Comparison of behavior of RCC and Steel Structure using ETABS Software

(Details for Structural Project and Analysis)

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***Abstract*— The residential housing sector (G+3, G+5, 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 steel frames using Etabs2016.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 frame for both steel and RCC and to introduce the container into the steel frame and analyze its seismic response. 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; ETABS2016; IS 1893:2002

I. INTRODUCTION

There are tons of empty containers out there waiting to be reused or recycled. Due to recent development of technological innovation, reuse of shipping containers for home building usage might deserve further investigation between its other usages. Promising cases of transforming containers to youth center, classroom, emergency shelter, office, house and hotel are emerging around the world each year. This would be a kind of offset in a way, which could result in greener and healthier coastlines without creating another issue in landfill. However, the matter is how to transform those containers sustainably for homebuilding purposes in a way that makes our society greener and healthier. 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 can be 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. This paper emphasized to prefer steel frame over the RCC as it perform far better than RCC under the seismic loading. Some people might not have any idea that shipping containers can be used as home building materials. Steel for house building purposes reduces the need for newest materials used in conventional construction. It is well established that containers are produced in the same standard dimensions with some inbuilt properties, which makes them a spectacular modular structural component. The recent use of prefabricated shipping containers may be a substitute of traditional timber-framed construction.. Steel are designed to carry and bear very high loads, as well as resist to aggressive environments. In this project we are doing the seismic analysis of the G+6 building. Many RCC structures proved to be inconvenient in many case like ductility, time period, base shear etc..The analysis and validation of these factors are done in the project to compare the RCC structure with steel structure like container house.40 feet long containers are introduced and seismic analysis is done, so that the container house can be proved to be safe in seismic zones. Cargo containers are manufactured from weathering steel. Weathering steel includes alloying elements that affect the materials corrosion procedure. Weathering steel creates an amorphous inner layer that protects the integrity of the steel against external harmful agents. Figure 1.1shows the placement of the layer as well as its composition. The continuity of the layer also adds to the protection of the steel.

II. LITERATURE GAP

RCC Frame structure is requiring more time period compared to steel structures like container house.Base shear for RCC structures is more compared to steel structures.More time period due to increased weight of RCC.Seismic weight of RCC frame structure is more than steel frame structure. Because of its greater dense cross-section of structural member.RCC structure has less strength and ductility.Steel structure have very low insulation. Steel buildings should be proven to be safe in seismic prone areas.

III. OBJECTIVE

To prove by validation that, Ductility is more for steel structures is more than RCC structures. Strength is more for steel structures is more than RCC structures. Base shear is more for steel structures is more than RCC structures. Value of highest time period is more for RCC structures than steel structures. Lateral forces are withstanded more by steel structures than RCC structures. To implement this validated steel frame structure is required. To provide seismic or dynamic loading using E Tabs to show that steel buildings are safe in seismic zone too.

IV. SCOPE

The future scope of the project is to introduce container into the steel structure which has been analyzed using ETabs 2016 and introduce the seismic load into it. Thus proving that steel based shipping container buildings are safe in seismic prone areas.

V.FRAME DETAILS

In the present study G+6 of RCC and Steel frame structure in zone IV are being analyzed by equivalent static method by using ETABS2016 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:-

