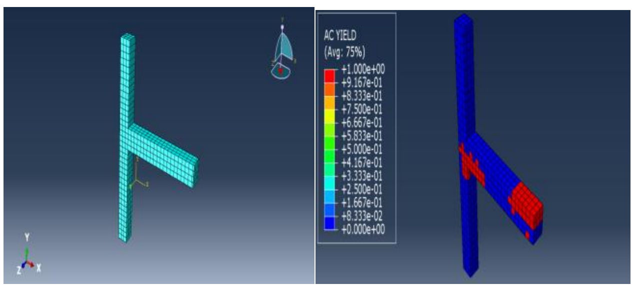

Fig. 5. Meshing and yielding of reinforcement and cracks in the model

From the figure 5 shows that the meshing the T shape beam column joint meshing size is 0.11mm. the yielding of reinforcement and cracks in the model and also showing the deflection.

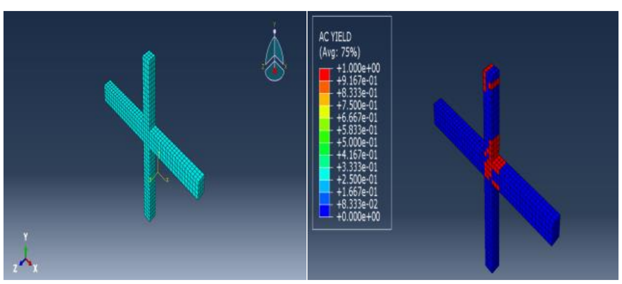

Fig. 6. Meshing and yielding of reinforcement and cracks in the model

From the figure 6 shows that the meshing the T shape of the beam column joint meshing size is 0.11mm. the yielding of reinforcement and cracks in the model and also showing the deflection.

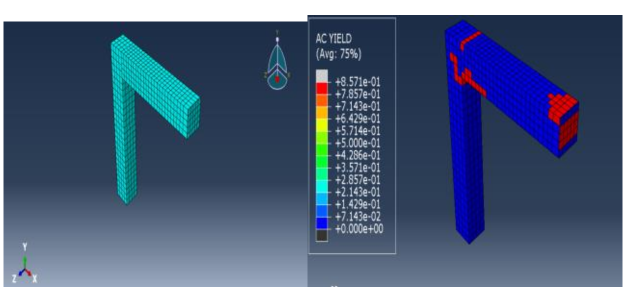

Fig. 7. Meshing and yielding of reinforcement and cracks in the model

From the figure 7 shows that the meshing the T shape of the beam column joint meshing size is 0.11mm. the yielding of reinforcement and cracks in the model and also showing the deflection.

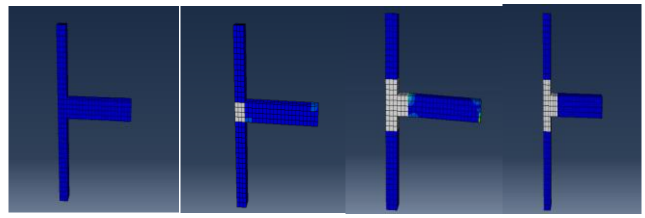

Fig. 8. PVA composite adding in T shape BC joint junction

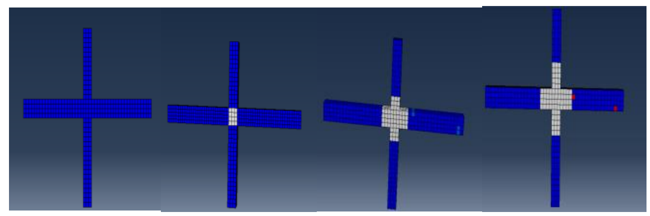

Fig. 9. PVA composite adding in L shape BC joint junction

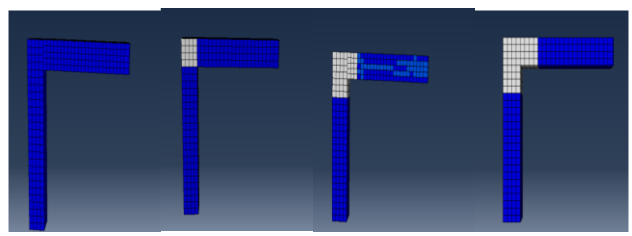

Fig. 10. PVA composite adding in L shape BC joint junction

Table 5
Material properties of CDP

Parameter name	Value
Dilation angle	30degree
Eccentricity	0.1
Fbo/Fco	1.1
K	0.667

The different material properties for nonlinear analysis, such as deformation, stress strain, are active for the analysis under cyclic loading. the increasing in percentage of the poly vinyl alcohol FRCC as the 0.25%,0.50%,0.75%,1% and increasing load carrying capacity and the deformation of the beam column joint.

