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COMPARATIVE STUDY OF R.C.C. AND COMPOSITE MULTISTORIED BUILDING

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Abstract: This project deals with the comparative study of multistory R.C.C. building and composite structure. The composite structure is far more advantageous over RCC structure regarding strength, costs and time period requirements.For this study steel concrete composite with RCC option are considered for comparative study of G+8 storey of residential building which is situated in earthquake zone II and for earthquake loading, the provision of IS:1893(part 1)-2002 is considered. For modeling of composite and RCC structures, STAAD-pro software is used.The purpose of this work is to introduce steel-concrete composite members and construction to explain the composite action of the two different materials to show how the structural members are used particularly in building construction and their advantage over concrete and steel structures, to give a brief introduction to composite building structure, to describe the elements and the connections.The G+8 RCC building model analysis is carried out by using software STAAD-pro and G+8 building composite model is analysed also by using software STAAD-pro.

Index term: Stad pro , composite marerial.

Introduction Steel section can take very high tensile forces where as under compression the functional behaviour of buckling steel section comes into play, which is always less than the tension carrying capacity of the section. In case of concrete, the material has such a less capacity of resisting tension that for all practical purposes its tension carrying capacity is not consider in design. But concrete section can take high value of compressive force.

The methodology of composite design involves both concrete and steel and tie them together by using shear studs or some other anchorages so that they can act together as a composite section concrete carrying mainly the compressive force and steel the tensile force. It helps the designer to design a section having lesser depth and thereby a substantial saving in material cost is possible. The basic idea of designing a composite section is that the coefficient of thermal expansion of both concrete and steel are nearly same, which is also the basis for the development of R.C.C., designs.

3.3 Unique benefits of composite construction

1. Most effective utilization of materials i.e. concrete in compression and steel in tension.
2. Steel component has the ability to absorb the energy released due to seismic forces.
3. Quality of steel is assured since it is produce under controlled environment in the factory.
4. Steel is more durable, highly recyclable and environment friendly. So sustainable structure could be constructed using more steel in it.
5. Offers considerable flexibility in design and is easy for fabrication.
6. Facilities faster construction scheduling of projects.
7. Enables easy construction scheduling even in congested sites.
8. Permits large span construction repair/modification.
9. The most effective utilization of steel and concrete is achieved.
10. As the depth of beam reduces, the construction depth reduces, resulting in enhanced headroom.

3.4 Advantage of composite construction

In conventional composite construction, concrete slabs rest over steel beams and are supported by them. Under load, these two components act independently and a relative slip occurs at the interface if there is no connection between them. With the help of a deliberate and appropriate connection provided between the beam and the concrete slab, the slip between them can be eliminated. In this case, the steel beam and the slab act as a "composite beam" and their action is similar to that of a monolithic Tee beam. Since concrete is stronger in compression than in tension, and steel is susceptible to buckling in compression, by the composite action between the two, we can utilize their respective advantages to the fullest extent. There are many advantages associated with steel-concrete composite construction. Some of these are listed below:

1. The most effective utilization of steel and concrete is achieved.
2. Keeping the span and loading unaltered, a more economical steel section (in terms of depth and weight) is achievable in composite construction compared with conventional non-composite construction.
3. As the depth of beam reduces, the construction depth reduces, resulting in enhanced headroom.
4. Because of its larger stiffness, composite beams have less deflection than steel beams.
5. Composite construction is amenable to "fast-track" construction because of using rolled steel and pre-fabricated components, rather than case-in-situ concrete.
6. Encased steel beam sections have improved fire resistance and corrosion.
7. Considerable flexibility in design, pre-fabrication and construction scheduling in congested areas.

Objective of project

i. To provide brief description of various components of steel concrete framing system for building.
ii. To introduced the composite action of two different materials.
iii. To investigate the cost effectiveness of steel-concrete composite frames over traditional reinforced concrete frames for building structures.

