NON-LINEAR FINITE ELEMENTS ANALYSIS OF INFILLED CONCRETE COLUMNS WITH STEEL AND CFRP WRAPPING

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Abstract - *This project is based on the analytical study on different thickness of steel tube and CFRP wrapping having square cross sections. The analytical results indicate that the expansion in the thickness of steel tube and CFRP in a segment can altogether enhance the pliability and the vitality dispersal limit of a segments and deferral in the neighborhood clasping of the steel tube; however has no undeniable impact on disappointment mode. . Various characteristics such as strength, displacement and failure modes are discussed. Interpretation of the analytical results indicated that as the increase in thickness of steel tube and CFRP as an infill material has a considerable effect on the strength.*

Key Words: **ANSYS MECHANICAL APDL, STEEL TUBE, CFRP, COMPOSITE COLUMNS, NON-LINEAR ANALYSIS**

1. INTRODUCTION

Concrete filled steel tubes (CFST) are composite people incorporating a steel tube in loaded with concrete. In exhibit day global exercise, CFST segments are utilized inside the main parallel resistance structures of both propped and unbraced building frameworks. Concrete-filled steel tubes are increasing developing unmistakable quality in an assortment of designing structures, with the principal cross-fragment shapes being square, rectangle and round opening areas.

The boundary of concrete fill has slightly little effect on the flexural resistance and it will also increase the axial load resistance of the concrete. The tube which is filled with concrete will also increment a definitive quality of the part with no expansion of cost. Primary impact of solid which postpones the nearby clasping of tube divider and cement in the limited state itself. Also, which could maintain higher anxieties and strains in the over the top state as it were. These columns would be a good choice for the moment resisting frame.

CFRPs are composite materials. For this situation the composite comprises of two sections: a grid and fortification. In CFRP the support is carbon fiber, which gives the quality. The network is typically a polymer pitch, for example, epoxy, to tie the fortifications together. Since CFRP comprises of two particular components, the material properties rely upon these two components.

The support will give the CFRP its quality and inflexibility; measured by stress and versatile modulus separately. Dissimilar to isotropic materials like steel and aluminum, CFRP has directional quality properties. The properties of CFRP rely upon the designs of the carbon fiber and the extent of the carbon filaments in respect to the polymer. The two distinct conditions representing the net flexible modulus of composite materials utilizing the properties of the carbon filaments and the polymer network can likewise be connected to carbon fiber strengthened plastics.

2. NON-LINEAR FE MODEL

In this venture show, square sections are demonstrated with various thicknesses of steel tube and CFRP wrapping. The size of column is taken as 100x100x3000 mm. These thicknesses are provided in outer and central portion of the column. Provided thickness of steel fibers are 0.2, 0.4, 0.8, 1.2, 1.6, 2mm for square column. Different lateral loads of 200, 400, 800,1000N are applied on the column to get a nonlinear curve. From the nonlinear solution for different lateral loads there in is increase in the displacement values.

Dimension for different cross section, modulus of elasticity and poisons ratio values for different type of column are shown in a below table.

Table -1: Material properties of concrete, steel and CFRP

Name	Modulus of Elasticity (E) Gpa	Poissons Ratio (μ)
Concrete	21.6	0.15
steel	200	0.3
CFRP	234	0.2

Table -2: Values related to critical buckling of various configurations

For Steel		
	Full wrapping	Central wrapping
Thickness (t) mm	Critical load (N)	Critical load (N)

0	50603	50603
0.4	65038	56609
0.8	79884	61416
1.2	94841	65173
1.6	109939	68189
2	125192	70661
For CFRP		
	Full wrapping	**Central wrapping**
Thickness (t) mm	**Critical load (N)**	**Critical load (N)**
0	50603	50603
0.4	67538	57513
0.8	84883	62776
1.2	102361	66761
1.6	120006	69880
2	137835	72385