4. Results and Discussion

A. T shape beam column joint under lateral loading and stress strain

1) Load v/s Displacement graph

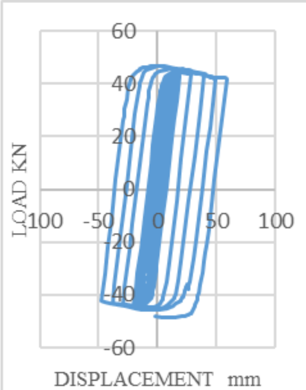

Fig. 11. Load v/s Dis

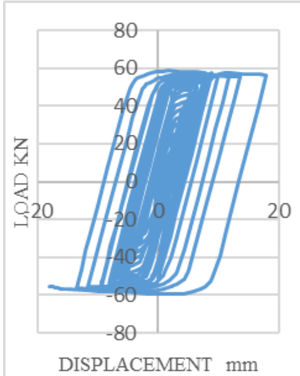

Fig. 12. Load v/s Dis

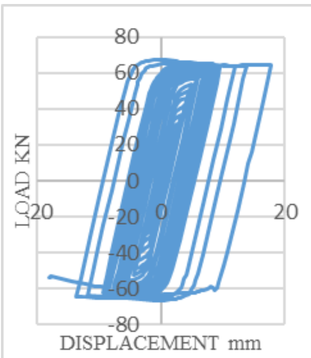

Fig. 13. Load v/s Dis

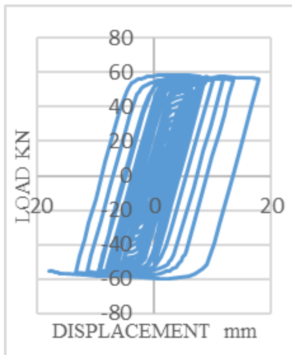

Fig. 14. Load v/s Dis

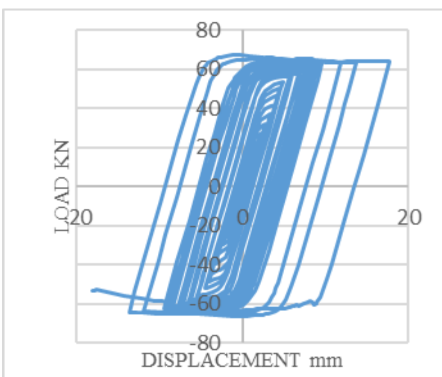

Fig. 15. Load v/s Dis

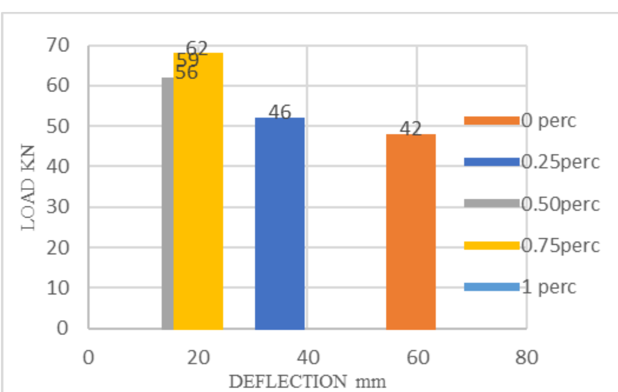

Fig. 16. Load v/s Displacement

From the Fig. 16 is the Comparison of maximum load and minimum deflection and the various percentage of the PVAFRCCs. T shape BC joint is the maximum load is 64KN and the deflection is the 18.4mm. it shows that the 0.75% of the PVAFRCCs is the maximum strengthening, more loading carrying capacity and less deformation. Without and with1% PVAFRCCs is the low load carrying capacity and larger deformation.

