International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 14 Issue 6, June-2025

Seismic Analysis in Building with Conventional Composite, Steel with Composite and RCC with Composite Columns

Rambha Thakur[1], Abhishek[2]

[1]Assistant Professor, Department of Civil Engineering, Rattan Institute of Technology and Management, Haryana, India
[2]Research Scholar, Department of Civil Engineering, Rattan Institute of Technology and Management, Haryana, India

ABSTRACT

The world is flowing in high- rise building construction by using different type of materials in construction. Construction in the modern day is widely influenced by using concrete steel composite construction has significantly reduced the use of RCC and steel construction. Erecting composite columns requires specialized knowledge and careful supervision during construction to ensure proper bonding between the concrete and steel components. Many local and small contractors in India may not have experience with composite construction, which could lead to challenges in implementation. Over time, maintenance requirements for composite columns can be higher compared to RCC columns, particularly in terms of inspecting and maintaining the bond between the steel and concrete to prevent corrosion and ensure structural performance. It is that in high rise structure columns of upper floors are having less force as compare to the bottoms floors which results there is scope for optimization in sizes.

INTRODUCTION

General

Reinforced concrete structures have been satisfying greater demands in civil and structural engineering sector for more than 3-4 decades. The application and usage of R.C.C have dynamic role in structural as well as architectural view, stands as a witness and demonstrated its versatility very well. As in the time of up gradation construction sector is also moving towards the usage of composite materials where advantages of two or more materials are used in it. Composite construction is a generic term to describe any building construction involving multiple dissimilar materials. Composite construction is often used in building aircraft, watercraft, and building construction. There are several reasons to use composite materials including increased strength, aesthetics, and environmental sustainability. In developing countries like India, most of the building structures fall under the category of low rise building. So these conventional Reinforced cement concrete and pure sectional steel construction prove to be convenient and economical in nature hence widely used all around. But when it comes to the need for vertical growth of building due to lack of land space area and rapid growth of population, medium high rise building emerges as a solution to full - fill this need. Figure- 1 shows the construction in RCC.

