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Contrast of Seismic Behavior of R.C.C. and Composite Columns in G+15 Storied Buildings with GFRG Infill

Athira K B
PG scholar,
Department of Civil Engineering ,
Sree Buddha College of Engineering,
Alappuzha/Pathanamthitta cluster of APJ Abdul Kalam Technological University, Ayathil, Elavumthitta P.O, Pathanamthitta-689625

Linda Ann Mathew
Assistant Professor,
Department of Civil Engineering,
Sree Buddha College of Engineering,
Alappuzha/Pathanamthitta cluster of APJ Abdul Kalam Technological University, Ayathil, Elavumthitta P.O, Pathanamthitta-689625

***Abstract* - Composite constructions are extremely accepted and widely used. The composite construction is favourable in resisting seismic forces because of reduced the seismic weight as compared to R.C.C building. The Better properties of steel and concrete combines in the composite building. Hence this study has been carried out to compares seismic evaluation of G+15 storey building of R.C.C column and composite column with and without GFRG infill located in seismic zone V. composite column of two types have been chosen fully and partially concrete encased composite column used for analysis. Column element in the structure is only taken as composite remain part will be made of conventional concrete for all structures. The equivalent single strut model is used for modeling of GFRG infill. The seismic behavior of the study frames is evaluated by Response Spectrum analysis by ETABS software.**

Key Words: Composite columns, Overturning moment, Roof displacement, Seismic behavior, Storey drift etc.

I. INTRODUCTION

Most of the buildings are low rise in India. Due to rapid urbanization population increases, due to limited land in urban areas low rise building needs more spaces for construction so we use high rise building. Composite column constructions can be used for better and economical building for high rise structure. Composite construction of all structural elements takes more difficulty in design so here considered only column as composite element. Conventional concrete construction widely used due to its simple design and longevity. Because of huge dead load RCC structure are uneconomical.

Glass Fiber Reinforced Gypsum infill (GFRG) panels are used increase the stiffness and strength of composite frame. These panels can also be used as structural member by cavities of panels partially filled or fully filled with reinforced concrete. To provide high rigidity modeling of infill panels by single diagonal strut method. this paper is to study the Seismic Analysis of Steel Concrete Composite System with RCC Structures with GFRG infill.

II. OBJECTIVES

- To study performance of structure with R.C.C column, composite column with fully and partially concrete encased steel sections.
- To determine the effective structure by comparing composite building with column fully and partially concrete encased steel sections

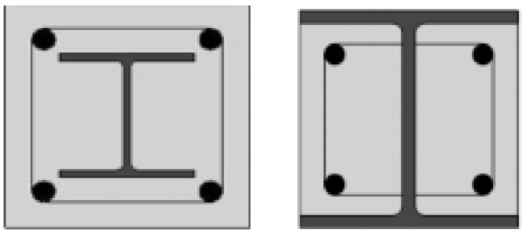

Fig.1 Column fully and partially concrete encased steel sections

III. GFRG PANEL

Glass fiber reinforced gypsum, abbreviated as GFRG is the name given to a new building panel product, made of gypsum plaster, reinforced with glass fibers. GFRG is of particular relevance to India, where there is a tremendous need for cost-effective mass-scale affordable housing, and where gypsum is abundantly available as an industrial by-product waste. The product is not only eco-friendly or green, but also resistant to water and fire. GFRG panels are presently manufactured to a thickness of 124 mm, a length of 12m and a height of 3m. Although its main application is in the construction of walls, it can also be used in floor and roof slabs in combination with reinforced concrete.

Fig.2 GFRG Panel

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IV. METHODOLOGY

Methodology employed is response spectrum method of analysis.

A. Modelling of Building

Here the study is carried out for the behaviour of G+15, with R.C.C column and composite column with fully and partially concrete encased steel sections. Floor height provided as 3m. Three models including G+15 with GFRG infill are created. Properties are different for different models. The modeling of buildings was created in ETABS software.

B. Building Plan and Dimensions

A building of plan 20m x 20 m(i.e. 400m^2) is considered with G+15 storey in zone V. A medium soil stratum is considered at the location.

