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Analysis And Comparison Between Rcc Column And Composite Column In Irregular Building By Using Response Spectrum Method

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Abstract: The construction industry has witnessed significant advancements in materials and methodologies over the past decades. Reinforced Cement Concrete (RCC) and Composite structures are two prominent systems widely used in building construction. This study provides a comparative analysis of these two structural systems, focusing on their design, performance, cost-efficiency, and environmental impact. RCC structures, known for their simplicity in construction and durability, are extensively utilized in conventional construction. Conversely, composite structures, which integrate steel and concrete, offer enhanced strength-to-weight ratios, flexibility in design, and faster construction timelines. The analysis explore into factors such as load-bearing capacity, seismic resistance, material consumption, construction speed, and lifecycle costs. Additionally, the environmental implications of both systems are examined to align with sustainable construction practices. The study aims to provide a comprehensive understanding for selecting the optimal structural system for different building requirements.

Key Words – R.C.C, High-rise Structures, Composite, Seismic Response, Shear Connectors.

1.INTRODUCTION-

The construction industry has witnessed significant advancements in materials and structural systems over the years. Among the most commonly used structural systems in modern construction are Reinforced Cement Concrete (RCC) and Composite structures. Both have distinct advantages and limitations, making them suitable for different applications based on factors such as cost, durability, load-bearing capacity, and construction speed.

Reinforced Cement Concrete (RCC) buildings are primarily constructed using concrete reinforced with steel bars. RCC structures are known for their durability, fire resistance, and ability to withstand compressive forces efficiently. They have been widely used in residential, commercial, and infrastructure projects due to their reliability and ease of availability of materials. However, RCC structures can be heavy, leading to increased foundation costs and longer construction times.

On the other hand, Composite buildings utilize a combination of steel and concrete to optimize structural performance. In these structures, steel sections and concrete work together to enhance strength, reduce weight, and accelerate construction speed. Composite buildings have gained popularity, especially in high-rise construction, due to their superior load-bearing capacity, seismic resistance, and flexibility in design. The integration of steel and concrete in composite construction allows for efficient material usage, reducing overall project costs and environmental impact.

This comparative study aims to analyze the key differences between RCC and Composite buildings by examining their structural behavior, construction methodology, cost-effectiveness, sustainability, and overall performance. The objective is to provide a clear understanding of the advantages and limitations of each system.

2.OBJECTIVES OF THE STUDY –

i) To understand the structural behavior of RCC and composite columns under axial and lateral loads through software-based modeling.

ii) To compare the load carrying capacity of RCC columns and composite columns under similar loading and boundary conditions.

iii) To evaluate the performance of RCC and composite columns in terms of strength, stiffness, ductility, and stability.

iv) To analyze the effect of cross-sectional size and material usage on structural efficiency and space utilization in both column types.

v) To identify the advantages and limitations of each type of column system in various building applications.

3.COMPOSITE STRUCTURE ELEMENT-

1) Composite Column – A composite column is a vertical structural element made by combining steel and concrete, so both materials work together to support loads. These columns are used to take advantage of the strength of steel and the durability and fire resistance of concrete.

2) Composite Beam – A composite beam is a structural member composed of two or more distinct materials, typically a steel section and a reinforced concrete slab**,** that are rigidly connected to act as a single unit under loading conditions. The structural efficiency of composite beams arises from the interaction between the concrete in compression and the steel in tension, effectively utilizing the favourable mechanical properties of both materials.

3) Composite Slab – A composite slab is made by combining a steel deck and a layer of concrete poured on top. The steel deck acts as temporary formwork during construction and later as reinforcement for the slab when the concrete hardens. This combination allows both materials to work together to resist loads the concrete handles compression while the steel deals with tension. Because of this, composite slabs are strong, lightweight, and fast to construct**.** They are commonly used in multi storey buildings**,** industrial floors**,** and bridges**.** Composite slabs reduce the need for extra supports during construction and allow for longer spans than regular RCC slabs.

