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Seismic Analysis of RCC and Steel Frame Structure By Using ETABS

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Abstract: *The residential housing sector (G+3,G+6 etc.) use of steel has increased, but RCC construction still predominates the Indian construction business.In the present study an attempt has been made to analyze the seismic behavior of RCC and steelframes using Etabs2015.The high self-weight and brittleness of concrete is not favorable to seismic prone structures whereas steel structures are 60% lesser in weight through they can withstand earthquake more effectively than the concrete structures.Aim of the study to compare the seismic performance of G+6 and G+9 frames for both steel and RCC. For current study all frames are analyzed under equivalent static method. In this comparative study it is concluded that steel frames are most effective than the concrete as it has the highest strength to weight ratio.*

Keywords: *Steel frame, RCC frame, Seismic Analysis, ETABS2015, IS 1893:2002*

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I. Introduction

In India most of the people approached towards the concrete structure instead of steel as they find concrete as convenient and cost effective in nature. But as India is becoming worlds second most populous country and the area is just limited then vertical hike is in the building construction is very necessary.so, for construction of this multistoried building steel canbe a truly effective material in all engineering aspect. The use of steel as a core construction material is not yet become prevalent in India as it is in other developing where maximum construction both commercial and residential high rise structures are being built of steel.it is very stiff and they possesseshigh strength to weight ratio which shows great integrity against the seismic loading. Now, availability of steel is deeply in favor of Indian consumers as India became third biggest steel producer with 101.4MT per annum. The advancement in building, Information, modeling have integrated design, detailing, and fabrication of steel which will result in high performance under earthquake loading. This paper emphasized to prefer steel frame over the RCC as it perform far better than RCC under the seismic loading.

II. Frame structure Details

In the present study G+6 and G+9 of RCC and Steel frame structure in zone IV are being analyzed by equivalent static method by using ETABS2015 software. In case of RCC structure, all structural members are considered as per IS 456:2000 and Steel sections are considered as per steel table and IS 800:2007.The basic planning and loading for the RCC and Steel structure are kept similar for the study.The details of RCC and Steel frame structure are as shown below in Fig No.1, and Table No.1.

Table no 1 : Structural Member Details

PARTICULARS	RCC		STEEL	
NO OF STORY	G+6	G+9	G+6	G+9
TOTAL STORY HEIGHT	21m	30m	21m	30m
BEAM SIZE	300mm X 450mm	400mm X 600mm	ISHB 450	ISHB 450
COLUMN SIZE	300mm X 550Smm	500mm X 700mm	ISWB 500	ISWB 600
SLAB/DECK	150 mm SLAB	150 mm SLAB	100mm DECK	100mm DECK

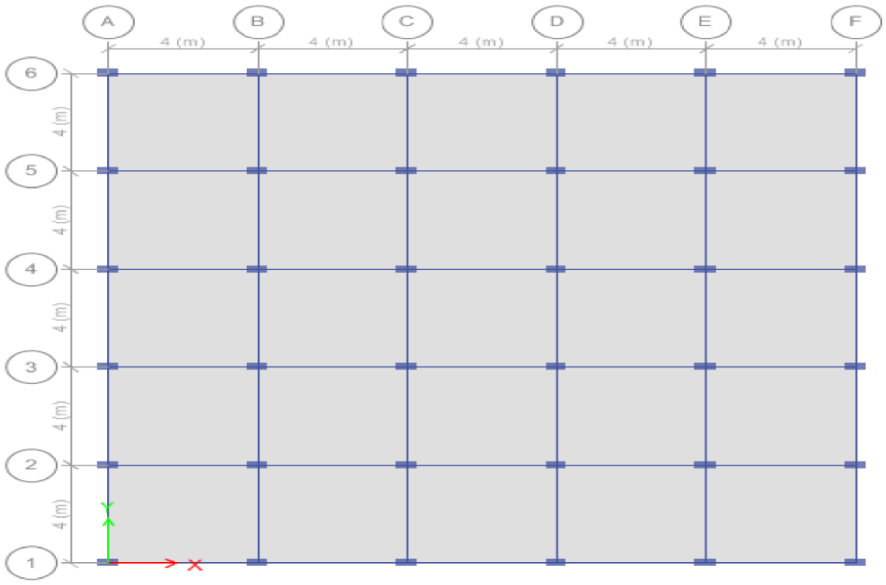

Figure No 1: Plan of G+6 & G+9 Framed Structure.

