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Comparative Study of Reinforced Cement Concrete and Steel Structures

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Abstract: In India Reinforced Cement Concrete is commonly used construction material particularly in case of average and low-rise buildings. For high-rise structures steel is preferred. The material used in construction should be cheap, safe and easy handling. Every material used for construction has its own pros and cons. RCC and steel are the materials that are mostly used in framing system for most of the building. Steel members have the advantages of high tensile strength and ductility while concrete members have the advantages of high compressive strength and stiffness. Our main endeavour is to deal with the comparative study of structural analysis between Steel framed and Reinforced concrete structures. Three-dimensional model of RCC and steel structure are analysed with the help of software ETABS and Staad Pro. This study shows comparison of various aspects of building construction for steel and RCC buildings considering various researches involve in this topic.

Keywords: Comparative study, RCC, steel structure, STADD Pro, ETABS

I. INTRODUCTION

A variety of modernized construction material options have recently become available due to ongoing research and support in innovative technologies. An ideal and modern construction material will aim to maintain structural strength while reducing its impact on the environment. In addition, modern construction materials must be able to adapt to various weather and site conditions. Comparative study includes deflection, axial force, story drift, base shear. The main objective of this project is to do analytical investigation on RCC frame structure and Steel frame structure using Etabs and Staad Pro and comparing their results. Both the reinforced cement concrete structures and steel framed structures are suitable choice for the construction of building because of their versatility and reliable properties. RCC is the composite material having concrete with steels bar embedded in it. They ensure better compression and tension withstanding capacity and are used in large number for structural construction to satisfy the basic requirements like stability, strength and serviceability. On the other hand, due to the large strength to weight ratio, steel structures tend to be more economical than concrete structures for tall buildings and large span buildings and bridges and an eco-friendly material, which can easily be dismantled and sold as scarp. Failure of many masonry buildings and multistorey RCC buildings due to earthquake have necessitate structural engineers to look for the different method of construction. Due to significant potential in improving the overall performance through rather modest changes in construction technology, use of Steel frame structure is of particular interest. There is great potential for increasing the volume of steel in construction.

II. LITERATURE REVIEW

2.1 Mustafa M. Wagh, Ankita. M. Sukhija, [2016] - "A Review on comparative study of composite RCC and steel structure". Composite structure has more advantage over RCC and steel frame structure. The study about the behaviour and the characteristics of composite over RCC and steel is the prime need. Steel concrete composite construction can be built in place of RCC structures to get maximum advantage of steel and concrete and to produce efficient and economic structures. The response of composite structure is better than RCC structure composite structure produces less displacement and resists more structural forces. Composite Structure are more economical than RCC and Steel structure in case of high-rise building. Composite structure is better option for high rise structure as compared to RCC and Steel structure. Composite structures are resulted into lighter construction than traditional concrete construction as well as speedy construction.

2.2 Gorakh Vinit, Nishit Kadia, Kiranmoy Samanta, [2018] - "Comparative study of RCC and steel structures for different floor heights". In India reinforced concrete structures are mostly used since this is the most convenient & economic system for low-rise buildings. So, the Structural engineers are facing the challenge of striving for the most efficient and economical design solution while ensuring that the final design of a building must be serviceable for its

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intended function, habitable for its occupants and safe over its design life-time. The results of this work show that the Steel Structures are the best solution for high rise structure as compared to R.C.C structure as shown in literature is for commercial buildings having large span. Comparative study includes deflection, axial force and shear force, bending moment in column and beam, cost. In this project study of various multi-storeyed residential buildings like G+7, G+14, G+21 is analysed by using STAAD-Pro software. Axial forces are lower in Steel structures due to the lower Weight of Steel structure compared to RCC structure. According to the results, the deflection of the Steel structure is quite higher than RCC as Steel is a ductile material and allows a larger deflection.

2.3 Jyothi D N, [2018] **-** "Comparative analysis of RCC and steel structure". In India concrete is very popular material of construction especially in case of medium and low-rise buildings. As India is a fast-developing country the demand of construction he is huge, hence finding out the best suitable material for construction is very important. The material used in construction should be the most economical, safe and easy to handle. Before modern engineering and the ability to manipulate concrete and steel, the world of Civil Engineering consisted of wood, Adobe, thatch and cave dwellings. We have come a long way today. Cities reveal skies filled by buildings so tall and austere. Every material used for construction has its own pros and cons. Steel members have the advantages of high tensile strength and ductility while concrete members have the advantages of high compressive strength and stiffness.

