



COMPARISON BETWEEN RCC AND COMPOSITE COLUMN IN IRREGULAR MULTISTORIED BUILDING

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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 explores 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.
- ii) 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

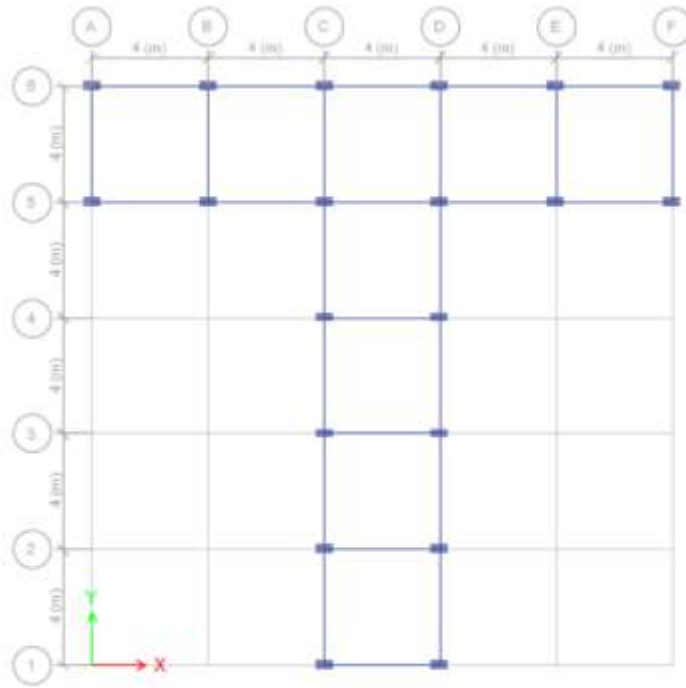


FIG.1:IRREGULAR PLAN MODEL WITH RCC COLUMNS

CASE II: IRREGULAR PLAN WITH COMPOSITE COLUMN

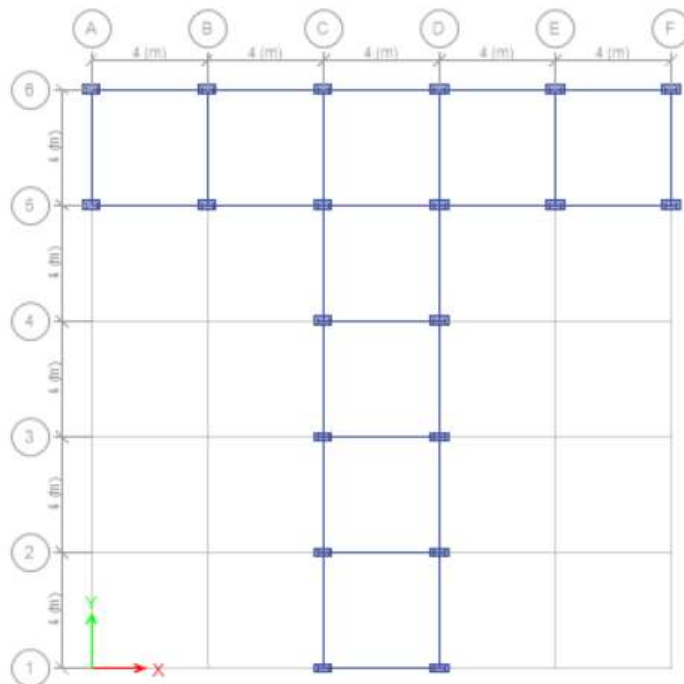


FIG.2: IRREGULAR PLAN WITH COMPOSITE COLUMN

4.1 Model Description

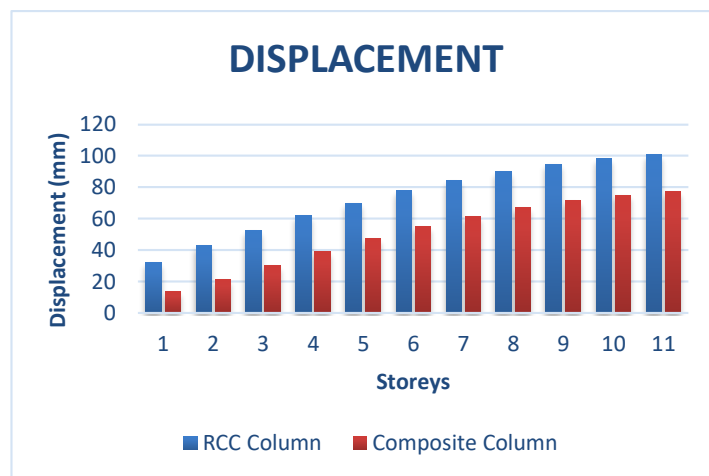
Description	Criteria
Shape of building	T Shape
Type of Building	RCC, Composite
Plan Dimension	20m X 25m
No. of stories	G+10
Hight of each Storey	3m
Size of composite column	300mm x 600mm
Size of RCC beams	300mm x 600mm
Grade of concrete	M30
Grade of Steel	HYSD 500
Slab Thickness	150mm
Embedded steel 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:

