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COMPARISON OF SEISMIC BEHAVIOUR OF TYPICAL MULTI STOREY STRUCTURE WITH STEEL ENCASED CONCRETE COLUMNS AND RCC COLUMNS

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Abstract : An extensive study has been carried out on the behavior of composite column in a structure. In composite column construction steel and concrete are united in such a manner that the advantages of the materials are employed in an efficient manner. By bonding and friction between steel and composite material these materials will accept the external loading in composite columns. In this study comparison of composite and conventional structure is carried out. Just varying the design of column i.e., by using composite and conventional column and keeping all other structural members same for both the structures. Composite column design is carried out according to Euro code 4 and conventional column design is by IS 456-2000. The buildings are taken to be true to be placed in III seismic zone. Seismic design is followed by IS 1893-2002. There are many different types of composite column from those we have taken concrete encased composite column for our analysis. Concrete encasement would increase the load resistance of steel column. During seismic activity the response of structure is also influenced by the material property which depends on the materials and also its configuration in the structural system. The base of the structure is assumed to be fixed. The building height is 30 m which comes under low rise building. Modeling and analysis has been carried in ETABS software. The results are obtained of various parameters such as time period, mode shapes, storey displacements, storey drifts, storey shears and storey stiffness, thus by obtaining those results graphs have been plotted. And comparison of two different type of structure has been done. Thus, we found that the composite structure is more efficient and can resist more earthquake load than the conventional RCC structure.

***Keywords** - Composite columns, seismic zone, seismic zone, RCC structure.*

1. INTRODUCTION

In India most of the building structures fall under the category of low rise buildings. So, for these structures reinforced concrete members are used widely because the construction becomes quite convenient and economical in nature. But since the population in cities is growing exponentially and the land is limited, there is a need of vertical growth of buildings in these cities. So, for the fulfillment of this purpose a large number of medium to high rise buildings are coming up these days. For these high rise buildings it has been found out that use of composite members in construction is more effective and economic than using reinforced concrete members. The popularity of steel-concrete composite construction in cities can

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be owed to its advantage over the conventional reinforced concrete construction. Reinforced concretes frames are used in low rise buildings because loading is nominal. But in medium and high rise buildings, the conventional reinforced concrete construction cannot be adopted as there is increased dead load along with span restrictions, less stiffness and framework which is quite vulnerable to hazards.

In construction industry in India use of steel is very less as compared to other developing nations like China, Brazil etc. Seeing the development in India, there is a dire need to explore more in the field of construction and devise new improved techniques to use Steel as a construction material wherever it is economical to use it. Steel concrete composite frames use more steel and prove to be an economic approach to solving the problems faced in medium to high rise building structures.

2. Outline of the project

The aim of the present study is to compare seismic performance between (G+10) story RCC and composite building frame situated in earthquake zone III.

- In the first stage, three dimensional models will be developed and gravity design check will be carried out using ETABS software.
- In the second stage, modal analysis and response spectrum analysis will be carried out for both the structures.

In the third stage, seismic analysis of the composite and RCC structure will carry out. Followed by discussion on comparisons of results obtained.

3. RESULTS AND DISCUSSION

A. Mode shapes

A mode shape is a specific pattern of vibration executed by a mechanical system at a specific frequency. Different mode shapes will be associated with different frequencies. The experimental technique of modal analysis discovers these mode shapes and the frequencies.

