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ANALYSIS AND DESIGN OF R.C. AND COMPOSITE STRUCTURES COMPARATIVE STUDY AND REVIEW

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Abstract: *This paper presents a review of the previous work done on the seismic performance of reinforced concrete structure and composite structure. This paper focus on the R.C.C Structure and Composite Structure and their relative significance. The seismic performance of buildings having reinforced concrete structure and composite structure is comparable but the differences exist. Composite structure as on today was first used in both a buildings and bridges. As compared to R.C.C structure Composite structures are more famous due to both speed and economy can be achieved in case of composite systems. Steel-concrete composite systems for buildings are form a bond with each other and they form a complete composite structure with the help of shear connectors etc.*

Keywords: *Composite steel-concrete systems, Soft storey, Equivalent static method, Response spectrum method, Base shear. Shear connector, ETAB software. Ratio, Displacement, Infill frame, Inter-Storey, drift, Strut.*

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INTRODUCTION

steel concrete composite systems have become quite popular in recent times because of their advantages against conventional construction. Composite construction combines the better properties of the both i.e. concrete and steel and results in speedy construction. Composite members are made up of two different materials such as steel and concrete which are used for beams and columns. The steel and concrete structures have wide applications in multi-storey commercial buildings and factories as well as in case of bridges. Steel and concrete have almost the same thermal expansion, concrete is efficient in taking compression loads and steel is subjected to tensile loads Composite structures are becoming popular and steel or purely concrete structures can be minimized .in composite construction initial construction loads will be carried out by steel frame sections including self-weight during the construction and then concrete is cast around the section or concrete is poured inside the tubular section. in the comparative study includes deflections of the members, size and material consumption of members in composite with respect to R.C.C. , seismic forces and behavior of the building under seismic condition in composite with respect to R.C.C. foundation requirements and type of foundation can be selected for Composite structure with respect to building .

II COMPONENTS OF COMPOSITE STRUCTURES

Composite slab

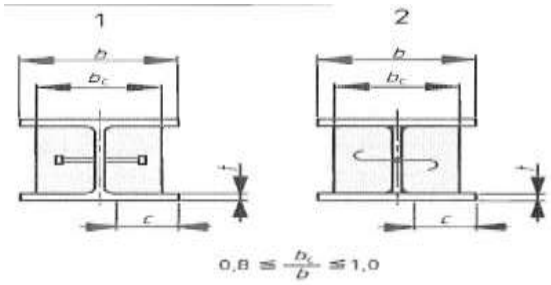
A composite slab in which steel sheets are connected to the composite beam with the help of shear connectors, initially steel sheets act as permanent shuttering and also act as bottom reinforcement for steel deck slab and later it is combined with hardened concrete.

Shear connectors

Shear connectors (studs) are used to connect the concrete and structural steel and they give the sufficient strength and stiffness to the composite member.

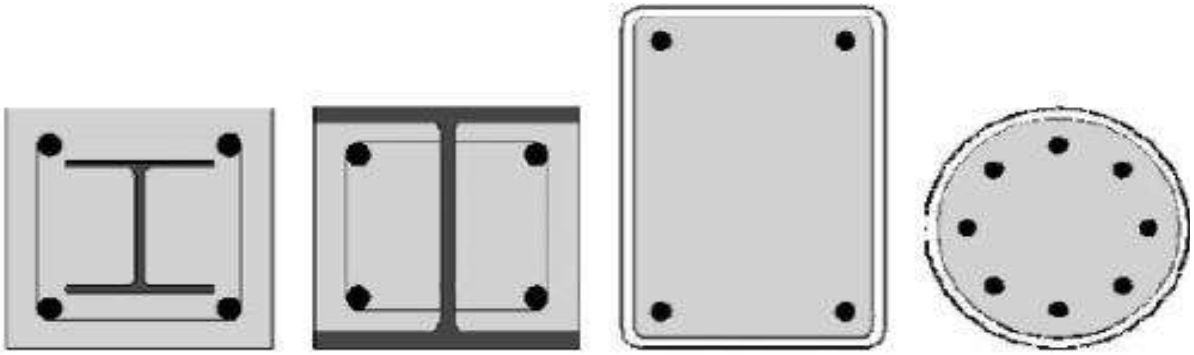
Composite beam

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



Composite column

Composite columns are a composite compression members or bending and compression members with steel encased sections partially or fully and concrete filled tubes.



