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Seismic Analysis of Steel-Concrete Composite and Conventional RCC (G+6storey) Building

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Abstract – *The need of today is to construct a structure which can withstand seismic force with much lower construction cost. This can be achieved by using composite structures as an alternative to conventional RCC structure. The present study carried out to analyze the structural performance of G+6 storey framed structure subjected to seismic loading of Zone II using ETABS software. Three similar models having same plan configuration is prepared. The comparison of conventional reinforced cement concrete structure with two composite structures having concrete filled steel tubular section (CFST) as column , one with RCC beam and another with steel beam is done and the result obtained is compared in terms of structural performance of following parameters-maximum storey displacement, storey drift, storey shear and storey stiffness.*

***Key Words*: CFST, ETABS, Response Spectrum, Storey Drift, and Storey Displacement**

1. INTRODUCTION

Concrete Filled Steel Tube (CFST) is the composite section formed by filling concrete into a hollow steel tube. The load applied on the CFST section is resisted by composite action of steel and concrete, the use of steel tubes and concrete together is advantageous as it increases its strength and is being used in structures such as bridges, electricity towers, buildings etc. In recent years, the use of concrete filled steel tube columns is increased significantly in medium-rise to high-rise buildings, it possess high ductility, strength and stiffness properties. These properties are considered to be important, especially for the multi-storied buildings required to be erected in earthquake prone areas. Therefore, the behavior of buildings with CFST sections needs to be studied.

2. METHODOLOGY

In this study the seismic analysis for G+6 storey building is carried out for all three type of structural model using ETABS software. The structure is located in zone II. The plan dimension of structure is 20m X 15m.

2.1 Response Spectrum Method

The response spectrum method is linear dynamic analysis which determines response in each mode of vibration and overlay the responses in several modes to attain total response. Response can be appeared in the form of deformation, acceleration etc. The graph between maximum response and natural period is known as response spectrum.

2.2 Modeling in ETABS

The analysis is performed for proposed building using ETABS. The plan for all building structure considered is same which is shown in fig. 1. The 3D model of structure is shown in fig. 2.

