ANALYSIS OF MULTISTORIED RCC AND COMPOSITE STRUCTURES SUBJECTED TO STATIC AND DYNAMIC LOADINGS

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Abstract -Composite structures are known for two load carrying structural members that is integrally connected and deflected as a single unit. As we increase the height of the building, the risk of wind and earthquake pressure increases. Thus, a structure is more complex without using lateral load resisting systems. In the present study, typical 30 storied building composing of RCC sections and composite sections are considered along with lateral load resisting systems for both type. ETABS is used for analysis for the seismic zone V. Equivalent Static Method of Analysis and Response Spectrum Analysis Method are carried out and comparison is drawn for both RCC and composite structures based on parameters such as displacement, drift and base shear. majorly 8 different types of models are considered. The results show that the shear wall structure reduces the displacement greatly than bracing system. It is found that the difference in the percentage of displacement is around 20% to 25%. The overall analysis briefs that the composite structures are better compared to RC structure due to its reduction in displacement and increase in its stiffness.

Key Words: composite construction, concrete encased steel, core wall, bracing system, shear wall, coupling beams.

1.INTRODUCTION

The strength and safety of regular buildings are the most important thing and must be given and carefully need to be designed by the structural consultant. At present with high land cost in all major cities where the further more horizontal expansion is not that much possible due to shortage of space, we are left with viable vertical expansion.

Steel and concrete composite construction proves to be a faster technology which will save time in the construction and being economical, enhancing the total life and expect of the entire structure. This technique provides the more carpet area than all other types of construction.

CONSTRUCTION AND COMPOSITE STRUCTURES

The main reason why the composite construction is now considered is so good that can be told in simpler way. Concrete is very good in compression and the steel is very good in tension. Combining these two materials will enhance its strength, which can even be exploited in order to create an efficient and lightweight designs, Where the steel component like I-sections is combined with concrete, there will be transfer of the forces and all the moments occur between them then the composite member will be formed. The main structural components in composite construction will consists of following elements,

1.Composite columns
2.Composite beams
3.Composite slabs
4.Shear connectors

Various forms of structural systems

There are various forms of structural systems based on adoptability and feasibility. The lateral resisting systems incorporated in this studies are;

1.Core wall system
2.Bracing system
3.Coupling beams

OBJECTIVES

- To assess the method of modelling, analysis of High-rise building
- The behaviour of tall building with the inclusion of different lateral load resisting systems such as Core wall system, Bracing's system, coupling beam system.
- Analysis is then conducted for both the static and dynamic loadings
- The study is concluded based on parameters such as displacement, drift and base shear.

2.MODELLING AND ANALYSIS

Structure		Composite Structure.
No. of storey		30 Storey.
Concrete grade		M 50
Steel	Reinforcement	Fe550
	Structural steel (I Section)	Fe490
	First storey	3.6m.
	Upper storey	3.6 m
Type of building usage		Commercial (Assumption)
Foundation Type		Isolated footing, Fixed Support
Seismic zone		Z-5
Assumed Dead Load Intensities		
Floor finishes		1.50 KN/m^2
Live Load Intensities		
Floor		4.0 KN/m^2
Partition Wall Load		1.0 KN/m^2
Wall thickness		300mm
Plan area of wall		5mx5m
Bracing element(X bracing)		ISMB 150
Coupling beams		300X1200mm

Model details:

Model A1 – RC column beam structure.
Model A2 – RC Core wall structural system.
Model A3 – RC building with Bracing system.
Model A4 – RC shear wall structure with coupling beams.
Model B1 – Composite column beam structure.
Model B2 – Composite Core wall system.
Model B3 – Composite building with Bracing system.
Model B4 – Composite shear wall structure with coupling beams.

