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Comparative Study of R.C.C and Steel (G+4 Storey) Building

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ABSTRACT:- Analysis and design of buildings for static forces is a routine affair these days because of availability of affordable computers and specialized programs which can be used for the analysis. On the other hand, dynamic analysis is a time consuming process and requires additional input related to mass of the structure, and an understanding of structural dynamics for interpretation of analytical results. Reinforced concrete (RC) frame buildings are most common type of constructions in urban India, which are subjected to several types of forces during their lifetime, such as static forces due to dead and live loads and dynamic forces due to the wind and earthquake.

Here the present works (problem taken) are on a G+4 storied regular building. These buildings have the plan area of 63.2m x 29.5m with a storey height 3.6m each and depth of foundation is 1.5 m. & total height of chosen building including depth of foundation is 18 m. The static and dynamic analysis has done on computer with the help of STAAD-Pro software using the parameters for the design as per the IS- 1893- 2002-Part-1 for the zones- 3 and the post processing result obtained has summarized.

1) INTRODUCTION

In this modern era the buildings are constructed to fulfill our basic needs and to provide better serviceability. It is not an issue to construct merely a building, however, it is important to build an efficient building which will serve for many years without any failure. In 21st century due to proliferation in the population the land area is decreasing day by day. So, to overshadow this problem the type of construction preferred nowadays is vertical expansion i.e., high rise buildings are constructed everywhere. In the analysis of such buildings various factors are needed to be considered such as its own height, SBC of soil, type of soil, self-weight of many materials, etc.

RCC is acronym for Reinforced Cement Concrete. It is strong in compressive strength but feeble in tensile strength Most of the Steel construction is done with a type of steel called Mild Steel. It is immensely strong. This immense strength is of great advantage to building.

For external forces that act on the building, beam, column, and the reinforcement should be designed in such away that it efficiently counteracts these forces without any damage. This type of analysis is tedious for us to do it manually, so another way is required, which is fulfilled by STAAD Pro.STAAD pro makes such analysis and design quite easy to carry out.

The construction industry in India integrates a variety of locally sourced materials. India consists of different types of building according to the requirement. Different types of building are Residential building, commercial, residential and commercial combined.

A noticeable movement of the surface of the earth is known as earthquake. They are the result of an unexpected sudden release of enormous amount of energy in the earth's crust which in turn generates seismic waves. India is divided into 4 seismic zones according to the Indian earthquake zoning map. The four seismic zones are zone II, III, IV & V in which zone II has lowest level of seismicity and zone V has highest level of seismicity. No structures will completely resist seismic forces without damage. Most of the structures will undergo minor or major damage due to earthquake. The damage to the structure may be minor if the magnitude of the earthquake is small, whereas structure may collapse if the magnitude of the earthquake is very high. therefore Now a day all high rise building and some low rise building also design for earthquake resistant.

2) OBJECTIVE

1) To study which structure is better.

2) To study the bending moment of RCC and steel structure.

3) To study the shear force of RCC and Steel structure.

4)To study the maximum displacement, support reaction in the structure

3) ADVANTAGE AND DISADVANTAGE OF RCC STRUCTURE

a) ADVANTAGE OF RCC STRUCTURE:-

1) Reinforced concrete has a high compressive strength Compared to other building material.

2) Fire and weather resistance of reinforced concrete is fair.

3) The maintenance cost of reinforced concrete is very low.

4) It act like rigid material with minimum deflection.

5) As reinforced concrete can be molded to any shape required, it is widely used in precast structural components.

6) Compared to the use of steel in structure, concrete requires less skilled labor for the erection of the structure

7) Reinforced concrete, as a fluid material, in the beginning, can be economically molded into a nearly limitless range of shapes.

b) DISADVANTAGE OF RCC STRUCTURE:-

1) The tensile strength of reinforced concrete is about one-tenth of its compressive strength.

2) The cost of the forms used for casting RC is relatively higher.

3) Shrinkage causes crack development and strength loss.

4) ADVANTAGE AND DISADVANTAGE OF STEEL STRUCTURE

a) ADVANTAGE OF STEEL STRUCTURE:-

1) Steel offers much better compressive and tensile strength than concrete.

2) Lighter construction .

3) Steel can be easily recycled and it is environment friendly.

4) Erection is faster.

5) Connections using bolting, welding, and riveting can be done easily.

6) Structural steel is used in load bearing frames in building, truss member, bridges , etc.

b) DISADVANTAGE OF STEEL STRUCTURE :-

1) It require fire protection. Strength reduce at higher temperatures.

2) It requires corrosion protection.

3) Welding, tightening of high strength friction grip bolts require proper training.