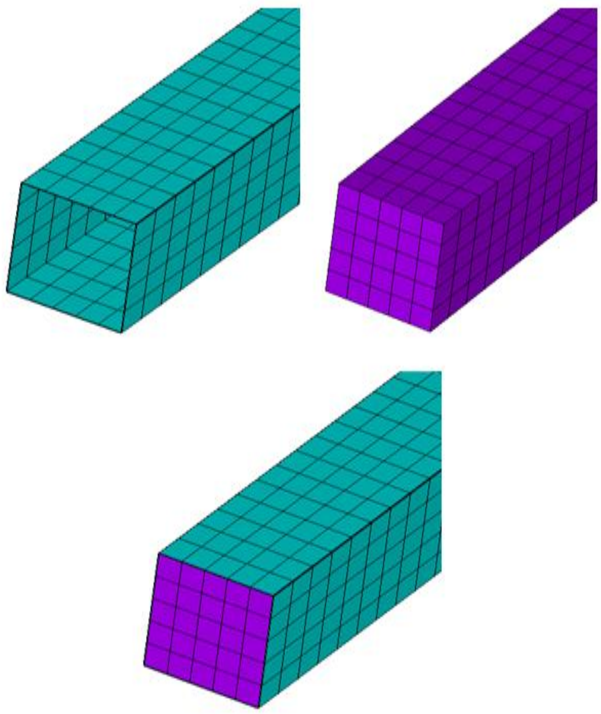


Fig -1: Finite Element Model of full-wrapped concrete column

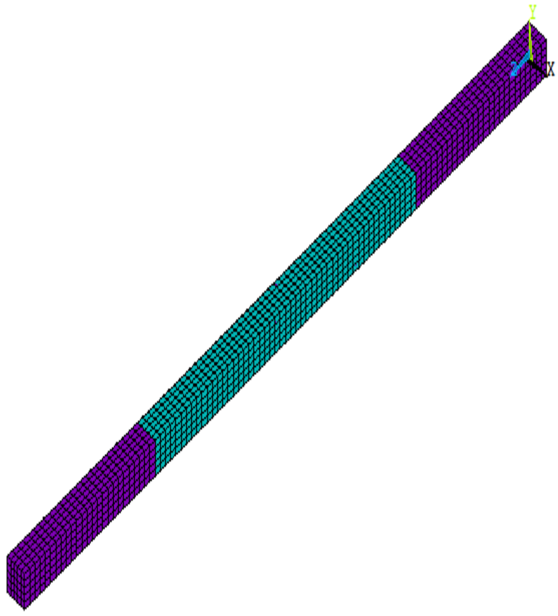


Fig – 2: Finite Element Model of mid-wrapped concrete column

3. RESULTS AND DISCUSSIONS

This is the values of lateral load and displacement for which the Interaction Curve is shown for different thickness of steel tube and CFRP wrapping. Wrapping which are provided in central and mid-portion of the concrete column. Likewise, later we have compared it for square column with different thickness of steel tube and CFRP wrapping.