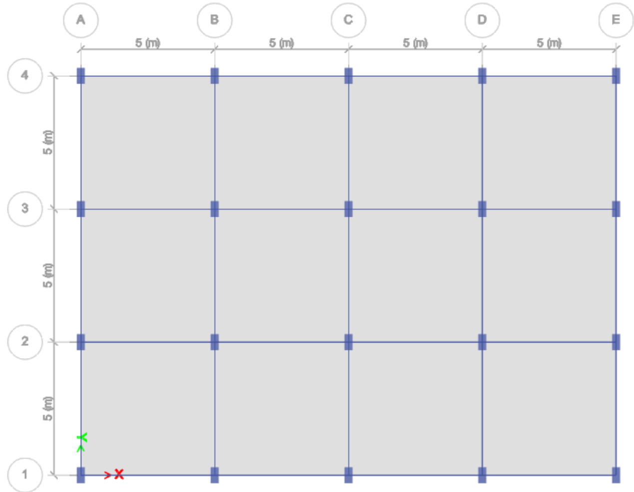

Figure-1 : Plan of structure

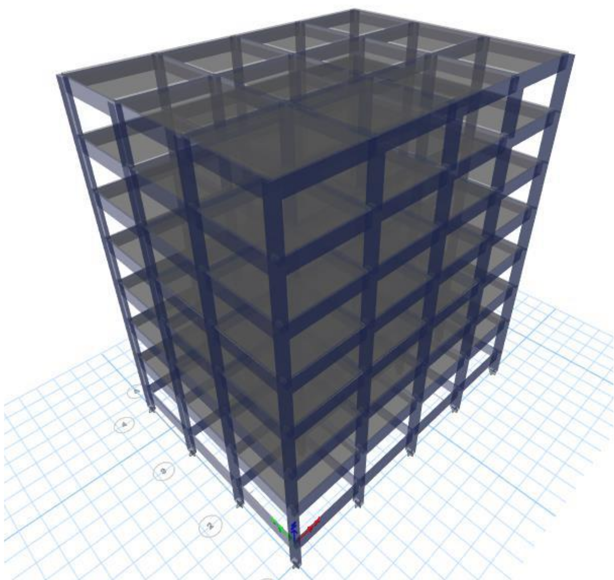

Figure-2: 3D view of structure

Table -1: Modeling details

	RCC structure	Composite structure 1	Composite structure 2
Floor Plan Detail	20m x15m	20m x15m	20m x15m
Height of each storey	3m	3m	3m
Height of storey below ground	2m	2m	2m
Total height	23m	23m	23m
Material Properties			
Grade of concrete (fck)	M30	M30	M30
Grade of steel (fy)	Fe500	Fe500	Fe500
Sectional Properties			
Column type	RCC	CFST	CFST
Size of column	300mm x 600mm	300mm x 300mm x 10mm	300mm x 300mm x 10mm
Beam type	RCC	RCC	Steel
Size of beam	230mm x 700mm	230mm x 700mm	ISMB 300
Thickness of slab	250mm	250mm	250mm
Load Assignment			
Live load	2KN/m^2	2KN/m^2	2KN/m^2
Floor Finish	1.5KN/m^2	1.5KN/m^2	1.5KN/m^2
Wall Load	7KN/m	7KN/m	7KN/m
Seismic data			
Seismic zone	II	II	II
Importance factor	1.2	1.2	1.2
Zone factor	0.1	0.1	0.1
Soil type	Hard strata	Hard strata	Hard strata
Response reduction factor	5	5	5

3. Result

The comparison between the structures is done for the parameters like storey drift, storey shear, maximum storey displacement and weight of the building.

- *Storey displacement*

It is the displacement compared to the base of the structure. The value of storey displacement is higher at top floor. The maximum storey displacement for wind and earthquake is shown in chart 1 and chart 2 respectively.

- *Storey drift*

It is the movement of the storey compared to the next storey. Its value is higher at middle storey. The storey drift for wind and earthquake is shown in chart 3 and chart 4 respectively.

The graphs are shown below which are generated after analyzing the models where:

A- *Reinforced concrete structure*
B- *Composite structure with CFST column and RCC beam*
C- *Composite structure with CFST column and steel beam*