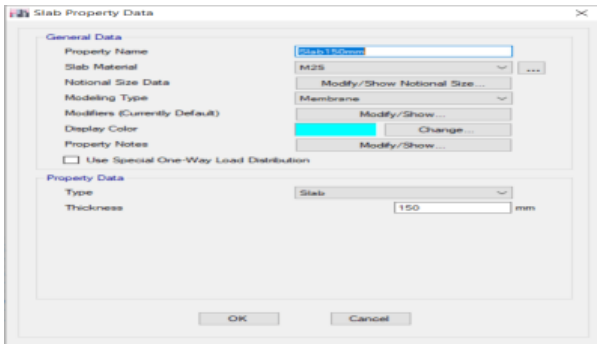

Figure: 1, Sectional property of RCC Slab

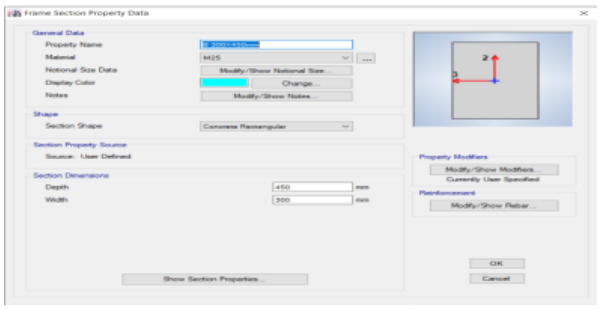

Figure: 2, Sectional property of RCC Beam

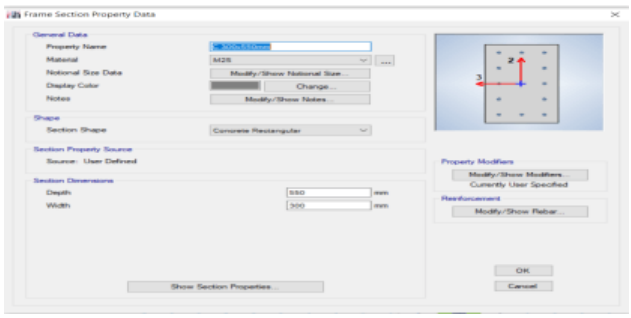

Figure: 3, Sectional property of RCC Column

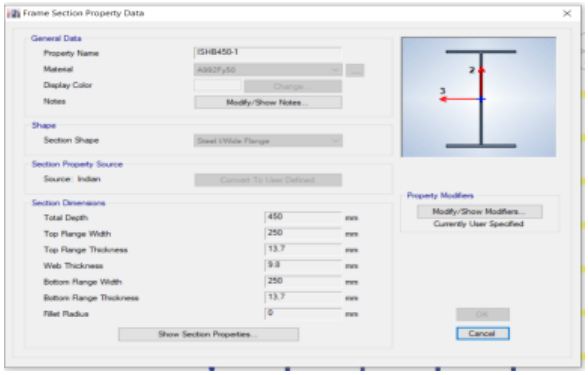

Figure: 4, Sectional property of Steel beam

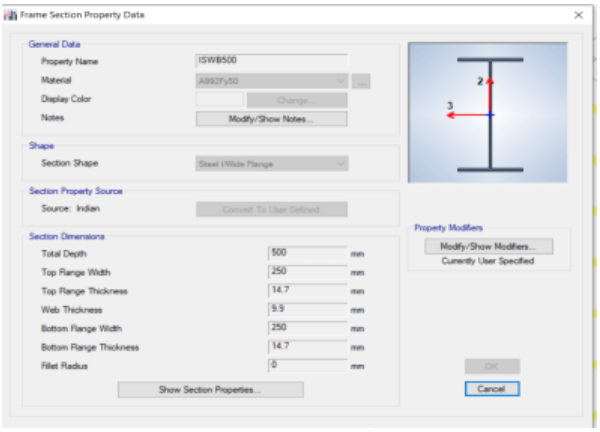

Figure: 5, Sectional property of Steel Column

TABLE 1 Structural Member Details

PARTICULARS	RCC	STEEL
NO OF STORY	G+6	G+6
TOTALSTORYHEIGHT	21m	21m
BEAM SIZE	300X450mm	ISHB450
COLUMN SIZE	300x550mm	ISWB500
SLAB/DECK	150mm	150mm

