RESEARCH ARTICLE OPEN ACCESS

Comparison of R.C.C. And Composite Multistoried Buildings

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ABSTRACT
Steel concrete composite construction has gained wide acceptance world wide as an alternative to pure steel and pure concrete construction. The use of steel in construction industry is very low in India compared to many developing countries. There is a great potential for increasing the volume of steel in construction, especially in the current development needs India and not using steel as an alternative construction material and not using it where it is economical is a heavy loss for the country. In the present work steel concrete composite with RCC options are considered for comparative study of G+15 story building which is situated in earthquake zone-IV and for earthquake loading, the provisions of IS: 1893 (Part1)-2002 is considered. A three dimensional modelling and analysis of the structure are carried out with the help of ETAB software.
***Index terms*:** Composite column, Composite beam, shear connectors, ETAB Software

I. INTRODUCTION

Composite structures can be defined as the structures in which composite sections made up of two different types of materials such as steel and concrete are used for beams, columns. This paper includes comparative study of R.C.C. with Steel Concrete Composite G+ 15 story building which situated in earthquake zone IV. Equivalent Static Method and Response Spectrum Method of Analysis is used.. Comparative study includes deflection, story drift, base shear, stiffness. It is found that composite structure is more economical and speedy than R.C.C. structure.

II. COMPSOITE CONSTRUCTION

In today's modern era of innovation, two materials widely and inevitably used as construction material are steel concrete for structures ranging from buildings to bridges. The failure of many multi-storied and low- rise RCC and masonry buildings due to earthquake has forced the structural engineers to look for the alternative method of construction having lesser depth which saves the material cost. The use of Steel in construction industry is very low in India compared to many developing countries.

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Elements of Composite Construction

A. Composite Column

Steel concrete composite column is a compression member, comprising either of a concrete encased hot rolled steel section or a concrete filled hollow section of hot rolled steel.

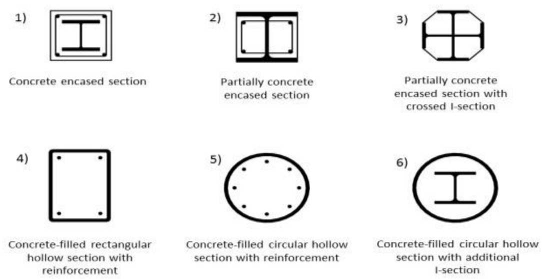

Fig.1. Composite Column

B. Composite Beam

A composite beam is a steel beam or partially encased beam which is mainly subjected to bending and it supports the composite deck slab.

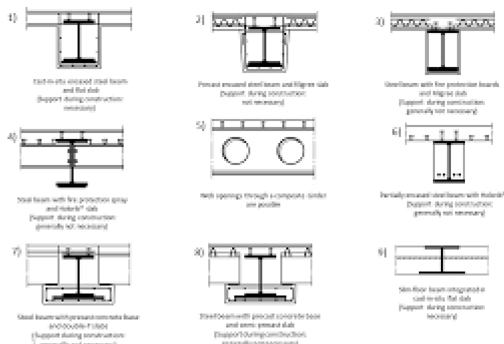

Fig.2. Composite Beam

C. Profile Deck

Composite floors using profiled sheet decking have become very popular in the West for high-rise buildings. Composite deck slabs are generally competitive where the concrete floor has to be completed quickly and where medium level of fire protection to steel work is sufficient. There is presently no Indian standard covering thedesign of composite floor systems using profiled sheeting.

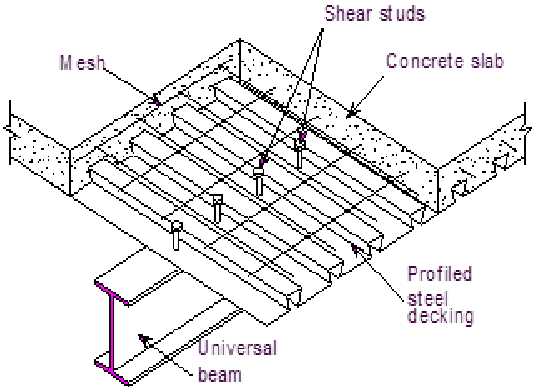

Fig.3. Composite Slab

D. Shear Connector

connectors are steel elements such as studs, bars, spiral or another similar devices welded to the top flange of the steel section and intended to transmit the horizontal shear between the steel section and the cast in-situ concrete and also to prevent vertical separation at the interface

