# Dynamic Behavior of Reinforced Concrete Beam Column Joint Strengthened with Concrete Jacketing

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***Abstract*—To avoid disaster in future calamities, one of the method of retrofitting the reinforced concrete building is concrete jacketing. The retrofitting are done by introducing additional stirrups and longitudinal bars to the existing building along with layer of concrete, to enhance the flexure and shear capacity. In this study, model a T-beam-column joint, and to analyse these under cyclic loading conditions. Then strengthen the same T-beam-column joint using concrete jacketing and reanalyse under the same loading conditions.**

***Keywords*— T-beam column joint, j-hooks, jacketing.**

## I. INTRODUCTION

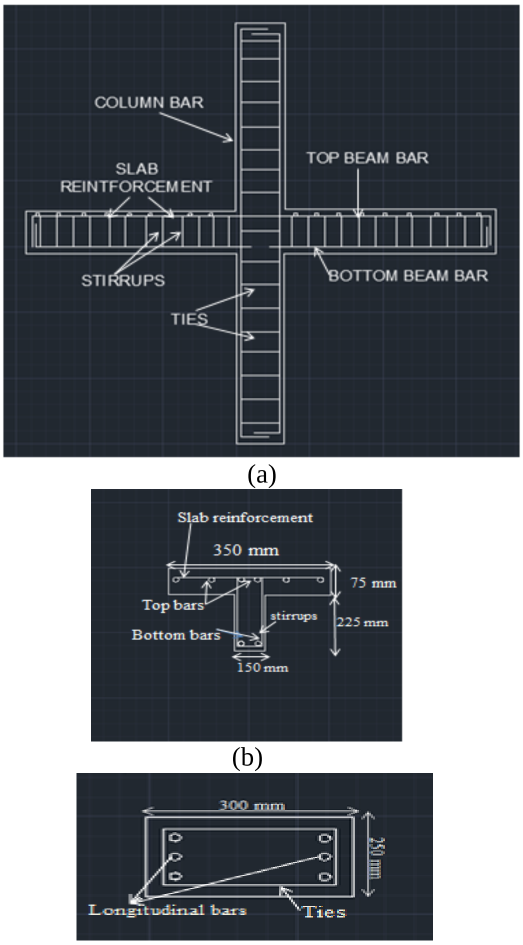
Natural calamities such as earthquakes, tornados, and tsunamis threaten the integrity of civil infrastructure and safety of their users. To assure the safety of the people; older and existing structures need to be repaired and strengthened to prevent their collapse. Efficient methods need to be developed for structural repair and strengthening. Jacketing is one of the methods for strengthening of structural members. In this study, the reinforced concrete jacketing method will be used. The retrofitting is done by introducing additional stirrups and longitudinal bars to the existing building along with layer of concrete, to enhance the flexure and shear capacity. Retrofitting ensures strengthening of existing structures and prevents excess damage during future disasters. In existing building designed as per current code of practises there may be lack of seismic strength and detailing required due to limited technical expertise. According to the availability of resources and seismic evaluation of building the retrofitting scheme is selected. For a structure, a combination of retrofit strategies is namely-global and local. The global retrofit strategies where applied to enhance the overall performance of the building.The main strategy of this retrofitting were resistance of seismic force acted in the building. The global retrofit includes adding of shear wall, braced frame and base isolation. The main target of local retrofitting strategy was resistance of seismic force acted in the building. One method of retrofitting the beams is by concrete jacketing. This Jacketing was done to the structural members like columns, beams, column-beam joint and foundation. Concrete jacketing done by adding a new layer of concrete with longitudinal reinforcement and stirrups.To improve the flexural and shear capacities.

## II. OBJECTIVE

To strengthen the T-beam - column joint using concrete jacketing and analyse under the different loading conditions.

## III. SPECIMEN DETAILS

One reference and one retrofitted specimens are tested. The both specimens are tested under cyclic loading. The height of the specimen from bottom fixed support to the top fixed support is 2.1 m. the total length of the beam was 3 m. The stub beams in transverse direction and slab over the beams. *Fig 1* shows the section details of the specimen.




(c)

Fig 1: section details of the specimen. (a)elevation of specimen: (b)beam section: (c) column section.

Reintforcement details of column-beam joint are shown in Table 1.