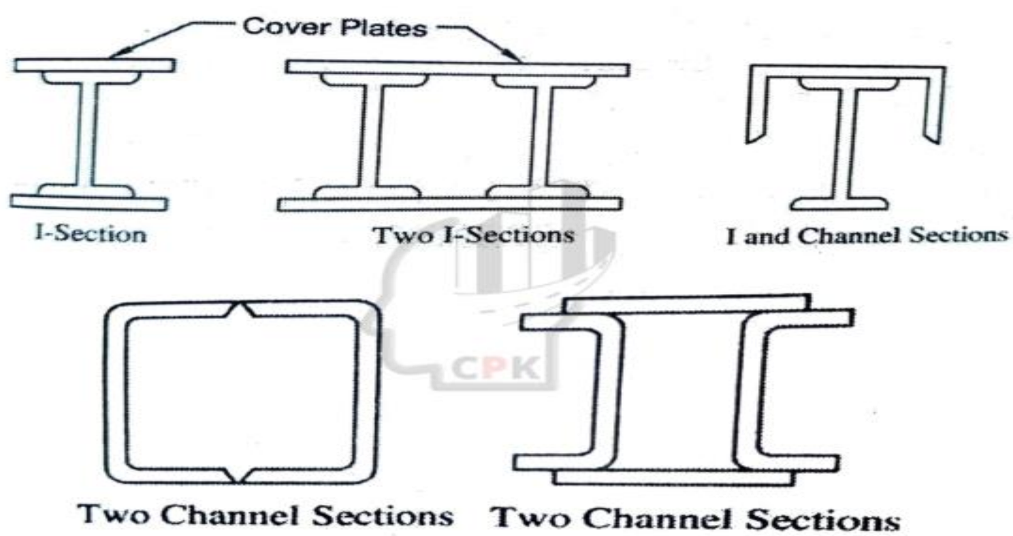
RCC COLUMNS

There are various types of RCC Column based on its shape, length and forces. Function and construction methods are discussed here for these types of column. Column is a vertical member which takes complete load of the beam, slabs and the entire structure and the floor and other area of the building is adjusted as per the requirement of the client or owner. The size of the columns, quantity of cement sand and aggregate to be mixed, the number of steel bars to be placed, spacing between the stirrups is all mentioned in the structural drawing which is designed by structural designer as per the actual load on the column and considering the factor of safety. A column is a vertical member which effectively takes load by compression. Basically column is a compression member as load acts along its longitudinal axis. Bending moment may occur due to wind earthquake or accidental loads. Column transfers the load of the structure of slabs beams above to below, and finally load is transferred to the soil. Position of the columns should be so that there are no tensile stresses developed at the cross section of the columns. Columns location should be such that it hides in the walls partially or fully. Fig 3 shows the different shapes of columns as it affects the strength of column. Sharp corners in rectangular or polygonal columns can lead to stress concentration, reducing their overall strength and potentially causing premature failure. Rounded or chamfered corners can help mitigate stress concentrations and improve the column‘s performance.

The objective of this project was to develop methodologies for finite element analysis of smart structures. In specific, the project attempted to compare experimental results obtained for health monitoring of lab sized Reinforced concrete (RC) frame with of numerical simulations, using finite element analysis .The study made use of high frequency dynamic response technique employing smart piezo ceramic (PZT) actuators and sensors.

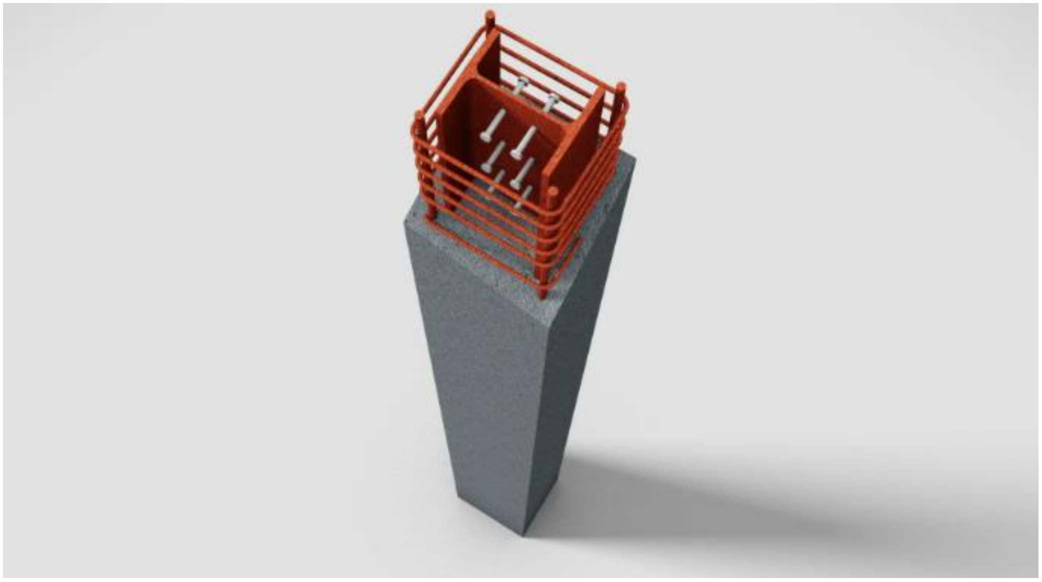
STEEL COLUMNS

Steel column is a structural element used in buildings and other structures. It is in a vertical position and transfers the upper load downwards. It is an essential part of the frame of any building, and its primary purpose is to support the structure and maintain its stability.



