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STUDY OF RCC & STEEL FRAME STRUCTURE ACCORDING TO IS CODE

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Abstract : As India is a fast developing country the demand of construction 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. 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. This paper reviews to analysis and design of steel sections to be used in construction of apartment building in steel structure, and its comparative study with conventional RCC 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. Two different types of 3D and 2Dmodels of same building are prepared using STAAD. Pro software for different types of models are RCC, and Steel structures. These models are analyzed for shear forces and bending moments using STAAD Pro software. The results obtained from each of the model are compared with each other to determine the best construction material.

IndexTerms - RCC, Steel Structure, STAAD.Pro, Bending Moment, Shear Force.

I. INTRODUCTION

Reinforced cement concrete structures have been satisfying greater demand in civil and structural engineering sector. The application and usage of RCC in large number in structural as well as architectural view. Composite structure are formed when two heterogeneous material bind together effectively so that act together as a single element from a structural point of view. When this occurs is called composite material (Reinforced cement concrete). Steel structure is the metal structure which is made of structural steel components connect with each other to carry a load to provide rigidity. Due to the grade and strength of steel is high so sectional area of steel is being lesser than RCC and dead load of steel also less. Structural steel structure are fabricated with specific shape and different chemical properties. Common shapes of steel component are I-beam, channel, W shape beam, square pipes, rectangular pipes etc. In developing countries like India most of the building structure under the categories of low rise building. So these conventional reinforced cement concrete and pure sectional steel construction proves to be convenient and economical in nature.

II. OBJECTIVE

1. Analysis and design of G+4 residential building by using STAAD.PRO. which area is 16mX30m and total height of building is 15m.
2. Design and analysis of steel frame structure and RCC frame structure according to IS code..
3. To study the behaviour of structure against dead load, live load, and their various combination.
4. To study the variation in result of both structural system and evaluating get satisfactory outcome.
5. To comparing of both the structure in aspect of structural performance and result.

III. PLAN

The proposed G+4 storied building is considered as a residential building in each floor their have 3BHK flat. The planning of RCC frame structure and steel frame structure are same and the basic loading in both type of structure kept same. The size of the building is 16m x 30mand total height is 15m.

IV. BUILDING PARAMETER

- Plan dimension : 480m^2
- Total height of building : 15M
- Height of each floor : 3M
- Beam size : 230MM X450MM
- Column size : 450MM X 230MM
- Thickness of slab : 150MM
- Thickness of wall : 230MM
- Floor finish : 1KN/M^2
- Live load of floor : 4KN/M2
- Soil condition : MEDIUM
- Seismic zone : ZONE II

IV. I Parameter for RCC (Reinforced Cement Concrete)

- Grade of Concrete : M25
- Grade of Steel : Fe415

IV.II Parameter for Steel frame

- Type of beam: ISMB200
- Beam size : Height: 200mm, width: 100mm, tw: 5.7mm, tf: 10.7mm
- Type of column : ISMB225
- Size of column : Height: 225mm, width: 110mm, tw: 6.5mm, tf: 11.80m

V. LITRETURE REVIEW

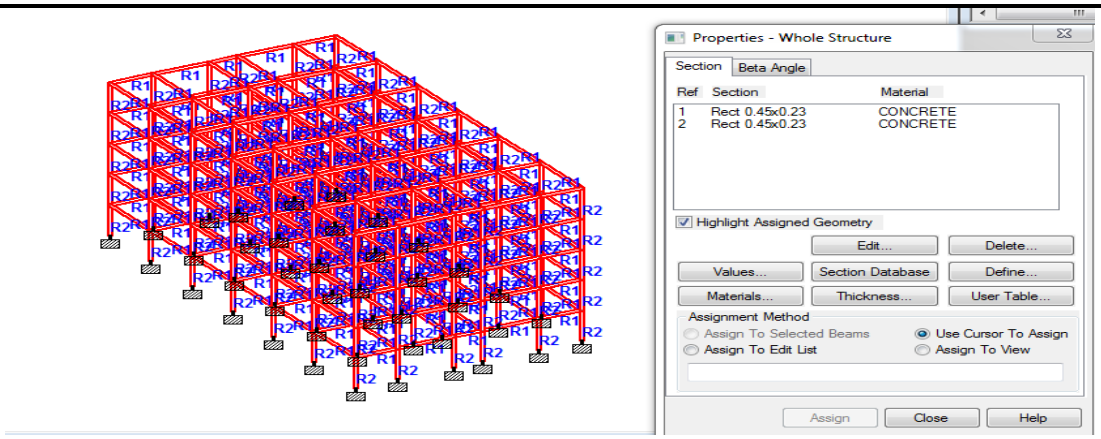
There is a considerable research work has been done in the direction of comparative study of steel structure and RCC structure it can be seen from the studied research work that to judge the suitability construction material, it is very necessary to compare the steel and RCC building for following aspect. After this comparison, one can be able to come decision that which structure should be constructed under various respective conditions.