TABLE 1: Reintforcement Details

| | | |
|---|---|---|
| Beam section | Slab reinforcement | 6Ø @ 200 c/c |
| | Top bar | 6-10Ø |
| | Bottom bar | 2-8Ø |
| | stirrups | 2 legged, 8Ø @150 c/c in the middle third of the span, and @200 c/c at the ends |
| Column section | Longitudinal Bar | 6-12Ø |
| | Ties | 10 Ø@ 150c/c |

## IV. MODEL OF BEAM-COLUMN JOINT WITHOUT JACKETING

The 3-dimensional Finite element model of beam-column joint was shown in Fig 1.

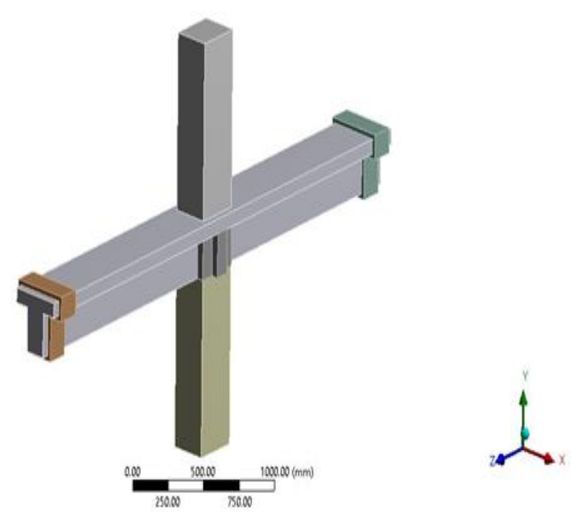



Fig 2: model of beam-column joint

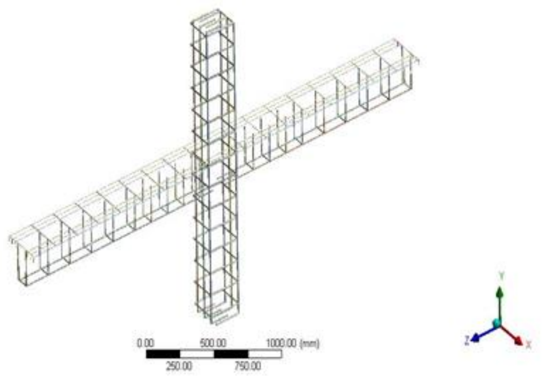



Fig 3: Detailing of column-beam joint

The reinforcement details and support condition of beam-column joint was shown in below figures (Fig3 and Fig 4). The both ends of column are fixed and the beam ends are free, and apply cyclic loading on both free ends.

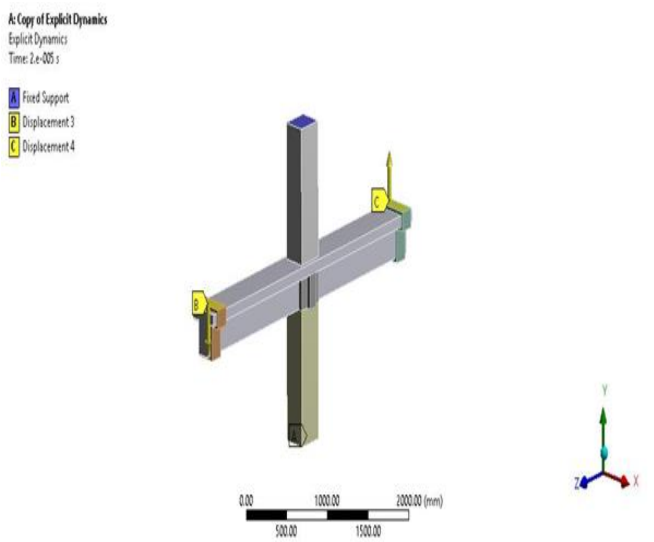



Fig 4: support condition of beam-column joint.

The details of input displacement cycle are shown in fig 5.