Figure: 6, Plan of RCC Structure

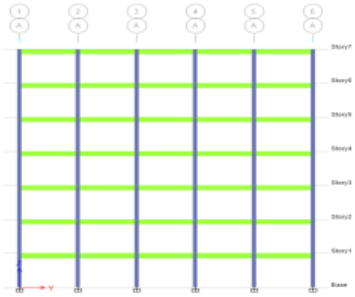

Figure: 7, Elevation of RCC Structure

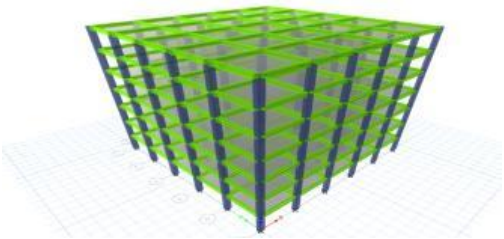

Figure: 8, 3D view of rcc structure

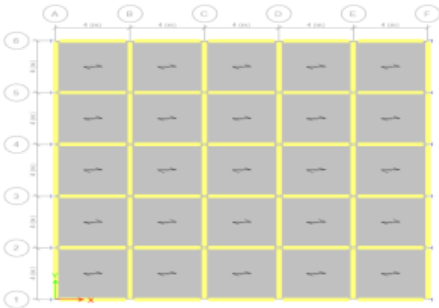

Figure: 9, Plan of Steel Structure

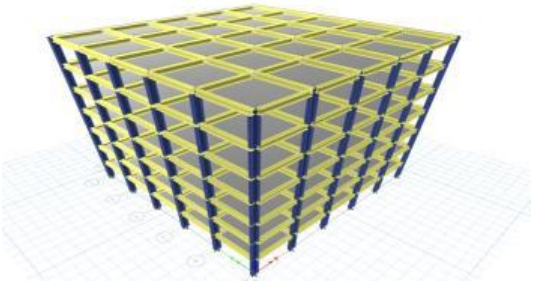

Figure:10, 3D view of Steel structure

VI. METHODOLOGY

The present comparative study deals with equivalent static method for seismic analysis of G+6 frame structure for both RCC and Steel building. The analysis of both the building models is run in software ETABS2016. For the analysis the parameters like Story Stiffness, Time Period, Frequency, Base Shear, Lateral forces and Seismic weight are studied significantly for the loading. Then to prove that steel structure is safe, then to introduce container into it. Seismic code 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. Finally to prove that steel buildings are safe in seismic prone zones.

VI. RESULT

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 1.087 sec & 1.011 sec respectively.

Modal Periods and Frequencies

1 of 12 | Reload | Apply

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency	Eigenvalue rad²/sec²
Modal	1	1.087	0.92	5.7801	33.4093
Modal	2	0.868	1.152	7.24	52.4182
Modal	3	0.839	1.192	7.4918	56.1267
Modal	4	0.358	2.793	17.5483	307.944
Modal	5	0.281	3.558	22.3531	499.6613
Modal	6	0.268	3.737	23.4829	551.4459
Modal	7	0.21	4.759	29.9008	894.0605
Modal	8	0.16	6.231	39.1477	1532.546
Modal	9	0.149	6.719	42.2187	1782.4204
Modal	10	0.148	6.756	42.4518	1802.1548
Modal	11	0.115	8.698	54.6517	2986.8117
Modal	12	0.109	9.182	57.6894	3328.0685

Figure: 11, Time period from validation of RCC Structure

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency	Eigenvalue rad²/sec²
Modal	1	1.011	0.989	6.2118	38.5869
Modal	2	0.54	1.852	11.6349	135.3701
Modal	3	0.487	2.054	12.9029	166.4857
Modal	4	0.339	2.948	18.5198	342.9827
Modal	5	0.205	4.868	30.5885	935.6566
Modal	6	0.175	5.708	35.8637	1286.2032
Modal	7	0.156	6.416	40.3106	1624.9419
Modal	8	0.151	6.625	41.6231	1732.4853
Modal	9	0.123	8.149	51.2041	2621.8567
Modal	10	0.107	9.339	58.6776	3443.0635
Modal	11	0.1	9.974	62.6664	3927.0822
Modal	12	0.099	10.101	63.4641	4027.6903

Figure: 12, Time period from validation of Steel Structure

b. From the obtained result Base Shear for RCC frame structure is on higher side as it has more seismic weight.