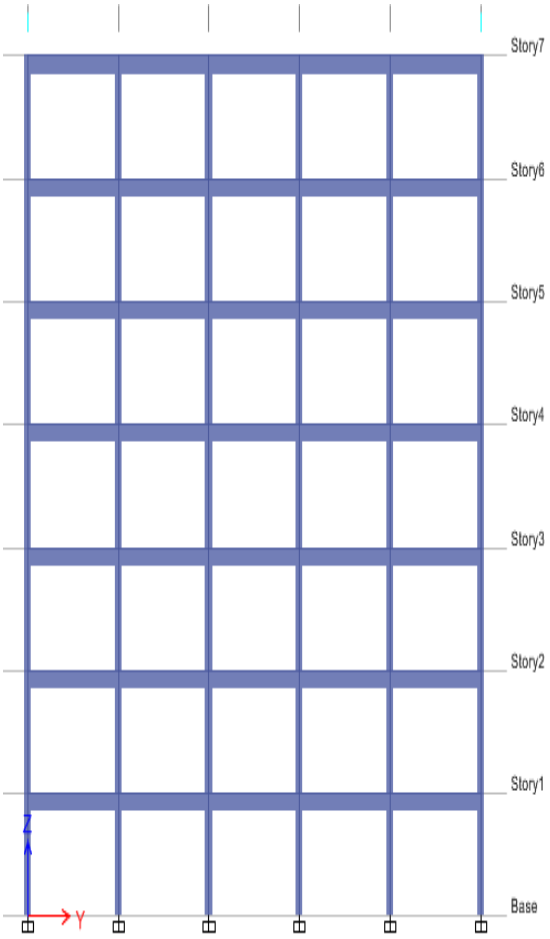

Figure No 2: Elevation of G+6 Framed Structure.

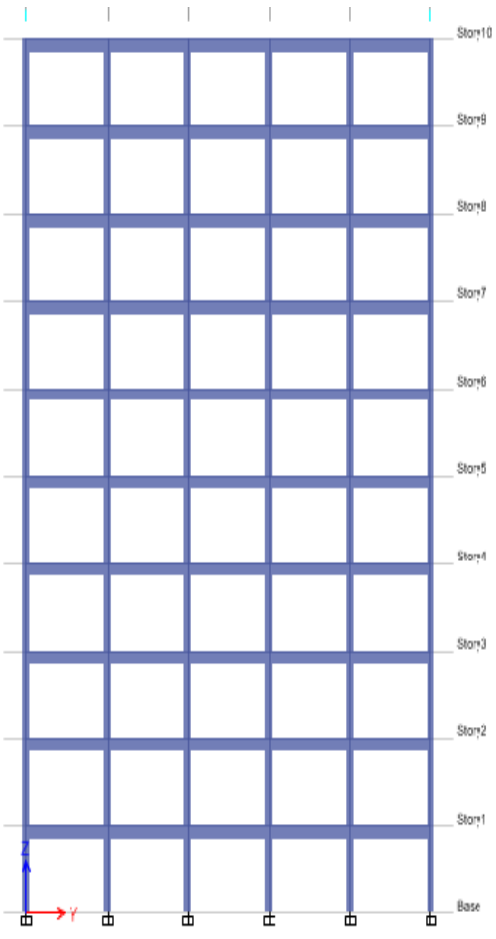

Figure No 3: Elevation of G+9 Framed Structure.

Table no 2: Specification of RCC & Steel Frame Structure.