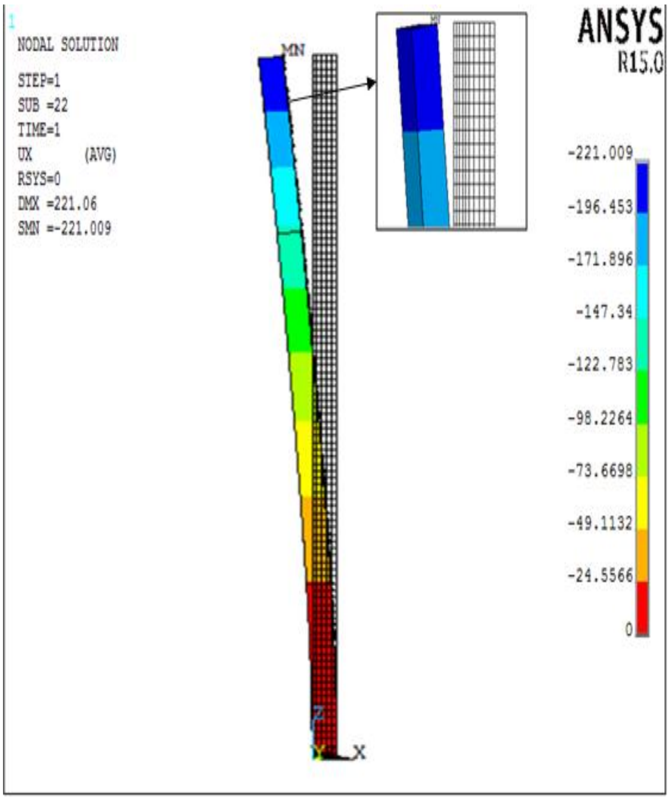


Fig -3: Displacement in lateral direction for concrete column with 2mm thick steel mid-wrap

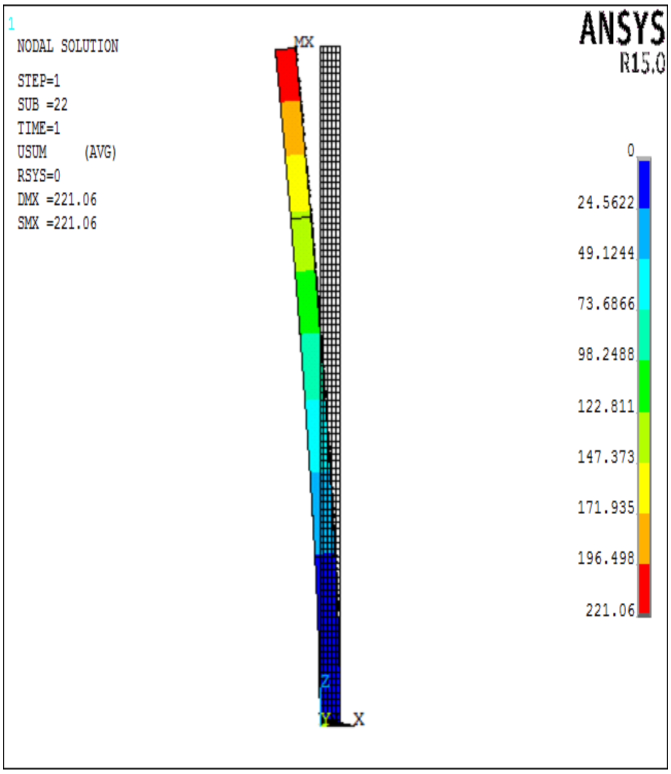


Fig -5: Vector sum of displacement for concrete column with 2mm thick steel mid-wrap

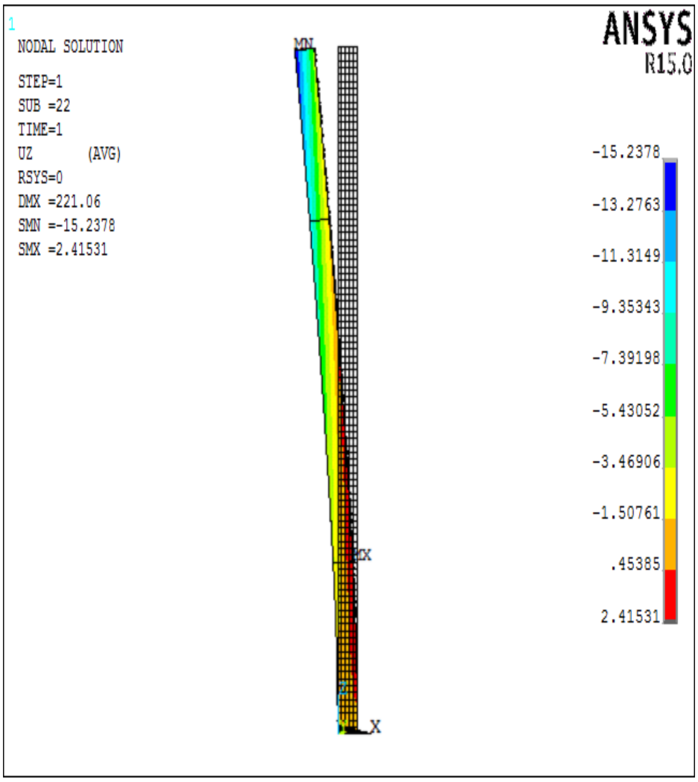


Fig -4: Displacement in vertical direction for concrete column with 2mm thick steel mid-wrap

