Seismic analysis of conventional RCC building with composite building having CFST column (G+6stotrey)

Himani Likhare[1], Deepti Hazari[2]
[1,2]*Department of Civil Engineering, Bhilai Institute of Technology, Durg, Chhattisgarh, India*

Abstract **- The present work performed to analyze the structural performance of G+6 storey framed structure subjected to seismic loading of Zone V using ETABS 2018 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 and storey shear.**

Index Terms **- CFST, ETABS, Response Spectrum, Storey Drift, Storey Shear and Storey Displacement.**

I.INTRODUCTION

CFST is concrete filled steel tubular section. It is the composite section in which the concrete is filled into hollow steel section. It is used in medium to high rise building as it posses high ductility, high strength and stiffness properties. The use of CFST with concrete is quite advantageous as it increases the strength of building. It is used in electricity tower, bridges, high rise buildings etc. Composite building having CFST columns are also advantageous over RCC building as they have greater load carrying capacity and perform better in seismic regions.

II. 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. It is the representation of maximum responses of a spectrum of idealized single degree freedom systems of different natural periods but having the same damping, under the action of same earthquake ground motion at their bases. The response referred to here can be maximum absolute acceleration, maximum relative velocity, or maximum relative displacement. 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.

2.2.1 Specification of structure

- The structure is model and analyzed using ETABS 2018 software
- Storey: G+6 Floors
- Location: Srinagar
- Floor to floor height: 3m and height up to plinth: 2m
- Total floor height : 23 m
- The concrete of grade used for analysis is M30
- The grade of steel used for analysis is Fe 500
- Seismic zone : V

2.2.3 Load on structure

Loads on all the three models are same as given below as per IS 875: 2015

- Live load - 2 KN/m^2
- Floor finish – 1.5 KN/m^2
- Wall load - 7 KN/m^2

2.2.2 Sectional Properties

The sectional properties of three types of models are considered below

Table-1: Sectional properties of Structure

Sr. No.	Detail	RCC (reinforced cement concrete) structure	Structure with CFST column and RCC beam	Structure with CFST column and steel beam
1.	Beam type	RCC	RCC	Steel
2.	Size of beam	230mm*700 mm	230mm*700mm	ISMB 300
3.	Column type	RCC	CFST	CFST
4.	Size of column	300mm*600 mm	300mm*300mm*10mm	300mm*300mm*10mm
5.	Size of column	300mm*600 mm	300mm*300mm*10mm	300mm*300mm*10mm

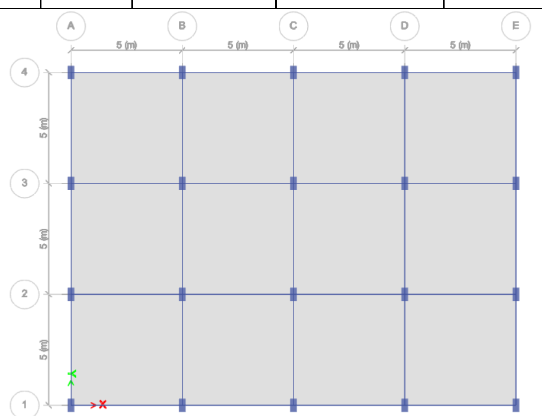

Fig 1 : Plan of building

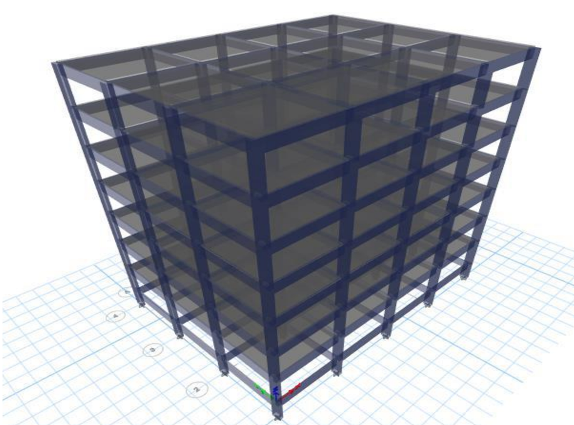

Fig 2 : 3D model of building

Table- 2: Parameters for wind and earthquake force

Sr. No.	Parameters	Zone V
1.	Zone factor	0.36
2.	Importance factor	1.2
3.	Response factor	5
4.	Wind speed	50m/s
5.	Site type	1

III. RESULT AND DISCUSSION

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

Storey drift - It is relative displacement between floors above and or below the storey under consideration. The storey drift for wind load and earthquake load is shown in chart 3 and chart 4 respectively.