2.4 Sumit Shah, S. Saranya, [2018] - "Comparative Study of Reinforced Cement Concrete (RCC) and Steel Structure". In South Asian countries concrete is mostly used as construction material, especially for low rise structures. Still steel is not predominantly used in high rise structures. Besides, Reinforced Cement Concrete (RCC) and steel structures; composite structures can be built to get maximum benefit of the steel and concrete, as well to produce reliable and economic structures. Reinforced concrete structures are the commonly used structural materials which have been used frequently over a century and ago. On the other hand, where the structures are located in highly seismic prone zones, where forces carrying on the structures are directly proportional to the weight of the structures; then the use of steel structures makes the much more impact. Steel structures have higher rigidity, ductility, and are cost effective too due to which the use of steel structures is used for every type of structures like high rise building, bridges, tower, airport terminal, industrial plants, etc. Generally, RCC structures are stronger in compression but due to higher strength/weight ratio of steel structures they are more susceptible to more buckling.

2.5 G. Hemalatha, Uma. S. G, Muthulakshmi. S, [2020] - "Comparative Analysis of Steel and RCC Frame Structure of a Commercial Building"**.** In India concrete is commonly used construction material particularly in case of average and low-rise buildings. For high-rise structures steel is preferred. This project compares between the RCC and steel structures in accordance to their structural performance and cost. In this project a G+5 building is considered for analysis. objective of this project is to do analytical investigation on RCC frame structure and Steel frame structure using Etabs and comparing their results. It has been observed that cost of construction for steel structure is more than RCC structure. However faster construction may brand Steel building economically viable. Further, Steel structures are expected to show better performance under earthquake due to higher ductility.

2.6 Ishwor Thapa, Achyut Bhandari, Bikash Subedi, [2020] - "Comparative Study of Structural Analysis between Reinforced Cement Concrete Structure and Steel Framed Structure". main endeavour is to deal with the comparative study of structural analysis between steel framed structure and reinforced cement concrete structure. Three-dimensional model of RCC and steel structure are analysed with the help of software ETABS. RCC is the composite material having concrete with steels bar embedded in it. They ensure better compression and tension withstanding capacity. Steel structure is an assemblage of elements rolled to a basic cross-section making desired size and form in the site . On the other hand, due to the large strength to weight ratio, steel structures tend to be more economical than concrete structures for tall buildings and large span buildings and bridges and an eco-friendly material. The mass material for RCC is greater than for steel frame structure. Maximum storey stiffness was greater for steel than concrete. Story displacement was more for RCC frame model than steel frame model.

2.7 Er. Surya Nand, Er. Sumit Sharma, [2020] - "Comparative Study on Steel Framed and Reinforces Concrete Buildings". RC structure is ruling and steel structure is entering slowly for multi-storey structure structures in India. When same building is designed as reinforced concrete and steel structure then structural behaviour and performance varies widely. Considering lateral drift and vertical deflections, stiffness of RC building is higher than of steel. Considering torsion in both the building, steel building is showing vey less torsion & we can make the larger span with the less size of sections. Considering moment in both the building, steel building is showing more moment & we can say that can bear higher moment under permissible limit.

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2.8 Er. Tushar Loya, Er. Ravindra Bansode, Dr. M.R. Shiyekar, [2020] - "Comparative Study on Analysis and Design of Steel Building and Conventional RC Building". The study of this paper reviews to analysis and design of steel members or sections to be used in construction of apartment building in steel structure, and its comparative study with conventional RC building. Such newer techniques are studied to perform more fast and precise work on field. In the present work a G+4 storied apartment building whose ground floor is considered as parking floor, is situated in second tier city of Nasik. Nasik city belongs to the earthquake zone-III. As ground floor is considered as parking floor rest other floors have same plan comprising of 8 2BHK flats on each floor. As 4 storied building is earthquake dominating so keeping the wind analysis deprived and analysing the building for various combinations of earthquake loads. Provision of IS: 1893(Part 1)-2016 is reviewed using commercial software for the analysis of models. Steel structures are expected to show superior performance under earthquake due to high ductility than the conventional RCC structure. Axial forces are lower in steel structure due to lower weight of steel structure compared to RCC structure. Due to this the reaction obtained in steel is lesser than RCC, which gives better response during earthquake conditions.

III. CONCLUSION

Building structures with RCC consumes a large amount of raw materials. Therefore, the bulk material for RCC is larger than for steel frame construction. Steel structures are expected to have better seismic performance than traditional RCC structures due to high ductility. Due to the lighter weight of the steel structure compared to the RCC structure, the axial forces in the steel structure are lower. According to the results, the deflection of the steel structure is much larger than that of RCC because steel is a ductile material and allows for greater deflection. If lateral displacements and vertical deflections are taken into account, the rigidity of reinforced concrete structures is higher than that of steel. If you take into account the torsion in both buildings, the steel structure has significantly less torsion and we can achieve larger spans with smaller cross-sections. Shear at the base is much less in steel structures compared to RCC, which provides better response during an earthquake. It has been observed that the cost of building a steel structure is higher than that of an RCC structure. However, faster construction can mean that steel construction makes economic sense.

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