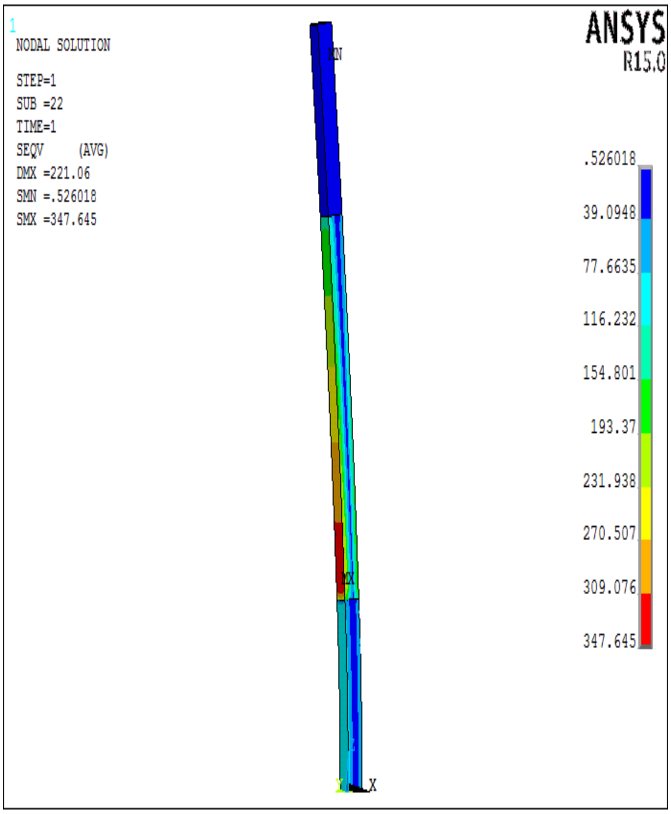
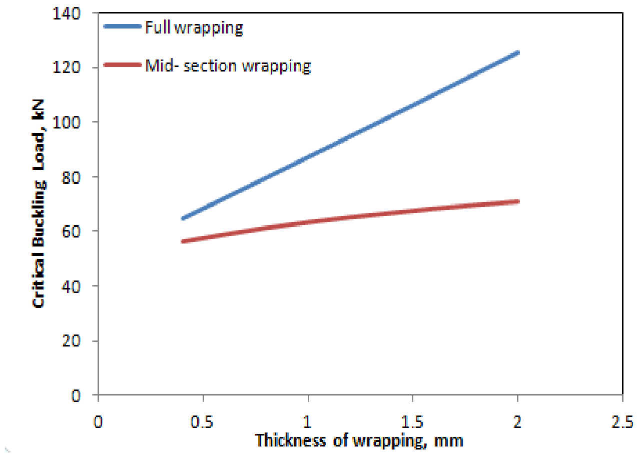
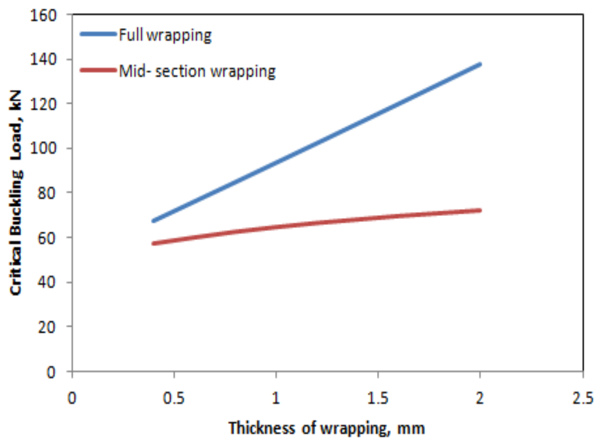