4.MODELING AND ANALYSIS

CASE I: IRREGULAR PLAN WITH RCC COLUMN WITH SHEAR WALL

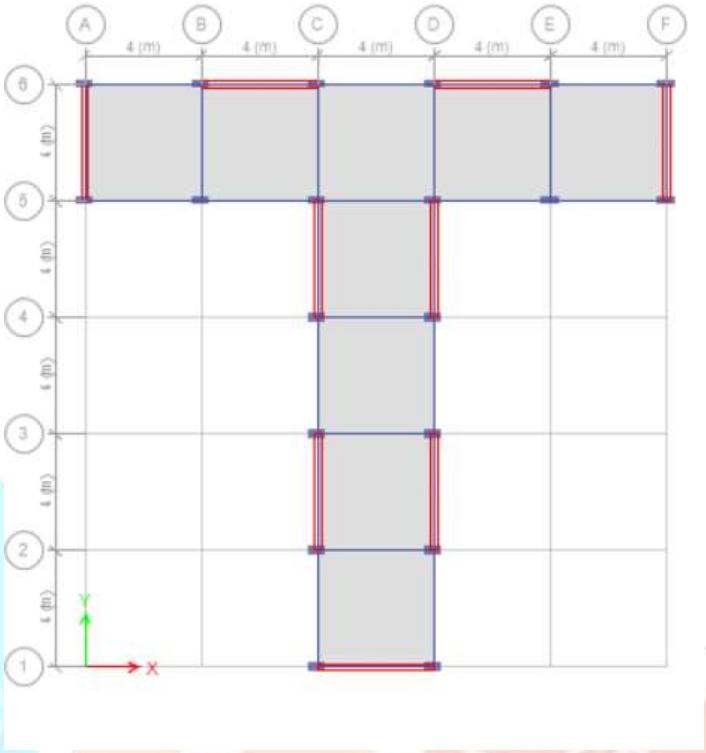


FIG.1:IRREGULAR PLAN MODEL WITH RCC COLUMNS WITH SHEAR WALL

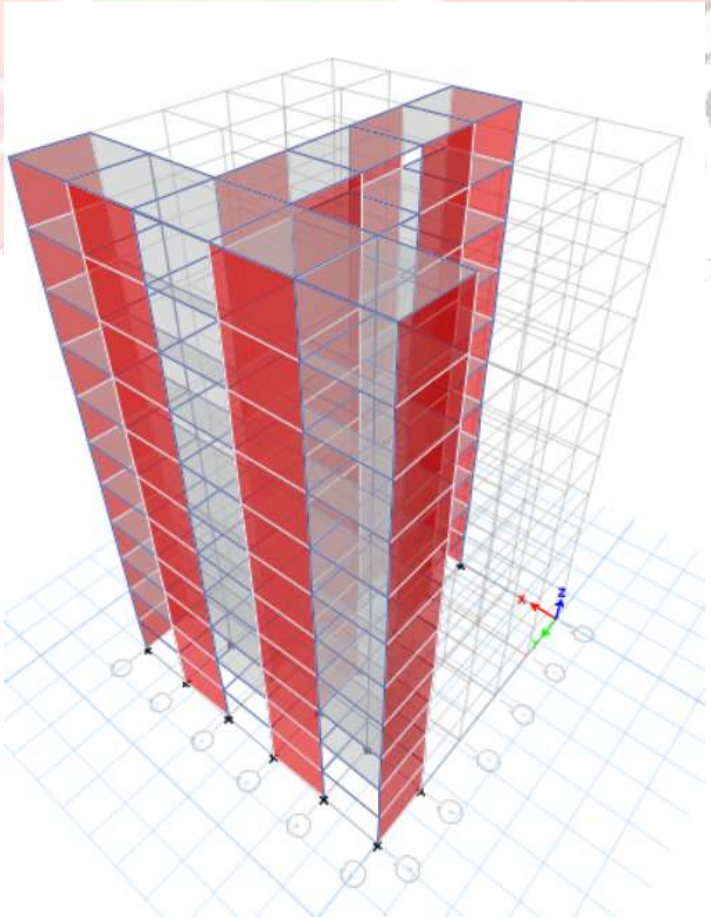


FIG.2: 3D VIEW OF RCC COLUMN WITH SHEAR WALL BUILDING

CASE II: IRREGULAR PLAN WITH COMPOSITE COLUMN

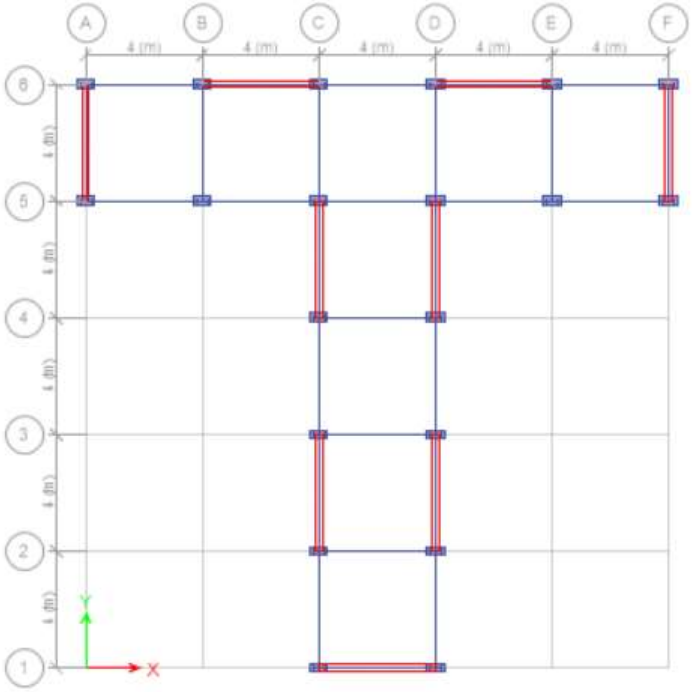


FIG.3: IRREGULAR PLAN WITH COMPOSITE COLUMN

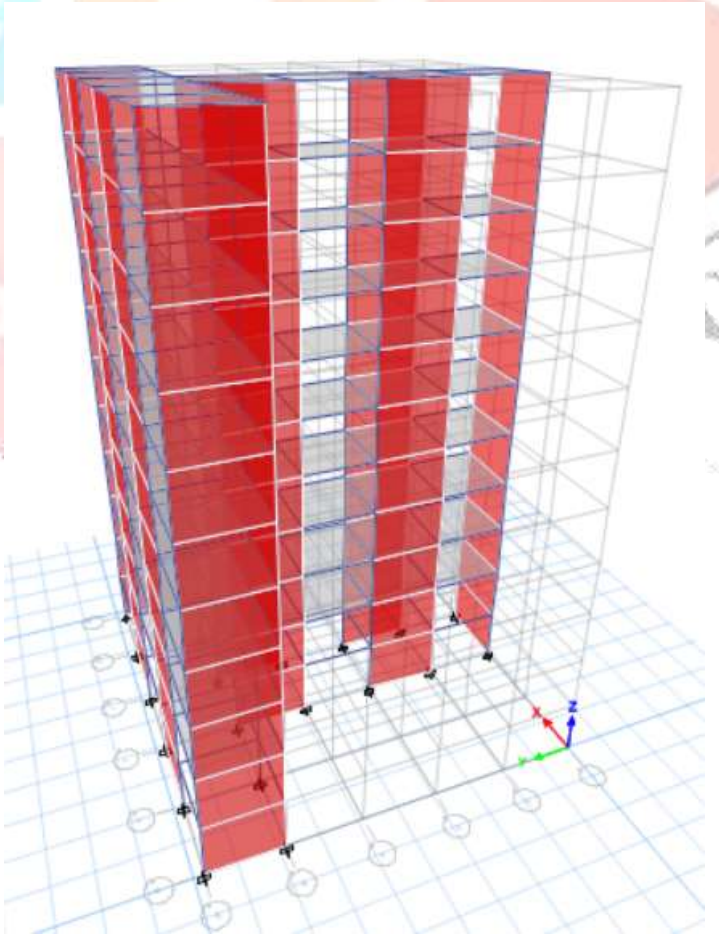


FIG.4: 3D VIEW OF COMPOSITE COLUMN WITH SHEAR WALL

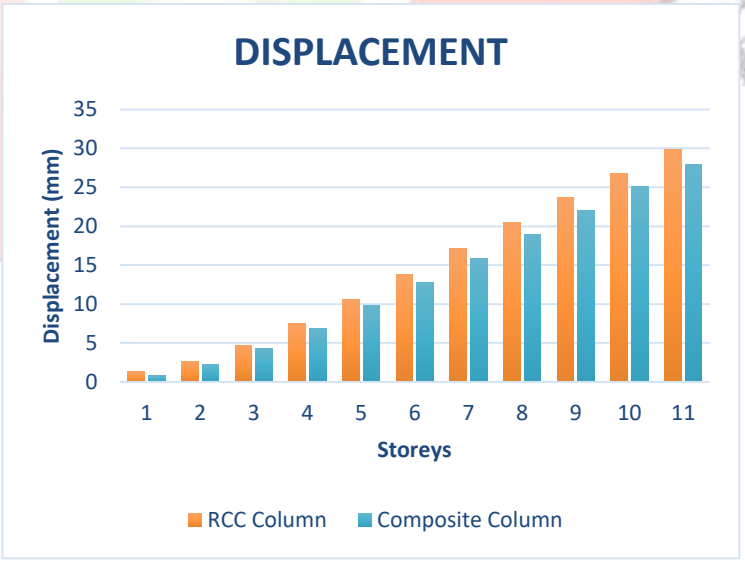
4.1.Model Description

Description	Criteria