Gorakh Vinit,, Nishit Kadia (2018); In this paper studied comparative analysis of Reinforced cement concrete structure and Steel frame structure by using most popular civil analyzing structure software STAAD.Pro. Here, ISMB section are used in beam. It provide thick web to easily carried load of slab. Wide flange section are used in column design because it provide excellent section behavior in load transformation with high bending and buckling resistance. Axial load are lesser in steel structure as compared to RCC structure due to less dead weight of steel. according to result that deflection of steel structure quite higher than RCC as steel is ductile material and allows higher deflection.

Mustafa M. Wagh, Ankita M. Sukhija (2016); in this paper a review of comparative study of composite RCC and steel structureit is shown that steel and RCC structure can be compared with various aspect under various condition practical application of these comparision can make structure more safe and economical. According to result that RCC frame structure are more economical and better option as compared to steel structure.

Nirav S. Vaghani, Ritik G Borad (2018); In this paper studied that comparative analysis of RCC and steel frame structure (G+4 storey) building. Here the present works problem taken are G+4 storied regular building. This building have plan area of 63.2M X 29.5Mwith a storey height 3.6M each and depth of foundation is 1.5M and total height of building including foundation is 18M. analysis of the building done with the help of STAAD.Pro software using the parameter as the design. This paper concluded that the result of maximum shear force and bending moment of only steel structure is low as compare to RCC structure.

Renavikar Aniket V; in this paper performed the analysis on residential building with steel concrete composite and RCC construction. The proposed construction four multistoried building G+9, G+12, G+15, G+18 storied building of each height of floor is 3M.the overall plan dimension of the building is 15M X 9M. The analysis of the all structure is analyzed by STAAD.PRO 2007 software. They concluded that the seismic force are not also harmful to steel composite structure as compare to RCC structure as compare to low dead weight , the cost comparison reveals that steel concrete design is more costly reduction in direct cost of steel composite structure resulting from speedy erection will make steel composite structure is economic viable.



VI. METHODOLOGY

The project will be perform in Reinforced steel structure and steel frame structure the proposed building for 5 storey (G+4) with the total building height is 15m (for each floor height is 3m). The plan of both of the structure will be same. So the plan and layout should be created with the help of AutoCAD software. And this plan create in STAAD.PRO software by placement of node and beam for analysis and designing for both the conditions. Through the STAAD.PRO 3-D model using transitional repeat creating of the frame work of the RCC and Steel frame structure in this dimension of the beam and column and slab thickness is applied. After completing of geometry and property of the model we applied the supports in the proposed model and applying of load condition and load combination and after this analysis will run before checking of errors and warning.

Methodology adopted in present study following below:

- Study of two different frame structure and selection of the structure for comparison.
- Preparation of the common building plan and column plan layout by using AutoCAD.
- Creating of 3-D modeling of proposed plan in STAAD.PRO
- Applying of the properties like Size of beam and column and thickness of slab load condition in the 3-Dmodel.
- Analysis and design of the selected plan in both frame structure condition by using STAAD.PRO software.
- Comparison of the structure of both RCC and steel frame structure.

Software

- STAAD.Pro V8i

STAAD.Pro has been used for analysis and design of software. STAAD.Pro is one of the most widely used software product in worldwide. STAAD.Pro can generate the load such as wind and earthquake as per building code of selected countries. It also used to design steel and reinforced concrete building as per codes of selected countries. It has a simple and easy to understand interface. It gives accurate result in shear force, bending moment diagram for each and every beam, and structure column.