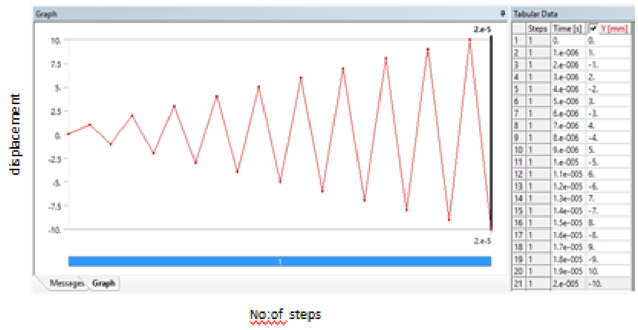



Fig 5: Input displacement cycle

## V. RESULT

The dynamic analysis of beam-column joint without jacketing using ANSYS 16 is done. The value of total deformation and the corresponding equivalent stress is obtained, and also draw the hysteresis curve.

### A. *Total Deformation*

The maximum deformation value obtained is 11.156 mm

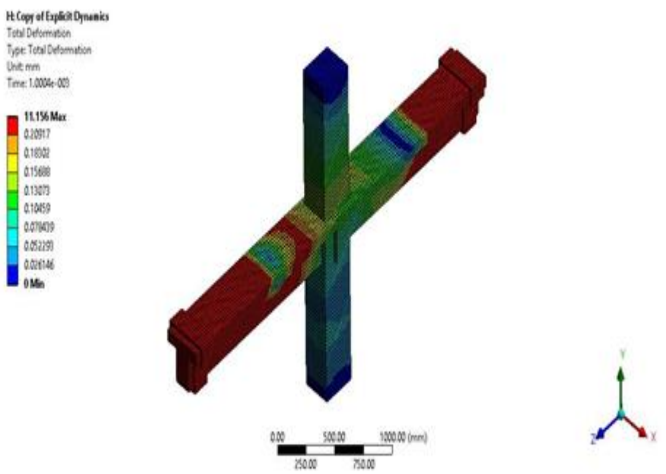


Fig 6: Total Deformation of Beam-Column Joint.

### B. *Equivalent Stress*

The equivalent stress obtained from the dynamic analysis is 43.54MPa

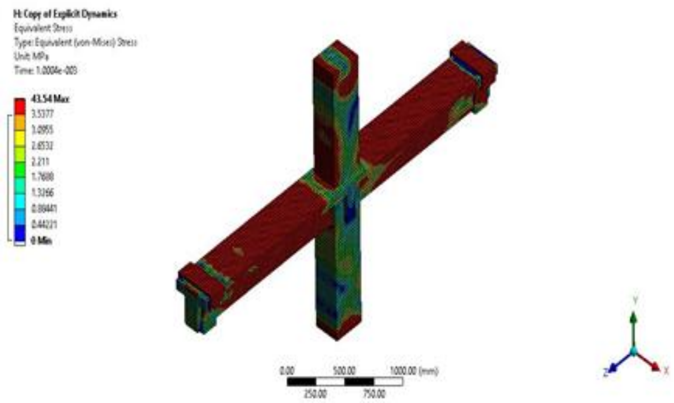


Fig 7: Equivalent stress in beam-column joint

### C. *Load Versus Displacement Curve*

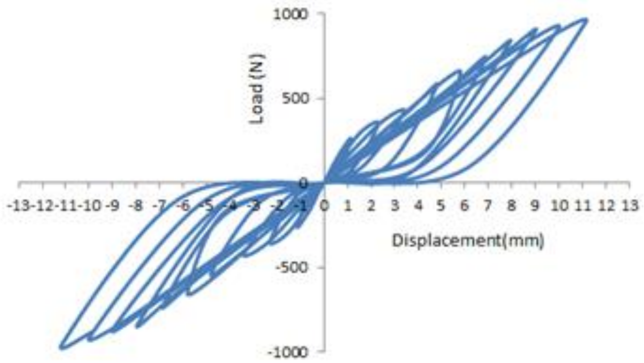



Fig 8:Load versus displacement curve

## VI. MODEL OF BEAM-COLUMN JOINT WITH JACKETING

The jacketing is done by the anchorage of additional reinforcement cage to the existing beam. The reinforcement cage consists of open stirrups which is then attached to the slab by using J-hooks.