Shape of building	T Shape
Type of Building	RCC, Composite
Plan Dimension	20m X 25m
No. of stories	G+10
Height of each Storey	3m
Size of composite colum	300mm x 600mm
Size of RCC beams	300mm x 600mm
Shear Wall	230 mm
Grade of concrete	M30
Grade of Steel	HYSD 500
Slab Thickness	150mm
Embedded steel section	ISWB 550
Seismic Zone considered	Zone 4
Zone Factor	0.24

5.RESULTS AND ANALYSIS

5.1 Comparison between Rectangular RCC column and Composite column in Irregular plan:

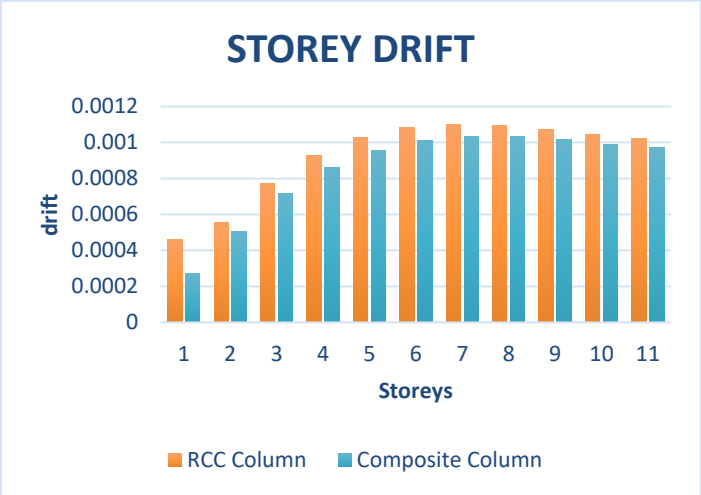
- DISPLACEMENTS:



Story	RCC Column	Composite column
Story11	29.869	27.929
Story10	26.804	25.019
Story9	23.669	22.046
Story8	20.449	19.001
Story7	17.163	15.904
Story6	13.858	12.803
Story5	10.611	9.769
Story4	7.527	6.901
Story3	4.741	4.323
Story2	2.581	2.264
Story1	1.377	0.817
Base	0	0

It is observed that the displacement values for the composite column structure are consistently lower than those of the RCC column structure across all storeys, indicating better lateral stiffness and performance under loading conditions. The maximum displacement at the top storey is approximately 27.929 mm for RCC columns, whereas it is reduced to 20.894 mm for composite columns.