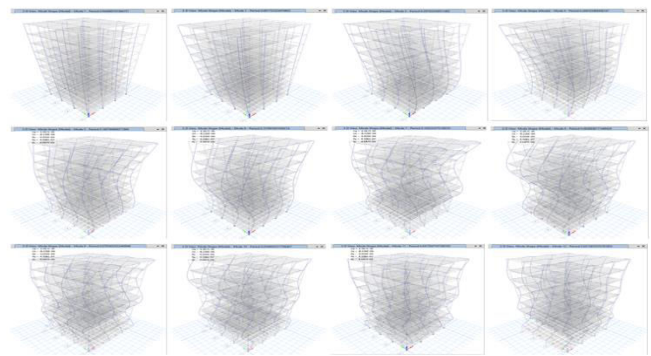

Figure.1: Mode shapes of symmetry RCC structure

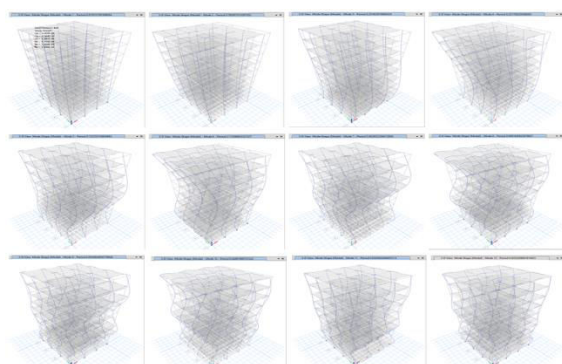

Figure.2: Mode Shapes of Symmetry Composite structure

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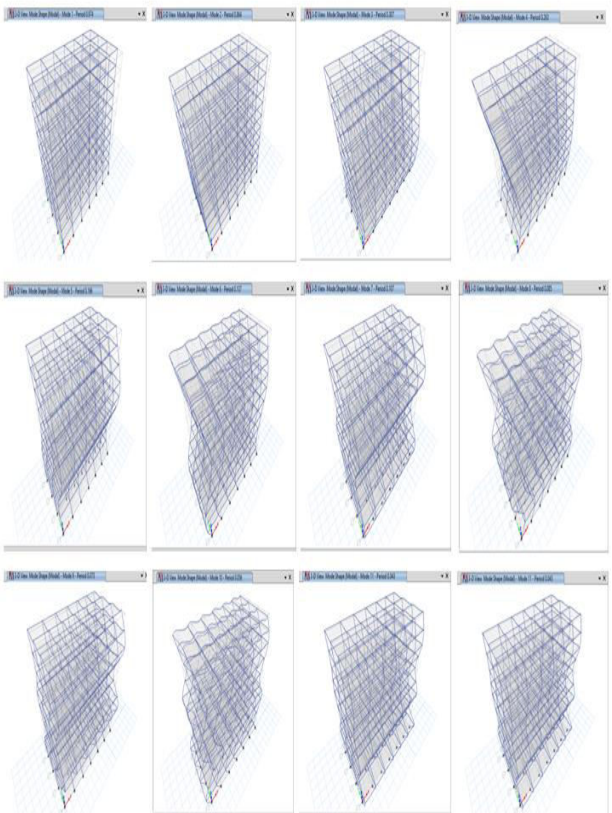

Figure.3: Mode shapes of Asymmetry RCC structure

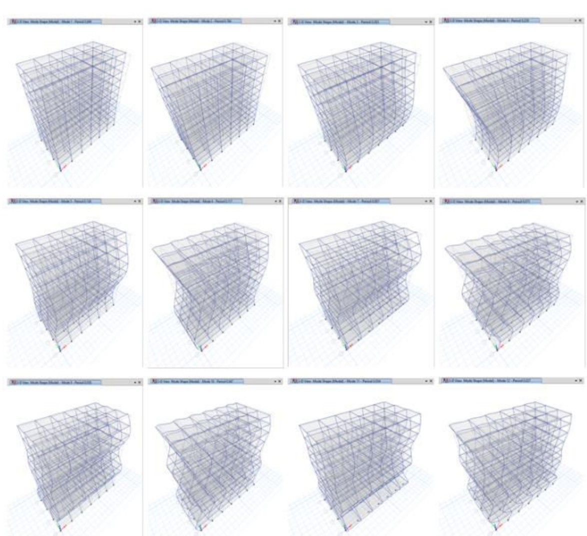

Figure.4: Mode Shapes of Asymmetry Composite structure

C. Asymmetry Structures

a. Storey displacements

The storey displacements of asymmetry RCC and composite structuresfor earthquake load in X and Y directions variations are shown in below figures 5 to 8.

