ANALYSIS OF CONCRETE-ENCASED CFST BEAM-COLUMN JOINTS.

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Abstract- *Beam- column joints are the most seismically affected element in a framed structure, hence seismic performance of joint is of great importance for overall structural safety. In order to make appropriate design decisions for joints, it is necessary to know how joints behave. Concrete-encased concrete-filled steel tubular (CFST) beam-column joints consist of CFST inside and reinforced concrete outside. Several investigations have been conducted on joints with steel beams and RC columns and with steel beams and CFST columns. This paper studies load carrying capacity of concrete-encased CFST beam-column joints by ANSYS software.*

Key Words: Beam-column joints, CFST, load carrying capacity.

1. INTRODUCTION

The intersection portion common to column and beam in a building is known as beam column joint. Frames that resist moment in reinforced concrete, the joint in between the column and beam is critical. During severe ground shaking, it is exposed to large forces, and its behaviour has a notable impact on the response of the structure. Connection between beam and column in a frame structure is most likely to sustain damage during a seismic disaster. The proper design and execution of it is necessary for a better performance. In order to make appropriate design decisions for joints, you need to know how joints behave. A composite element is a structural element that is made of two or more different materials. Composites offer the benefit of combining the properties of each material into one unit that performs more effectively than its constituent parts individually. One of the most popularly used composite members in the structural engineering industry is steel-concrete composite. We all know that concrete is week in tension and good in compression also steel is week in compression and good in tension, by combining both we can make a member which exhibits both properties of concrete and steel and hence give better performance. Beam-column joints with concrete filled steel tube (CFST) with concrete encasing consisting CFST inside and concrete with reinforcing outside. Steel tubes filled with concrete (CFST) have a number of structural advantages, such as increased strength and resistance to fire attacks, as well as high ductility and energy absorption efficiency. The embedded steel tubes in such joints make them stronger, more ductile, and more able to carry more weight than ordinary concrete beam-column joints. Compared with ordinary CFST members, the members with concrete encasing CFST have better fire resistance and durability by the protection of external RC component. Also, it shows favorable seismic behaviour and can be used in earthquake-prone areas. Moreover, construction speed is increased because the CFST can be constructed initially to carry the total construction loadings and the concrete part and reinforcing bars are poured or installed later.

CFST beam- to column joint with concrete encasing is made up of CFST as core and reinforced concrete (RC) outside. The Performance of concrete-encased CFST beam-column joints is to be evaluated by finite element method using ANSYS.

1.1 AIM & OBJECTIVE

- To study load carrying capacity of encased CFST beam-column joints.
- To analyze concrete encased CFST beam-column joints cyclically using ANSYS.

2. MODELLING AND ANALYSIS OF CONCRETE ENCASED CFST BEAM-COLUMN JOINT.

The Parametric Studies to be done are:

- Effect of concrete encased CFST in different types of joints.
- Effect of different mix proportions of concrete.

The parameters considered for the modelling and analysis of exterior CFST column- steel beam joint is:

- Steel beam- concrete encased CFST column joint is considered
- Length of beam: 1.75 m
- Length of column: 1.5 m
- Reinforcement
    - Main bar: 18mm
    - Middle bar: 14mm
    - Stirrups: 8mm
- Mix proportion of concrete: M25

And material properties are:

For Structural Steel,

- Density: 7850 Kg/m^3
- Young's modulus: 2 x 10^5 MPa
- Poisson's ratio: 0.3
- Tensile yield strength: 250 MPa
- Tensile ultimate strength: 460 MPa
- Compressive yield strength: 250 MPa

2.1 EXTERIOR JOINT WITH M25 GRADE CONCRETE

- Density: 2300Kg/ m^3
- Young's modulus: 29250 MPa
- Poisson's ratio: 0.18
- compressive ultimate strength: 25 MPa

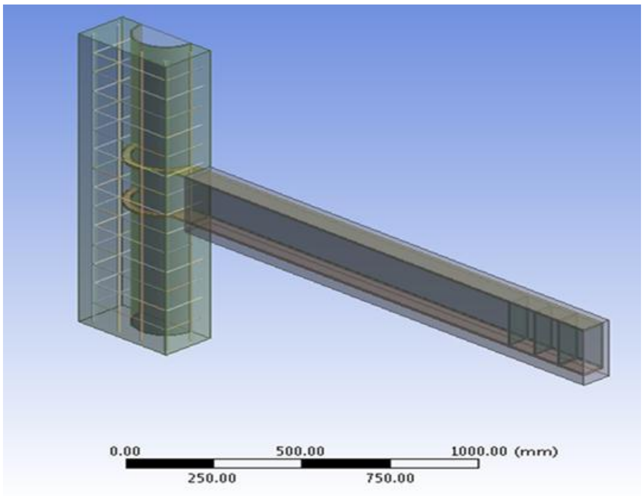

Fig-1: symmetry model used for analysis of exterior CFST joint.