PARTICULARS	RCC FRAME		STEEL FRAME	
	G+6	G+9	G+6	G+9
Type of frame	Moment Resisting Frame	Moment Resisting Frame	Moment Resisting Frame	Moment Resisting Frame
Total height of building	21m	30m	21m	30m
Height of each story	3m	3m	3m	3m
Plan of the building	20m × 20m	20m × 20m	20m × 20m	20m × 20m
Thickness of walls	230mm	230mm	230mm	230mm
Live load	3.0 kN/sq.m	3.0 kN/sq.m	3.0 kN/sq.m	3.0 kN/sq.m
Grade of Concrete	M-25	M-25	M-25	M-25
Grade of reinforcing Steel	Fe415	Fe415	Fe415	Fe415
Grade of structural steel	Fu= 410N/mm2,	Fu= 410N/mm2,	Fu= 410N/mm2,	Fu= 410N/mm2,
Density of Concrete	25 kN/m3	25 kN/m3	25 kN/m3	25 kN/m3
Density of brick masonry	20 kN/m3	20 kN/m3	20 kN/m3	20 kN/m3
Zone	IV	IV	IV	IV
Soil type	Rock	Rock	Rock	Rock
Importance factor	1.0	1.0	1.0	1.0
Response reduction	5.0	5.0	5.0	5.0
Seismic zone factor	0.24 for zone IV	0.24 for zone IV	0.24 for zone IV	0.24 for zone IV

III. Methodology

The present comparative study deals with equivalent static method for seismic analysis of G+3 and G+9 frame structure for both RCC and Steel building. The analysis of both the building models is run in software ETABS2015. For the analysis the parameters like Story Stiffness, Time Period, Frequency, Base Shear, Lateral forces and Seismic weight are studied significantly for the loading. Seismic codes varies with the every region across the country. In India standard criteria for earthquake resistant design of structures IS 1893(PART-1):2002 is the main code which gives the idea about the seismic design force according to the various zones.

IV. Result and Discussion

a. After calculating time period of both RCC & Steel structure, it is found that RCC structure shows more time period than steel due to its higher weight. The value of highest time period for RCC & Steel frame structure of G+6 is 1.04 sec & 0.943 sec respectively G+9 are 1.14 sec & 1.02 sec respectively.

b.

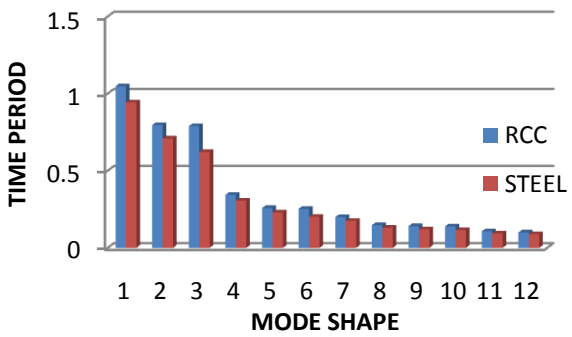

Figure No 4: Mode Shape Vs Time Period (G+6).

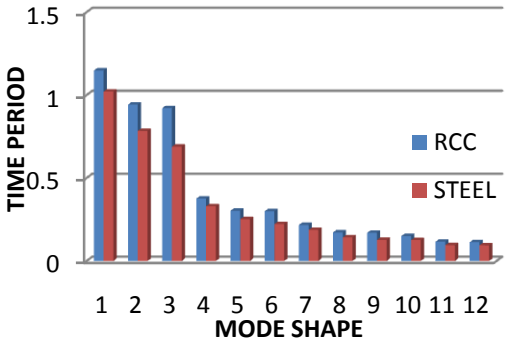

Figure No 5: Mode Shape Vs Time Period (G+9)

c. From the obtained graph Base Shear for RCC frame strucutre is on higher side as it has more seismic weight.

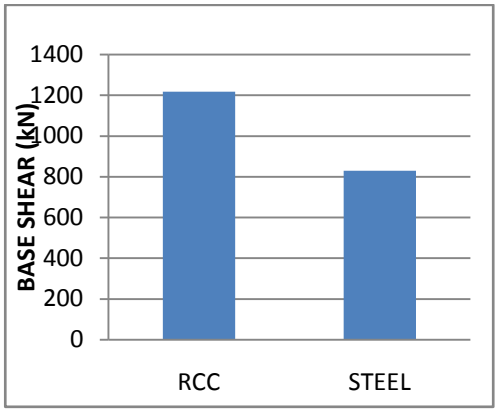

Figure No 6: Base Shear (G+6).