Table 6
The T shape BC joint load vs deflection

Model name	% PVAFRCCs	Load @ failure (KN)	Deflection (mm)
Model 1	0%	42	59
Model 2	0.25%	46	35
Model 3	0.50%	56	18.6
Model 4	0.75%	64	18.4
Model 5	1%	59	18.2

B. The results stress v/s strain without and with various percentage of PVAFRCCs

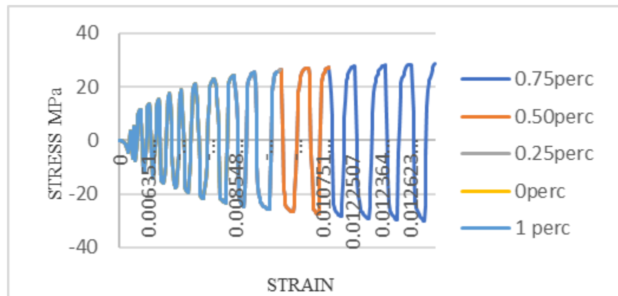

Fig. 17. Stress v/s strain without and with various percentage of PVAFRCCs

It showing that from the 17 graph it is clarifying that maximum stress point is 30 MPa stress and 0.01 strain has recorded with 0.75% of PVAFRCCs. without PVAFRCCs is the 25 MPa stress and 0.011 strain it is minimum stress.

Table 7
Results stress v/s strain

Model name	% PVAFRCCs	Stress (MPa)	Strain
Model 1	0%	24	0.016
Model 2	0.25%	26	0.011
Model 3	0.50%	28	0.012
Model 4	0.75%	30	0.0123
Model 5	1%	25	0.011

C. LVDT shape of BC joint comparing the results load v/s deflection without and with various percentage of PVAFRCCs

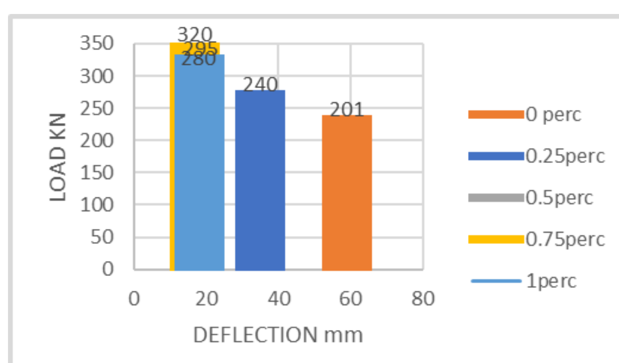

Fig. 18. Maximum load and minimum deflection of the without and with various percentage of IN PVAFRCCS LVDT BC joint

From the Fig. 18 is the Comparison of maximum load and minimum deflection and the variation of the PVAFRCC. LVDT shape BC joint is the maximum load is 320KN and the deflection is the 18.2 mm. it shows that the 0.75% PVAFRCCs is the more strengthening capacity and larger deformation more loading carrying capacity. without and with 1%PVAFRCCs is the larger deflection and low loading carrying capacity.

Table 8
The LVDT shape BC joint load v/s deflection

Model name	% PVAFRCCs	Load @ failure (KN)	Deflection (mm)
Model6	0%	201	59
Model 7	0.25%	240	35
Model 8	0.50%	280	17.3
Model 9	0.75%	320	18.2
Model10	1%	295	18.4

D. LVDT shape of BC joint results stress v/s strain without and with various percentage of PVAFRCCs

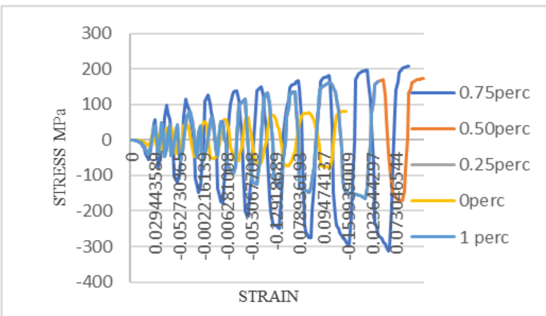

Fig. 19. LVDT shape of BC joint results stress v/s strain without and with various percentage of PVAFRCCs

It showing that from the fig. 19 it is clarifying that the maximum stress point is 220 MPa stress and 0.12 strain has recorded with 0.75% of PVAFRCCs. without PVA fibbers is the 99 MPa stress and 0.014 strain it is the minimum stress point.