Storey shear-The seismic force at the base of the building is called as base shear. The lateral force due to earthquake at different floors is known as storey shear. The value of storey shear is minimum at top storey and maximum at bottom storey. The storey shear for wind load and earthquake load is shown in chart 5 and chart 6 respectively.

The graphs are given below are generated after analyzing the models where:

1. Reinforced concrete structure
2. Composite structure with CFST column and RCC beam
3. Composite structure with CFST column and steel beam
4. ucture with CFST column and steel beam

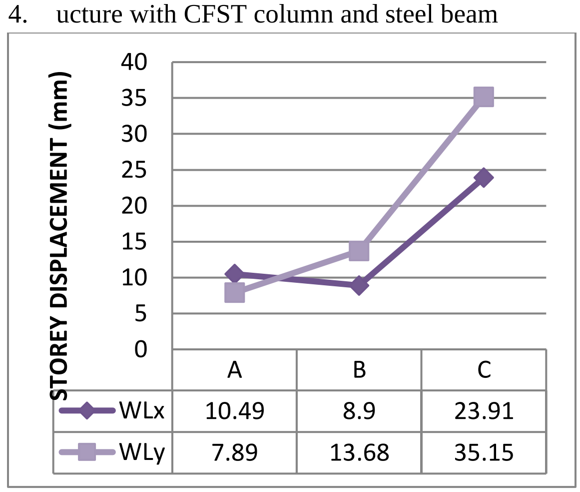

Chart-1: Max Storey Displacement for Wind load

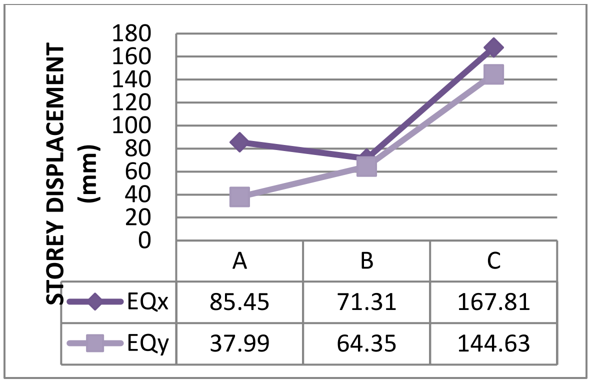

Chart-2: Max Storey Displacement for Earthquake load

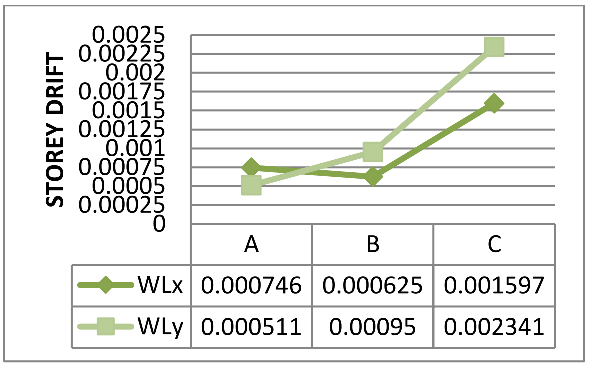

Chart-3: Storey Drift for Wind load

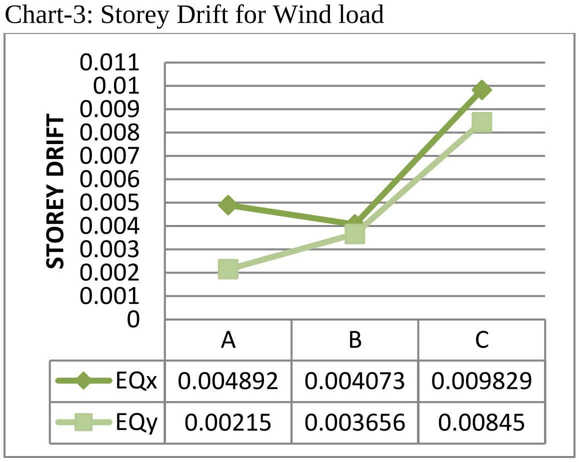

Chart-4: Storey Drift for Earthquake load

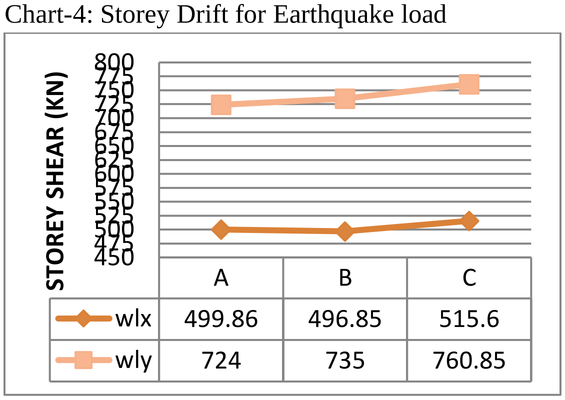

Chart-5: Storey Shear for Wind load

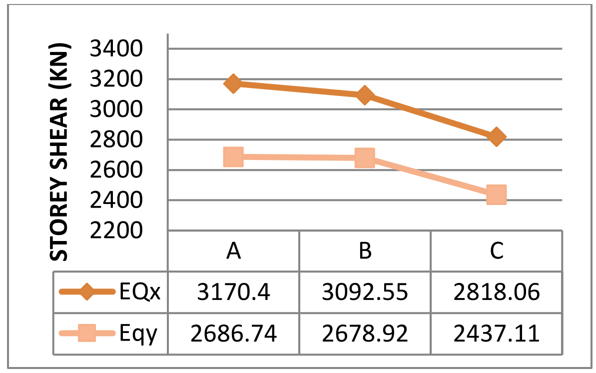

Chart-6: Storey Shear for Earthquake load

IV.CONCLUSION

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 (i.e. CFST with concrete beam) in X direction decreases about 15% 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 (i.e. CFST with steel beam) in X direction increases about 127% 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 (i.e. CFST with concrete beam) in Y direction increases about 86% 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 (i.e. CFST with steel beam) in Y direction increases about 350% because stiffness of building C is less in Y direction as compared to building A.
7. It is observed that variation in X and Y direction for storey shear values for building B and building C is ±11%.
8. It is observed that building B (i.e. CFST with concrete beam) behaves well as compared to building C (i.e. CFST with steel beam).

REFERENCES

[1]. Parag Jain, Rahul Satbhaiya, "Analysis of tall structure considering composite steel section column using ETABS," International Journal of Scientific Research in Civil Engineering, ISSN: 2456-6667, Volume 3, Issue 3, 2019.