MODEL MA1 &MB1

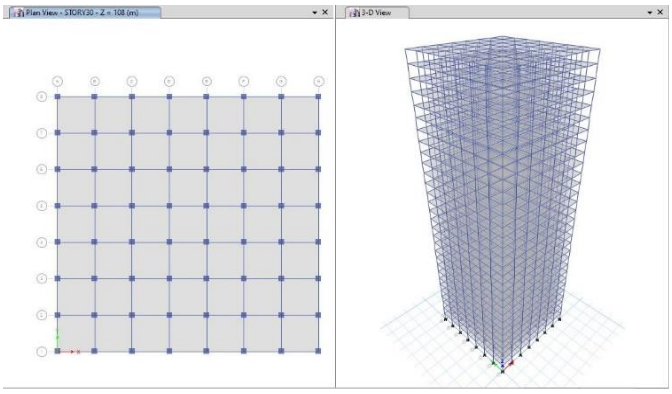

Fig.1 ETABS plan and 3D view of Regular RCC and composite structure

MODEL MA2&MB2

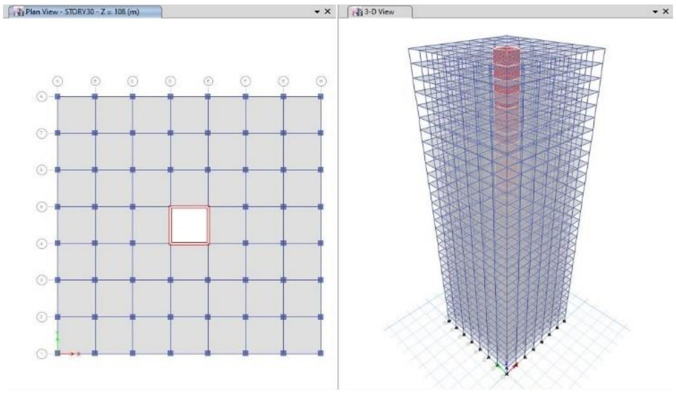

Fig.2 ETABS plan and 3D view of RCC and composite core wall system

MODEL MA3 &MB3

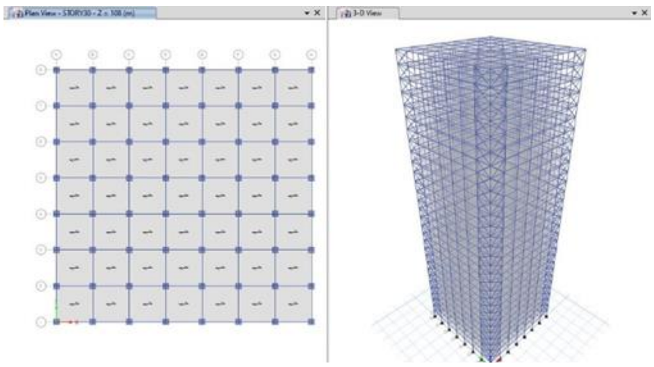

Fig.3 ETABS plan and 3D view of RCC and composite Bracing system

MODEL MA4 &MB4

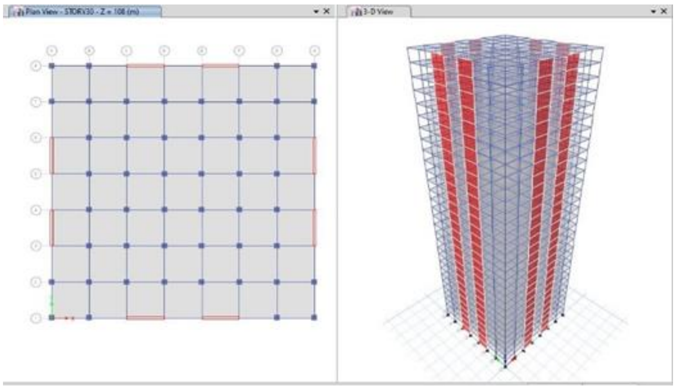

Fig.4 ETABS plan and 3D view of RCC and composite Shear wall structure with Coupling

RESULTS

DISPLACEMENTS (EQUIVALENT STATIC ANALYSIS)

STOREY	MODEL M-A1	MODEL M-A2	MODEL M-A3	MODEL M-A4
30	147	136	141	121
29	145	133	139	119
28	143	131	137	116
27	141	128	135	113

Table 1 Displacement of model MB1 TO MB4

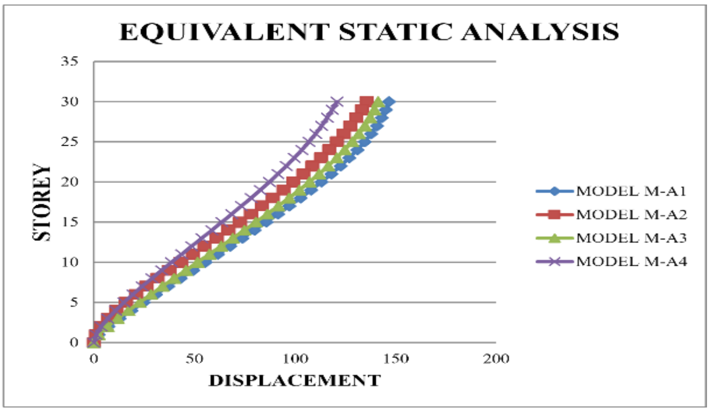

Fig.1.1 Storey v/s Displacement of model MB1 TO MB4

STOREY	MODEL M-B1	MODEL M-B2	MODEL M-B3	MODEL M-B4
30	145	131	136	119
29	144	129	134	117
28	142	126	132	114
27	139	123	130	112