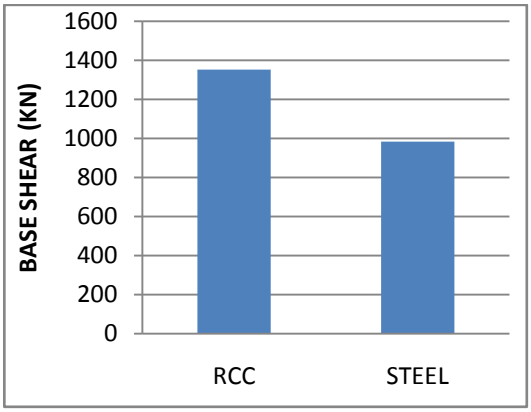

Figure No 7: Base Shear (G+9).

d. Steel structure shows relatively more ductility than RCC which is most efficient under effect of lateral forces. Graph shows lateral forces acting on RCC are more than Steel structure hence,Steel Structure is less perceptive against seismic forces acting on frame Structure.

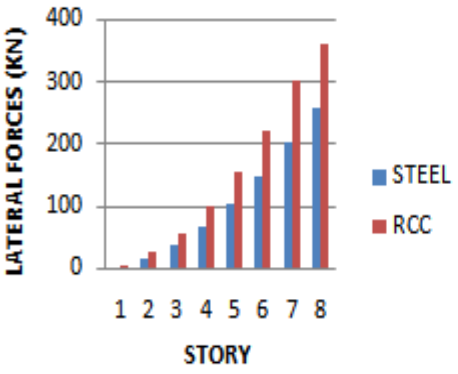

Figure No 8:Story Vs Lateral forces (G+6).

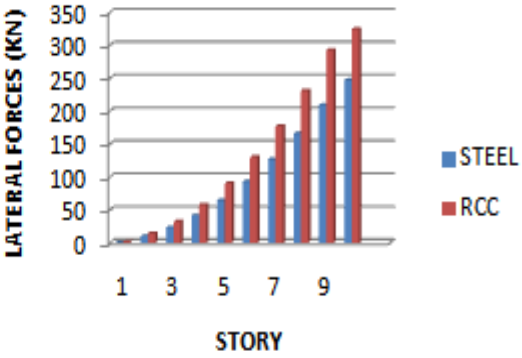

Figure No 9: Story Vs Lateral forces (G+9).

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e. Seismic weight of RCC frame structure is more than Steel Frame structure because of its greater dense cross-section of structural member.

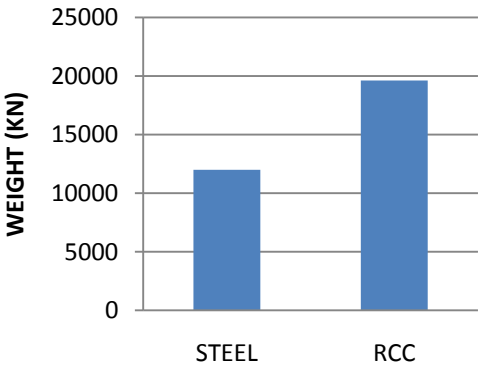

Figure No 10: Type of Structure Vs Weight (G+6).

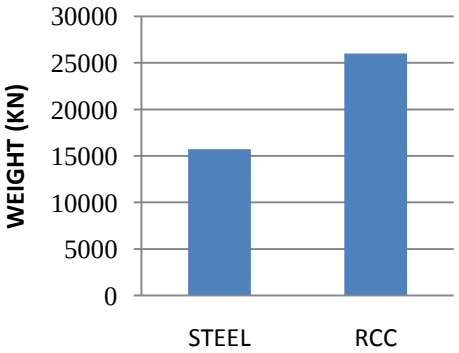

Figure No 11: Type of Structure Vs WeightG+9).

V. Conclusion

The major conclusions drawn from present study are as follows

1. Time period for RCC frame structure is more as compared Steel Structure due higher mass of RCC frame Structure.
2. The value of highest time period for RCC & Steel frame structure of G+6 is 1.04 sec & 0.943 sec respectively G+9 are 1.14 sec & 1.02 sec respectively.
3. The Base shear found in RCC framed structure is more as compared to Steel frame structure.
4. As the story rises from G+6 to G+9 then the percentage variation in Base shear in RCC frame Structure is found as 11.09 % and for Steel frame structure it is 18.55%
5. Seismic weight of RCC frame structure is more than Steel Frame structure because of its greater dense cross-section of structural member.
6. From the study it is concluded that Steel's strenght and ductility combind with the solid engineering and design, make it a safe choice in seismic zone for greater performance of structure.

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