[2]. Umesh Rajendra Tubachi, Manohar K, "Analysis of steel concrete composite structure and its comparison with RCC structure," International Journal of Engineering Science and Computing, ISSN 2321 3361, Volume 9, Issue 6, June 2019.

[3]. Dr Panchal, PM Marathe, "Comparative study of RCC, steel and composite (G+30storey) building," Institute of Technology, Nirma University, Ahmedabad – 382 481, 08-10 December 2011.

[4]. Preetha V, Govidhan S, Eniyachandramouli, Ranjith Selvan K, "Comparative study on response spectrum analysis of building with composite columns and RCC columns," International Journal of Scientific & Technology Research,ISSN 2277-8616, Volume 9, Issue 04, April 2020.

[5]. S S Charantimath, Swapnil B Cholekar, Manjunath M Birje, "Comparative study on structural parameter of RCC and composite building," Civil and Environmental Research, ISSN 2225-0514, Volume 6, No. 6, 2014.

[6]. Manjari Blessing BV, Gayathri S, "Comparative analysis of CFST and RCC structures subjected to seismic loading" International Journal of ChemTech Research ISSN: 0974-4290, Vol.10 No.8, pp 409-416, 2017.

[7]. Nitish A. Mohite, P.K. Joshi, W.N. Deulkar, "Comparative analysis of RCC and steel-concrete (B+G+11storey) building" International Journal of Scientific and Research Publications, ISSN 2250-3153, Volume 5, Issue 10, October 2015.

[8]. D. Kornack and P. Rakic, "Cell Proliferation without Neurogenesis in Adult Primate Neocortex," Science, vol. 294, Dec. 2001, pp. 2127-2130, doi:10.1126/science.1065467.

[9]. IS 456:2000, Indian Standard Code of Practice for "Plain and Reinforcement Concrete" (Fourth Revisions), Bureau of Indian Standards (BIS), New Delhi.

[10]. IS 875 (Part- I): 1987, IS 875 (Part- I): 1987, Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures "Dead Loads", Bureau of Indian Standards, New Delhi.

[11]. IS 875 (Part- II): 1987, IS 875 (Part- I): 1987, Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures "Imposed Loads"., Bureau of Indian Standards, New Delhi.

[12]. IS 875 (Part- III): 1987, IS 875 (Part- I): 1987, Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures "Wind Loads", Bureau of Indian Standards, New Delhi.

[13]. IS: 1893 (part 1): 2002, "Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards, New Delhi.