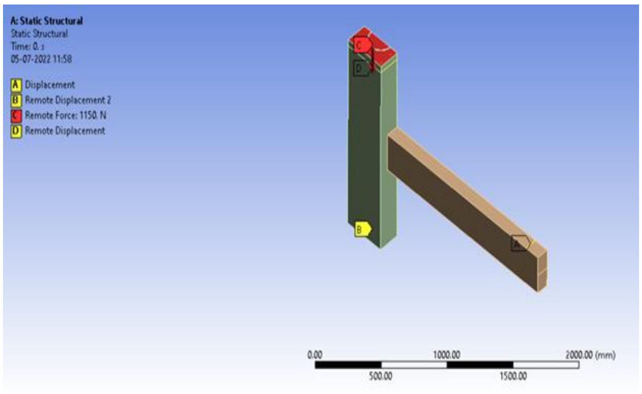

Fig-2: boundary conditions of exterior CFST joint.

Table -1: maximum load carried by exterior CFST joint.

Pmax (+) (KN)	149.09
Pmax (-) (KN)	140.2

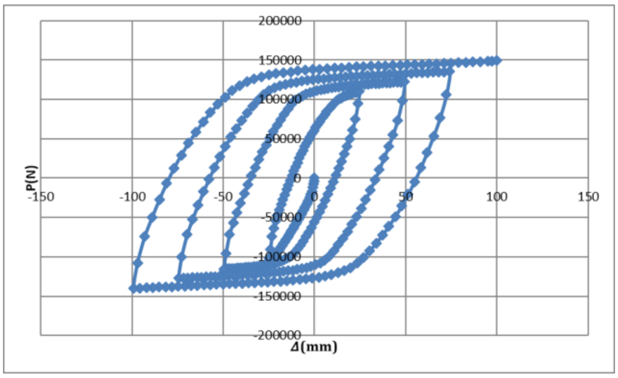

Chart -1: Hysteresis loop of exterior joint.

2.2 3D JOINT WITH M25 GRADE CONCRETE

- Density: 2300Kg/ m^3
- Young's modulus: 29250 MPa
- Poisson's ratio: 0.18
- compressive ultimate strength: 25 MPa

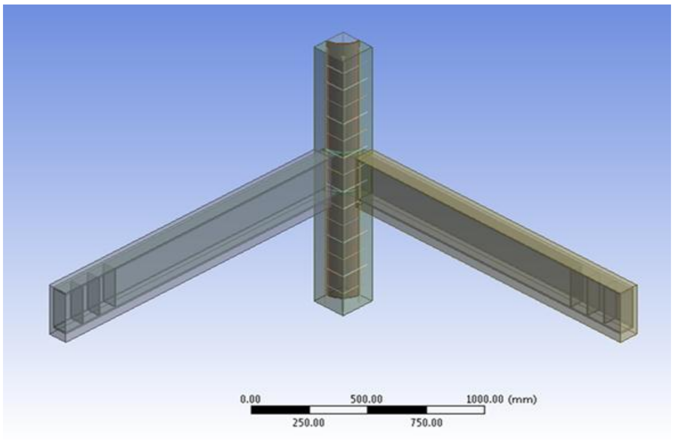

Fig-3: symmetry model used for analysis of 3D CFST joint.

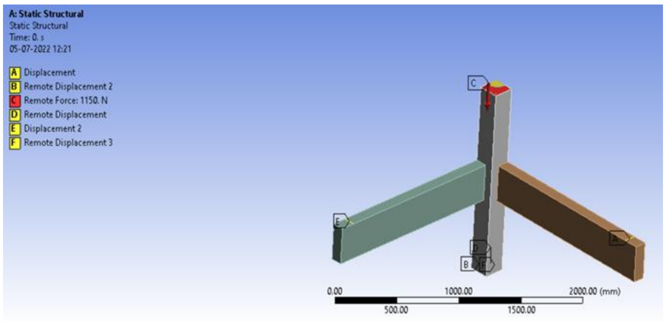

Fig-4: boundary conditions of 3D CFST joint.

Table -2: maximum load carried by 3D CFST joint.