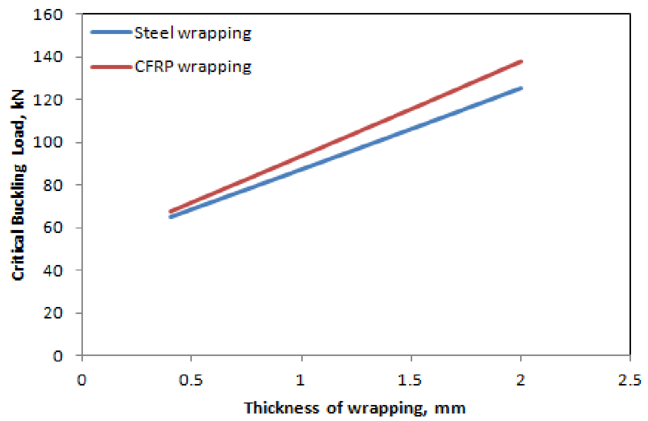
Fig -6: Von- Mises plot for concrete column with 2mm thick steel mid-wrap



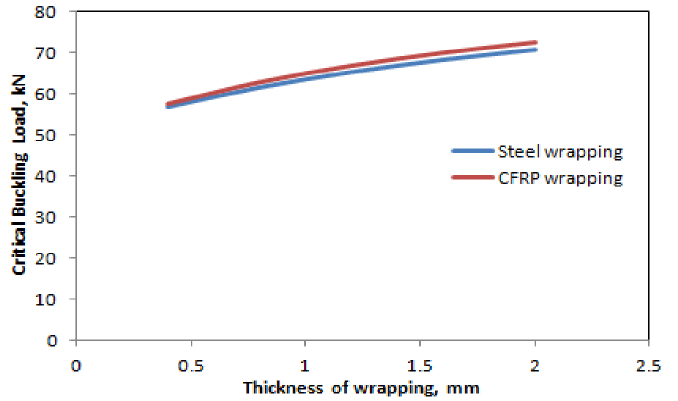
Graph -1: Critical buckling load variation for different Steel wrapping thickness configuration



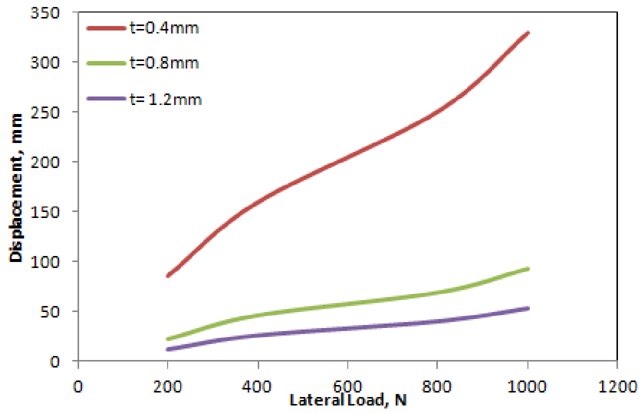
Graph -2: Critical buckling load variation for different CFRP wrapping thickness configuration



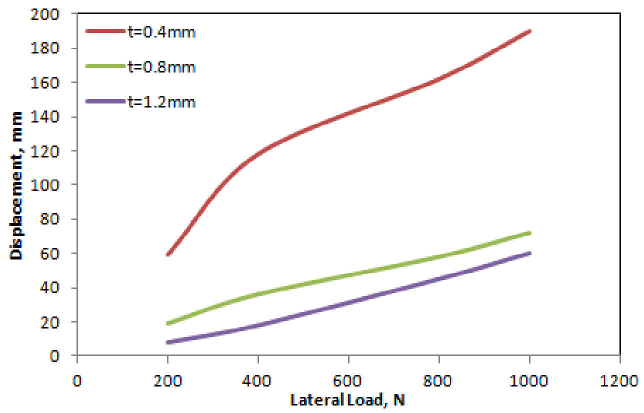
Graph -3: Comparison of critical buckling load variation of different thickness Steel and CFRP full wrapping