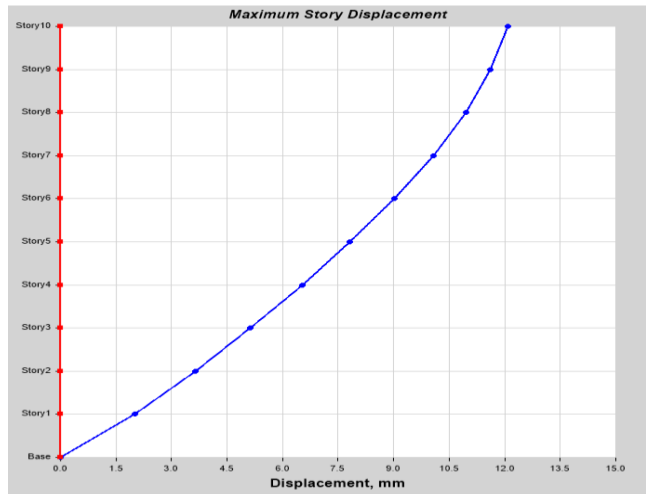

Figure.5: Maximum storey displacements of RCC asymmetry structure for EQ X

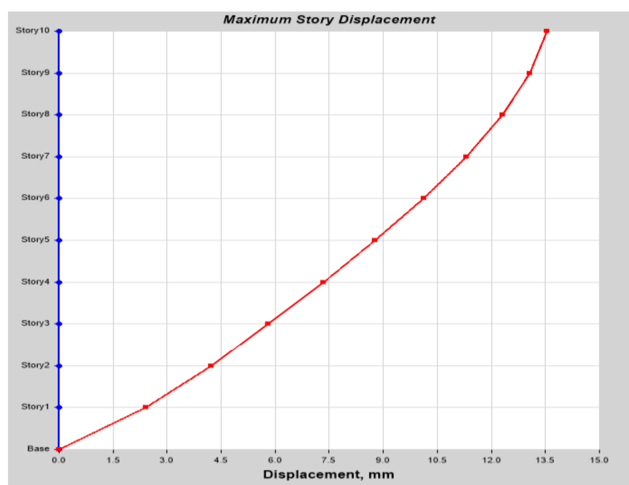

Figure.6: Maximum storey displacements of RCC asymmetry structure for EQ Y

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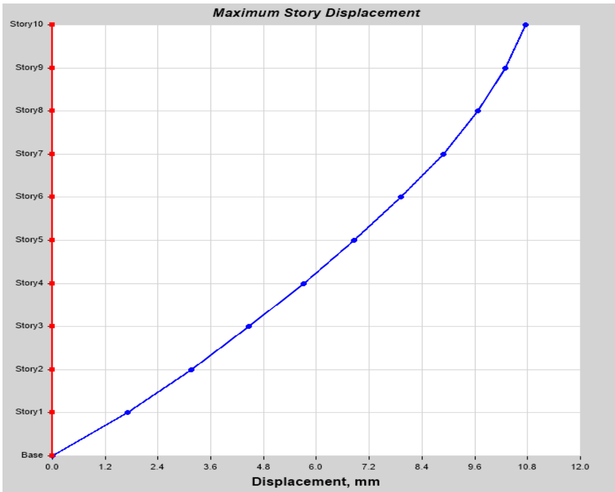

Figure.7: Maximum storey displacements of composite asymmetry structure for EQ X

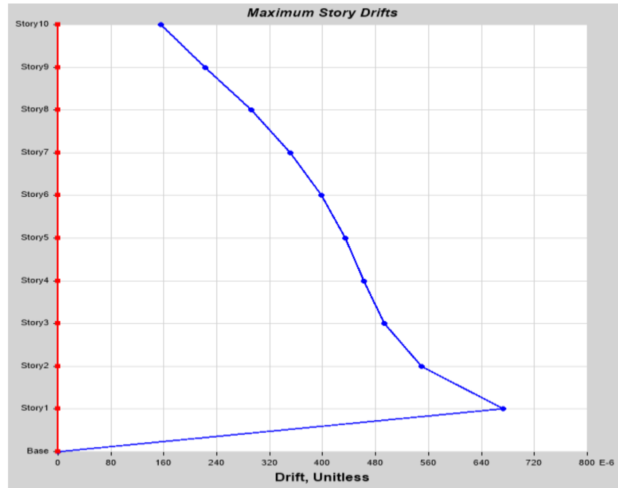

Figure.9: Maximum storey drifts of RCC asymmetry structure for EQ X

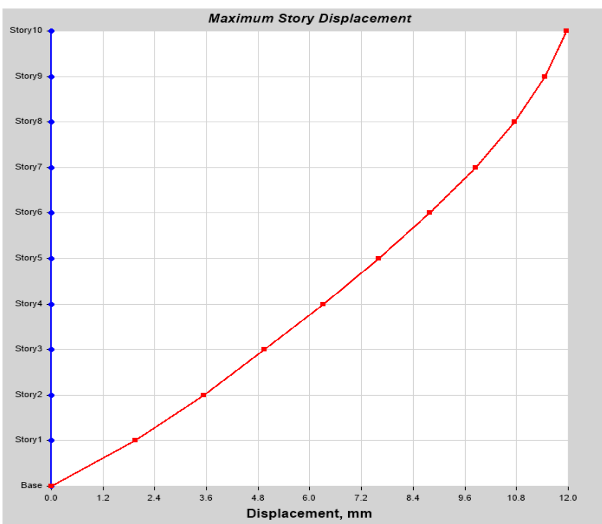

Figure.8: Maximum storey displacements of composite asymmetry structure for EQ Y

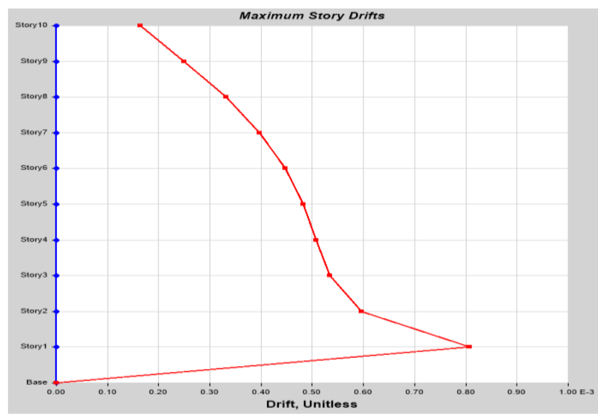

Figure .10: Maximum storey drifts of RCC asymmetry structure for EQ Y

b. Storey drifts

The storey drifts of asymmetry RCC and composite structures for earthquake load in X and Y directionsvariations are shown in figures 9, 10, 11 and12.