4) In many cases cost of steel structure, work out to be more than the concrete structures.

5) WHY STAAD PRO

Staad pro is comprehensive structural engineering software that address all aspects of structure engineering including modal development, verification, analysis, design and review of result we have chosen staad pro because of it's following advantages :

- Easy to use interface
- Confirmation with the Indian standard code
- Accuracy of the solution

LOAD CONSIDERATION

1) Dead load
2) Live load
3) Wind load
4) Seismic load
5) Load combination

6) DESIGN OF RCC& STEEL STRUCTURE

Geometry of structure

1) The geometry of the structure as a whole is define by the at the end of the various structural members, and each node has a unique member.

2) The Location of each node is define relative to a global coordinate system.

Plan dimension	63.20m X 29.5m
Height of each storey	3.6m
Total height of building	18m
Size of column	750mm X 750mm
Size of beam	750mm X 500mm
Size of column section	ISMB600
Size of beam section	ISMB450
Slab thickness	150mm
Seismic zone	III
Wind speed	44 m/s
Soil condition	1
Importance factor	0.16
Zone factor	3 KN/M²
Live load at all floors	
Damping ratio	5%

Table 1

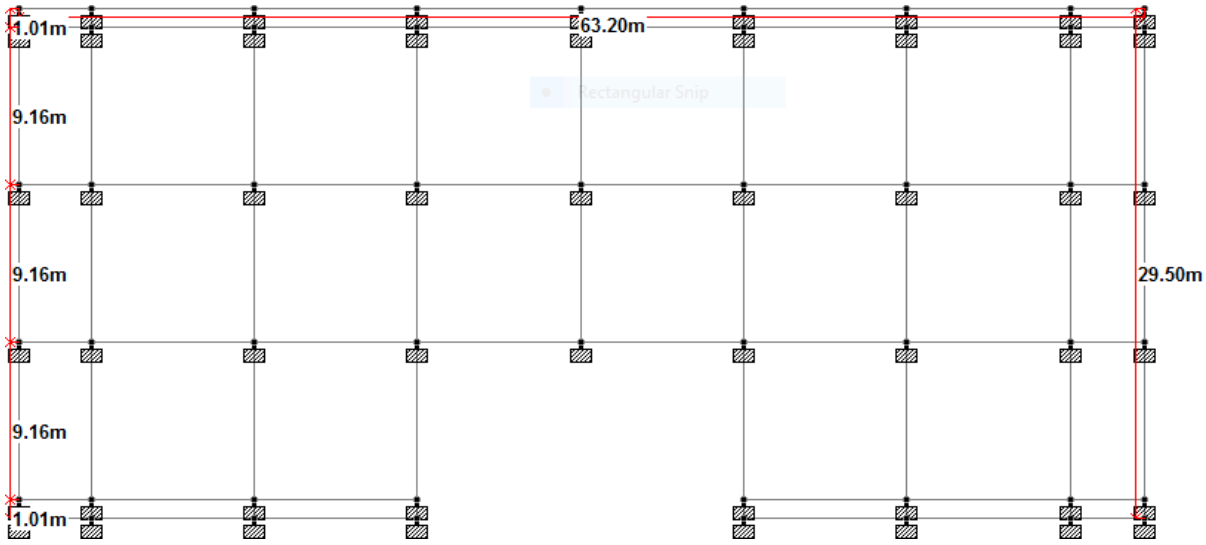

Fig 1: Grid plan

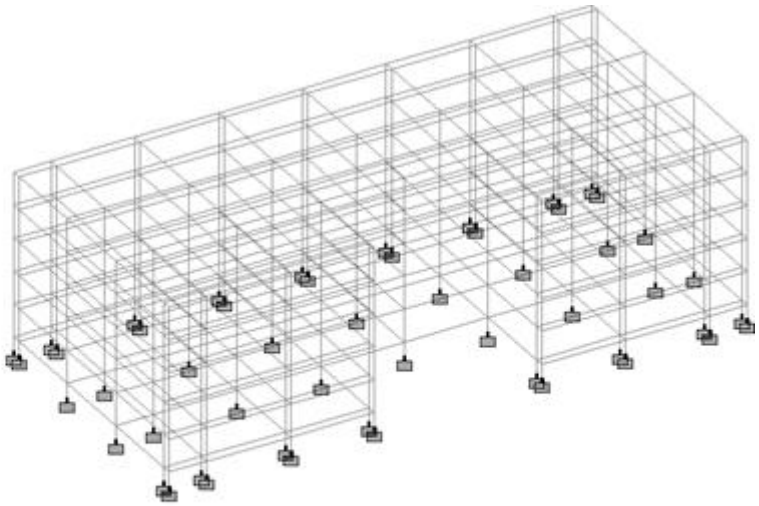

Fig 2: The base supports of the structure were assigned as fixed.