Plastic resistance of a composite column of a cross section will be determined by following equation

For concrete encased and partially concrete encased sections
PPC = Aa*fyd + 0.85Ac*fcd + As*fsd

For concrete filled sections
PPC = Aa*fyd + Ac*fcd + As*fsd

Aa – cross sectional area of structural steel
Ac – cross sectional area of concrete
As – cross sectional area of reinforcing steel
fyd – design value of yield strength of structural steel
fcd – design value of yield strength of cylindrical compressive strength of concrete
fsd – design value of yield strength of reinforcing steel

III LITERATURE REVIEW

There is a considerable research work has been done in the direction of comparative study of RCC and composite structures.

1)Umesh P. Patil, Suryanarayana (June-2015)Comparing to RCC structures, steel concrete composite system are being more popular due to the various advantages they offer. Both speed and economy can be achieved in case of composite systems. An attempt was made in this work to evaluate and compare the seismic performance of G+ 15 storey's made of RCC and composite structures ETABS 2013 software was used for the purpose. Both steel and concrete composite structures and RCC structures were having soft storey at ground level, structures were located in the region of earthquake zone III on a medium soil. Equivalent static and response spectrum method is used for analysis. Storey drift, self weight, bending moment and shear force, are considered as parameters. When compared composite structures shows better performance than RCC.

2) Murtuza S. Aainawala (Volume 3, Special Issue 1, ICSTSD 2016) Composite construction as we know it today was first used in both a building and bridge. Comparing to RCC structures, steel concrete composite system are being more popular due to the various advantages they offer. Both speed and economy can be achieved in case of composite systems. An attempt was made in this work to evaluate and compare the seismic performance of G+15 storey's made of RCC and composite structures ETABS 2015 software was used for the purpose. Both steel and concrete composite structures having concrete filled steel tube and RCC structures were having

soft storey at ground level, structures were located in the region of earthquake zone IV on a medium soil. Equivalent static and response spectrum method is used for analysis. Storey drift, Displacement, self weight, bending moment and shear force, are considered as parameters. When compared composite structures shows better performance than RCC.

3)Shweta A. Wagh*, Dr. U. P. Waghe**

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.

IV STUDY AND REVIEW

Umesh P. Patil, Suryanarayana (June-2015) made attempt to study the seismic behaviour of rcc and composite structure (g+15) on etab software 2013 and structure was located in III region on medium soil .

Equivalent static and response spectrum method is used for analysis. Storey drift, self weight, bending moment and shear force, are considered as parameters. When compared composite structures shows better performance than RCC.

In this method multiple modes of vibrations are considered where base shear of each mode can be calculated separately. It can be calculated by determining the modal mass and modal mass participation factor for each mode.

EQX- Equivalent static in X direction
EQY- Equivalent static in Y direction
SPX- Response spectrum in X direction
SPY- Response spectrum in Y direction