### A. *Additional Reintforcement Details*

TABLE 2. REINTFORCEMENT DETAILS

| | |
|---|---|
| J-hooks | 20mm φ , 200mm spacing |
| Longitudinal Bottom Bars | 2-10φ |
| Transverse Bars | 2 legged,8mmφ @ 100 c/c in the middle third of the span @ 150 c/c at the ends |

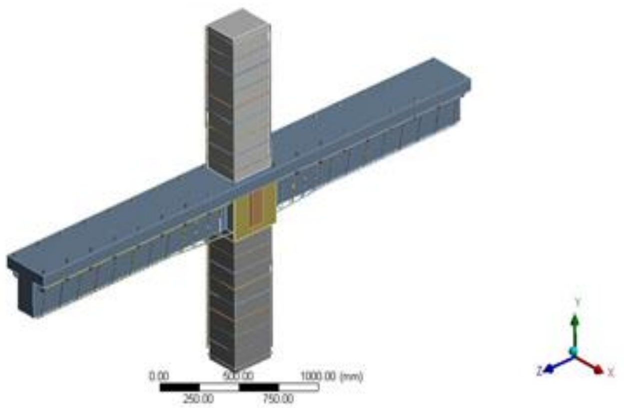


Fig 9: jacketed beam-column joint

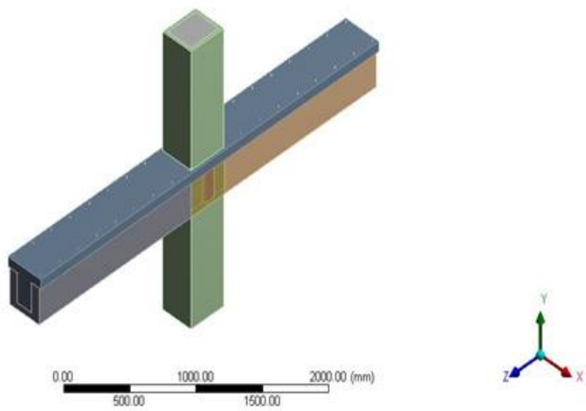


Fig 10: model of beam-column joint

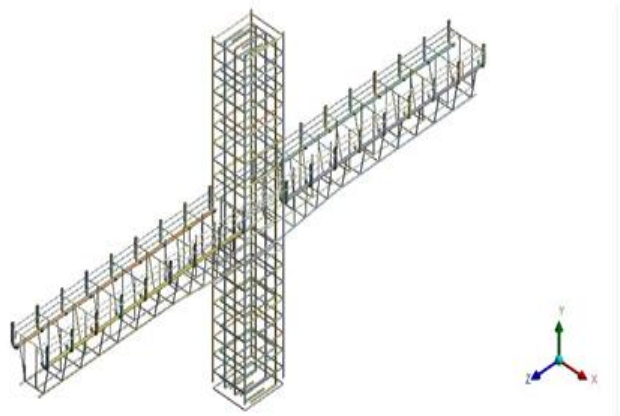


Fig 11: reinforcement details of beam-column joint

The reinforcement details and support condition of beam-column joint was shown in below figure (Fig11 and Fig12). The both ends of column are fixed and the ends of beam are free, and cyclic loading is applied on both the free ends.