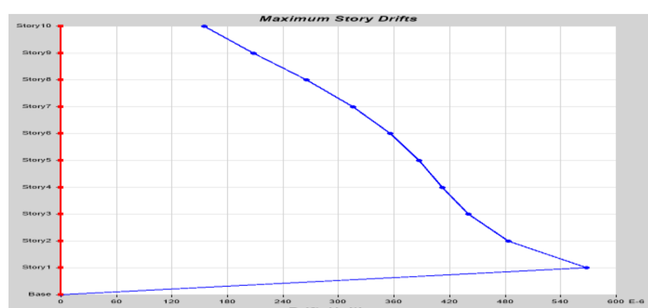

Figure.11: Maximum storey drifts of composite asymmetry structure for EQ X

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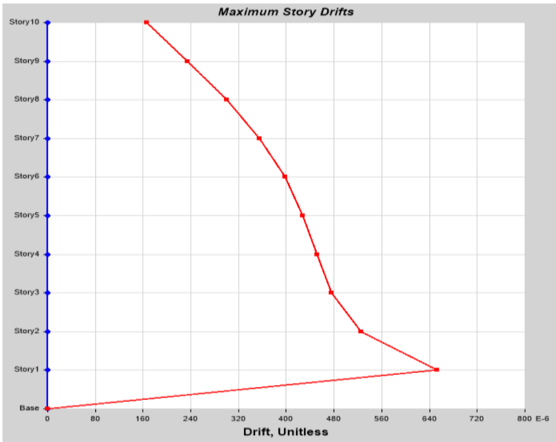

Figure.12: Maximum storey drifts of composite asymmetry structure for EQ Y

c. Storey shears

The storey shears of asymmetry RCC and composite structures variation in X and Y directions is shown in figures 13,14, 15 and 16.

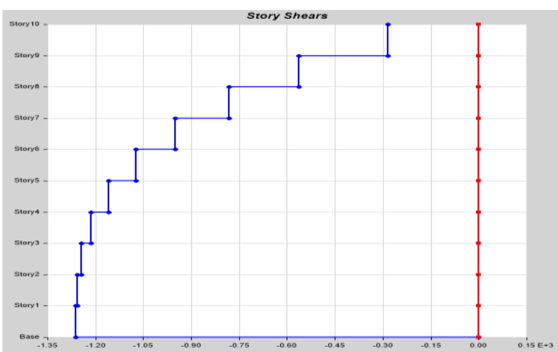

Figure.13: Maximum storey shears of RCC asymmetry structure for EQ X

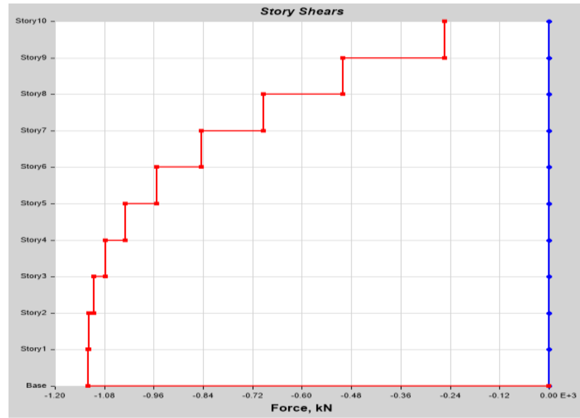

Figure.14: Maximum storey shears of RCC asymmetry structure for EQ Y

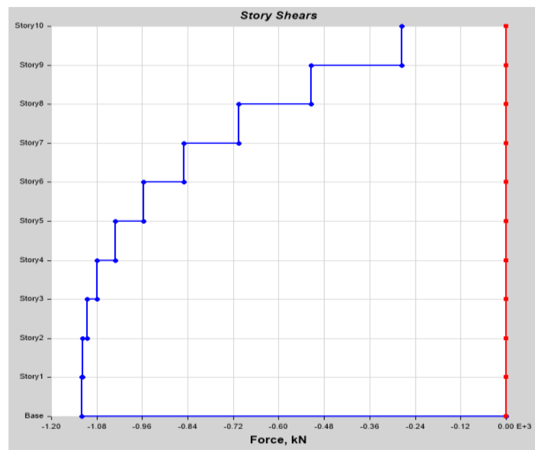

Figure.15: Maximum storey shears of composite asymmetry structure for EQ X

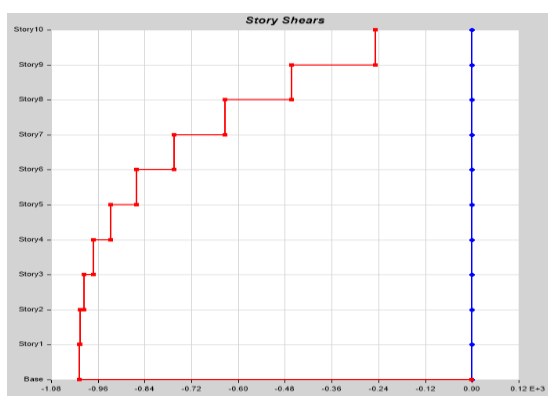

Figure.16: Maximum storey shears of composite asymmetry structure for EQ Y

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d. Storey stiffness

The storey stiffness of asymmetry RCC and composite structures variation in X and Y directions is shown in figures 17, 18, 19 and 20.