Table 9
The LVDT shape BC joint stress v/s strain

Model name	% PVAFRCCs	Stress (MPa)	Strain
Model 6	0%	99	0.014
Model 7	0.25%	152	0.056
Model 8	0.50%	182	0.067
Model 9	0.75%	220	0.12
Model 10	1%	172	0.058

E. L shape of BC joint BC joint comparing the results load v/s deformation without and with various percentage of PVAFRCCs

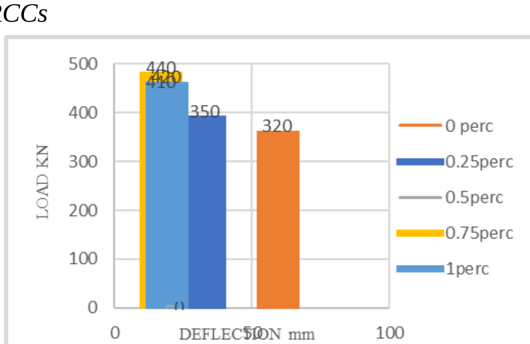

Fig. 20. L shape of BC joint BC joint comparing the results load v/s deformation without and with various percentage of PVAFRCCs

From the Fig. 20 is the Comparison of maximum load and minimum deflection and the variation of the PVAFRCC. LVDT shape BC joint is the maximum load is 430KN and the deflection is the 18.5mm. it shows that the 0.75% of PVAFRCCs is the more strengthening capacity and more loading carrying capacity, larger deformation. without PVAFRCC and with 1% PVAFRCCs is the larger deflection and low loading carrying capacity.

Table 10
L shape BC joint load v/s deflection

Model name	% PVAFRCCs	Load @ failure (KN)	Deflection (mm)
Model 11	0%	340	14
Model 12	0.25%	349	11.2
Model 13	0.50%	375	18.42
Model 14	0.75%	430	18.5
Model 15	1%	380	18.6

F. L shape of BC joint BC joint comparing the results stress v/s strain without and with various percentage of PVAFRCCs

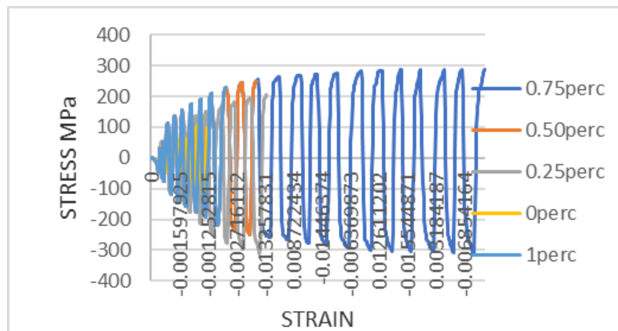

Fig. 21. L shape of BC joint BC joint comparing the results load v/s deformation without and with various percentage of PVAFRCCs

It showing that from the graph it is clarifying that maximum stress point is 295 MPa stress and 0.14 strain has recorded with 0.75 % of PVAFARCCs. Without PVA fibbers is the 175 MPa stress and 0.06 strain it is the minimum stress point.

Table 11
The L shape BC joint stress v/s strain

Model name	% PVAFRCCs	Stress (MPa)	Strain
Model 11	0%	175	0.062
Model 12	0.25%	202	0.12
Model 13	0.50%	245	0.011
Model 14	0.75%	295	0.014
Model 15	1%	230	0.013

5. Conclusion

The following conclusion can be drawn.

1. As the percentage of PVA fibres increases, the load carrying capacity increases up to 0.75% of fibres content, beyond 0.75% increases in PVA fibre's content it will not contribute increasing strength.as the percentage of fibres increases the beam column joint sections can undergo larger deformation.
2. As the percentage of fibre's increases, the beam column joint sections can undergo large stress.
3. As the percentage of fibres increases the beam column joint sections can undergo larger deformation.

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