LOAD CALCULATION

1) DEAD LOAD:- Self weight of member is calculated by STAAD PRO it self by input dimensions.

a) Self weight = -1 in y direction

b) member load =19.6 KN/m

c) Floor load = 3.75 KN/m

2) LIVE LOAD:- Live load is considered 3KN/m

3) WIND LOAD :- In the wind load we considered the surat place. In the surat basic wind speed is 44m/s

Pz(Intensity)	Height
0.88	10
1.004	15
1.070	18

Table 2

4) Seismic load:- In the seismic we have to first define the seismic definition as per IS 1893-2002. Then in this we have to add the seismic zone, then select importance factor etc.

Then after we add the seismic in X,-X,Z,-Z direction

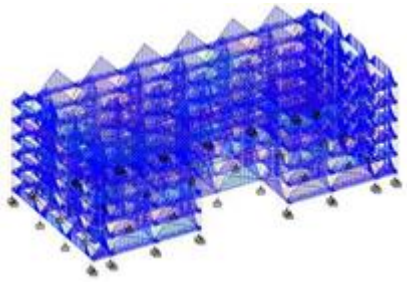

Fig 3: Application of live load

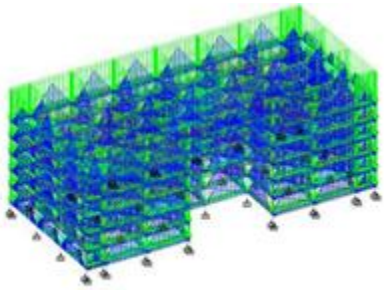

Fig 4: Application of floor load

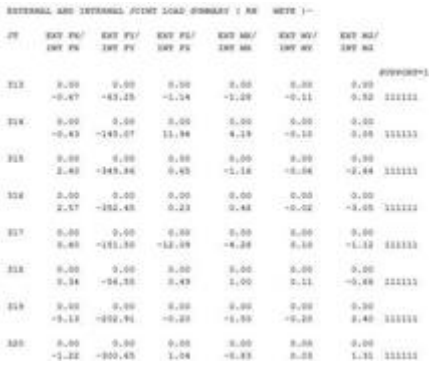

Fig 5: Analysis

RESULTS

1) MAXIMUM DISPLACEMENT:

	RCC	STEEL
Max X (mm)	43.072	11.492
Min X (mm)	-1.656	-0.971
Max Y (mm)	1.387	0.474
Min Y (mm)	-9.123	-2.823
Max Z (mm)	53.933	57.947
Min Z (mm)	-0.796	-0.305

Table 3

2) MAXIMUMSHEARFORCEFLOORWISE

For g+4

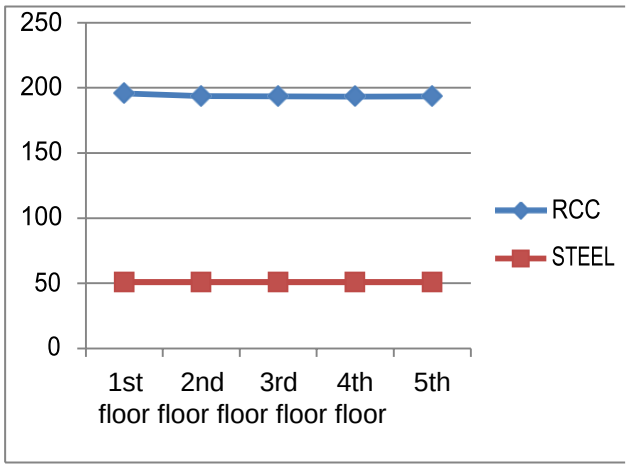

Fig.6

3) MAXIMUMBENDINGMOMENTFLOORWISE

For g+4

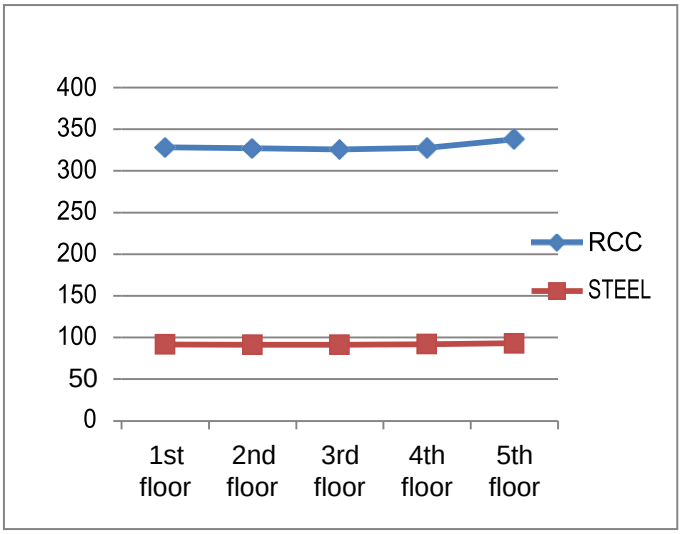

Fig. 7

4) STOREY DRIFT OF R.C.C.