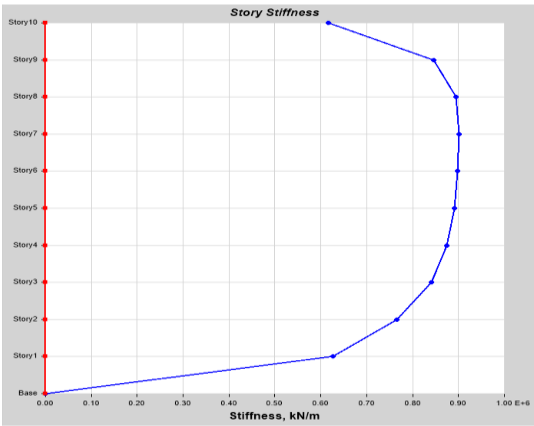

Figure.17: Maximum storey stiffness of RCC asymmetry structure for EQ X

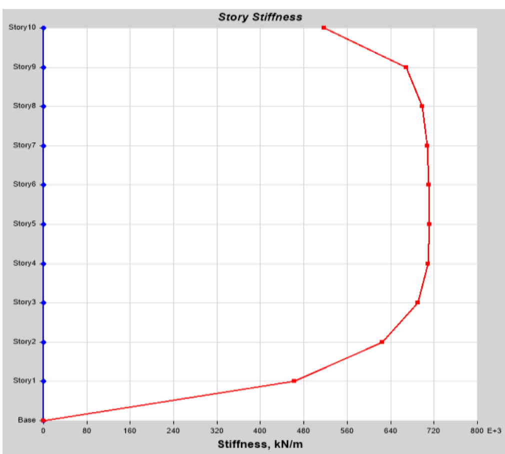

Figure.18: Maximum storey stiffness of RCC asymmetry structure for EQ Y

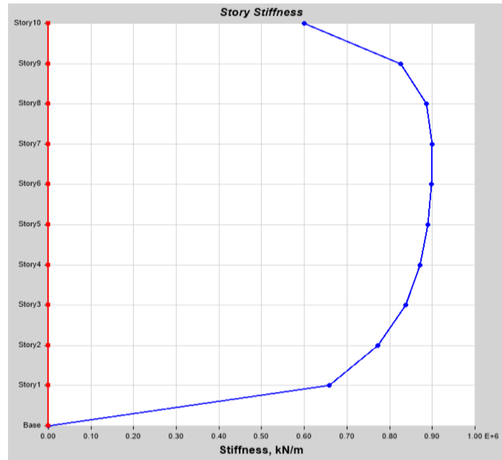

Figure.19: Maximum storey stiffness of composite asymmetry structure for EQ X

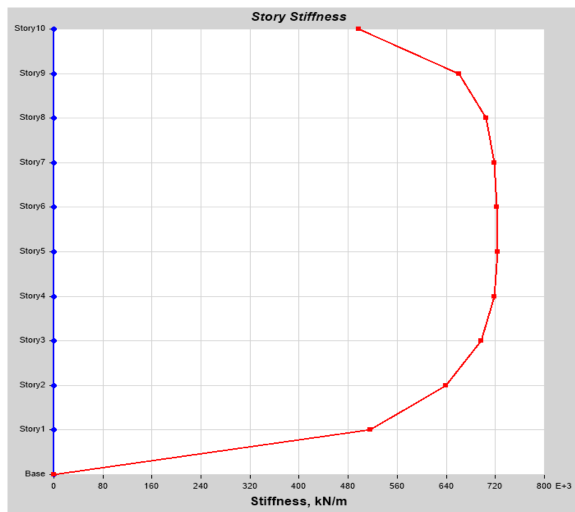

Figure.20: Maximum storey stiffness of composite asymmetry structure for EQ Y

D. Symmetry Structures

a. Storey displacements

The storey displacements of symmetry RCC and composite structures earthquake load in X and Y directions variations are shown in figures 21, 22, 23 and 24.

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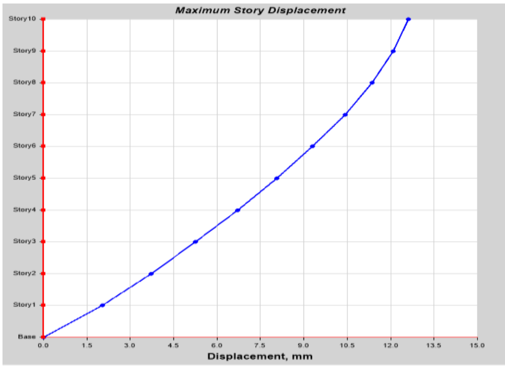