from the study it is broadly concluded that,

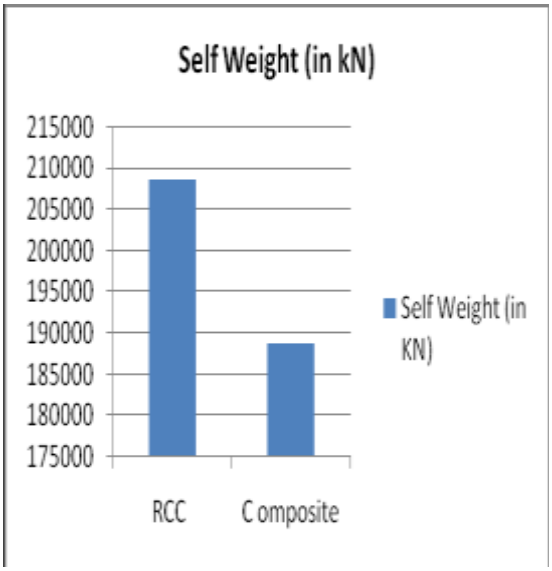


Chart 1 Values of self-weight of structure for rcc and composite structure

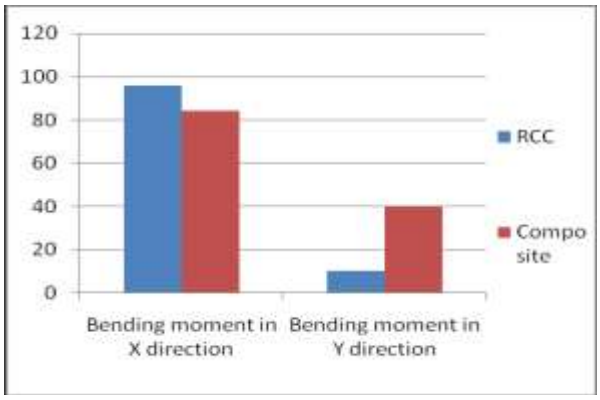


Chart 2 Values of bending moments in x and y directions for rcc and composite structure

Bending moments in x direction is more in rcc as compared to composite structure but bending moment in y direction is less in rcc structure as compared to composite structure

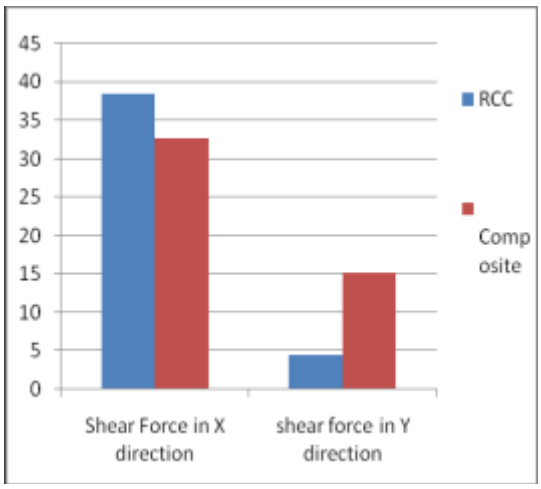


Chart 3 Values of shear force in x and y directions for rcc and composite structure

Shear force in x direction is more in rcc structure as compared to composite structure but shear force in y direction is less in rcc structure as compared to composite structure.

Murtuza S. Aainawala An attempt was made in this work to evaluate and compare the seismic performance of G+15 storey's made of RCC and composite structures ETABS 2015 software was used for the purpose. Both steel and concrete composite structures having concrete filled steel tube and RCC structures were having soft storey at ground level, structures were located in the region of earthquake zone IV.

Table 1 Values of bending moments in x direction

Bending Moment (in kN – m) for Corner Column Models	Bending moment in X direction
RCC	47.44165
Composite	43.78986