- AutoCAD

AutoCAD has been used for planning of the structure. AutoCAD is most popular software in civil engineering field. It should be used for 2-D plan and 3-D modeling of the plan. In this project this software is used for 2-d planning of the residential 3BHK plan. Which size is 16mX30m.

VII. ANALYSIS AND DESIGN

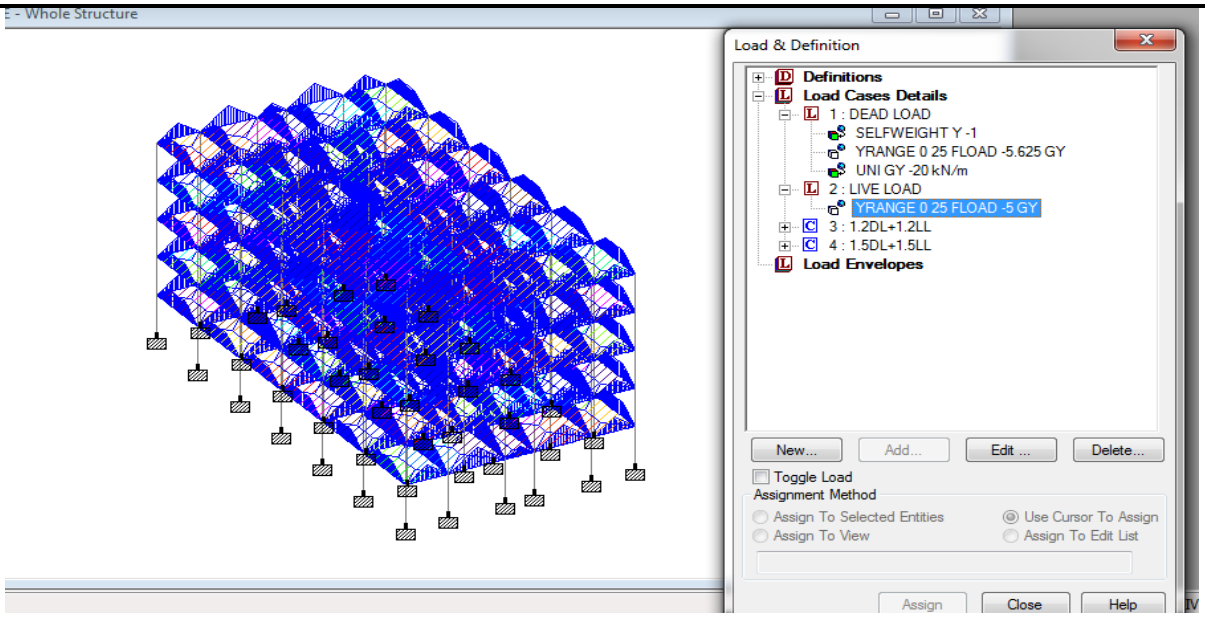
- Modeling

Creating of two model of same numbers of stories and same floor size plan of 16m X 30m were considered for this study. For floor plan were divided into five by seven bays. The floor height of the building was assumed as 3 meter for all floors.

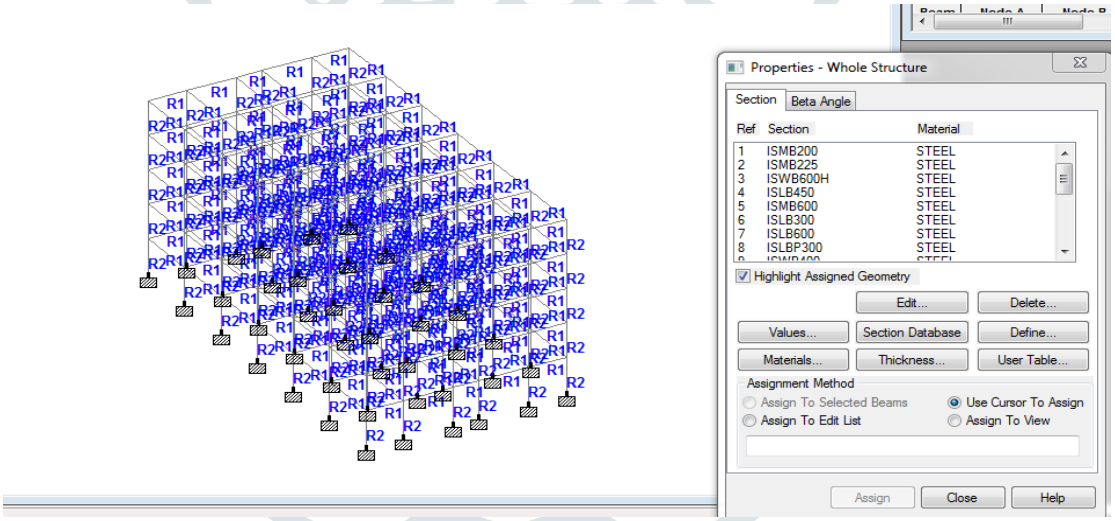
- Material properties of modelling structure
  - Material properties for RCC (Reinforced cement concrete) structure

