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DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURE AS COMPARATIVE WITH REINFORCED CONCRETE STRUCTURE BY ADAPTING STAAD. PROV8I

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Keywords: Composite structure, composite column, G+15, equivalent static method, steel beam, shear connectors & STAAD. pro

ABSTRACT
Steel-concrete composite structure implies steel section encased in concrete for columns and the concrete slab or profiled deck slab is connected to the steel beam with the help of mechanical shear connectors so that they act as a single unit. Steel-concrete composite with Reinforced cement concrete options are considered for comparative study of G+15 storey office building which is situated in earthquake zone IV and for earthquake loading, the provisions of IS:1893(Part1)-2002 is considered by Equivalent Static Method of Analysis. For modeling of Composite & R.C.C. structures, STAAD. pro software is used. In this study, the seismic design and performance of composite steel-concrete frames are discussed in particular. Comparison of parameters like time period, displacement, moments and load carrying capacity is done with steel and Reinforced cement concrete structures. The results are compared and it is found that composite structure are more good in several aspect.

INTRODUCTION & OBJECTIVES
In India reinforced concrete members are mostly used in the framing system for most of the buildings since this is the most convenient & economic system for low-rise buildings. However, for medium to high-rise buildings this type of structure is no longer economic because of increased dead load, less stiffness, span restriction and hazardous formwork. Steel concrete composite frame system can provide an effective and economic solution to most of these problems in medium to high-rise buildings. This paper includes the Comparative study of R.C.C. with Composite (G+15) Storey building which further includes the details of time period, storey drift, deflections, bending moments in x & y direction, axial force and shear force in columns & beams. The main objectives of the study are

- To provide a brief description to various components of steel concrete framing system for buildings.
- To investigate major parameters like, time, seismic response of steel-concrete composite frames over traditional reinforced concrete frames and steel frames for building structures.

Elements of composite construction:

1. Composite beam, slab & shear connectors
A steel concrete composite beam consists of a steel beam, over which a reinforced concrete slab is cast with shear connectors. The composite action reduces the beam depth. Rolled steel sections themselves are found adequate frequently for buildings and built up girders are generally unnecessary. The composite beam can also be constructed with profiled sheeting with concrete topping or with cast in place or precast reinforced concrete slab.

2. Composite Column
A steel – concrete composite column is conventionally a compression member in which the steel element is a structural steel section. There are three types of composite columns used in practice which are Concrete Encased, Concrete filled, Battered Section.

3. Shear Connectors
Shear connections are essential for steel concrete construction as they integrate the compression capacity of supported concrete slab with supporting steel beams / girders to improve the load carrying capacity as well as overall rigidity. Therefore, mechanical shear connectors are required at the steel-concrete interface. These connectors are designed to
(a) Transmit longitudinal shear along the interface
(b) Prevent separation of steel beam and concrete slab at the interface.

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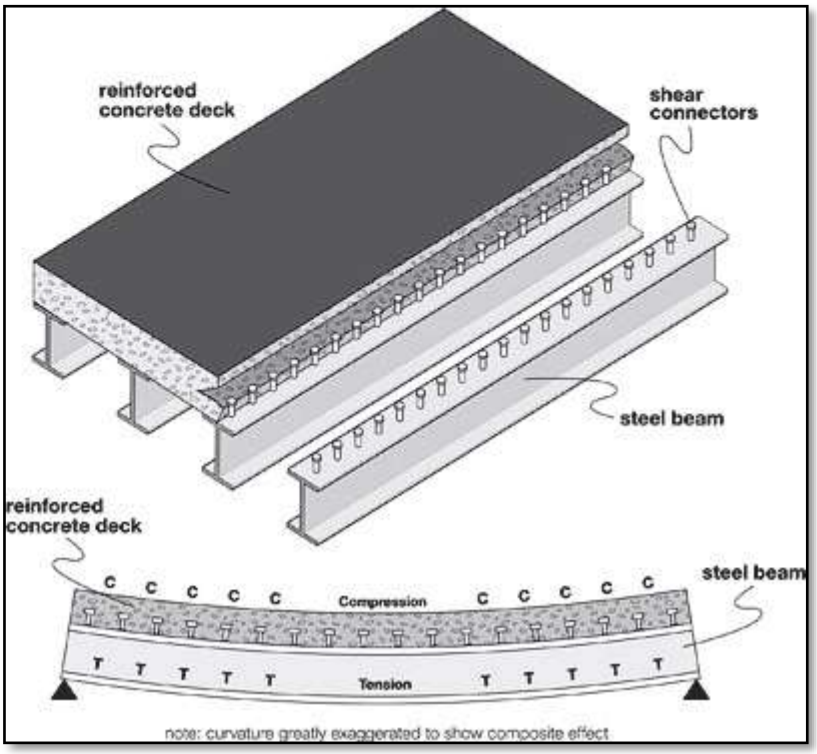