Pmax (+) (KN)	134.2
Pmax (-) (KN)	131.7

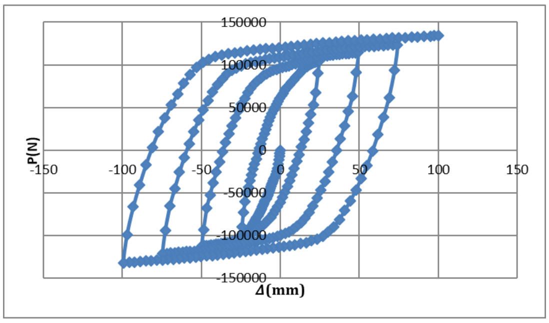

Chart-2: Hysteresis loop of 3D joint.

2.3 PLANAR JOINT WITH M25 GRADE CONCRETE

- Density: 2300Kg/ m^3
- Young's modulus: 29250 MPa
- Poisson's ratio: 0.18
- compressive ultimate strength: 25 MPa

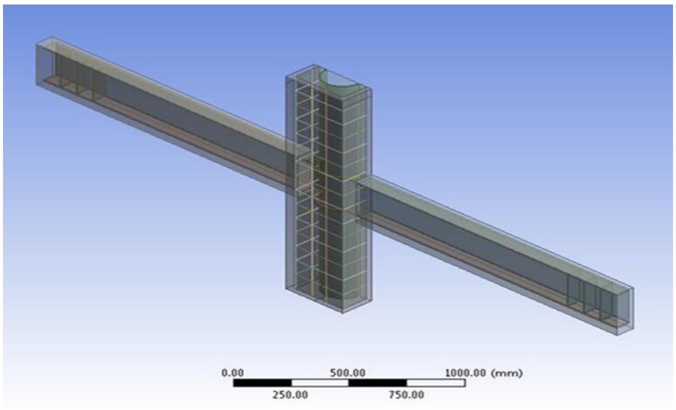

Fig-5: symmetry model used for analysis of planar CFST joint.

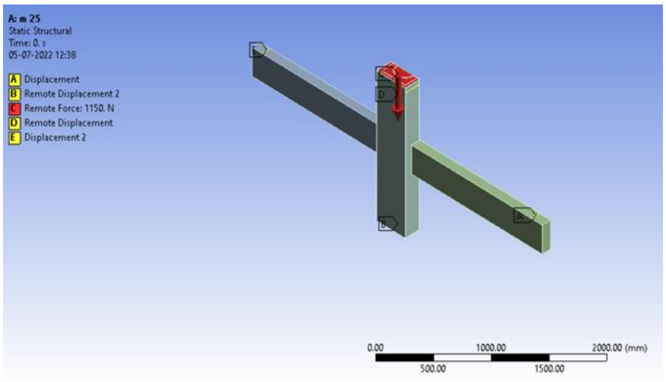

Fig-6: boundary conditions of planar CFST joint.

Table -3: maximum load carried by planar CFST joint.

Pmax (+) (kN)	249.4
Pmax (-) (kN)	253.02

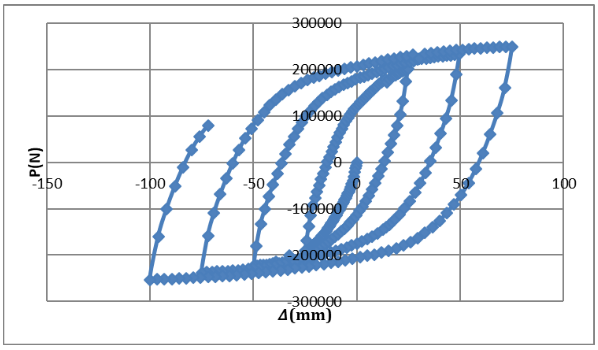

Chart-3: Hysteresis loop of planar joint.

2.4 EXTERIOR JOINT WITH M30 GRADE CONCRETE

- Density: 2300Kg/ m^3
- Young's modulus: 27117 MPa
- Poisson's ratio: 0.18
- compressive ultimate strength: 30 MPa

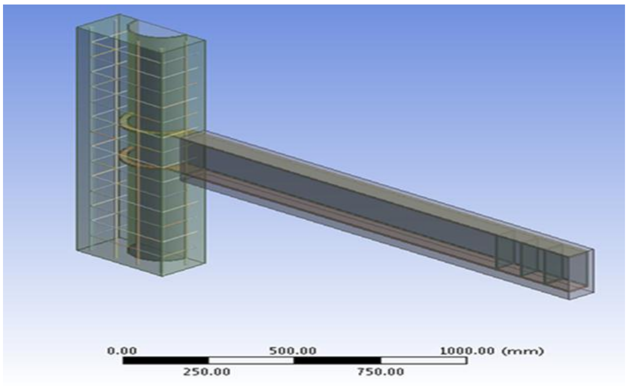

Fig-7: symmetry model used for analysis of exterior CFST joint.