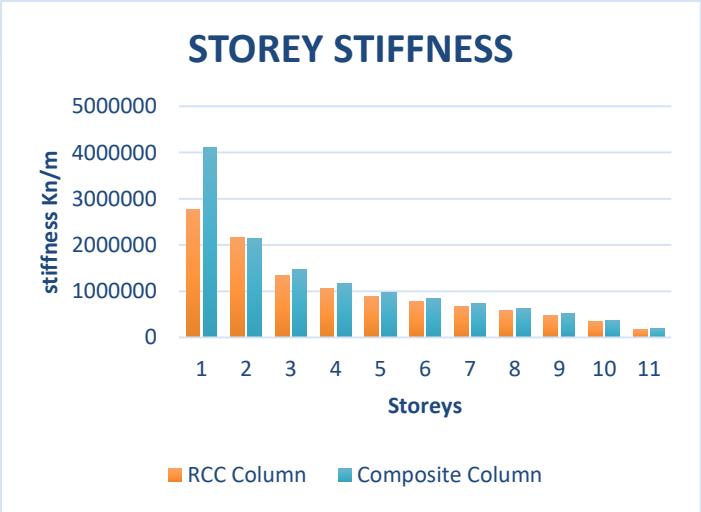
- STORY DRIFTS:



Story	RCC Column	Composite column
Story11	0.001022	0.00097
Story10	0.001045	0.000991
Story9	0.001073	0.001015
Story8	0.001095	0.001032
Story7	0.001102	0.001034
Story6	0.001082	0.001011
Story5	0.001028	0.000956
Story4	0.000929	0.000859
Story3	0.000774	0.000713
Story2	0.000557	0.000507
Story1	0.000459	0.000272
Base	0	0

It is observed that the storey drift in composite column structures is consistently lower than that in RCC column structures across all storeys, demonstrating improved lateral performance. The maximum drift is recorded at the 7th storey, with 0.000937 for RCC columns and a reduced value of 0.000727 for composite columns, indicating better control of inter-storey movement in composite systems.

- STOREY STIFFNESS :



Story	RCC Column	Composite column
Story11	178620.328	190609.941
Story10	345146.247	369259.116
Story9	477579.98	512435.617
Story8	584811.565	629457.96
Story7	679951.782	734255.549
Story6	776982.962	841947.783
Story5	893517.902	971833.243
Story4	1058157.948	1155689.96
Story3	1339386.48	1466511.589
Story2	2161898.786	2145123.282
Story1	2775558.27	4101156.025
Base	0	0

Composite columns exhibit higher storey stiffness than RCC columns across all storeys, especially at the lower levels, indicating better resistance to lateral loads and improved structural performance.

6.Conclusion:

- It is observed that composite columns result in significantly lower lateral displacements compared to RCC columns, which contributes to better control over building sway during seismic activity.
- It is observed that storey drift values in composite column structures are consistently lower than those in RCC structures, ensuring improved inter-storey movement control and enhanced occupant comfort.
- It is observed that composite columns offer higher storey stiffness across all floors, particularly at the lower levels, which improves the building's resistance to lateral forces.
- It is observed that composite columns make more efficient use of materials by combining the compressive strength of concrete with the tensile strength of steel.
- It is observed that the overall structural performance, construction speed, and material economy are better in composite structures, making them a more viable choice for irregular and high-rise buildings.
- It is observed that adopting composite columns can lead to reduced construction time and lighter structural weight, which in turn reduces foundation load and cost.

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