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Review on Comparison between Steel, RCC and Composite Structure

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Abstract: ***In India, plain concrete is a very common material in construction, especially in medium and low-rise buildings. Steel is also widely used in high-rise buildings, and composite construction is not as popular, but it is possible that composite construction will be more beneficial in medium and high-rise buildings. Reinforced concrete is a widely used construction material. Steel beams are embedded in concrete to obtain an efficient composite material, reinforced concrete. Composite construction is known for two load-bearing structural parts that are securely connected and bent into a single unit. Composite structure is considered one of the most economical and short-lived structures compared to RCC and steel structures. A composite structure mainly consists of a column with an I-section enclosed or embedded in concrete or concrete and steel filled steel tube. Part I as beam and deck plate consisting of cold deck steel plates and mortar. The beams are connected to the deck slab with shear joints that have strength and fire resistance.***
Keywords: Steel Concrete Composite Building, RCC building, Seismic Analysis etc.

I. INTRODUCTION

In India, plain concrete is a very common material in construction, especially in medium and low-rise buildings. Steel is also widely used in high-rise buildings, and composite construction is not as popular, but it is possible that composite construction will be more beneficial in medium and high-rise buildings.

Steel concrete composite structure can be built instead of RC structures to get the maximum benefit from steel and concrete and produce efficient and economical structures. It depends on the character of the building and the material used, and according to these characteristics, the type of material can be chosen to achieve the best result. A composite structure occurs when two heterogeneous materials are effectively bonded together so that they function together as a single element in the structure. Composite construction is a new technique that is often used to save construction costs and save money on construction.

In the current age of innovation, steel and concrete are two materials widely and inevitably used as construction materials, from buildings to bridges. Although these materials may have different properties and characteristics, they both seem to complement each other in many ways. Steel has excellent resistance to tensile loads, but a lower weight ratio, so thin parts are used, which can be prone to bending. On the other hand, concrete is very resistant to compressive forces. Steel can be used to increase durability, which is an important criterion for a tall building, while concrete can be used for corrosion protection and thermal insulation. Correspondingly, the bending of steel with concrete can also be limited. Composite construction is widely preferred to get the best of both materials. It is very important to choose a suitable construction type according to the requirements of the owner and the construction site. Compared to other developing countries, the use of steel in construction in India is very low. Steel structural members are prone to local and lateral bending. Concrete structural members are generally thicker and less prone to shrinking and shrinking over time. Steel is a harder material, so it can absorb more shocks and shock loads. In this way, a composite structure is created to use both materials. It has been shown that the performance of a structure during an earthquake depends on several factors such as stiffness, ductility, lateral strength, and simple and proper assembly. Thus, all three building types should be compared based on displacement, base movement, floor deflection and lateral force to make a final comparison decision.

II. PROPOSED SYSTEM

In this project we study the analytical study between steel RCC and composite structure. So we call this project a comparative study of steel RCC and composite structure. Price is an important factor when comparing steel, RCC and composite buildings. Because expensive constructions are usually neglected in construction when there is another cheaper option in front of them. What if we find a structure that gives more strength and is cheaper. This comparison allows us to examine the cost and strength of the structure.

As a good engineer, saving natural resources is a big task. The main ingredients of cement are very expensive and limited. Thus, it is very important to find an alternative material with relevant properties such as strength, cost and time. Engineers are also reluctant to accept steel and concrete composite structures because the analysis and design are unknown. The availability of structural steel materials is easy in the market, such as I-profile, C-profile, Z-shape, L-angle, rail profiles, sheets or plates, etc.

Steel provides a lightweight structure of composite concrete steel. The dead weight of the structure can be reduced by using light materials such as aerated concrete walls, panels, etc. Easily rebuilt and expanded if needed.

Steel Structure Offers Fast construction, very durable, gains strength instantly, biodegradable and recyclable, offers long service life. This leads to less health risks, less waste, less energy consumption, less emissions and better environmental performance in low- and high-rise buildings.

III. PROBLEM STATEMENTS

Considerable research has been done in the direction of comparative research on steel, RCC and composite structures. It can be seen from the research that it is very necessary to compare steel, RCC and composite buildings from a cost perspective to assess the suitability of the building material.

In this work. A comparative study of R.C.C, Steel and Composite Structure for Industrial Building (G 3) is presented. The parameters to be checked are beam cost, column cost, nodal displacement, section deflection, maximum bending moment and maximum shear force.