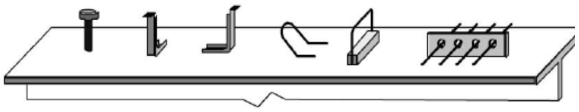

Fig.4. Shear Connector

Advantages of composite construction

- Permits easy structural repairs/ modification.
- Lighter construction
- Good fire resistance
- Enables easy construction scheduling in congested sites.
- Composite sections have higher stiffness than the corresponding steel sections and thus the deflection is lesser.

III. BUILDI`NG DETAILS

The building considered here is an residential building having G + 15 storied located in seismic zone IV and for earthquake loading, the provisions of the IS:1893(Part1)-2002 is considered. The wind velocity 44m/s. The plan of building is shown in fig. the building is planned to facilitate the basic requirements of an residential building. The plan dimension of the building is 20 x 20 m. Height of each storey for composite and RCC is 3.2m. The floor plans were divided into five by six bays in such a way that center to center distance between two grids is 4 meters by 4 meters respectively. The study is carried out on the same building plan for RCC and composite construction with some basic assumptions made for deciding preliminary sections of both the structures.

Fig.5. Typical Floor Plan

Table I: Data for RCC and Composite Structure

Plan dimension	20 m x 20 m
Height of each storey	3.2 m
Height of parapet	1..2 m
Thickness of slab	0.150 m
Thickness of external wall	0.230 m
Thickness of internal wall	0.150 m
Floor Finish	1 KN/m ²
Live Load	1.5 KN/m ²
Grade of reinforcing steel	Fe 500
Density of concrete	25 KN/m³
Density of brick	18 KN/m³
Grade of concrete for beams	M 20
Grade of concrete for columns	M 20
Grade of concrete for slab	M20
Seismic zone	0.16
Soil condition	Medium soil
Wind speed	44 m/s
Importance factor	1
Zone factor	IV
Damping ratio	5 %
Column size R.C.C	300 mm X 1100 mm
Beam size R.C.C.	230 mm X 700 mm
Column size Composite	600 mm X 600mm ISHB 400
Beam size Composite	Primary ISWB 400
	Secondary ISMB 250

IV. LOAD COMBINATIONS

The gravity loads and earthquake loads will be taken for analysis. The basic loads are Dead loads (DL), Imposed load (LL), Earthquake load (EQ) along X and Y in positive and negative direction. As per IS 1893 (Part I): 2002 Clause no. 6.3.1.2, the following

Earthquake load cases have to be considered for analysis.

1.5(DL + LL) 0.9DL ± 1.5EQ
1.5(DL ± WL) 1.5(DL ± EQ)
0.9DL ± 1.5 WL 1.2(DL + LL ± WL)
1.2(DL + LL ± EQ)

V. ANALYSIS OF BUILDING

The explained 3D building model is analysed using Equivalent Static Method and Response Spectrum Method. Different parameters such as deflection, story drift, base shear and time period are 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.