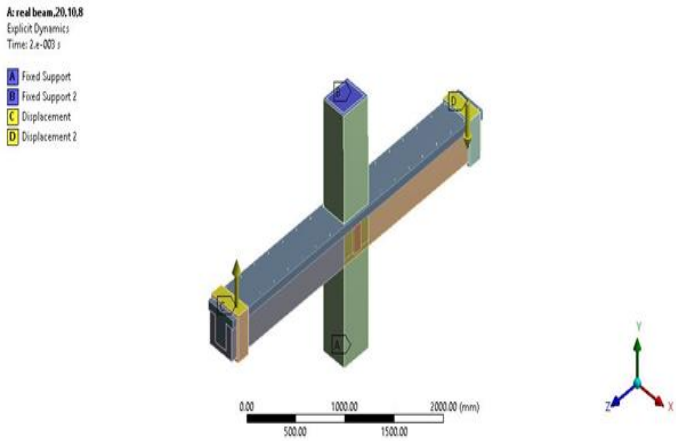



Fig 12: support condition of beam-column joint

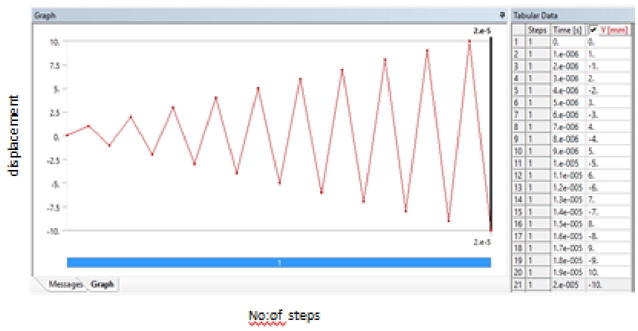



Fig 13: input displacement cycle

## VII. RESULT

The dynamic analysis of beam-column joint with jacketing using ANSYS 16 is done. Obtained the value of total deformation and the equivalent stress, and also draw the hysteresis curve.

### *A. TOTAL DEFORMATION*

The maximum deformation value obtained is 10.398 mm

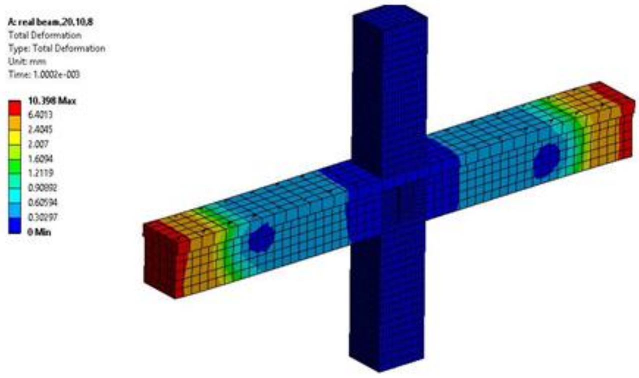



Fig 14: Total Deformation of Beam-Column Joint.

### *B. EQUIVALENT STRESS*

The equivalent stress obtained from the dynamic analysis is 34.262 MPa

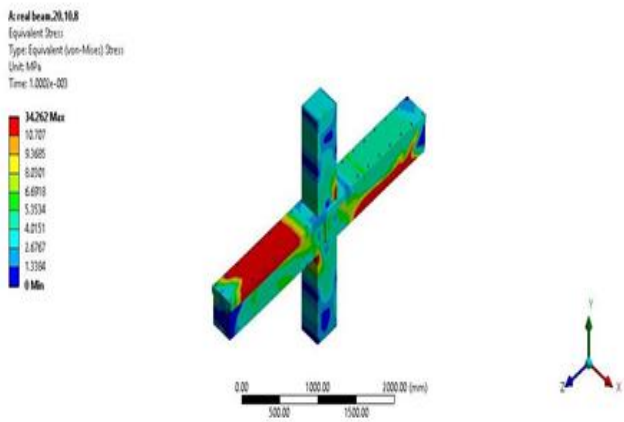
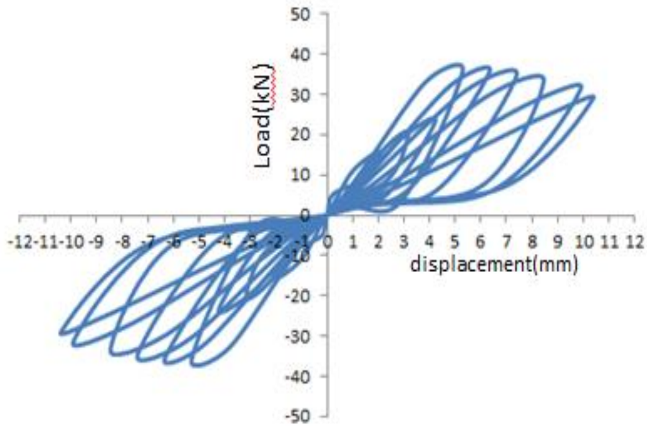



Fig 15: Equivalent stress in beam-column joint

### *C. Load Versus Displacement Curve*



## VIII. CONCLUSION

- The percentage variation of deformation in beam-column joint with and without jacketing is found to be 7.31%.
- The percentage variation of stress in beam-column joint with and without jacketing is found to be 27.07%.
- From the obtained data it is clear that the provision of steel jacketing reduce the stress demands on the components.
- The larger and more closely spaced stirrups significantly increase the specimen's ability to resist the larger number of cycles in the inelastic range leading to a greater energy dissipation capacity.

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