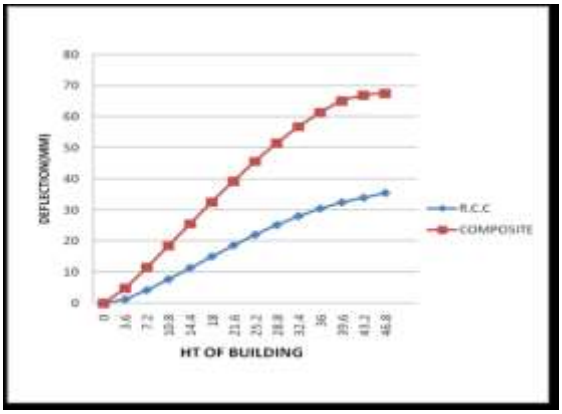
Table 2 Values of shear force

Shear force (in kN)	Shear force
Rcc	387245.46
composite	357434.8857

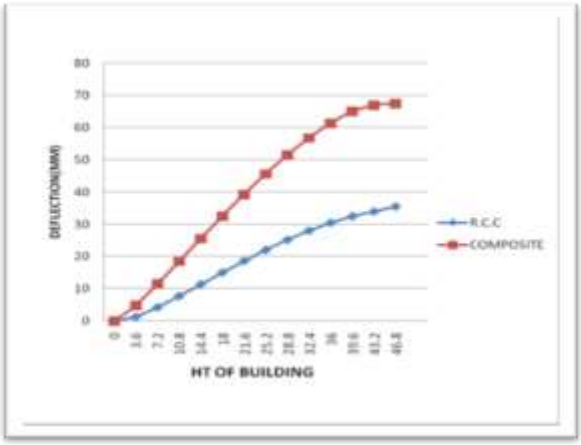
From the study it is broadly concluded that, bending moments in x direction is more in rcc as compared to composite structure but bending moment in y direction is less in rcc structure as compared to composite structure shear force in x direction is more in rcc structure as compared to composite structure but shear force in y direction is less in rcc structure as compared to composite structure.

Shweta A. Wagh , Dr. U. P. Waghe In this paper study of Four various multistoried commercial buildings i.e. G+12, G+16, G+20, G+24 are analyzed by using STAAD-Pro software. Where design and cost estimation is carried out using MS-Excel programming and from obtained result comparison can be made between R.C.C and composite structure.

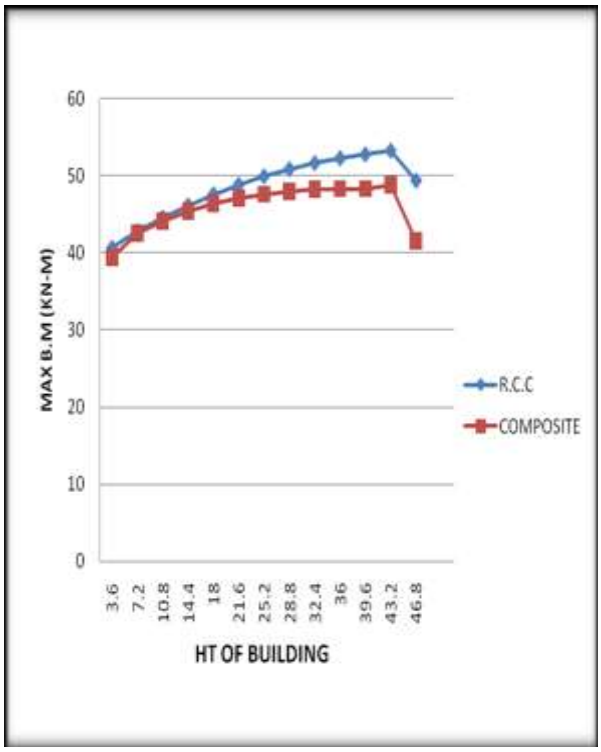
Graph 1 Height of building vs deflection



Graph 2 Deflection vs height of building



Graph 3 shows that there is significant reduction in B.M of column (Z-DIR) in composite structure.