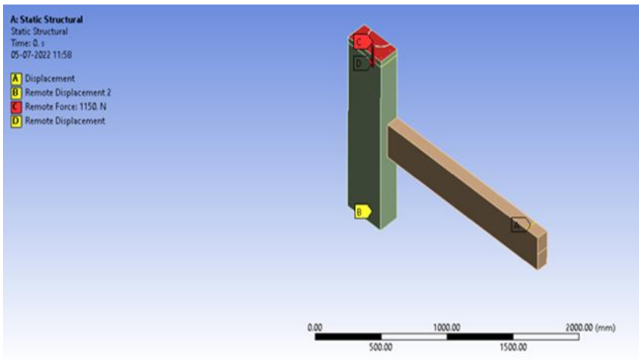

Fig-8: boundary conditions of exterior CFST joint.

Table -4: maximum load carried by exterior CFST joint.

Pmax (+) (KN)	162.78
Pmax (-) (KN)	153.15

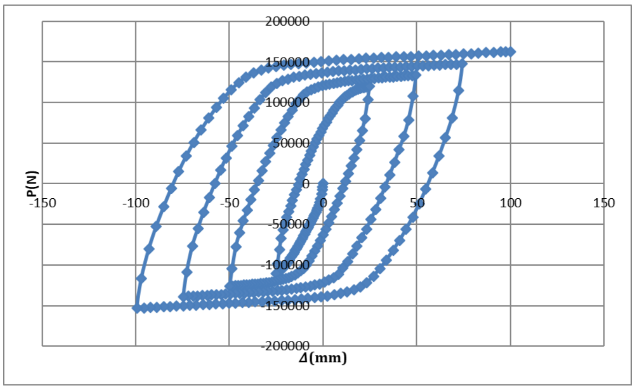

Chart -4: Hysteresis loop of exterior joint.

2.5 3D JOINT WITH M30 GRADE CONCRETE

- Density: 2300Kg/ m^3
- Young's modulus: 27117 MPa
- Poisson's ratio: 0.18
- compressive ultimate strength: 30 MPa

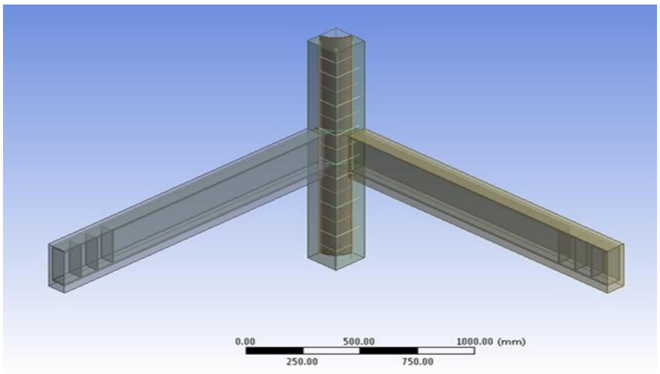

Fig-9: symmetry model used for analysis of 3D CFST joint.

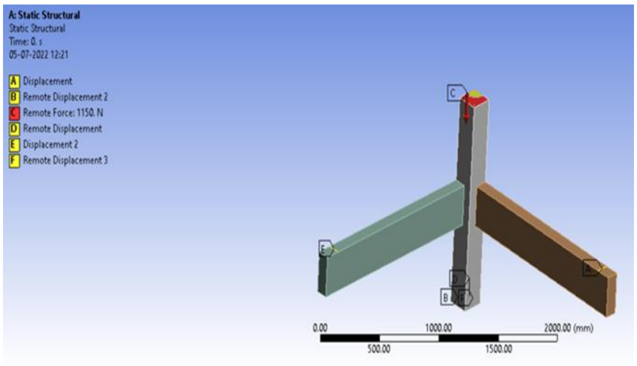

Fig-10: boundary conditions of 3D CFST joint.

Table -5: maximum load carried by 3D CFST joint.