After creating grid line we have to defined the material by using the menu. After defined the material beam is drawn. Line command and column is drawn using create column command and slab is assign as membrane for RCC and steel structure building. the material properties is assign to model as per requirement. The material properties of concrete are (modulus of elasticity E, Poisson's ratio, density etc.) will be assign along with cross-section.

The density of concrete is 25KN/m^3 , Poisson ratio is 0.17 after constructing the model we have to define various load such as (Dead load, Live load, seismic load etc.) and load combination using the menu. After the defined the material properties assigned the fixed support.



- Material properties of Steel Frame structure
  Creating a model plan using STAAD Pro software. After creating a model we have to assign material properties. To define the material of the composite beams, using define menu sections are created. In that dialogue box we get a steel section for steel beams,and steel column. To assign slab as per required dimension. steel density is 78.5kN/m3. Then we assign the selected beams, column steel structure.



- Load and Load Combination

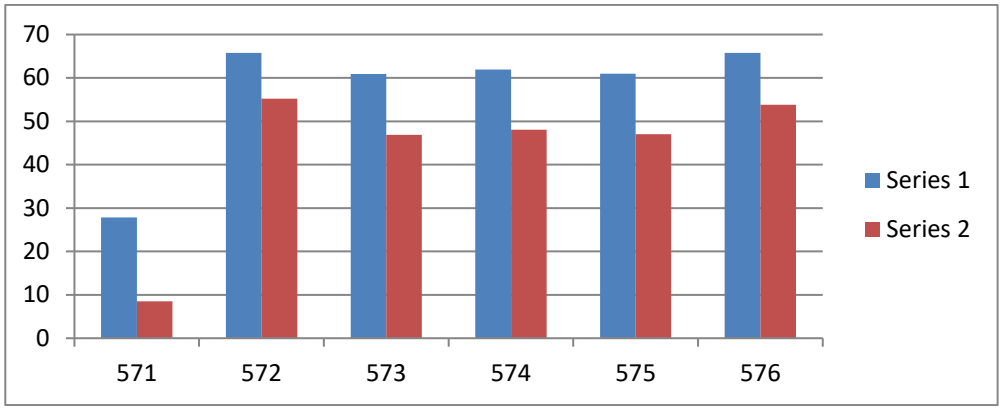
➢ DEAD LOAD : Dead load shall be calculated on the basis of unit weight which shall be established taking into consideration the materials specified for construction. Alternatively, the dead load may be calculated on the basis of unit weight of material given in IS875 (part). The loading procedure are same in both model.

➢ LIVE LOAD : Live load assumed in accordance (IS875 Part-2 of Table no. 1clause 3.1). Taking live load of slab is 4KN/M^2. The loading procedure are same in both the model.

➢ LOAD COMBINATION : The various loads should, therefore be combined in accordance with the simplulation in relevant design code. In the obscene of such recommended the following load combination l;which ever combination produces the most unfavorable effect in building, foundation and structural member. Using partial safety factor in accordance with clause 36.4 of IS-456 2000 combination of load.
Dead load + Live load =1.5 (1.5DL+1.5LL)
Dead load + Live load =1.2 (1.2DL+1.2LL)