Figure.21: Maximum storey displacements of RCC symmetry structure for EQ X

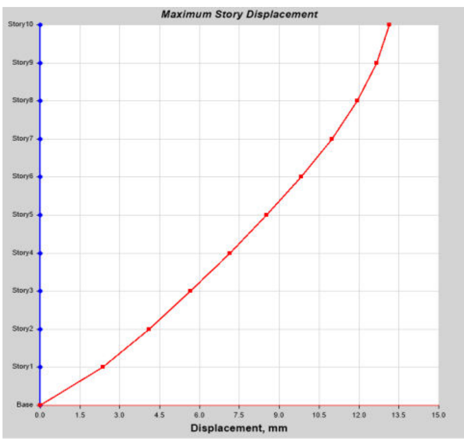

Figure .22: Maximum storey displacements of RCC symmetry structure for EQ Y

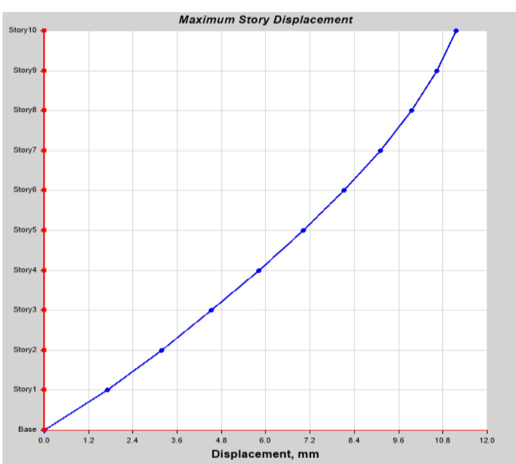

Figure.23: Maximum storey displacements of composite symmetry structure for EQ X

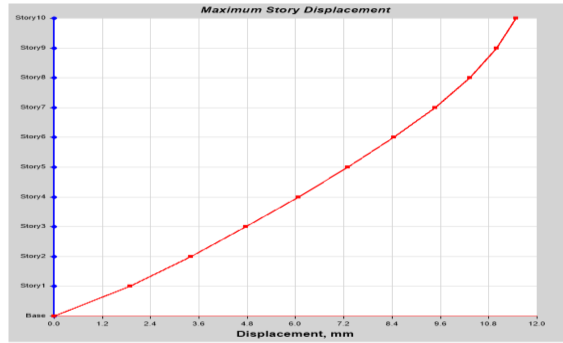

Figure.24: Maximum storey displacements of composite symmetry structure for EQ Y

b. Storey drifts

The storey drifts of symmetry RCC and composite structures earthquake load in X and Y directions variation are shown in figures 25, 26, 27 and 28.