Graph 4 Base shear vs height of building

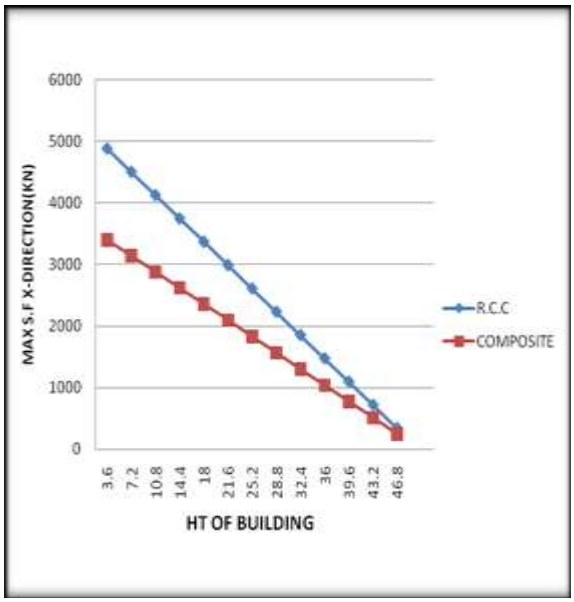
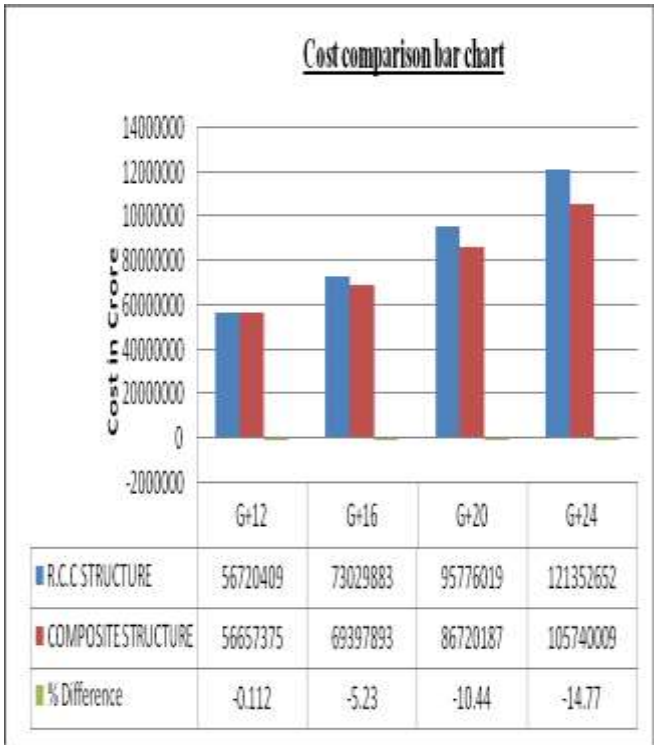


Chart 5 Cost comparison



	G+12	G+16	G+20	G+24
R.C.C STRUCTURE	56720409	73029883	95776019	121352652
COMPOSITE STRUCTURE	56657375	69397893	86720187	105740009
% Difference	-0.112	-5.23	-10.44	-14.77

- It is obvious that increase in the number of story results in increased cost for RCC construction as compared to composite construction.
- It is been seen that the values of self-weight of composite structure is reduced by nearly 30% with respect to rcc structure
- As the sizes of the steel members from steel option to the composite option reduces about 25 % in main beams and about 60 % in secondary beams.
- In all the options the values of story displacements are within the permissible limits as per code limits.

V SCOPE OF WORK

In this review paper it is shown that RCC and Composite structures can be compared in various aspects under the various conditions. But also the soil condition affects the structure and in india this aspect is not considered fully. But practical applications of these comparison can make structure more safe and more economical. And more accurate comparison processes and aspects can be developed

VI CONCLUSION

This paper presents a review of the seismic performance of multi-storied buildings for different floor heights and rcc and composite structure. It seems that the seismic performance of buildings having rcc and composite structure is comparable but the differences exist. For e.g. the base shear of a multi-storey rcc structure is more as compared to composite structure , also the axial force in the intermediate columns are more in case of rcc structure than composite structure.

Storey drift is different in both X and Y direction because of the difference in moment of inertia in the column sections.

It is possible to control the drift in soft storey by providing 1) Shear walls 2) Bracings 3) Stiffer column 4) Lateral load resisting system.

The beams and columns in the soft storey are designed 2.5 times of obtained bending moments and shear forces. And shear walls are designed by a factor of 1.5 times the storey shear.

Self-weight of composite structures reduces as compared to RCC which in turn reduces the foundation cost. Due to the reduction of self-weight of composite structures, it induces fewer amounts of lateral forces.

Bending moments and shear forces in columns for composite structures are less as compared with RCC structures in X direction, but in Y direction RCC have more bending moments.

Composite structures are being more ductile, resist lateral load better than RCC structures.

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