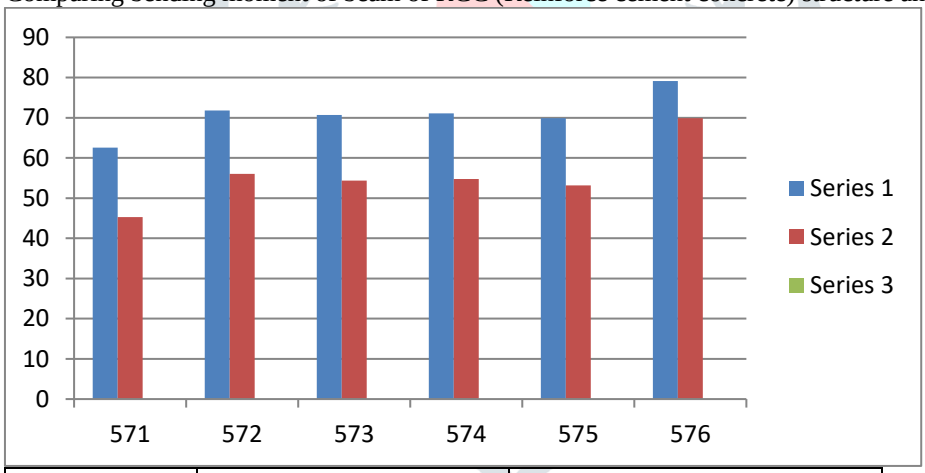
VIII. RESULT

- Comparing shear force on beam of RCC (Reinforce cement concrete) structure and Steel structure.



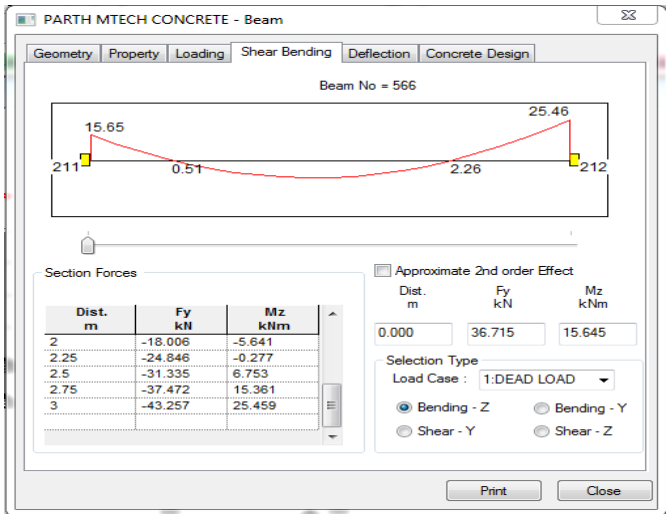
BEAM NUMBER	RCC STRUCTURE (KN)	STEEL STRUCTURE (KN)
571	27.80 KN	8.51 KN
572	65.76 KN	55.2 KN
573	60.91 KN	46.89 KN
574	61.91 KN	48.05 KN
575	60.97 KN	47.02 KN
576	65.76 KN	53.81 KN

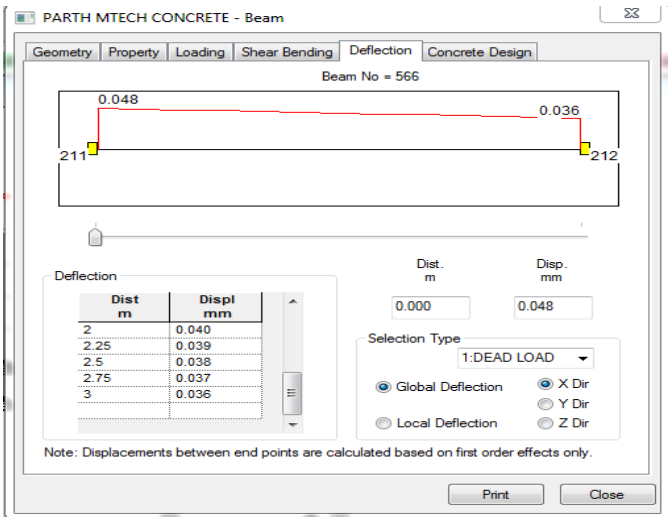
- Comparing bending moment of beam of RCC (Reinforce cement concrete) structure and Steel structure