VI. RESULT

A. Weight of Structure for RCC and Composite

Table II : Variation of Wt. of Structure

WEIGHT OF STRUCTURES IN KN	
RCC	96576.25
COMPSOITE	72012.54

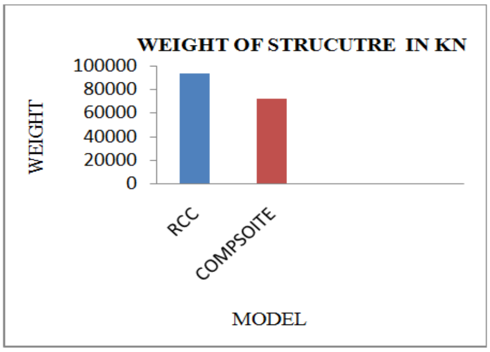

Fig.6. Graph for Wt. of Structure

B. Base Shear of RCC and Composite

Table III: Variation of base shear

BASE SHEAR IN X DIRECTION	
RCC	2895.76 KN
COMPOSITE	2215.29 KN

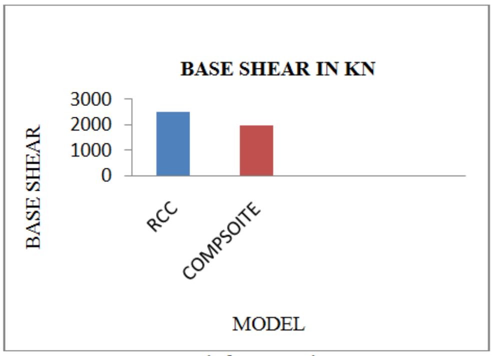

Fig.7. Graph for Base Shear

C. Axial force on Corner Column RCC and Composite

Table IV: Variation of Axial force

AXIAL FORCE ON CORNER COLUMNS IN KN	
RCC	4529
COMPSOITE	3951

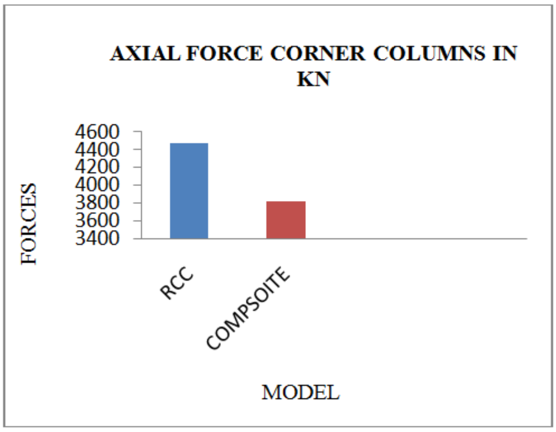

Fig.8. Graph for Axial force in Corner column

D. Time period for RCC and Composite

Table V: Variation of Time Period

TIME PERIOD IN SEC.	
RCC	2.83
COMPOSITE	3.29

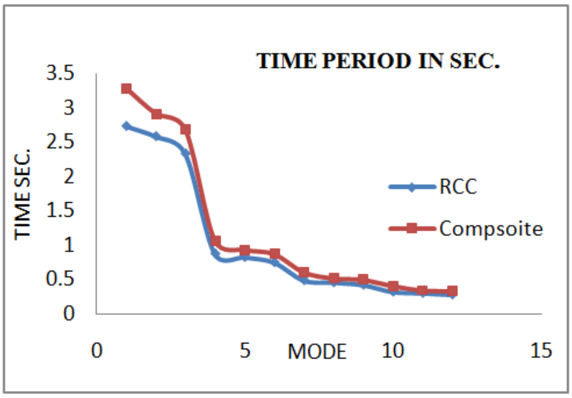

Fig.9. Graph for Time Period

E. Story Displacement of RCC and Composite

Table VI: Variation of Story Displacement

STORY DISPLACMENT IN MM X DIRECTION		
STORY NO.	RCC	COMPOSITE
15	42.35	47.25
10	32.18	35.28
5	12.81	15.29

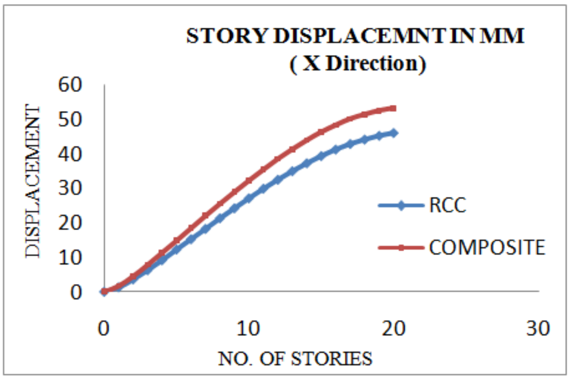

Fig.10. Graph for Story Displacement

VII. CONCLUSION

1. From table II .it is clear that the wt. of Composite structure is reduced by 33% as compared with RCC Structure.
2. From table III. it is clear that the base shear of Composite structure is reduced by 15% as compared with RCC structure.
3. From table IV. It is clear that the axial force in Composite structure is less as compare with RCC by 15%, because the self wt. of the RCC structure is more.
4. From table V. It is clear that the time period of Composite is more as compare to RCC.
5. The displacement of Composite structure is more as compare with RCC. Deflection is within permissible limit.
6. Composite structure is more economical than the RCC structure
7. Time required for construction of composite structure is less as compare with RCC structure because no form work is required.

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