COMPOSITE COLUMNS

Now days, where we get to see a lot of structures, big and small, modern and old, what catches our eyes the most are the modern skyscrapers, these structures are made out of extraordinary attainments in science and engineering. Nowadays, the main focus has been shifted to constructing safe buildings keeping in mind the economic aspects of the project, As far as residential and commercial purpose is considered, generally, high-rise buildings, tall structures, towers and blocks are constructed. They may also be known as vertical city. Consist of the ability to give more ground space and accommodating more people in less space. Hence giving us benefit such as a beautiful skyline, important landmarks and optimum land use. Main reason behind these have achieved structure‘s stability, strength and stiffness and for reached that purpose new innovation came in to introduction. ‗Composite construction'. Composite construction governs the non- residential high storey buildings sector. This has been the case for over twenty years. Its recognition is due to it has strength and stiffness that can be achieved, with minimum use of material the reason why composite construction is frequently so good can be expressed in one simple way - concrete is good in compression and steel is good in tension.



LITERATURE REVIEW

Vrunda R Laddha et al. [1] The structure considered here is a commercial 8 storey (G+7) building with plan dimension 28m x20m and height of structure is 28m. Study is carried out for the same building plan of both composite frame and RCC frame with all loadings on structure are kept same. It results that maximum axial on column base due to DL + LL shown on RCC building and the lateral forces acting on a composite structure are about 18% to 33% lesser than RCC structure. Storey shear is about 54% to 60% lesser for composite structure as compared to RCC structure it is because of its lower self- weight of RCC structure. Composite column has significantly less value of shear force and bending moment for same column as compared to RCC column.

Vrunda R Laddha et al. [2] The structure considered here is a commercial 8 storey (G+7) building with plan dimension 28m x20m and height of structure is 28m. Study is carried out for the same building plan of both composite frame and RCC frame with all loadings on structure are kept same. It results that maximum axial on column base due to DL + LL shown on RCC building and the lateral forces acting on a composite structure are about 18% to 33% lesser than RCC structure. Storey shear is about 54% to 60% lesser for composite structure as compared to RCC structure it is because of its lower self- weight of RCC structure. Composite column has significantly less value of shear force and bending moment for same column as compared to RCC column.

Umair Ahmed et al. [3] works on economic and functional feasibility of concrete and steel composite column building structure which concludes that cost is reduced as height of structure is rises. These are also works on design of column. Building is located in Islamabad, Pakistan as seismic zone 2B according to Building Code of Pakistan, 2007. Lateral forces on RCC buildings are shown more in above stories. Storey drift is less in RCC is less than encased composite column structure in both X and Y direction. The overturning moments of RCC structure is 5.5% more than encased composite column structure.

Riyaz J. Mulla et al. [4] study on cost comparison of RCC and Composite structures with STAAD Pro. Software and work on 4 different storey height structures. General geometric considerations of the buildings are plan dimensions 3.5X5m with different story height, importance factor is 1, seismic zone is III with response reduction factor 5. In this study he concludes that base shear of composite building is reduced as compare to RCC. Design moments and forces for columns are also reduced in composite columns.

Md. Yaser et al. [5] done study on comparative cost analysis and dynamic analysis of RCC, Steel and Steel Concrete Composite frame of low, medium and high rise buildings which consider the general requirements as building located in seismic zone IV having framing plan 36X20m with 63m building height. Conclusion of this gives the result base shear shows less values in steel buildings of all type of buildings. RCC building fails in designing as values are exceeds from its permissible limits for high rise structure.

Rajeswaramma Maradi et al. [6] analysis on G+12 storey structure with different RCC, Steel and composite Building using ETABS software. General considerations for building which is apply for all type of structural building are height is 50m, location of building is Surat, type of soil is 2, type of frame is SMRF. Plan dimensions of building are 22.5X22.5m. Results are observed are as follows, RCC building have more seismic weight which effect its base shear. RCC structure possesses less flexibility, rendering them stiffer which leads to maximum storey stiffness.
Parameshwar Hiramath et al. [7] presented comparison in analyses of Conventional RCC, Steel and Composite Columns. For this Comparative study G+10 building is considered which is located in seismic zone 5 with Importance factor 1.5.Overall height of structure is 40m and have different plan shapes i.e. rectangular, C, L and I. Span length in building is 4m. As per results it is found that R.C.C.