Steel-concrete composite systems have recently become very popular due to their advantages over conventional construction. Composite structure combines the compression of concrete with the superior properties of steel, with almost the same thermal expansion and resulting in rapid construction.

IV. OBJECTIVE

The objectives of the proposed work are as follows:

1) Study Bureau of Indian Standard/other countries standard rule for analysis and design of steel, RCC and composite structures.
2) Carry out analysis of steel, RCC and composite structure G 3 residential buildings as per Bureau of Indian Standard / Standard Rules of other countries.
3) Design Steel, RCC and Composite Structure G 3 Residential building as per Bureau of Indian Standard/Standard Rules of other countries.
4) Compare steel, RCC and composite G 3 houses.

V. LITERATURE REVIEW

This project shows that steel, RCC and composite structures can be compared from different perspectives under different conditions. However, the ground conditions can be changed on non-hard ground and compared to the worst conditions. And in India these aspects are usually not fully considered. However, practical applications of these comparisons can make the structure safer and more economical. And more precise comparison processes and aspects can be developed.

D.R. Panchal et.al, (2011): Reinforced concrete composite systems studied in this paper have become very popular in civil engineering due to their advantages over conventional construction. Based on the results, steel structure is better than RCC, but among all the three options, composite is preferred for tall buildings. The dead load of the steel structure can be reduced by 32% compared to the RCC structure, and the composite structure is 30% compared to the RCC structure. Compared to the RCC structure, the axial load on the column can be reduced by 6% in the steel structure and 7% in the composite structure.

Renavikar Aniket V et.al, (2013): This study uses STAAD.Pro software for analysis. A steel - concrete composite frame system can provide an efficient and economical structure to solve most of this problem for medium and high-rise buildings. The cost of the steel structure can be reduced compared to the RCC structure due to the reduction in the dimensions of the steel members. Axial strength, bending moment and deflection of RCC is more than steel composite structure which increases the cost. The combination of elements is easy, which leads to quick completion of the structure considering the earthquake and adds advantages due to inherent elastic properties, Steel concrete structure works best because of this compared to RCC structures.

Shashikala. Koppad et.al, (2013): In medium and high-rise buildings, the RCC structure is no longer economical due to occupational hazards, lower stiffness, tendon limits and increasing self-weight composite construction is suitable for economical construction. Structural steel members are subject to local and lateral bending. RCC members are generally larger and less flexible, but can creep and contract under load. A combination of building materials is reinforced concrete, which has a wide range of

applications in buildings. The profitability of reinforced concrete construction comes from improvements in the overall efficiency of construction technologies.

Zafar Mujawar et.al, (2015): Steel-concrete composite structures have found wide application, as a faster splicing technology that saves a lot of time in construction, making the structure simple and manufacturable in minimum time. The presence of internal space is more compared to RCC structure and also improves the service life of the composite structure. Based on the experimental results, the base movement is reduced by 29% in the composite structure and 29% in the composite structure compared to the RCC structure. The axial forces of the steel structure are reduced by 8% and the composite structure by 50% compared to the RCC structure. From the results, it is concluded that reducing the axial force of the base leads to a reduction in the size of the leg.

Prakarsh Sangaveet.al, (2015): In some countries steel structures are very little applied. In big cities like Delhi, Mumbai, Bangalore etc., reinforced concrete composite structure is very necessary as there is no horizontal expansion. The steel industry is one of the rapidly developing industries almost everywhere in the world, and the applications of composite construction are widespread, strength, time and cost are the most important parameters from the point of view of construction. The maximum floor displacement is increased by 8% on the packed steel frame compared to the RCC structure and they can better withstand earthquake without damage. In the steel frame structure, the bending moment of the beam and column, as well as the axial force, is less compared to the RCC structure.

Sattainathan.A et.al, (2015): In this study steel-concrete composite system has become quite popular compared to RCC structure. Many engineers do not know the complexity of analysis and design. Steel-concrete composite construction is a system that can be implemented because of its advantages compared to traditional construction. As a result, the reinforced concrete system can provide a very economical structural system with high durability, fast erection and excellent seismic properties. Composite structures have the best results from steel to concrete.