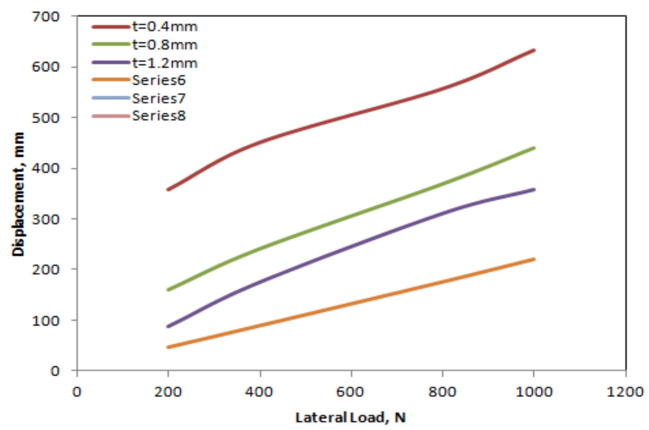
Graph -4: Comparison of critical buckling load variation of different thickness Steel and CFRP mid- section wrapping



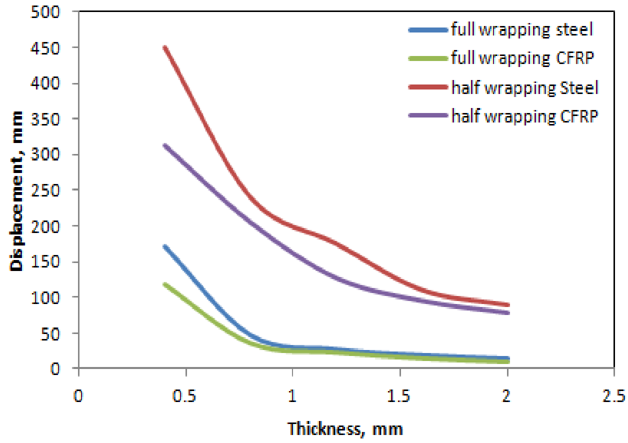
Graph -5: Lateral Load versus Displacement for different thickness of full wrap of Steel for square cross section



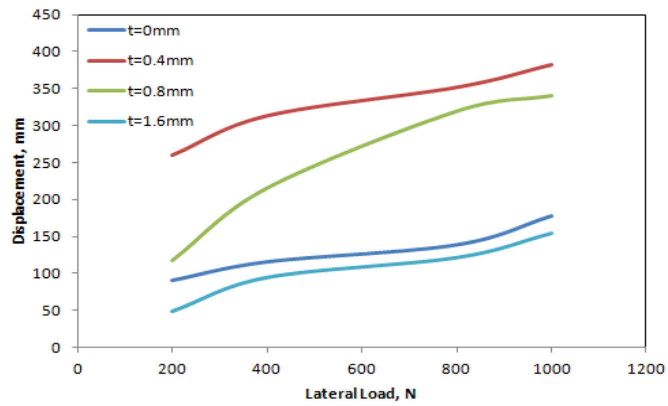
Graph -6: Lateral Load versus Displacement for different thickness of full wrap of CFRP for square cross section



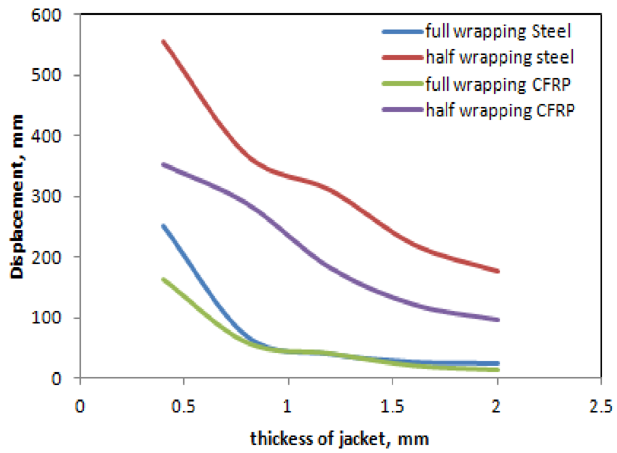
Graph -7: Lateral Load versus Displacement for different thickness of mid- wrap of steel for square cross section