Table 2 Displacement of model MB1 TO MB4

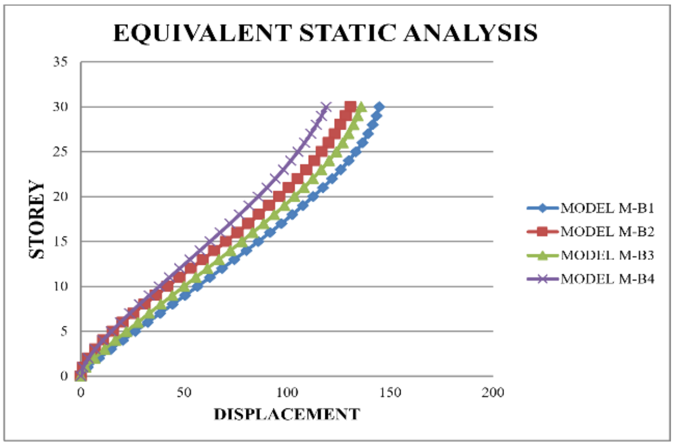

Fig2.1 Storey v/s Displacement of model MB1 TO MB4

DISPLACEMENTS (RESPONSE SPECTRM ANALYSIS)

STOREY	MODEL M - A1	MODEL M - A2	MODEL M - A3	MODEL M - A4
30	113	99	107	89
29	112	97	106	87
28	111	95	105	86
27	109	93	103	84

Table 3 Displacement of model MB1 TO MB4

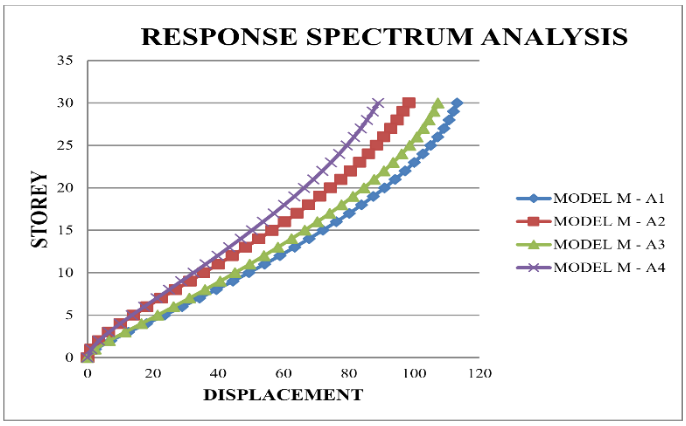

Fig 3.1 Storey v/s Displacement of model MB1

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 09 | September - 2022 Impact Factor: 7.185 ISSN: 2582-3930

STOREY	MODEL M - B1	MODEL M - B2	MODEL M - B3	MODEL M - B4
30	110	95	104	88
29	109	93	103	86
28	108	92	101	84
27	106	90	100	82

Table 4 Displacement of model MB1 TO MB4

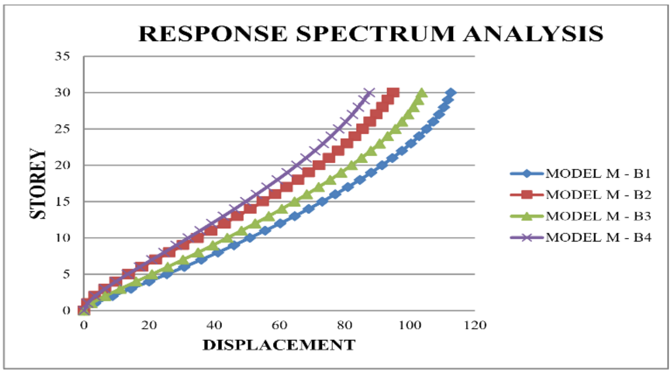

Fig4.1 Storey v/s Displacement of model MB1 TO MB4

The above charts show that models with shear wall with coupling beam system shows lesser displacement compared to other structural system in terms of 18% reduction in equivalent static analysis and 22% reduction in response spectrum analysis. It is also observed that the models with core wall and shear wall with coupling beam i.e., Model M-A2&M-A4 are having maximum displacement than model M-B2 and M-B4 from both equivalent static analysis and response spectrum analysis.