ANALYSIS AND RESULT

GENERAL

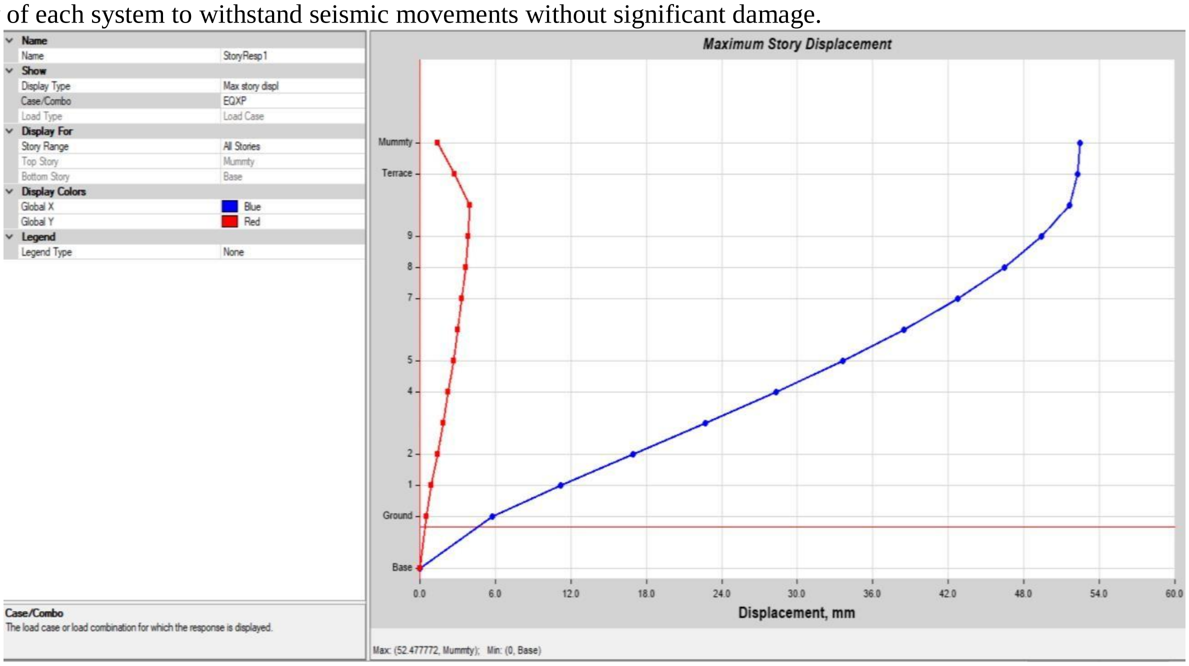
When comparing seismic analysis in a G+10 with conventional composite, steel with composite and RCC with composite columns, you can focus on several critical aspects to provide a comprehensive evaluation. Here are some key comparisons you can make:

BASE SHEAR:

Compare the distribution of base shear forces among the different column systems during seismic events. Evaluate which system exhibits lower or more uniform base shear distribution.

DISPLACEMENT:

Evaluate the demand for lateral displacements in each structural system. Compare maximum displacements and assess the ability of each system to withstand seismic movements without significant damage.



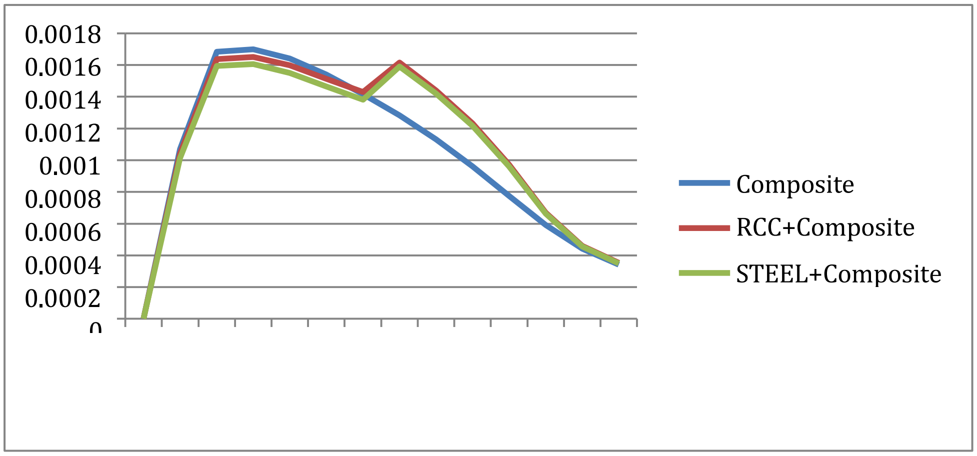
TIME PERIOD:

Time period is crucial in seismic design to evaluate the building's response to earthquake- induced lateral forces. Building codes often specify requirements based on the relationship between time period and seismic hazard.

INTER- STORY DRIFT:

Analyze and compare the inter-story drift ratios across the height of the building for each column system. Assess which system provides better control over drifts, indicating structural stability and safety.

International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 14 Issue 6, June-2025



CONCLUSION

a) Model III have less seismic weight as the lighter hollow sections are used in upper levels so, it shows lesser base shear as compare to other models. There is 5% difference in base shear in model III

b) In type of model III which have steel sections in upper levels so it provides stiffness in building. So, it results that more stiffness in model III but it is in there permissible limits.

c) Time period in model III is 1.55s. In model I &II time period is 1.56s & 1.57s respectively. Time periods in all the three structures are almost the same. As model III has slightly less time period, it is stiffer than model I and II.

d) Inter- storey drift value ranges from 0.0001 – 0.004 in all models with in there permissible limits.

e) Sizes in model III is observed lesser as compare to the I &II.

REFERENCES

[1] Parameshwar Hiramath ―Comparison of Conventional RCC, Steel Columns and Composite Columns‖

[2] Rajeswaramma Maradi, Dr. Sudarsana Rao, Dr. Vaishali. G. Ghorpade ―Comparative Analytical Study of Seismic Response & Cost of Multi- Storey (G+12) RCC, Steel & RCC Steel Composite Building.‖

[3] Md. Yaser, Ajith Kumar Dey, ―Comparative Cost Analysis & Dynamic Analysis of RCC,

[4] Steel And Steel- Concrete Composite Frame of Low, Medium & High Rise Buildings.‖

[5] Md. Mateen, Vishwanath Hiremath,‖Analysis & Comparative study on Multistoried Building with Composite Column And Conventional Column‖

[6] Prahlad Verma et al.‖Comparison of RCC & Composite Tall Structure on the Effect of Lateral Forces‖

[7] Riyaz J. Mulla et al.‖ Cost Comparison of RCC & Composite Structures‖

[8] Umair Ahmed et al. ―Economic & Functional Feasibility of Concrete & steel Composite column Building structure‖

[9] Anish N. Shah, Dr. P. S. Pajgade.‖Comparision of RCC & Composite Multistoried Buildings

[10] Vrunda R Laddha ET al.‖ Analytical Investigation of Composite Structure in Comparison of RCC Structure‖.

[11] Faizan Rafiq Wani, Er. Ajay Vikram.‖Investigation of Composite Structures in Comparison to RCC Structures using Etabs.

[12] Dr.Narayanan ‖Investigation of Steel – Concrete Composite Structure

[13] DR TK Bandyopadhyay ‖basic concept in composite structure

[14] DR D. Datta & DR. S. Ghorai ‖ multistoried Residential building (B+G+20) storied with steel concrete composite construction.

[15] DR. D. Datta & DR. A. Guha ‖design of embossed profiled sheets acting as composite deck

[16] Lalit Chaudhary & col. Vivek mathur ‖comparative studies of RCC and Steel composite structures

[17] DR. VR rathi ‖analysis and design of steel composite concrete structure

[18] M Shaju Pragash ‖steel-concrete composite and RCC Structure towards seismic resilience

[19] Mustafa M wagh ‖a review on comparative study of composite RCC and steel structure.