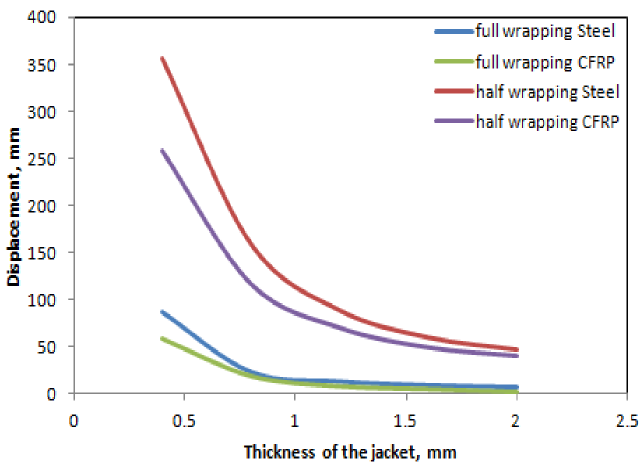
Graph -10: Variation of max. Displacement with thickness of wrapping for steel and CFRP configuration with 400N



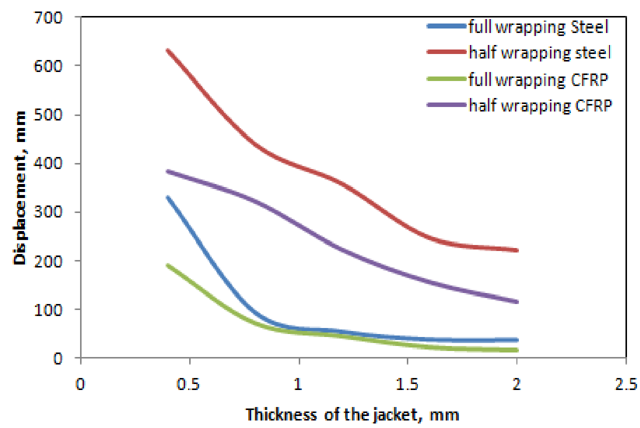
Graph -8: Lateral Load versus Displacement for different thickness of mid- wrap of CFRP for square cross section



Graph -11: Variation of max. Displacement with thickness of wrapping for steel and CFRP configuration with 800N



Graph -9: Variation of max. Displacement with thickness of wrapping for steel and CFRP configuration with 200N



Graph -12: Variation of max. Displacement with thickness of wrapping for steel and CFRP configuration with 1000N

4. CONCLUSIONS

- From the graph 5.1 and 5.2 full and mid- section wrapping of steel and CFRP, the full wrapping gives a higher critical load when compared to the mid-section wrapping and also for CFRP wrapping gives a higher critical buckling load.
- By comparing different thickness of steel and CFRP wrapping provided at full and mid-section, the full CFRP wrapping gives a good buckling load value when compared with the mid-section of steel wrapping.
- In the project we are provided with different thickness of wrapping for both steel and CFRP. From the different thickness 0.4mm thick of both steel and CFRP will gives a higher displacement values.
- As the thickness of wrapping increases both for steel and CFRP, there is an decrease in the displacement values.
- The lateral load configuration increases for both steel and CFRP thickness wrapping, there is a increase in the displacement value for both full and mid-section wrapping of steel and CFRP.
- Concrete filled steel tube is component with good performance resulting from the confinement effect of steel with concrete and design versatility. Concrete-filled steel tubes are increasing expanding conspicuousness in an assortment of designing structures. Segments are intended to oppose the dominant part of pivotal power by concrete alone can be additionally managed by the utilization of thin walled steel tube. The examination about the conduct and the qualities of CFST segments is the prime need.

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