Swapnil B. Cholekaret.al, (2015): The best way to design an efficient and economical building system is reinforced concrete composite structure and it is necessary in today's construction world. With population growth, the need for medium-sized and high-rise buildings becomes effective for the public. Reinforced concrete structures are usually designed for efficient and economical construction in conventional structures. The displacement values of structural joints are lower in composite structures than in RCC structures. Self-weight of composite structures is lower compared to RC structure, which gives a better response, base displacement values are reduced by 18%.

Varsha Patil et.al, (2015): Steel structures are actually elastic up to relatively high and usually well-defined stress levels because the beam is quite easy to connect in a short time. By introducing simple and efficient construction methods, it is necessary to reduce the market demand for services, construction time and costs. The two main advantages of fast construction are a reduced investment in the form of interest and an early return on invested capital. The most efficient use of the reinforced concrete composite structure results in more usable space and the displacements of the joints in the upper part are smaller because the rigidity of the details is greater than that of the RCC steel structure.

Mohd Amir Khan et.al, (2017): This paper deals with structural steel-concrete composites that are light in weight compared to RC structure, resulting in economical foundation design. A better combination of real estate ensures high strength of structural frames. Higher lateral load capacity on composite structural frame compared to RCC frame. The lateral displacement of the steel-concrete composite frame can be minimized and the overturning moment can be reduced compared to the RCC frame. The steel-concrete composite structural frame leaves a weak beam with a strong column behavior, because hinges instead of a column element are formed in the beams due to the lower axial load.

Gorakh Vinit et.al, (2018): This paper analyzes and designs multi-story buildings in a popular software called STAAD.pro. Here ISMB parts are used in the beams. This provides a thick mesh that can effectively carry the load of the slab. Wide flange profiles are used in the column design, as it provides excellent sectional behavior under load changes with high bending and buckling resistance. In steel structure, the axial load is less compared to RCC structure, due to less dead weight of steel. A final note is that building fast leads to faster ROI and more profit.

Jyothi D N, (2018): This paper states that steel structure is stronger than RCC structure. The steel structure has less dead weight, although the bending moment and shear strength are also less affected compared to the RCC structure. Steel structural parts have high strength per unit mass. Even in tall structures, the dimensions of the steel structural parts are small, which saves space in construction and improves aesthetic visibility. An important advantage of the steel structure is also the fast construction technology, which can also be manufactured in a machine shop, because steel profiles are available on the market and can be easily transported to the site.

Pallavi Harish Wagh et.al, (2019): According to studies, steel is a universal construction material in many multi-storied commercial buildings and factories and also in bridges. Both steel and concrete ensure fast construction and good adhesion properties. These two different materials are completely compatible and complement each other. A reinforced concrete composite structure is a single loaded unit with almost the same thermal expansion. This method is more economical than complete steel and reinforced concrete structures. The weight of the steel and concrete structure is less compared to the RCC structure due to the small amount of structural steel. This leads to a minimization of setup costs. Story Drift comparison for RCC and composite structures ranges from 22% to 32%. RCC structures have higher values of bending moment and shear due to increase in axial load.

Samadhan jagadale et.al, (2019): In this study, composite structures are the latest concepts in tall construction and have led to rapid construction. Steel frame gives good response compared to RCC but composite frame is suitable for tall buildings. Based on the results, the lateral movement of the upper part of the composite frame is 15% greater than that of the RCC frame and 17% less than that of the steel frame. For the G 7 layer beam, the maximum shear strength of the composite frame is almost 0.5% higher than the RCC frame and 112.29% lower than the steel frame, and the maximum bending moment of the composite frame is 23.2% higher than the RCC framework. and 178.83% lower than the steel frame. . The basic axial load is higher for RCC frame than composite frame and steel frame which are 2% and 81% respectively. Finally, the cost of composite frame G 7-story building is almost half of steel frame and 15% higher than RCC frame.

Madhav Rana et.al, (2019): In this study, steel structure provides better resistance to lateral and various other load combinations. Steel is a recyclable material, depending on the property requirements for which it can be used. Brazed bracing systems can increase the rigidity of all types of buildings, usually provided at corners to support loads. Maximum displacement in angle posts for "A Arc" type welds for "Av Arc" type, single elliptical and double elliptical supports is carried out. The "Av Arc" mount has the lowest maximum displacement and is the most efficient mounting system. The end result of the amount of steel material is less in the "A Arch" type supports and more in the double elliptical system.