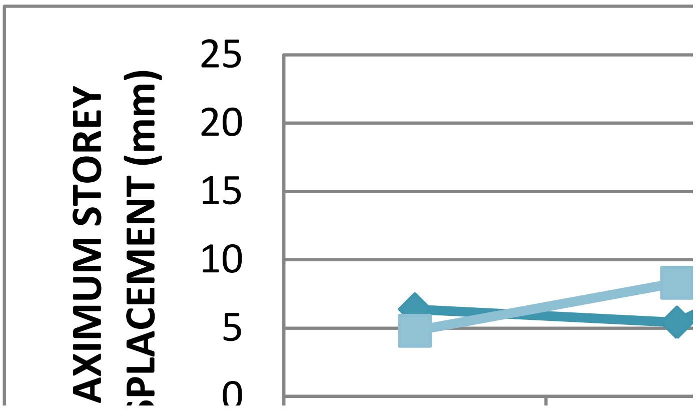

Chart-1: Max Storey Displacement for Wind load

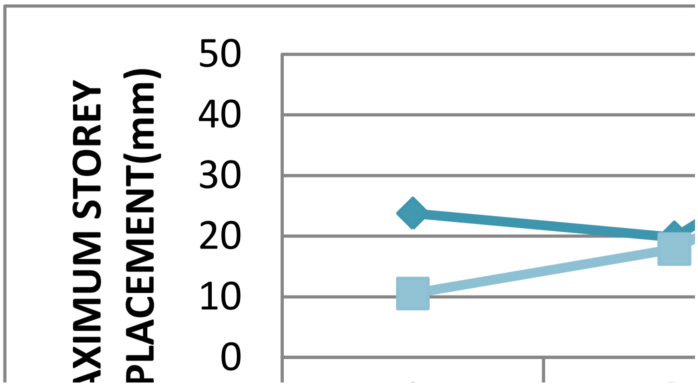

Chart-2: Max Storey Displacement for Earthquake load

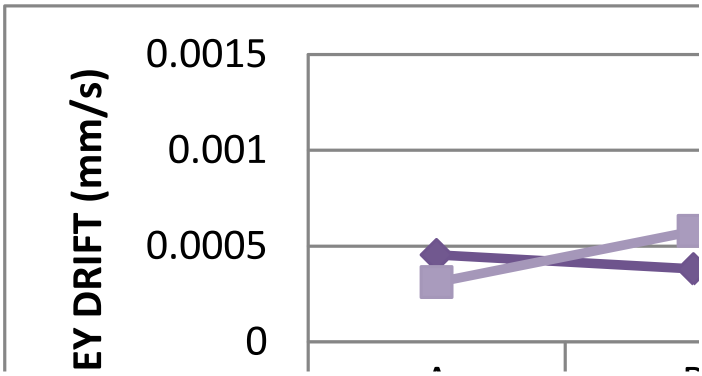

Chart-3: Storey Drift for Wind load

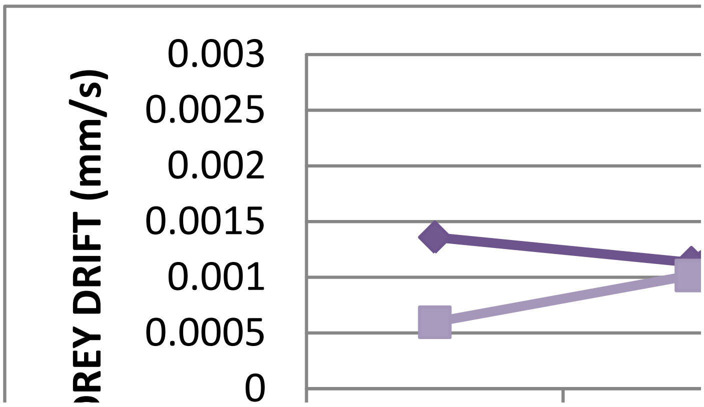

Chart-4: Storey Drift for Earthquake load

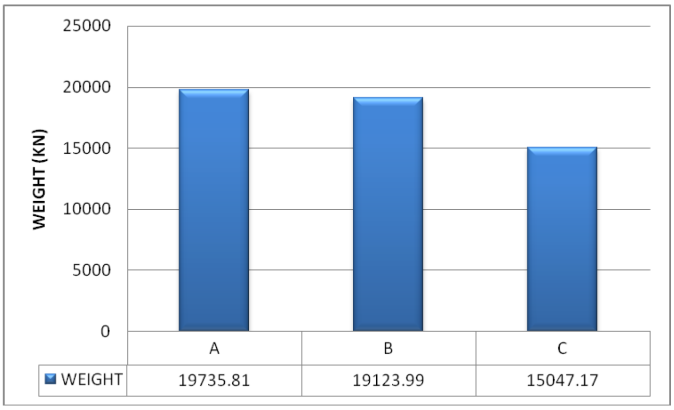

Chart-5: Weight of building A, B and C

4. CONCLUSIONS

1. As per confinement of concrete in CFST columns, the load carrying capacity has been increased from column section required in RCC is 300x600mm and in CFST is 300x300x10mm.
2. As reduction in sizes of columns will help to increase the area of utility of each floor
3. The maximum storey displacement and storey drift for building B in X direction decreases about 16% because stiffness of building B is more in X direction as compared to building A.
4. The maximum storey displacement and storey drift for building C in X direction increases about 128% because stiffness of building C is less in X direction as compared to building A.
5. The maximum storey displacement and storey drift for building B in Y direction increases about 85% because stiffness of building B is less in Y direction as compared to building A.
6. The maximum storey displacement and storey drift for building C in Y direction increases about 358% because stiffness of building C is less in Y direction as compared to building A.
7. It is observed that building B (CFST with concrete beam) behaves well as compared to building C (CFST with steel beam).
8. It is observed that weight of building C is lesser among all three building which find it economical.

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