Literature review

. D. Dabhade, N.A.Hedaoo, L. M. Gupta and G. N. Ronghe (2009), this paper presents a study on, time and cost wise feasibility of steel framed composite floor building. Today, fast track construction is a rapidly growing economy and therefore time saving in construction can compensate significant proportions of the overall construction cost. This paper presents a study on, time and cost wise feasibility of steel framed composite floor building. A case study considered for this work is 10 storied multilevel cars parking building. A major feature of this building is post-tensioned composite steel beams having span of 16m. Considering same plan, floor area, floor to floor height and loading conditions, this existing building is designed and constructed by other two ways viz. precast concrete frame with precast concrete floor and steel frame with precast concrete floor. While designing the above structure with precast concrete frame with precast concrete floor, one additional column is introduced in between 16m span lengths to the overall plan to suit the design criterion. The study shows that the time savings of 55.3% is achieved due to use of steel framed composite floor construction rather than precast framed with precast concrete floor and 14.3% time than that of steel framed with precast concrete slab. The construction of steel framed composite floor building saves time, which leads to an overall savings in net cost.

P.S. Pajgade and A.N. Shah (2013) describes 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 in compression and steel in tension, they have almost the same thermal expansion and results in speedy construction. This paper includes comparative study of R.C.C. with composite (G+15) storey building. Comparative study includes deflections, bending moments in x & y direction, axial force & shear force in columns & beams, size and material consumption of members in composite with respect to R.C.C. sections, also the comparison of cost of R.C.C. and composite construction is carried out, saving in saleable area, benefit of extra floor & benefit in terms of rent in composite construction is carried out. 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.

Mahbuba Begum, Md. Serajus Salekin, N.M. Tauhid Belal Khan and W. Ahmed (April 2003), give steel-concrete composite construction has gained wide acceptance world wide as an alternative to pure steel and pure concrete construction. Composite action increases the load carrying capacity and stiffness (i.e. reduces the deflection). The concrete forms the compression flange the steel provides the tension component and shear connectors ensure that the section behaves compositely. During construction, the beam is designed to resist concrete dead load and the construction load (to be treated as a temporary live load)..

Ali Shariati, N. H. RamliSulong, MeldiSuhatril and Mahdi Shariati (2012), deals with the study of an attempt has been made to review various types of shear connector in composite structures. This review tries to identify the shear connectors that are most relevant to composite structures.

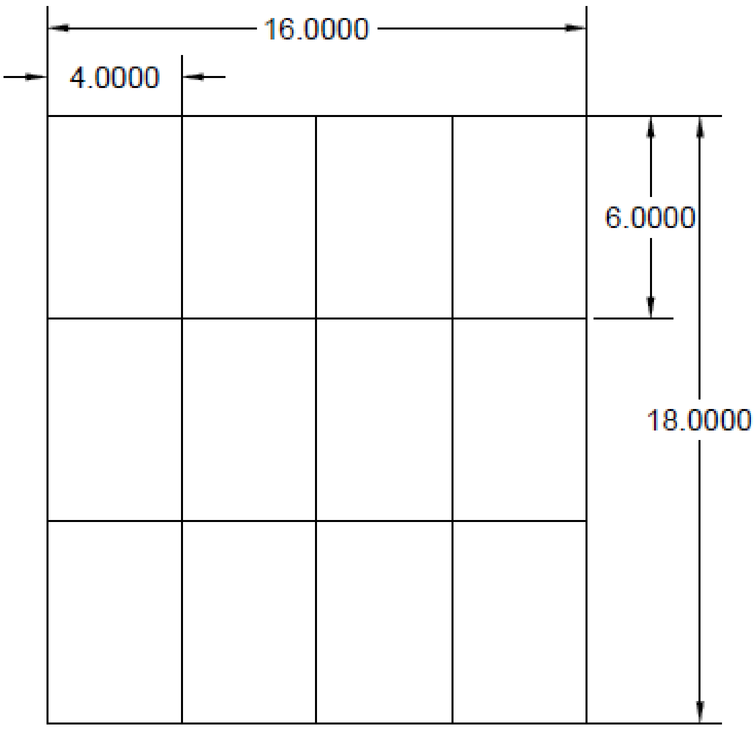
Material and Methodology

Selection of plan & details

The building considered here is a residential building having G+8 storied located in seismic zone II & wind velocity 44 m/s. The plan of building is shown in fig.4.1. The building is planned to facilitate the basic requirements of a residential building. The plan of building is kept symmetric about both the axes. The plan dimension of the building is 16m x18m. height of each storey is kept same as 3.35m and the total height of the building is 30.15m. The study is carried out on the same building plan for R.C.C. and composite construction with some basic assumption made for deciding preliminary sections of both the structures. The basic loading on both types of structures are kept same, other relevant data is tabulated in table.

