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Comparative Evaluation Of Reinforced Concrete, Steel And Composite Structures Under The Effect Of Static And Dynamic Loads

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ABSTRACT
Steel-concrete composite construction has gained wide acceptance all over the world as an alternative for pure steel and pure concrete construction. However this approach is a new concept for construction industry. R.C.C are no longer economical because of their increased dead load, hazardous formwork. The present study deals with comparison of reinforced concrete, steel and composite structures under the effect of static and dynamic loads. The results of this work show that composite structures are best suited for high rise buildings compared to that of steel and reinforced concrete structures. Response spectrum method is used for comparison of three structures with the help of ETABS software.
Keywords **-** Bare frame, Base shear, Displacement and Inter-storey drift.

I. INTRODUCTION

In today's modern era and faster growing economy with simultaneously increasing human population the need of shelter with higher land cost in major cities where further horizontal expansion is not much possible due to space shortage, we are left with the solution of vertical expansion. Steel-concrete composite construction is a faster technology which saves lot of time in construction which will help the planners to meet the demand with minimum time in real estate market. This technology provides more carpet area than any other type of construction. Composite construction also enhances the life expectancy of the structure.

Composite construction has gain wide acceptance because of their many advantages i.e. faster to erect, lighter in weight, better quality control, reduced time of construction, has better ductility and hence superior lateral load resisting behavior.

The present research is an attempt to study the behavior of reinforced concrete, steel and composite structures under the effect of seismic loading. The parameters considered are base shear, displacement and inter-storey drift.

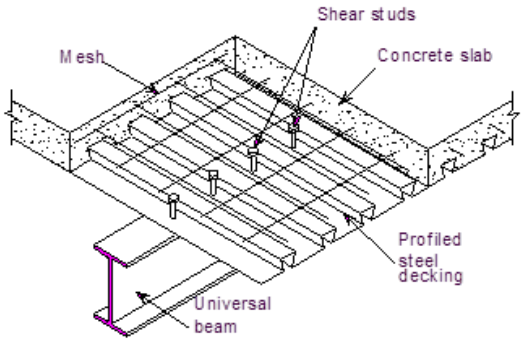

Fig. 1 Typical composite beam slab details


Fig. 2 Composite deck slab

II. MATHEMATICAL FORMULATION

A (G+10) storied structure for R.C, Steel and composite structure is considered and Response spectrum method of analysis is used.

Table-1 Data for analysis

Plan dimension	12mx12m
Height of each storey	3.2m
Slab thickness	150mm
Wall thickness	150mm
Seismic zone	III
Importance factor	1
Dead load	3KN/m^2
Live load	1KN/m^2
Density	25KN/m^3
Grade of concrete	M20
Damping ratio R.C.C STEEL COMPOSITE	 5% 2% 2%