Kentan Patel et.al, (2019): In this study, a comparative study of CFT, RC structure and steel structure of steel pipe filled with concrete was done. To achieve the best results, reinforced concrete composite columns are widely used in modern construction. It notes that CFT columns have been consistently used in the design of high-rise buildings as they offer economical construction compared to RCC and steel structures. In the 20-layer and 30-layer CFT frame structure, the load capacity increased by 19.10% and 11.80% compared to the steel structure. Also 27.30% and 22.80% compared to RC structure. Modern materials and technology are available for erection, which leads to the quick completion of the structure considering the earthquake, because steel is characterized by toughness.

Anil S. Savadi et.al, (2019): In this paper, to meet the requirements and needs of tall buildings for commercial use. Composite structure is best suited for infrastructural growth and economic structure other than RCC and steel structures. (G 2) a cost comparison of commercial buildings is carried out and the result is that the composite beam is 1.7% less than the steel structure and 13.7% less than the RC structure because the main advantage is the bending of the composite frame bar. structure and formwork are not required. The main parameter of composite structures is more economical than RCC and steel structures. For installation work such as beams, columns, etc. In case of composite structures, the labor requirement is very less than that of RCC structure. In composite structure, the deflection criteria are less than in steel structure and more in RC structure.

After studying the magazines, many researchers said that steel is the most commonly used and versatile material for engineering and construction purposes.

VI. BLOCK DIAGRAM

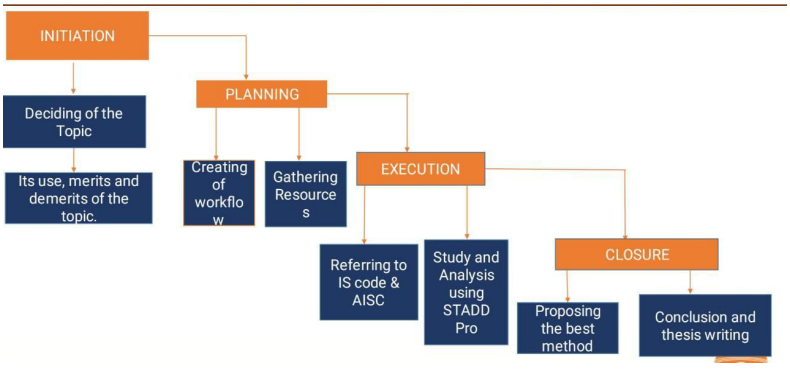

Fig.1. Working Methodology

VII. RESEARCH METHODOLOGY

1) In this work, it is proposed to prepare element models of a G 2-story industrial building using STAAD Pro V8i on the ground on a fixed base. a) R.C.C structure b) Steel structure c) Composite structure
2) Apply dead load, live load and wind load/earthquake load as per IS 875-1 and IS 1893-2002 and use appropriate method of static analysis.
3) Do design using limit state method as per IS 56-2000 and SP16-1980.
4) Perform quantity measurement of all three building types.
5) Estimate cost using Karnataka State Time Table Rate - 2018 Book.
6) Compare the result of all three structure types.

The following factors should be considered when deciding on the suitability of a structure. a) Seismic performance of the structure b) Deformation c) Resultant forces and moments d) Costs e) Weight f) Strength.

a) Overall response of composite structure is better than RCC structure ie. composite structure produces less displacements and withstands more structural forces.
b) Composite structures are the best solution for tall buildings and they lead to fast construction.
c) Steel option is better than RCC but composite is best for tall buildings.
d) Steel has excellent resistance to tensile loads but is prone to bending and concrete provides greater resistance to compressive forces. Steel can be used to increase strength and concrete can be used for corrosion and fire protection.
e) Composite constructions ensure lighter construction and faster construction than traditional concrete construction. Thus, the completion time of composite building is shorter than that of RCC construction.

