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"A COMPARATIVE STUDY & ANALYSIS OF SEISMIC BEHAVIOUR OF COMPOSITE AND RCC STUCTURE USING E-TABS"

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Abstract -

R.C.C and composite structures are popular these days. As a result alternative structural systems are gradually developing in India to compete with RCC structural systems. The majority of the structures are RCC. In India, RCC structures are currently dominant, with steel structures gradually making their way into multistory building structures. As a result, a comparative analysis is required to determine the most effective structure.

Key Words: RCC STRUCTURE & COMPOSITE STRUCTURE SYSTEM,AXIAL LOAD, BASE REACTION & COST ANALYSIS.

1. INTRODUCTION

In Indian construction industry use of structural steel is less as compare to other developing countries.

Seeing the development in constructing industry, there is a serious need to explore more in the field of construction and accept new improved techniques. Steel concrete composite frames prove to be an efficient and durable approach to solve the problems faced in high rise buildings

1.1). Reinforced Concrete

Concrete has excellent fire resistance properties, requiring no additional construction costs to adhere to the International Building Code (IBC) fire protection standards. However, concrete buildings will still likely use other materials that are not fire resistant.

Reinforced concrete, when constructed properly, has excellent corrosion resistance properties. Concrete is not only resistant to water, but needs it to cure and develop its strength over time.

1.2). Combining steel and reinforced concrete

Steel and concrete materials may have different properties and characteristics; they both seem to complement each other in many ways. Steel has excellent resistance to tensile loading but lesser weight ratio so thin sections are used which may be prone to buckling phenomenon. On the other hand, concrete is good in resistance to compressive force. Steel may be used to induce ductility an important criterion for tall building, while corrosion protection and thermal insulation can be done by concrete. Similarly buckling of steel can also be restrained by concrete. In order, to derive the optimum benefits from both materials composite construction is widely preferred.

2. METHODOLOGY

RCC structural systems have been formed. Again following same plan, composite structural systems have been formed. Then structural modeling and analysis have been performed by ETABS 2019 software for the selected two types of structural systems. Loads are assigned as per required for residential building. Load combinations are generated regarding. Comparisons of seismic structural behaviors have been prepared to evaluate better most effective structural system for the building used for this research.

DATA FOR ANALYSIS OF RCC AND COMPOSITE STRUCRTURE

1.	Plan Dimension	= 24Mx24M
2.	Story Height	= 3.5M
3.	Height of Structure	= 42M
4.	Depth of foundation	= -10.5M
5.	Seismic zone	= 4
6.	Zone factor	= 0.24
7.	Soil type	= hard soil
8.	Important factor	= 1
9.	Damping ratio	=0.05 or 5%
10.	Grade of concrete	= M30
11.	Grade of steel	= Fe-500

Design Loads

Both gravity loads (dead load and live load) and lateral load (earthquake load) are considered to analyze the selected building for the both types of structural systems. Design loads are considered and calculated.

Gravity loads

Live load and dead load are gravity loads considered for the design of the building for the intended design.

Design Live Loads

Live load considered to perform design work is given in Table 3.1. Live loads are considered as per EBCS.

Table 3.1 - Load

Function	Load (KN/m²)
Live load	2
Floor finish load	1.5
Brick bed Coba load	3

Dead Load Calculations

Self-weight of structure is considered by ETABS 2019 software. Finishing material Block work and supper dead are calculated and assigned in the software.

Lateral Load Calculation

Wind load is not considered in the analysis. Seismic load is calculated following IS-1893 (PART1) 2016 for the design of selected both types of structure.

3. RESULT AND DISCUSSION

3.1) Axial Load

Axial load is the vertical load from the structure transferred to the foundation. Comparison of maximum load is shown below.