STOREY	HEIGHT (m)	LOAD	AVG. DISP (CM)		DRIFT (CM)		STATUS
			X	Z	X	Z	
1	0.00	7	0.0934	-0.0001	0.0934	0.0001	PASS
		8	-0.0934	-0.0001	0.0934	0.0001	PASS
		9	0.0000	0.0930	0.0000	0.0930	PASS

		10	0.0000	-0.0932	0.0000	0.0932	PASS
2	3.60	7	0.8215	0.0033	0.7271	0.0033	PASS
		8	-0.8212	0.0034	0.7278	0.0035	PASS
		9	0.0002	0.8738	0.0001	0.7808	PASS
		10	0.0001	-0.8672	0.0001	0.7740	PASS
3	7.20	7	1.6627	0.0122	0.8412	0.0090	PASS
		8	-1.6618	0.0123	0.8406	0.0090	PASS
		9	0.0005	1.8756	0.0003	1.0018	PASS
		10	0.0004	-1.8510	0.0003	0.9839	PASS
4	10.80	7	2.4455	0.0259	.07828	0.0136	PASS
		8	-2.4439	0.0259	0.7820	0.0135	PASS
		9	0.0008	2.9072	0.0004	1.0316	PASS
		10	0.0008	-2.8555	0.0004	1.0044	PASS
5	14.40	7	3.0762	0.0430	0.6307	0.0171	PASS
		8	-3.0736	0.0429	0.6298	0.0170	PASS
		9	0.0013	3.8430	0.0005	0.9358	PASS
		10	0.0012	-3.7571	0.0004	0.9017	PASS
6	18.00	7	3.4718	0.0589	0.3957	0.0160	PASS
		8	-3.4684	0.0588	0.3947	0.0159	PASS
		9	0.0018	4.5734	0.0005	0.7304	PASS
		10	0.0017	-4.457	0.0005	0.6985	PASS

Table 4

5) STOREY DRIFT OF STEEL

STOREY	HEIGHT (m)	LOAD	AVG. DISP(CM)		DRIFT (CM)		STATUS
			X	Z	X	Z	
1	0.00	7	0.0207	0.0002	0.0207	0.0002	PASS
		8	-0.0207	0.0002	0.0207	0.0002	PASS
		9	0.0000	0.0902	0.0000	0.0902	PASS
		10	0.0000	-0.0899	0.0000	0.0899	PASS
2	3.60	7	0.1681	0.0026	0.1471	0.0024	PASS
		8	-0.1680	0.0026	0.1473	0.0024	PASS
		9	0.0000	1.1423	0.0000	1.0520	PASS
		10	0.0000	-1.1372	0.0000	1.0473	PASS
3	7.20	7	0.3599	0.0075	0.1918	0.0049	PASS
		8	-0.3597	0.0075	0.1917	0.0049	PASS
		9	0.0001	2.2034	0.0000	1.0611	PASS
		10	0.0001	-2.1883	0.0000	1.0512	PASS

4	10.80	7	0.5472	0.0143	0.1873	0.0068	PASS
		8	-0.5469	0.0143	0.1872	0.0068	PASS
		9	0.0001	3.1863	0.0001	0.9829	PASS
		10	0.0001	-3.1576	0.0001	0.9693	PASS
5	14.40	7	0.7033	0.0225	0.1561	0.0081	PASS
		8	-0.7029	0.0225	0.1560	0.0081	PASS
		9	0.0002	3.9930	0.0001	0.8067	PASS
		10	0.0002	-3.9481	0.0001	0.7905	PASS
6	18.00	7	0.8126	0.0313	0.1093	0.0088	PASS
		8	-0.8121	0.0313	0.1092	0.0088	PASS
		9	0.0003	4.4989	0.0001	0.5059	PASS
		10	0.0003	-4.4363	0.0001	0.4882	PASS

Table 5

CONCLUSIONS

1) It can be inferred from above results that the maximum shear force and bending moment of only Steel structures is quite low as compared to that of RCC structure.

2) Also, it can be inferred from table 2 that the displacement in steel structure is quite low as compared to that of RC structure.

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