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Comparative Analysis of Steel and RCC Frame Structure of a Commercial Building

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Abstract: *In India 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. Each material used for construction has its specific advantages and disadvantages. Steel members are excellent in tensile strength & ductility although concrete members are good in compression & stiffness. 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. Two different types of models of RCC, and Steel structures are created. These models are analysed for shear forces and bending moments using Etabs software.*

1. INTRODUCTION

Reinforced concrete is extensively used construction material. steel bars are embedded in concrete to produce an efficient composite material named reinforced concrete. This paper involves analysis and design of multi-storeyed [G+5] steel structure and reinforced concrete structure using a very popular designing software Etabs. The main objective of this project is to do analytical investigation on RCC frame structure and Steel frame structure using Etabs and comparing their results

2. LOADS CONSIDERED

Dead Loads, Imposed Loads, Seismic Loads, Wind Loads

2.1. Design Approach for RCC

The structural plan was analysed for possible placement of column. Main beams were placed connecting columns. The Geometrical layout was prepared in Etabs. The structure under consideration is a typical commercial building.Beams were of standard size 300 x 600 mm.The column sizes were decided considering the axial reactions at the bottom node of each column.

2.2. Design Approach for Steel

For the justification to the comparative study carried out here the layout has been kept same for both structures. ISMB sections with thick webs are used for beams. Although wide flanged sections are used in column design as they provide outstanding section presentation, with high bending & buckling resistance due to H-shaped procedure of flanges & the web. Second beams are also added on this steel structure which supports the steel deck slab. Proper bracing is provided around the building to resist the lateral load.

2.3. Analytical procedure

The analytical procedure adopted is linear dynamic analysis. Response-spectrum analysis is applied for the model under study to understand the dynamic behavior of the structure.

3. OBJECTIVES

- To analyze G+5 shopping mall of RCC and steel frame using response spectrum Analysis.
- To find the responses of the structures in terms of the base shear, maximum top displacement and story drift.

- To compare the results of both structures

4. METHODOLOGY

In this present work the response spectrum analysis of the two buildings are considered i.e. RCC and Steel. This is a G+5 storey shopping mall having 24 m height from the ground level First three floors are specially designed for shops, fourth floor is completely designed for food court and the fifth floor is allocated for four cinema halls.