Table 4.7 - Maximum axial load

Type of structure	FY(KN)
Composite	131269.15
RCC	170676.8

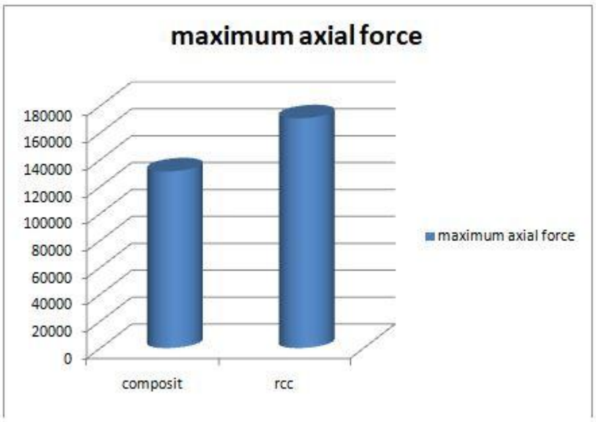

Fig. 3.1. Comparison of maximum axial load

3.2) Base reaction

Table 4-6 Base reaction

Direction	composite	RCC
rsp_x	563.59	6011.11
rsp_y	559.685	11117.06

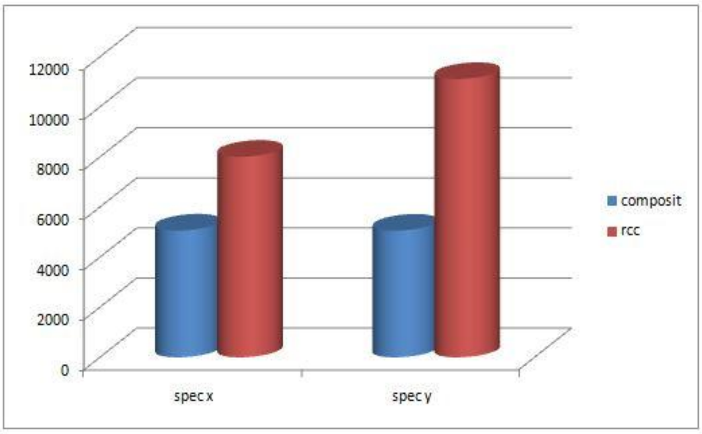

Fig. 3.2 Comparison of Base reaction due to rspx and rspy

3.3) Mode shape:

Mode shapes describe the configuration into which a structure will naturally displace. Lateral displacement patterns are of primary concern. Mode shapes of low-order expression Tend to provide the greatest contribution to structural response. As the order increase, mode shapes contribute less and less. It is reasonable to truncate analysis when the numberof mode shapes is sufficient. In the analysis we used twenty modes. The mass participation ratio for the selected 20 mode of structure is more than 90% for all three types of structures so 20 modes selected are enough. Here below the mass participation ratio of the three structures are discussed.

Composite Structure

The mass participation ratio shows the modes selected are more than enough. More than 95% of the mass of the composite structure is participated in the dynamic analysis in both directions. The table below shows the sum of mass participation ratio of composite structure in the X and Y direction.

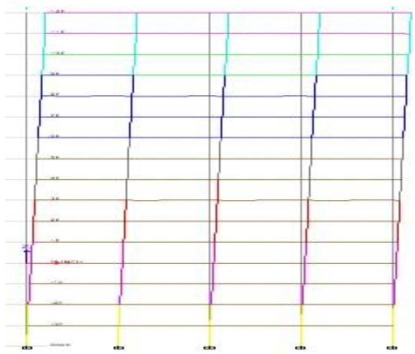

Fig.3.3 – RCC Structure Mode Shape 1 on axis 3

COMPOSIT								
Case	Mode	Period(sec)	UX	UY	UZ	SumUX	SumUY	SumUZ
Modal	1	3.35	0.0001	0.5585	0	0.0001	0.7085	0
Modal	2	3.292	0.4031	0.0001	0	0.4032	0.7086	0
Modal	3	2.976	0.2605	0.055	0	0.6637	0.7636	0
Modal	4	1.361	0.0058	0.07	0	0.6695	0.8336	0
Modal	5	1.318	0.0215	0.005	0	0.6910	0.8386	0
Modal	6	1.216	0.0595	0.0562	0	0.7505	0.8948	0
Modal	7	0.803	0.0663	0.0486	0	0.8168	0.9434	0
Modal	8	0.78	0.0458	1.28E-05	0	0.8626	0.9434	0
Modal	9	0.722	0.0001	0.0002	0	0.8627	0.9436	0
Modal	10	0.551	5.60E-07	0.0175	0	0.8627	0.9611	0
Modal	11	0.539	0.0236	1.08E-06	0	0.8863	0.9611	0
Modal	12	0.499	6.10E-06	0.0002	0	0.8863	0.9613	0
Modal	13	0.427	0.0003	0.0015	0	0.8866	0.9628	0
Modal	14	0.417	0.0112	0.0005	0	0.8978	0.9633	0
Modal	15	0.385	2.88E-06	5.66E-06	0	0.8978	0.9633	0
Modal	16	0.341	7.87E-07	0.0142	0	0.8978	0.9775	0
Modal	17	0.335	0.0124	1.28E-06	0	0.9102	0.9775	0
Modal	18	0.31	9.15E-06	4.26E-05	0	0.9102	0.9776	0
Modal	19	0.28	0.0004	0.0059	0	0.9106	0.9835	0
Modal	20	0.274	0.0051	0.0004	0	0.9157	0.9839	0
Modal	21	0.254	0.0004	2.33E-05	0	0.9161	0.9839	0