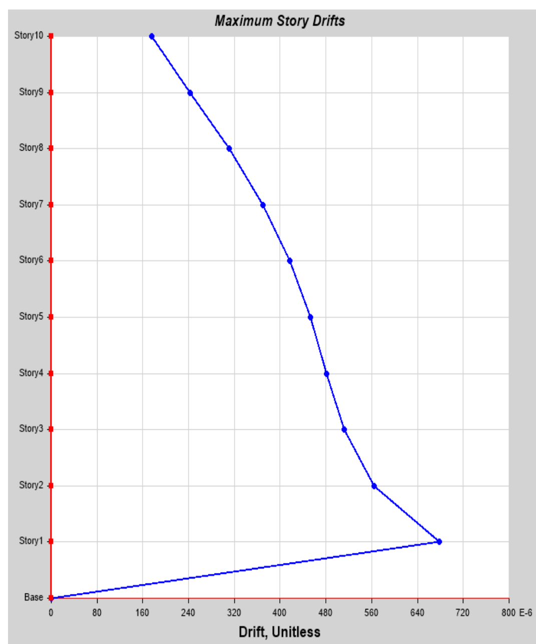

Figure.25: Maximum storey drifts of RCC symmetry structure for EQ X

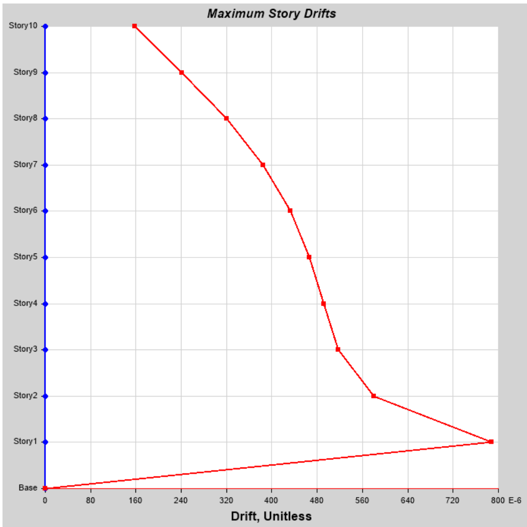

Figure.26: Maximum storey drifts of RCC symmetry structure for EQ Y

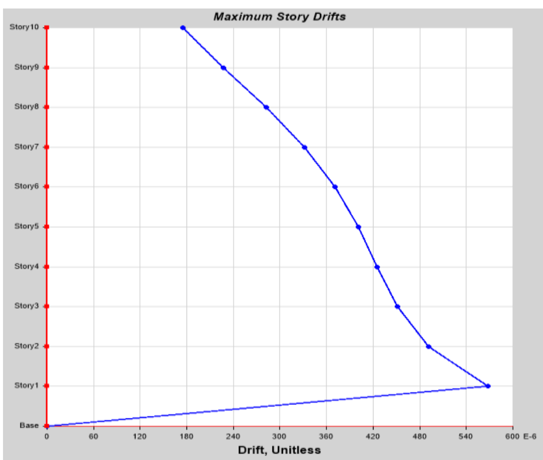

Figure.27: Maximum storey drifts of composite symmetry structure for EQ X

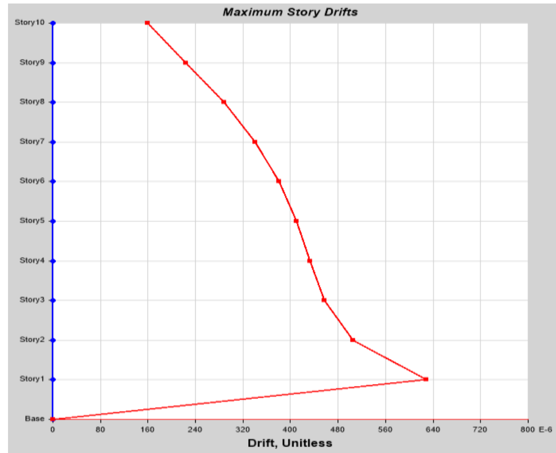

Figure.28: Maximum storey drifts of composite symmetry structure for EQ Y

c. Storey shears

The storey shears of symmetry RCC and composite structures variations in X and Y directions is shown in figures 29, 30, 31 and 32.

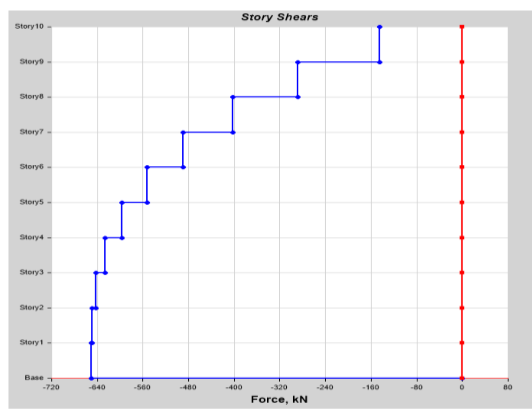

Figure.29: Maximum storey shears of RCC symmetry structure for EQ X

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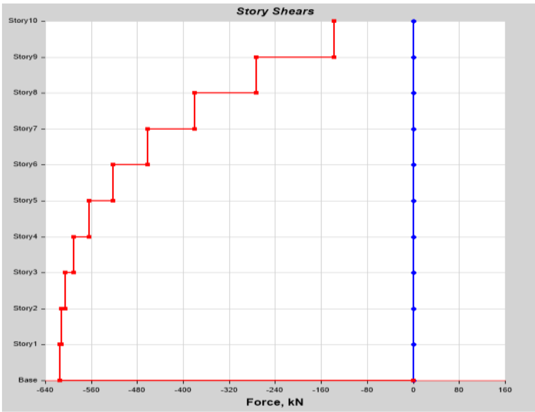

Figure.30: Maximum storey shears of RCC symmetry structure for EQ Y

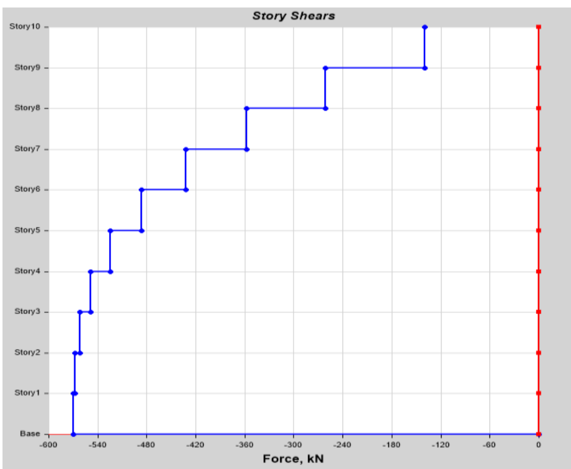

Figure.31: Maximum storey shears of composite symmetry structure for EQ X

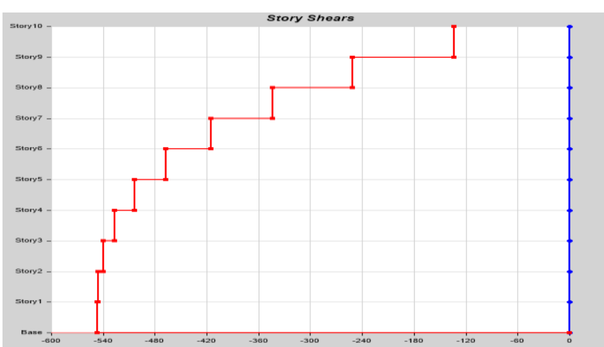

Figure.32: Maximum storey shears of composite symmetry structure for EQ Y

d. Storey stiffness

The storey stiffness of symmetry RCC and composite structures variation in X and Y directions is shown in figures 33, 34, 35 and 36.