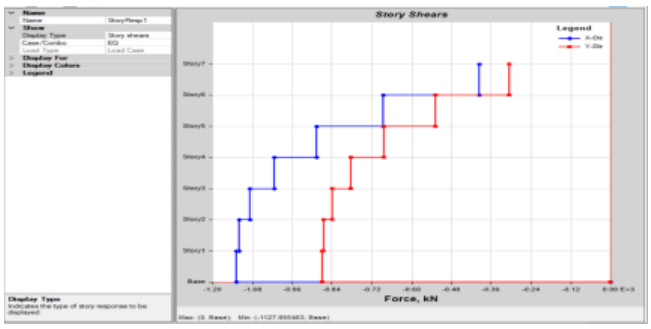

Figure: 13, Base shear from validation of RCC Structure

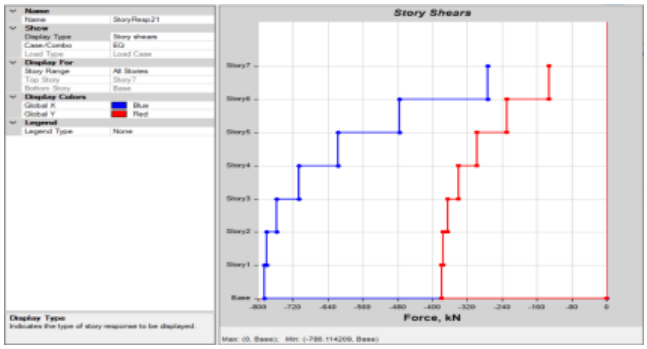

Figure: 14, Base shear from validation of Steel Structure

c. 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.

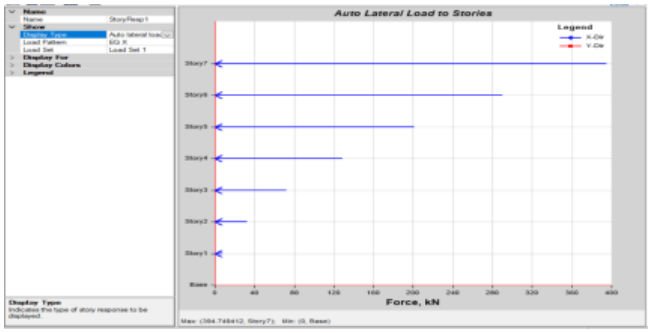

Figure: 15, Lateral force effect from validation of RCC Structure

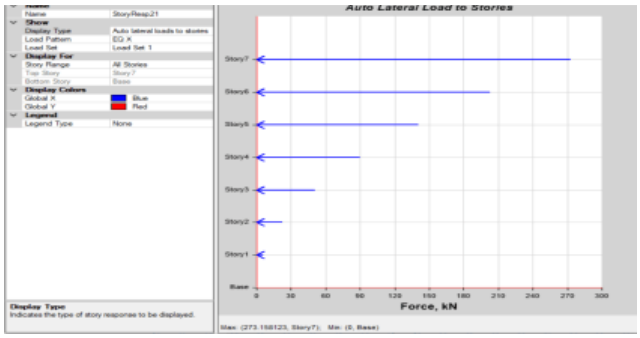

Figure: 16, Lateral force effect from validation of Steel Structure

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

Table 2 shows the result comparison between RCC and Steel Structures respectively.

RCC				STEEL			
PARAMETERS	JOURNAL	ETABS	% error	PARAMETERS	JOURNAL	ETABS	% error
TIME PERIOD	1.04	1.087	4.5	TIME PERIOD	0.943	1.01	7
BASE SHEAR	1210	1127.85	6.8	BASE SHEAR	820	786	4.15
LATERAL FORCE	370	394.7	6.7	LATERAL FORCE	260	273.15	5.1

VIII. 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.
3. The Base shear found in RCC framed structure is more as compared to Steel frame structure.
4. Seismic weight of RCC frame structure is more than Steel Frame structure because of its greater dense cross-section of structural member.
5. From the study it is concluded that Steel's strength and ductility combined with the solid engineering and design, make it a safe choice in seismic zone for greater performance of structure

IX. REFERENCES

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