Table 4.1 showing details of data about structure

1. Model G+8
2. Seismic zone - II
3. Floor height - 3.35m
4. Depth of foundation - 2.9m
5. Building height - 30.15m
6. Plan size - 16m x 18m
7. Total area = 288 m^2
8. Size of columns - (400 x 600) mm
9. Walls (a)External - 230mm
(b)Internal - 115mm
10. Thickness of slab - 125mm
11. Height of parapet - 1.0m
12. Size of beams 6.0m span - (400x600) mm
13. Size of beams 4.0m span - (300x450) mm
14. Earthquake load as per IS (1893-2002)
15. Type of soil type -II, Medium soil as per IS-1893
16. $E_c = 5000\sqrt{f_{ck}}$ N/mm^2
17. Live load - 3 kN/ m^2
18. Floor finish - 1.00 kN/ m^2
19. Material used concrete M-30 and reinforcement Fe-415
20. Software used STAAD-pro 2008
21. Zone factor Z = 0.1 as per IS-1893-2002 part -1



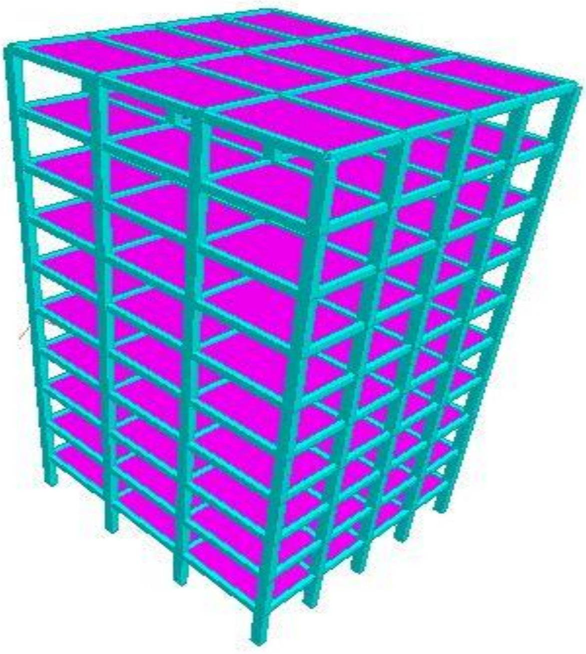


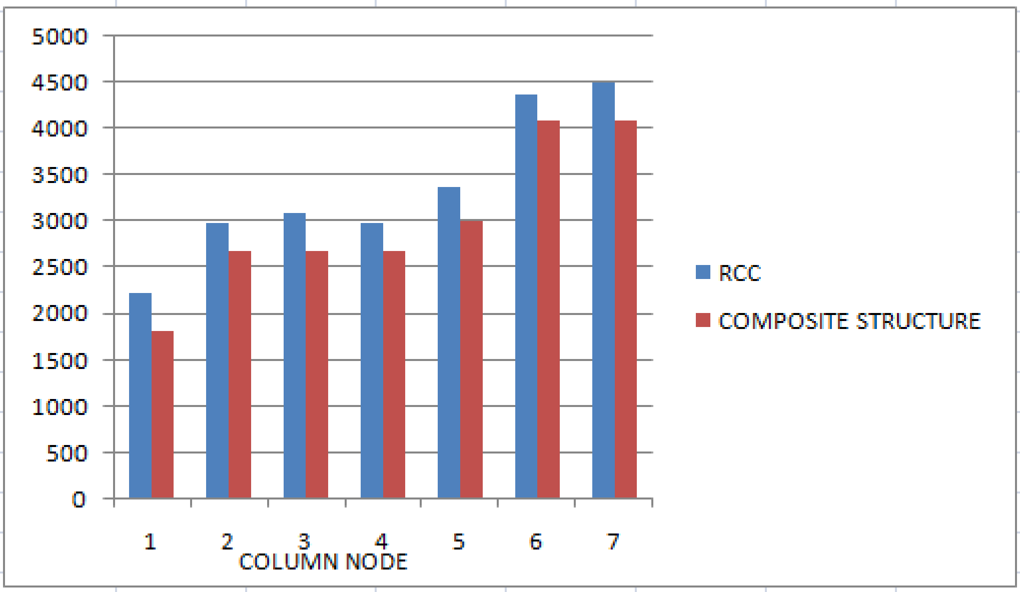
Figure . Rendering view (G+8) RCC building model