Figure 1: Typical Composite Beam Slab Details with shear connectors

MODELING AND ANALYSIS

The building considered here is a commercial building. The plan dimension is 30m x 24m. The study is carried out on the same building plan for both R.C.C and Composite construction. The floor plans were divided into five by six bays in such a way that center to center distance between two grids is 6 meters by 4 meters respectively as shown in Figure 2. The basic loading on both types of structures are kept same.

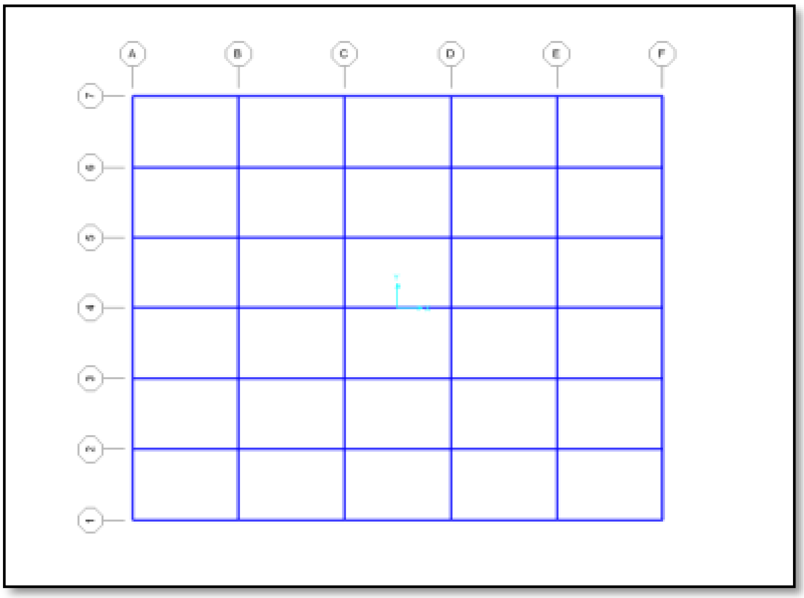

Figure 2: Floor plan of the structure

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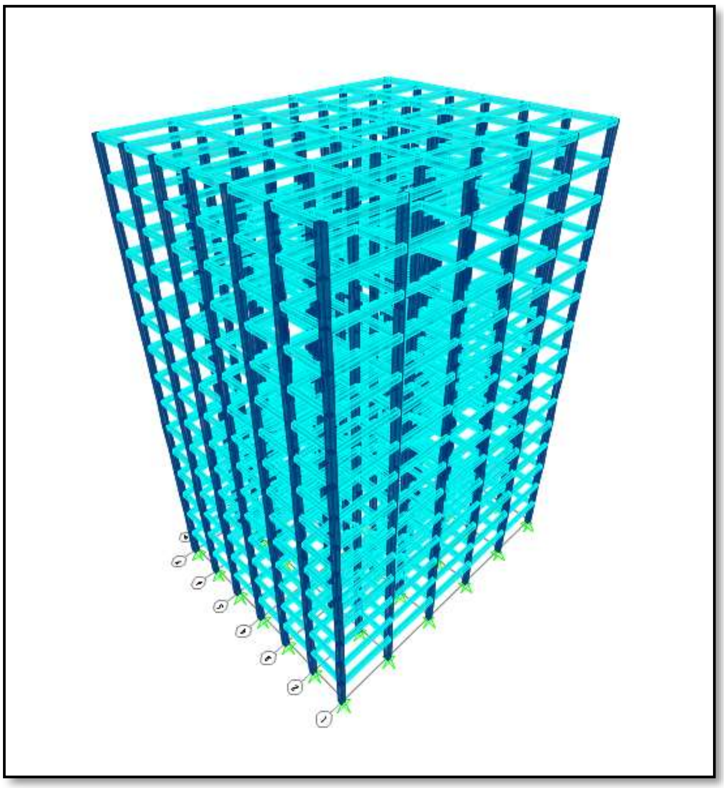