RC Structure

More than 95% of the mass of the RC structure is participated in the dynamic analysis in both directions. The table below shows the sum of mass participation ratio of RC structurein the X and Y direction.

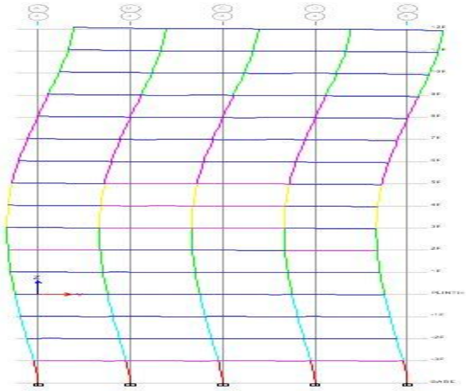

Fig.3.4 – RCC Structure Mode Shape 1 on axis 3

RCC								
Case	Mode	Period	UX	UY	UZ	SumUX	SumUY	SumUZ
Modal	1	3.173	0.0635	0.5601	0.0000	0.0635	0.5601	0
Modal	2	2.103	0.3905	0.1845	0.0000	0.4540	0.7446	0
Modal	3	1.757	0.2614	0.0441	0.0000	0.7154	0.7887	0
Modal	4	1.067	0.0083	0.0730	0.0000	0.7237	0.8617	0
Modal	5	0.596	0.0222	0.0001	0.0000	0.7459	0.8618	0
Modal	6	0.582	0.0637	0.0580	0.0000	0.8096	0.9198	0
Modal	7	0.451	0.0639	0.0143	0.0000	0.8735	0.9341	0
Modal	8	0.399	0.0003	0.0042	0.0000	0.8738	0.9383	0
Modal	9	0.288	0.0001	0.0015	0.0000	0.8739	0.9398	0
Modal	10	0.273	0.0371	0.0193	0.0000	0.9110	0.9591	0
Modal	11	0.221	0.0000	0.0010	0.0000	0.9110	0.9601	0
Modal	12	0.2	0.0293	0.0050	0.0000	0.9403	0.9651	0
Modal	13	0.177	0.0001	0.0006	0.0000	0.9404	0.9657	0
Modal	14	0.163	0.0164	0.0098	0.0000	0.9568	0.9755	0
Modal	15	0.145	0.0000	0.0004	0.0000	0.9569	0.9759	0
Modal	16	0.122	0.0004	0.0003	0.0000	0.9573	0.9762	0
Modal	17	0.12	0.0086	0.0028	0.0000	0.9659	0.9790	0
Modal	18	0.119	0.0030	0.0003	0.0000	0.9689	0.9793	0
Modal	19	0.114	0.0030	0.0025	0.0000	0.9719	0.9818	0
Modal	20	0.109	0.0003	0.0009	0.0000	0.9722	0.9827	0

4. CONCLUSIONS

RCC Structure

- RC Structure for earthquake response in the X-direction base shear shows 1.1% decrease when compared to the composite structure. For earthquake response in the y - direction base shear in RC structure shows 4.8% increase when compared composite structure.
- The maximum axial load for RC structure is 11% higher than that of Composite structure.

Composite Structure

- Composite Structure for earthquake response in the X-direction base shear shows 1.1% increase when compared to the RC. For earthquake response in the y-direction the base shear in composite structure shows 4.8% decrease when compared RC structure.

The maximum axial load for composite structure is 11% lower than RC structure.

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