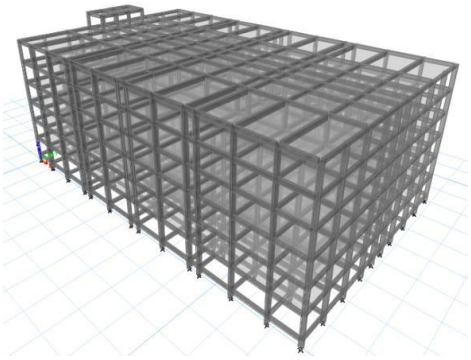


Fig1. *Concrete structure*

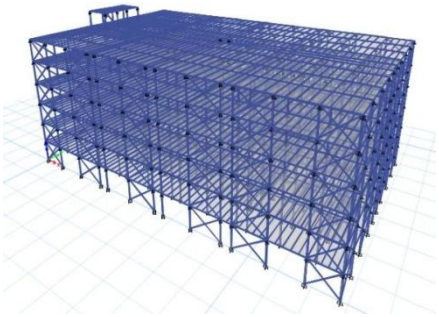


Fig2. *Steel structure*

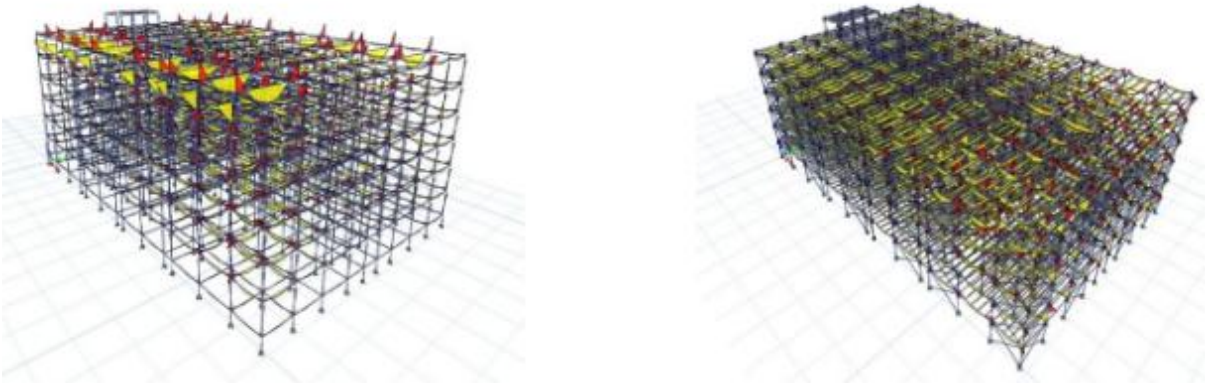


Figure3. *Bending moment diagram of the structures*

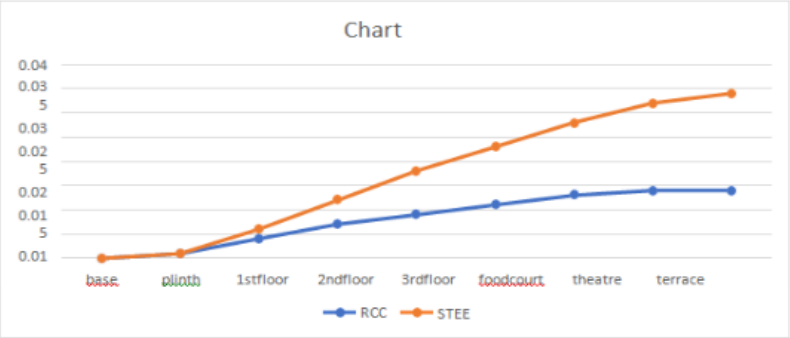
5. LOADING DETAILS OF THE STRUCTURE

UDL WALL LOADS			
OUTER WALLS(GLASS)		5	KN/M
INNER WALLS		10	KN/M
UDL SLAB LOADS			
SLABS	SDL	LIVE	
CORRIDER	1	3	KN/M2
FOOD COURT	1	4	KN/M2
SHOPS	1.125	4	KN/M2
STAIRS	2.5	3	KN/M2

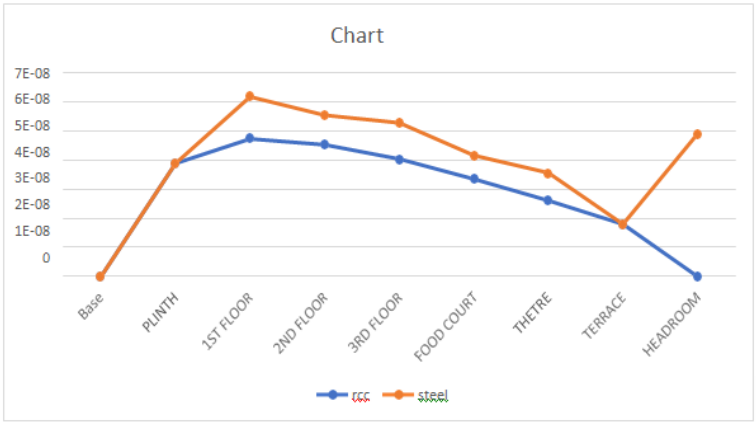
TERRACE	2	2.5	KN/M2
THEATRE	2.5	5	KN/M2
TOILET	2	2.5	KN/M2
WIND COEFFICIENT			
WIND-SPEED		50	M/S
TERRAIN CATEGORY		2	
IMPORTANCE FACTOR		1	
K1 FACTOR		1	
K3 FACTOR		1	
SEISMIC COEFFICIENT			
ZONE		0.16	
SITE TYPE		11	
IMPORTANCE FACTOR		1	

6. ANALYSIS

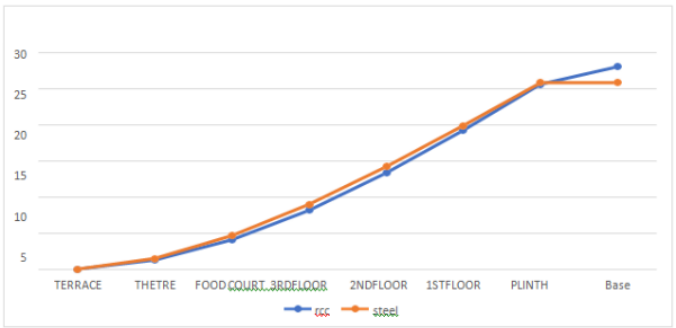
Both concrete and steel frame structures are subjected to linear dynamic analysis using ETABS. Structural responses in terms of deflection, shear force & bending moment are studied for both models as per IS 1893. Wind-forces are considered using code IS-875 (PART-3), which are inbuilt in the software



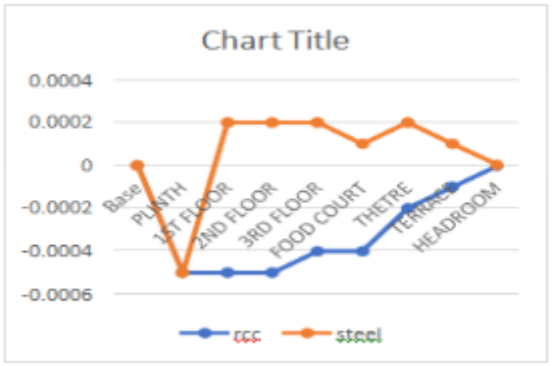
Maximum storey displacement



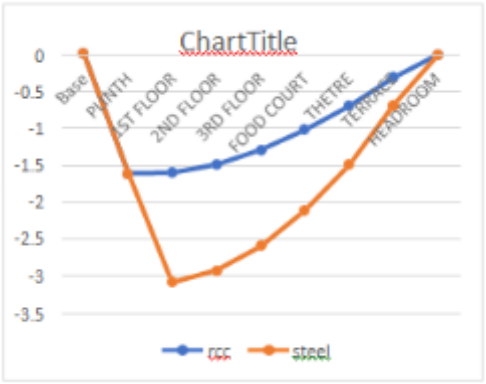
Maximum storey drift



Overturning moment- storeywise



Story shear – X direction



Story shear – Y direction

7. CONCLUSION

- 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.
- 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.

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