Figure 3: 3D Model of the Building

Table 1: Data for analysis for RCC structure and Composite structure

Sr. No.	Particulars	Dimensions/Value of RCC structure	Dimensions/Value of composite structure
1	Plan Dimension	30x24 m	30x24
2	Total height of the building	45m	45m
3	Height of each storey	3 m	3 m
4	Height of parapet	1 m	1 m
5	Depth of foundation	3 m	3 m
6	Size of beams 6.0m span	450x600	ISMB 450
7	Size of beams 4.0m span	300x450	ISMB 300
8	Size of outer columns	600x600	ISMB 450
9	Size of internal columns	450x450	ISMB 450
10	Thickness of slab	150mm	150mm
11	Thickness of walls	230mm	230mm
12	Seismic zone	IV	IV
13	Wind speed	50 m/s	50 m/s
14	Importance factor	1.0	1.0
15	Zone factor	0.16	0.16
16	Damping ratio	5%	5%
17	Floor finish	4.0kN/m^2	4.0kN/m^2
18	Live load at all floors	1.0 KN/m^2	1.0 KN/m^2
19	Density of concrete	25 KN/m^3	25 KN/m^3
20	Density of brick	20 KN/m^3	20 KN/m^3
21	Grade of concrete	M30	M20
22	Grade of reinforcing steel	Fe500	Fe415
23	Density of steel	-	7850 Kg/m^3
24	Soil condition	Hard soil	Hard soil

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The explained 3D building model is analyzed using Equivalent Static Method. The buildings models are analyzed by using STAAD-Pro V8i software. In composite structure the beam is modeled as composite beam element and column is modeled as RCC beam element and shear wall is modeled as RCC plate element. In RCC structure the beam and column is modeled as RCC beam element and shear wall is modeled as RCC plate element. The different parameters such as node displacement, maximum shear force, axial force and maximum bending moment, Time period were studied for the models. The dead load and live load are considered as per IS-875(part 1 &2) and wind load is considered as per IS-875(part 3).For earthquake loading IS: 1893 (Part1)-2002 is used.

RESULTS

- Analysis of the two types of structures is done and the results are as follows:

Factor	Composite Building	RCC building
Time period (sec)	5.9	3.45
Maximum nodal displacement (m)	0.128 in X direction 0.132 in Y direction	0.049 in X direction 0.047 in Y direction
Maximum support reactions (KN)	6016.5	7988.6
Storey Drift (m)	0.012 in X direction 0.019 in Z direction	0.0044 in X direction 0.0038 in Z direction
Maximum Axial force (KN)	7675.2	7724.6
Maximum Shear force (KN)	121.68	128.72
Maximum Bending moment (KNm)	421.23 in X direction 145.39 in Z direction	435.22 in X direction 126.58 in Z direction

- Here for the deflection pattern, axial force graph, bending moment and shear force we analyze a single particular column for our study.