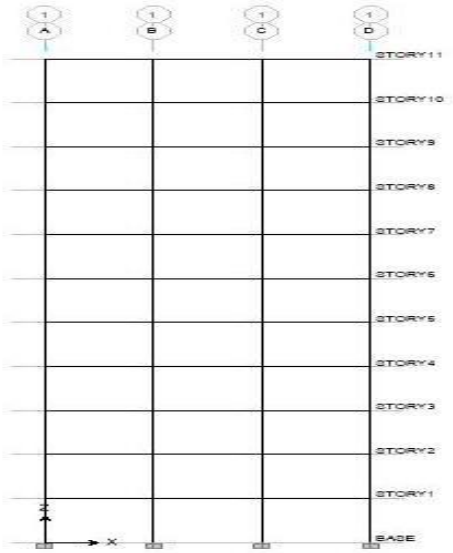

Fig. 3 Elevation of structure

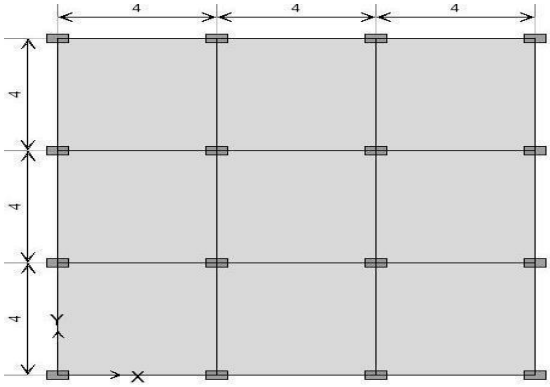

Fig. 4 Plan of structure

Table-2 Variation of base shear

BASE SHEAR (KN)			
STRUCTURE	R.C.C	Steel	Composite
EQX	184.03	129.27	127.61

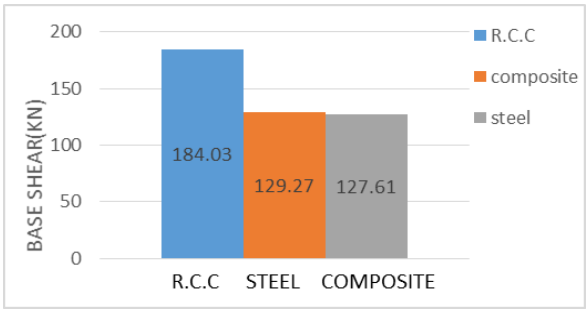

Fig. 5 Graph for base shear

Table-3 Variation of displacement

BARE FRAME			
DISPLACEMENT (mm)			
STOREY NO.	R.C.C	STEEL	COMPOSITE
11	10.2106	20.2977	19.8489
10	9.8655	19.6733	19.2432
9	9.3113	18.6247	18.2193
8	8.5583	17.1028	16.726
7	7.711	15.1258	14.7764
6	6.7384	12.8979	12.6862
5	5.6383	10.5184	10.3636
4	4.4083	7.9711	7.86
3	3.1417	5.3604	5.2879
2	1.8564	2.9405	2.9014
1	0.6627	0.9423	0.9299

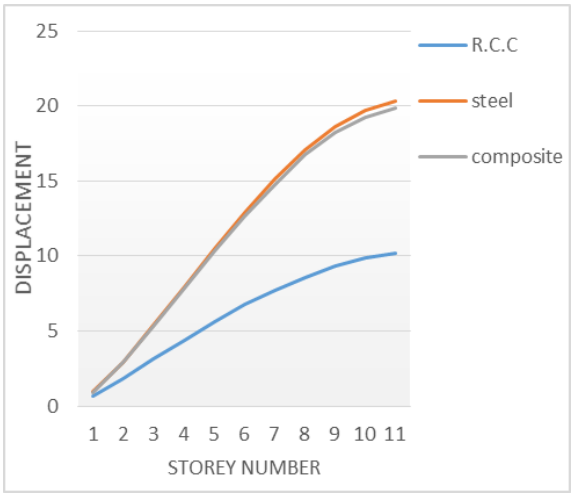

Fig.6 Graph for Displacement v/s storey number

Table-4 Variation of Drift

BARE FRAME			
DRIFT (mm)			
STOREY NO.	R.C.C	STEEL	COMPO
11	0.3451	0.6244	0.6057
10	0.5542	1.0486	1.0239
9	0.753	1.5219	1.4933
8	0.8473	1.977	1.9496
7	0.9726	2.2279	2.0902
6	1.1001	2.3795	2.3226
5	1.23	2.5473	2.5036
4	1.2666	2.6107	2.5721
3	1.2853	2.4199	2.3865
2	1.1937	1.9982	1.9715
1	0.6627	0.9423	0.9299

Table-5 Variation of column forces

Column forces			
Column	R.C.C	Steel	Composite
corner column	1555.12	707.29	679.33
Side column	2134.44	1123.58	1086.44
Inner column	2758.19	1563.15	1491.54