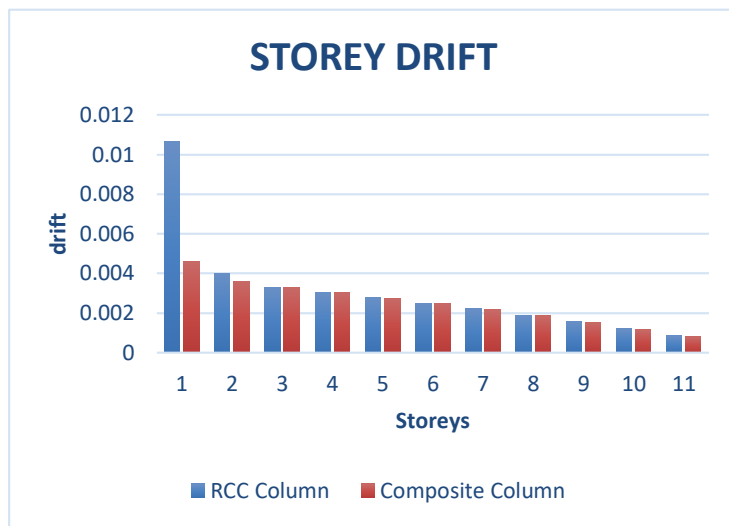
Story	RCC Column	Composite column
Story11	100.811	77.53
Story10	98.217	75.102
Story9	94.608	71.621
Story8	89.929	67.053
Story7	84.243	61.46
Story6	77.616	54.914
Story5	70.113	47.486
Story4	61.801	39.255
Story3	52.747	30.344
Story2	43.01	21.079
Story1	31.998	13.801
Base	0	0



The displacement in buildings with composite columns is consistently lower than that with RCC columns across all story levels. The maximum displacement at the top story (Story11) is 100.811 mm for RCC and 77.53 mm for composite, showing that composite columns offer better lateral stiffness and performance in irregular plans.

- **STORY DRIFTS:**

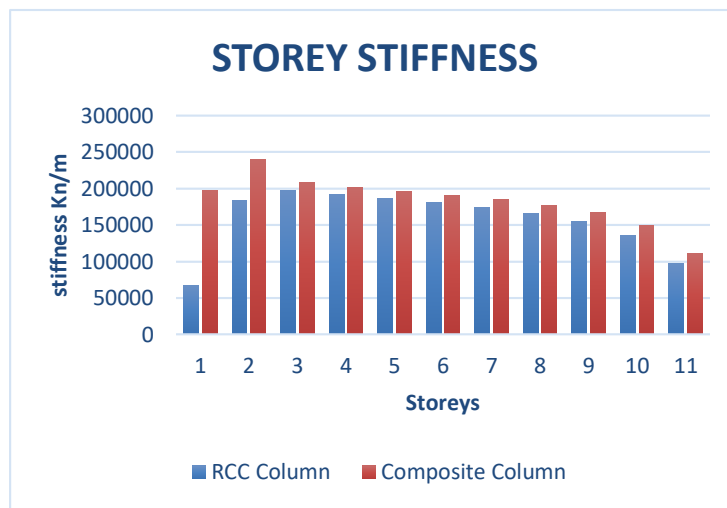
Story	RCC Column	Composite column
Story11	0.000874	0.000809
Story10	0.001206	0.00116
Story9	0.00156	0.001523
Story8	0.001896	0.001864
Story7	0.00221	0.002182
Story6	0.002502	0.002476
Story5	0.002772	0.002752
Story4	0.003021	0.00302
Story3	0.003276	0.003279
Story2	0.004	0.003622
Story1	0.010666	0.0046
Base	0	0



The storey drift is highest at the 1st storey for both structures. Composite columns show consistently lower drift than RCC columns, indicating better lateral performance, especially in lower floors.

- **STOREY STIFFNESS :**

Story	RCC Column	Composite column
Story11	97837.533	111330.514
Story10	136013.874	149409.231
Story9	154420.591	166768.09
Story8	165856.231	177193.474
Story7	174113.541	184614.731
Story6	180801.234	190622.56
Story5	186750.099	195828.069
Story4	192393.873	201059.124
Story3	197161.291	208724.157
Story2	183490.096	239943.597
Story1	67177.262	197813.045
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 the building with composite columns shows less lateral displacement at all floor levels compared to the RCC column building.
- It is observed that the maximum displacement at the top storey is 100.81 mm for RCC and 77.53 mm for composite columns, which shows better stiffness in the composite structure.
- It is observed that the storey drift is lower in composite columns, especially at the bottom floors, which means better performance during earthquakes.
- It is observed that the storey stiffness values are higher in composite structures than in RCC structures, especially in the lower floors, indicating stronger resistance to lateral loads.
- It is observed that composite columns improve the overall stability of the structure and help reduce building sway in irregular multi-storeyed buildings.

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