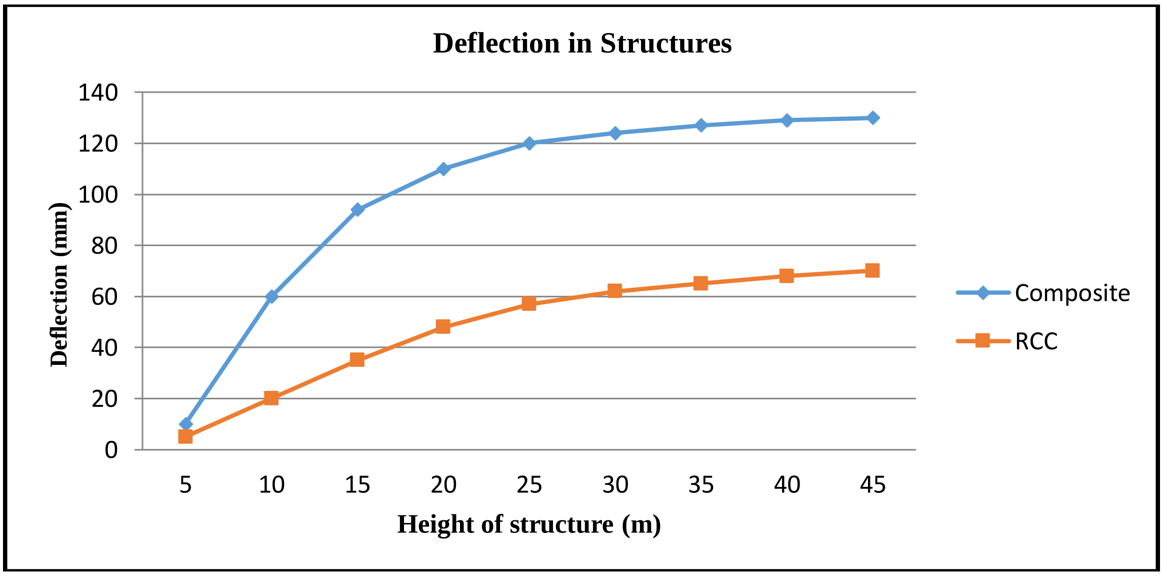

Figure 4: Deflection in Structures

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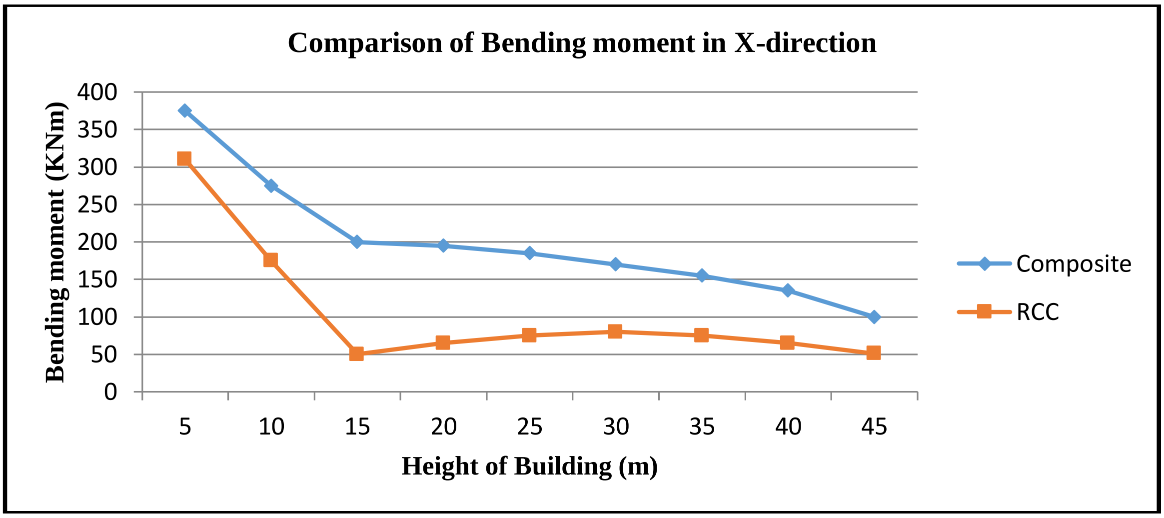