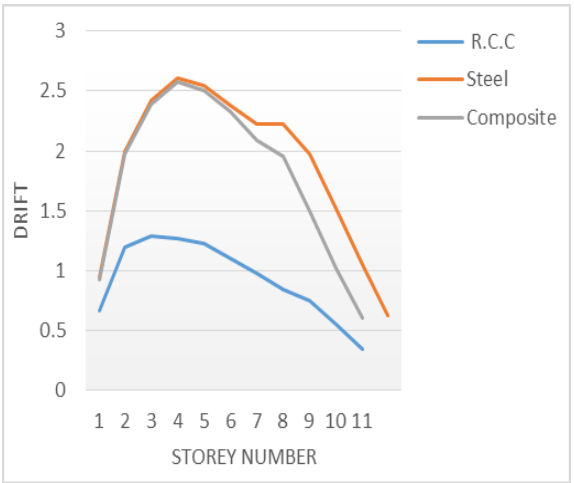

Fig. 7 Graph for Drift v/s storey number

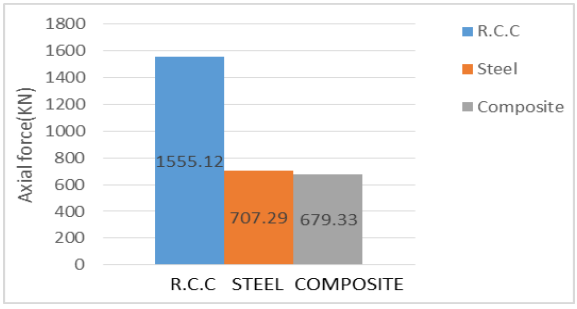

Fig. 8 Graph for Column forces

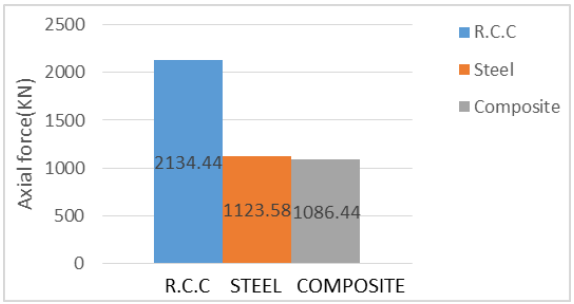

Fig. 9 Graph for Column forces

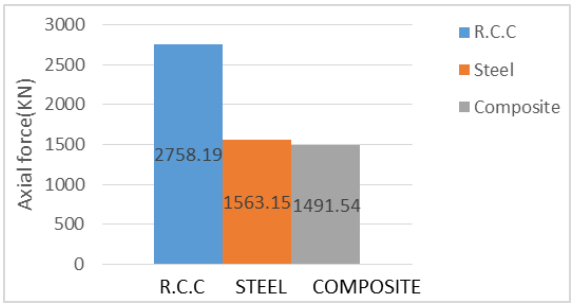

Fig. 10 Graph for Column forces

Table-6 Variation of Beam Moments

Beam moments(KN-m)			
Moment	R.C.C	Steel	Composite
support	44.01	25.31	15.02
Center	27.61	15.94	6.97

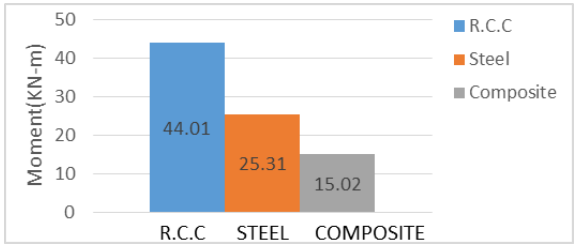

Fig. 11 Graph for Beam Moments

III. CONCLUSION

1. Base shear for composite structure has reduced by 31% and for steel structure by 29% compared to that of Reinforced concrete structure.
2. Displacement for composite structure has increased by 48% and for steel structure by 49% compared to that of Reinforced concrete structure.
3. Storey drift for steel structure is more compared to R.C.C and composite structure.
4. Drift of all structures is within permissible limit.
5. Column forces in steel structure have reduced by 48% and in composite structure by 50% compared to that of R.C.C structure
6. Beam moments in composite structures have reduced considerably compared to that of R.C and steel structures.
7. As column forces have reduced sizes of footings also reduces compared to that of R.C structure.
8. Composite structures are more economical compared to that of R.C structures.
9. Also time required for construction of composite structures is less compared to that of R.C structures as no formwork is required.

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