DRIFT

STOREY	MODEL M - A1	MODEL M - A2	MODEL M - A3	MODEL M - A4
30	1	2	1	2
29	1	2	1	2
28	2	2	2	2
27	2	2	2	2

Table 5 Drift of model MA1 TO MA4

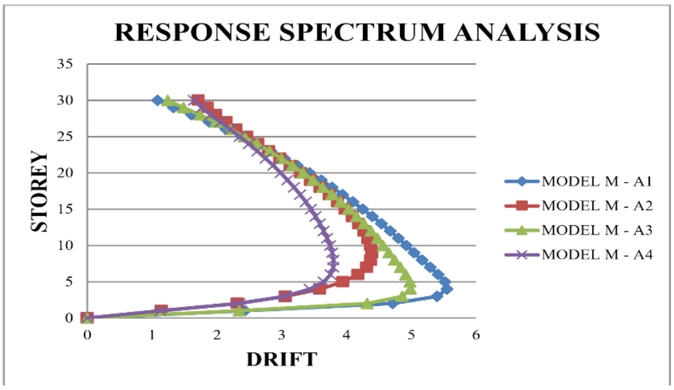

Fig.5.1 Storey v/s Drift of model MA1 TO MA4

The drift values seen from the graphs indicates that the drift is within the allowable limits. It is also seen that the maximum drift values are below the middle height of the structure. However, the values of all models are almost in a similar range.

BASE SHEAR

MODEL	BASE SHEAR
MODEL M-A1	9518
MODEL M-A2	10600
MODEL M-A3	9717
MODEL M-A4	12084

Table 6 Base shear of model MA1 TO MA4

Fig.6.1 Base shear of model MA1 TO MA4

MODEL	BASE SHEAR
MODEL M-B1	9209
MODEL M-B2	10445
MODEL M-B3	9592
MODEL M-B4	12257

Table 7 Base shear of model MB1 TO MB4

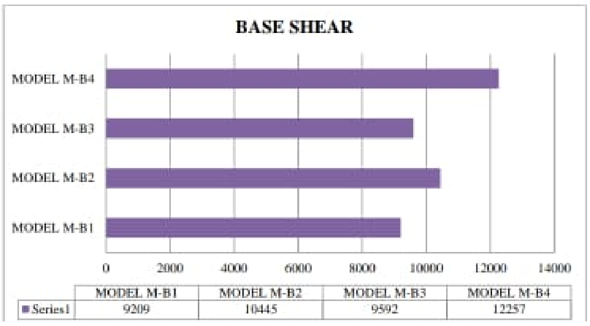

Fig 7.1 Base shear of model MB1 TO MB4

The base shear chart shows that the model M-A4 & Model M-B4 is having highest base shear values. Since, the base shear is depending on the seismic weight of the structure, it is understood that the models type 4 is having maximum weight comparatively in both type of analysis.

3. CONCLUSIONS

- The results extracted from the analysis are tabulated and compared. The conclusions are made based on the comparison of static and dynamic analysis.
- RC buildings are having higher time period than composite structure. Since, RC buildings are more flexible than composite structure.
- From the equivalent static analysis, it is observed that the models type A4 & B4 are having lesser displacement comparatively. It is also found that the shear wall structure reduces the displacement greatly than bracing system.
- The shear wall stiffness is far greater than the stiffness of composite columns & beams. And hence even though changing the columns from RC to composite, no major reduction in the displacement.
- The drift values for static analysis in all models are almost similar and within the allowable limits. i.e., 0.004h = 0.004x4000 = 16. And hence, drift values are not major concern in static analysis.
- The response spectrum analysis values are lesser than the values of static analysis. It is found that the difference in the percentage of displacement is found around 20% to 25%. And hence, response spectrum is to be considered for design.
- The drift values almost similar for Static analysis and response spectrum analysis and hence reliable.
- The base shear values of static and analysis and dynamic analysis will be same. However, the composite models are having lesser base shear than RC structure. It is also observed that the Model type 4 is having comparatively higher base shear than other type of structure.
- The overall analysis briefs that the composite structures are better compared to RC structure due to its reduction in displacement and increase in its stiffness.
- The Coupled shear wall system works better compared to all other structures. However, in case of coupling beams are not preferred due to reason that complex reinforcement details etc., core wall systems can be used as alternatively.

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