Figure 5: Comparison of Bending moment in X-direction

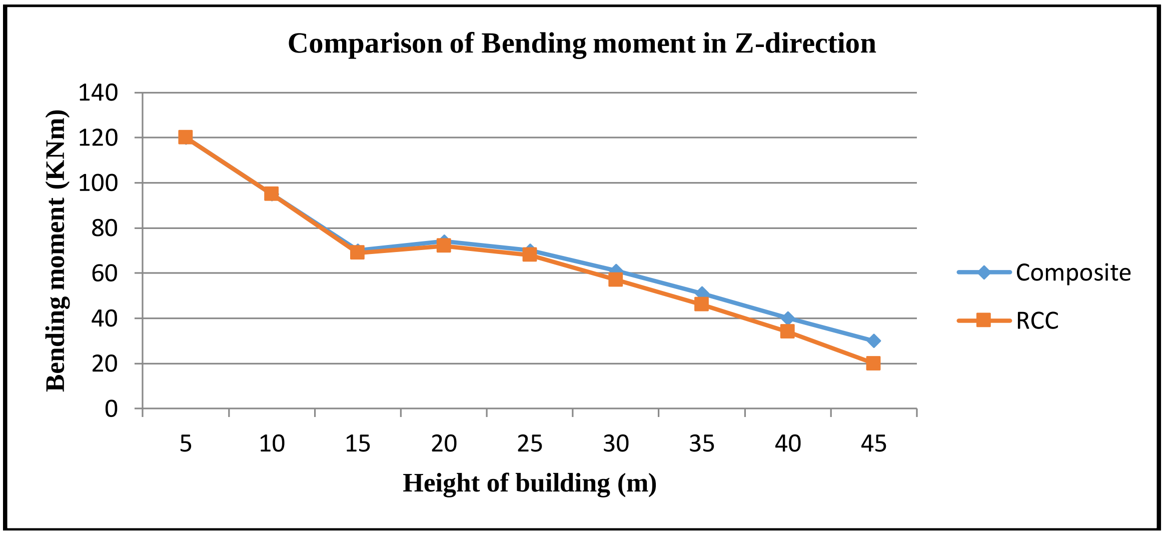

Figure 6: Comparison of Bending moment in Z-direction

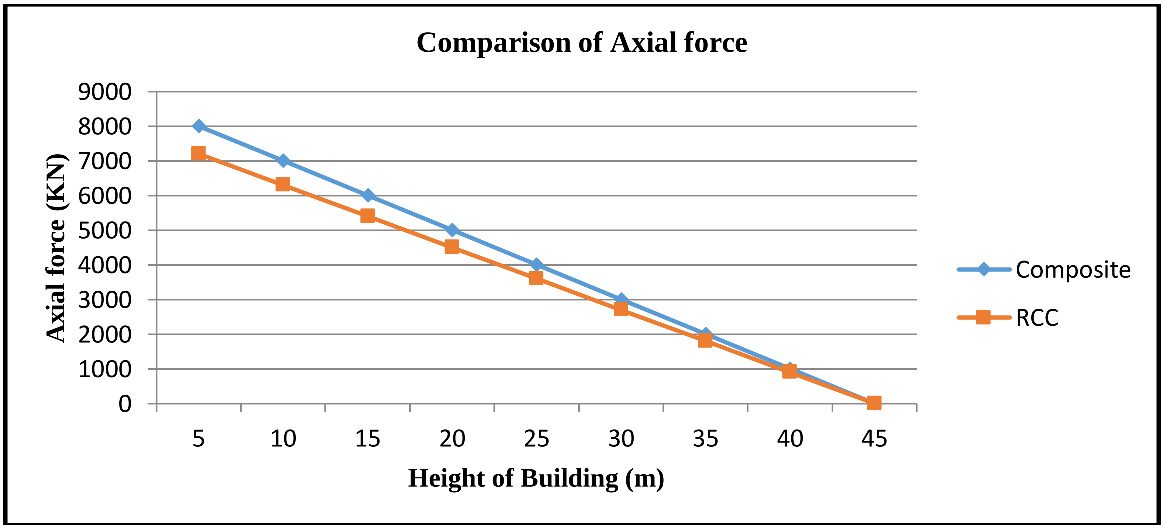

Figure 7: Comparison of Axial force

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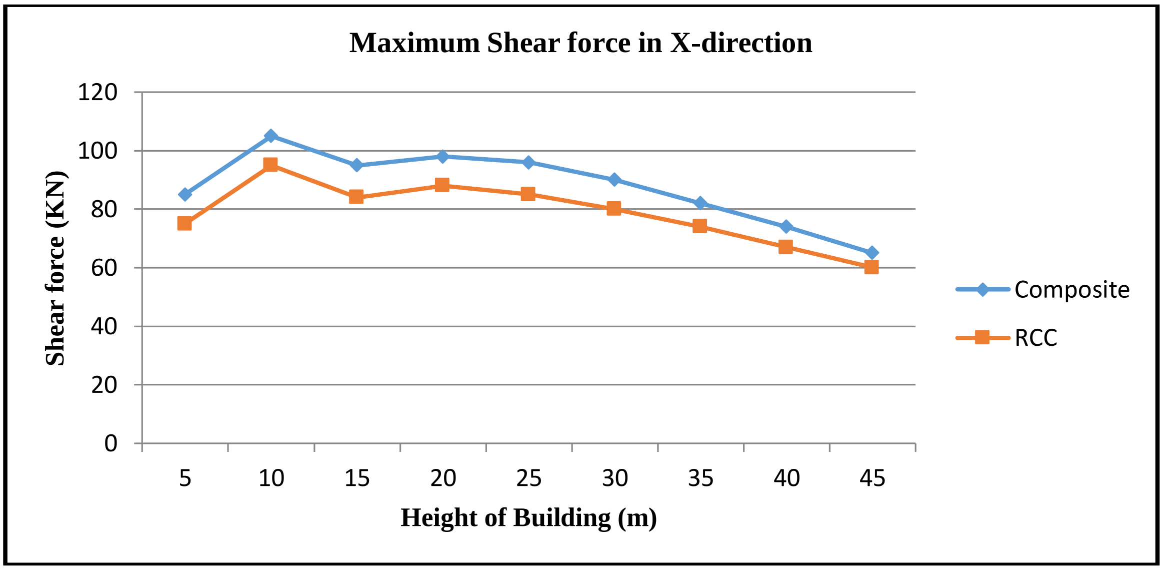

Figure 8: Maximum shear force in X-direction

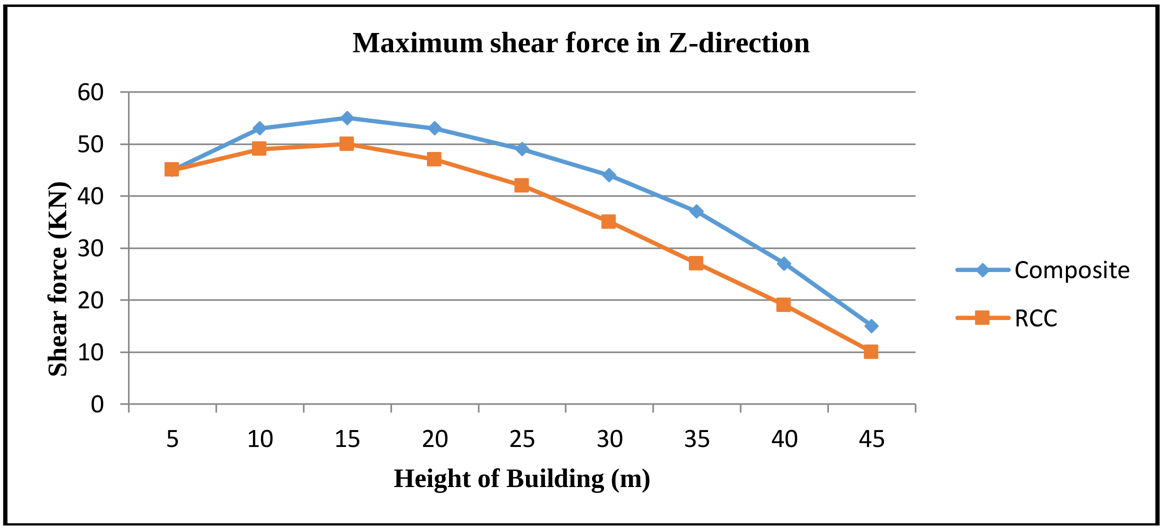

Figure 9: Maximum Shear force in Z-direction

CONCLUSION

Analysis and design results of G+15 storied building with comparison of results of composite column building and R.C.C. column building shows that:-

1. The deflection & storey drift in composite structure is nearly double than that of R.C.C. Structure but the deflection is within the permissible limit.
2. The graph shows that there is significant reduction in bending moments of columns in X Direction.
3. The graph shows that there is no significant difference in bending moments of columns in Z Direction.
4. Axial Force & Shear force in R.C.C. structure is on higher side than that of composite structure.
5. Max. bending moment in beams of composite structure is slightly on higher side in some storey's than R.C.C. Structure.

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