VIII. CONCLUSION

1) In composite constructions, the self-weight of the frame is lower, and thus a significant reduction in foundation construction costs is observed.
2) From seismic aspects steel concrete structure performs better than conventional R.C.C. structure
3) The high durability of the steel material ensures better seismic resistance of the composite profile. The steel part is tough, without premature failure and can withstand several load cycles before breaking.
4) Steel, because it is an expensive construction material, can cause higher material costs. However, fast construction, less dead load and many other factors can change the total cost of the project.
5) The lower cut of RCC frame is on the higher side because the weight of RCC frame is more than that of composite frame.
6) The analysis of the composite building shows that the axial force, moments and shear forces of the structure are much less than that of the RCC building under the same loads. Reduced moments and axial forces ultimately lead to smaller dimensions of columns and beams in a composite building. From this it can be concluded that the composite structure is more advantageous than the normal RCC structure.

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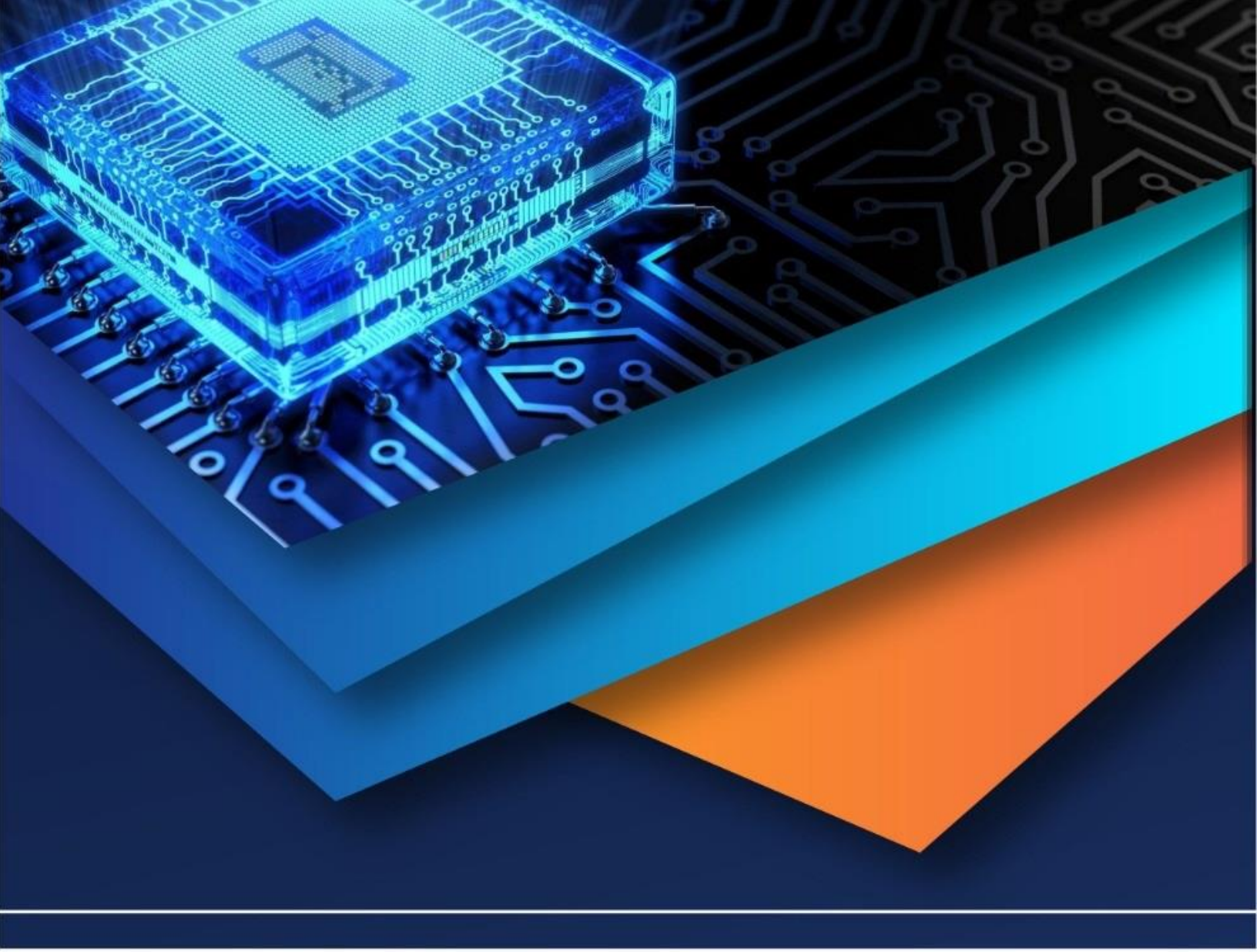

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