Pmax (+) (KN)	146.1
Pmax (-) (KN)	143.8

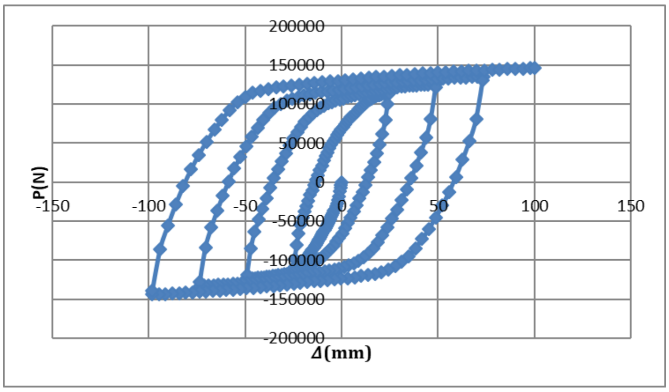

Chart-5: Hysteresis loop of 3D joint.

2.6 PLANAR JOINT WITH M30 GRADE CONCRETE

- Density: 2300Kg/ m^3
- Young's modulus: 27117 MPa
- Poisson's ratio: 0.18
- compressive ultimate strength: 30 MPa

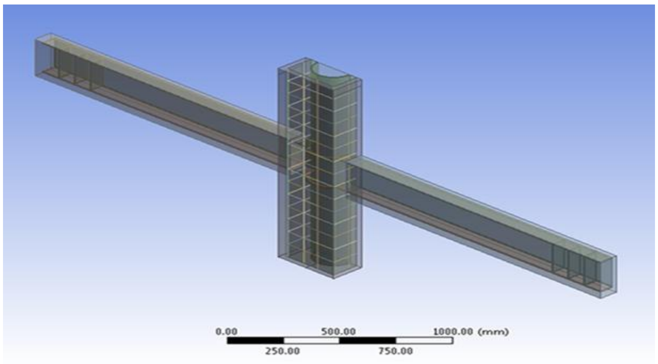

Fig-11: symmetry model used for analysis of planar CFST joint.

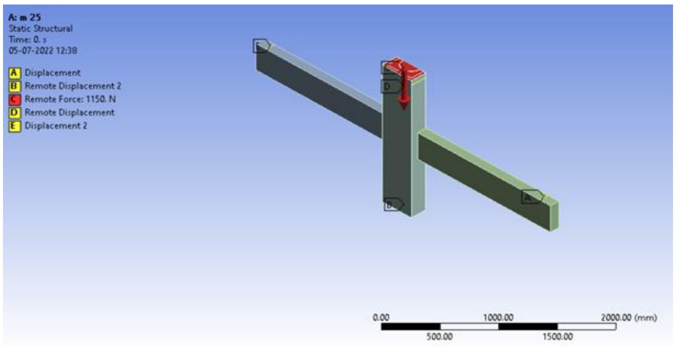

Fig-12: boundary conditions of exterior CFST joint.

Table -6: maximum load carried by planar CFST joint.

Pmax (+) (KN)	275.1
Pmax (-) (KN)	262.29

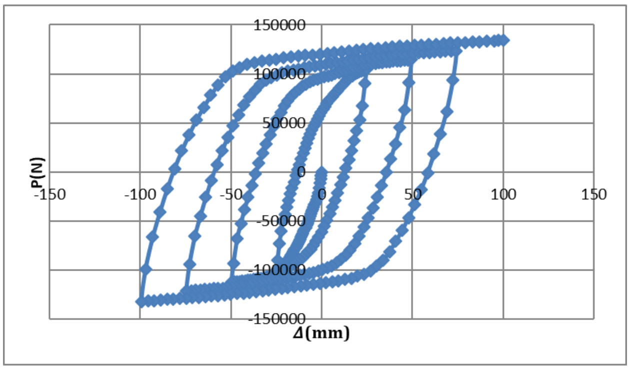

Chart-6: Hysteresis loop of planar joint.

3. CONCLUSIONS

The obtained results for concrete encased beam-column joints are as follows:

		Pmax (+) (kN)	Pmax (-) (kN)
Exterior joint	M25	149.09	140.2
	M30	162.78	153.15
3D joint	M25	134.2	131.7
	M30	146.1	143.8
Planar joint	M25	249.4	253.02
	M30	275.1	262.29

The concrete encased beam-column joints show better load carrying capacity. The embedded steel tubes in concrete-encased CFST beam-column joints make them stronger, more ductile, and more able to carry more weight than ordinary concrete beam-column joints. Compared with conventional CFST members, the concrete-encased CFST member have better durability and higher fire resistance due to the protection of external RC component. Hence it can be used for the construction of high-rise buildings and buildings in highly seismic prone areas.

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