Results

Comparision based on axial forces on both structures

Table 6.1 Axial forces on both structures

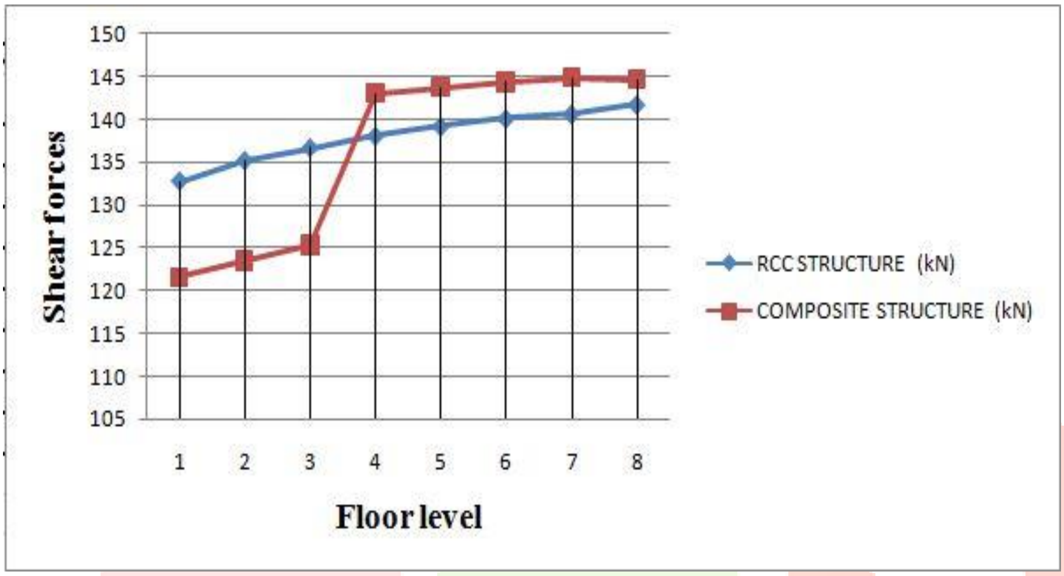
COLUMN NODE	RCC STRUCTURE (KN)	COMPOSITE STRUCTURE (KN)
1	2235	1827
2	2984	2676
3	3088	2675
4	2984	2675
5	3386	3003
6	4364	4095
7	4512	4095



Comparision based on displacement on both structures

Table 6.2 Displacement on both structures

FLOOR LEVEL	RCC STRUCTURE (mm)	COMPOSITE STRUCTURE (mm)
1	5.872	3.69
2	6.808	4.897
3	8.24	5.966
4	9.316	6.88
5	11.367	7.635
6	12.174	8.232
7	12.767	8.669
8	13.143	8.958



Conclusion

1. Axial force in RCC structure is on higher side than that of composite construction.

2. Displacement in RCC structure is on higher side than that of composite construction.

3. Max. Shear forces in beams of composite structure are slightly on higher side in some storey's than R.C.C. Structure.

4. Weight of composite structure is quite low as compared to R.C.C. structure which helps in reducing the foundation cost.

5. Bending moment in RCC structure is on higher than that of composite structure.
6. Composite structures are the best solution for high rise structure.

7. Speedy construction facilitates less project duration on so project cost reduces as interest on loan amount reduces.

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