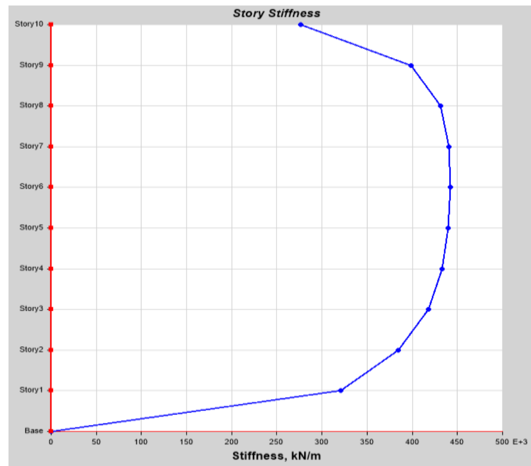

Figure.33: Maximum storey stiffness of RCC symmetry structure for EQ X

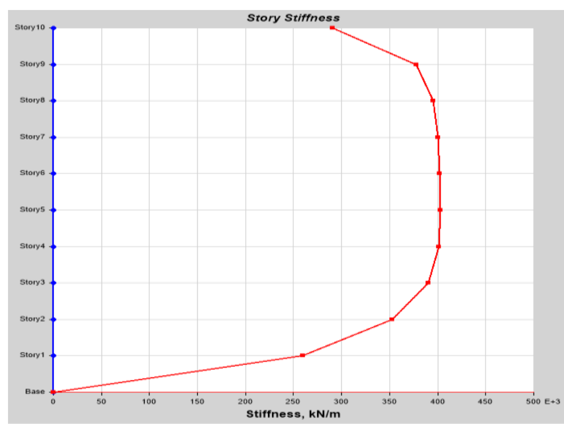

Figure.34: Maximum storey stiffness of RCC symmetry structure for EQ Y

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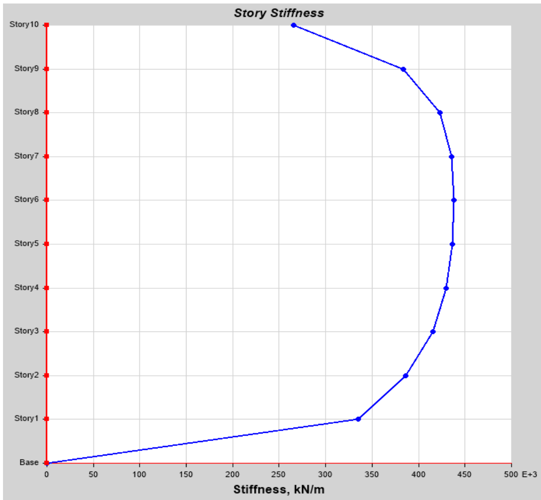

Figure.35: Maximum storey stiffness of composite symmetry structure for EQ X

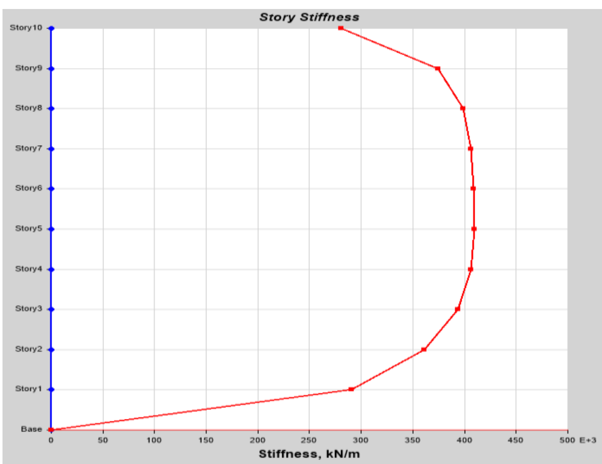

Figure.36: Maximum storey stiffness of composite symmetry structure for EQ Y

E. Summary

In this chapter results of response spectrum analysis of G+10 structures are presented. From this it is observed that the Bending Moment and Shear force are less in the composite structure as compared to RCC structure. The displacement drifts and shears of composite structure is less as compared to RCC structure. The time period is less in the composite structure as compared to RCC structure.

4. CONCLUSION

In this study, the comparative study of RCC and Composite multistoried building (G+10) is presented. Parameter considered are, beam deflection, maximum shear force, and maximum bending moment, time period and displacement.

a. The displacement of composite structures is lesser than the RCC structures.
b. The storey drifts, shears and stiffness values of composite structure are lesser than the RCC structure in both asymmetry and symmetry cases.
c. The asymmetry structure is more stiffer than symmetry structure in both RCC and composite structures.
d. The time period of composite structure is also less than the RCC structure.
e. The composite structure will perform well in earthquake condition than the RCC structure this will be decided by the comparative of displacement for both the structures i.e. composite structure and RCC structure.
f. Base shear is less in composite building compared to RCC building.

4. The data mentioned above is clearly said that composite section is always a better choice against R.C.C. structures. Composite Structure provides efficient and better performance against earthquake loads than R.C.C. structures.

5. Future Scope

a. The use of fully and partially encased steel sections in reinforced concrete is particularly beneficial for earthquake-resistant design. A further study on the

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suitability of other types of composite structural systems for earthquake-resistant design is highly recommended.

b. The wind analysis of multi-storied composite structure can be carried out and charts can be prepared for various wind pressure.

c. Non-linear dynamic analysis can be carried out of various types of composite and RCC structures.

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