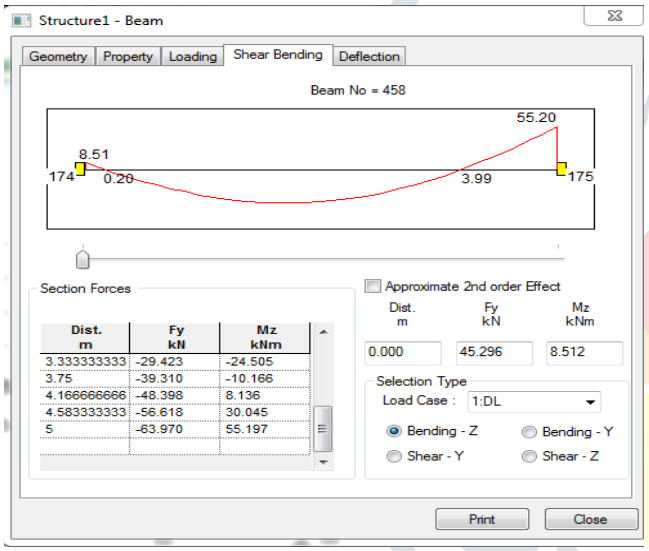
BEAM NUMBER	RCC BEAM (KN-M)	STEEL BEAM (KN-M)
571	62.6 KN-M	45.3 KN-M
572	71.8 KN-M	56.0 KN-M
573	70.7 KN-M	54.4 KN-M
574	71.1 KN-M	54.8 KN-M
575	69.9 KN-M	53.2 KN-M
576	79.1 KN-M	69.9 KN-M

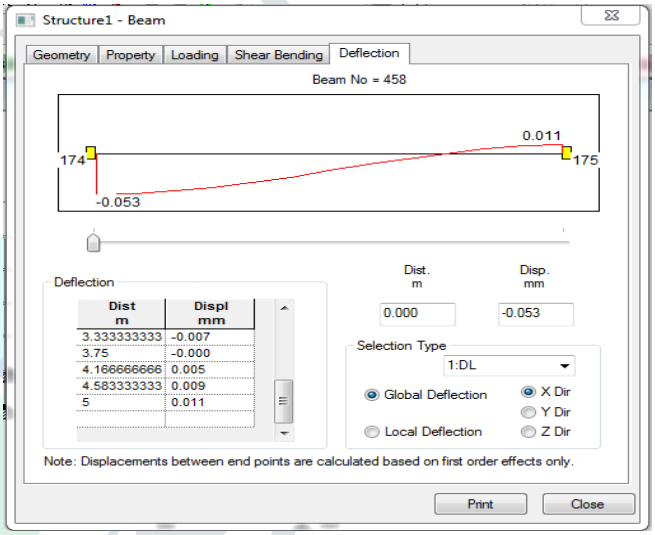
- **RCC BEAM SHEAR FORCE AND DEFLECTION DIAGRAM**





- **STEEL BEAM SHEAR FORCE AND DEFLECTION DIAGRAM**





Disscussion:

The shear force and bending moment of steel structure has lesser than RCC structure. And the section area of the RCC structure element is being larger than steel structure so dead load weight will be increases. The stress in steel structure found lesser than RCC structure.

IX. Estimation of structure

- For RCC structure

Particular	Quantity	Rate	Amount
Beam concrete	168m^3	5000Rs/m^3	8,40,000
Beam steel	19800kg	65Rs/kg	12,87,000
Column concrete	87m^3	5000Rs/m^3	4,35,000
Column steel	12200kg	65rs/kg	7,93,000
Slab concrete	358m^3	5000Rs/m^3	17,90,000
Slab steel	42500kg	65Rs/kg	27,62,500
		Total amount =	79,07,500

- For Steel structure

Particular	Quantity	Rate	Amount
Beam ISMB600	148215 kg	65 Rs/kg	96,33,975
Column ISWB600H	91350 kg	65 Rs/kg	59,37,750
Slab concrete	358m^3	5000Rs/m^3	17,90,000
Slab steel	42500kg	65Rs/kg	27,62,500
		Total amount =	1,76,38,225

X. CONCLUSION

The following conclusion can be obtained from the present study.

1. The stress generated in steel structure are found to be lesser compare to RCC structure, thereby giving an identification that the load carrying capacity of steel structure is more leading to economy.
2. Better quality control can be achieved in construction of steel structure.
3. Sectional area of RCC structure elements being large, leads more dead load weight of the structure as compared to steel structure.
4. Steel structure after better recycling leading to eco friendliness compared to RCC structure.
5. But steel structure are more costlier than RCC structure.

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