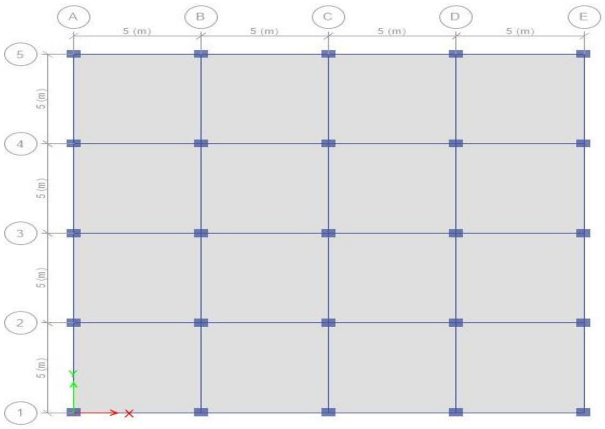

Fig.3 plan of building

Table 1
Details and dimension of the building models

Plan dimension	20 × 20 m
Height of each floor	3 m
Type of structure	Ordinary Moment Resisting Frame
Grade of steel	Fe 415
Grade of concrete	M_{30}
Density of R.C.C	25kN/m^3
Dimension of R.C.C column	450 × 550 mm
Dimension of R.C.C beam	350 × 450 mm
Column size for fully concrete encased steel sections	400 mm × 400 mm, ISHB 300
Column size for partially concrete encased steel sections	400 mm × 250 mm, ISHB 400

Table 2
Properties of GFRG Panel

Unit weight of GFRG panel	0.433 kN/m^2
Thermal expansion coefficient	12 × 10^{-6}mm/mm/℃
Modulus of Elasticity	7500 MPa

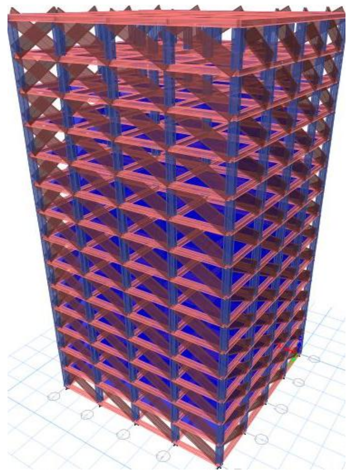

Fig.4 3D view of R.C.C building

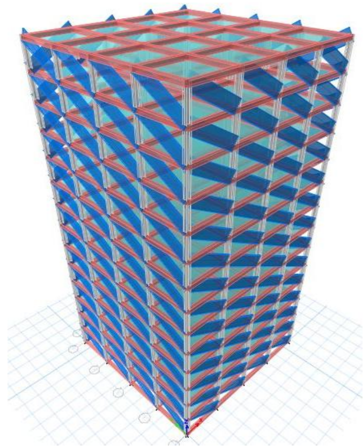

Fig.5 3D view of composite building with fully concrete encased columns

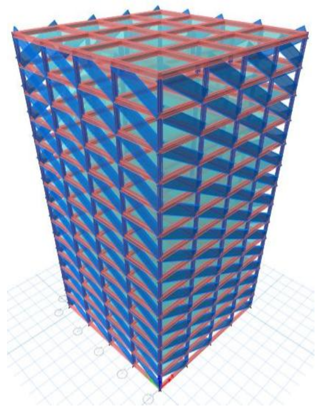

Fig.6 3D view of composite building with partially concrete encased columns

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V. COMPARISON OF RESULTS

After analysing the results obtained then it will be compared and find the seismic performance of the building with infill.

The building models and their abbreviations are given below:
A) R.C.C - M1
B) Composite Fully Encases Steel Section - M2
C) Composite Partially Encases Steel Section - M3

A. Base Shear

Table 3
Maximum Base Shear

R.C.C (M1)	COMPOSITE FULLY ENCASES STEEL SECTION (M2)	COMPOSITE PARTIALLY ENCASES STEEL SECTION (M3)
7389.79	6638.73	6261.51

For composite fully and partially encases steel section, the base shear is reduced up to 10 % when compared to that of R.C.C.

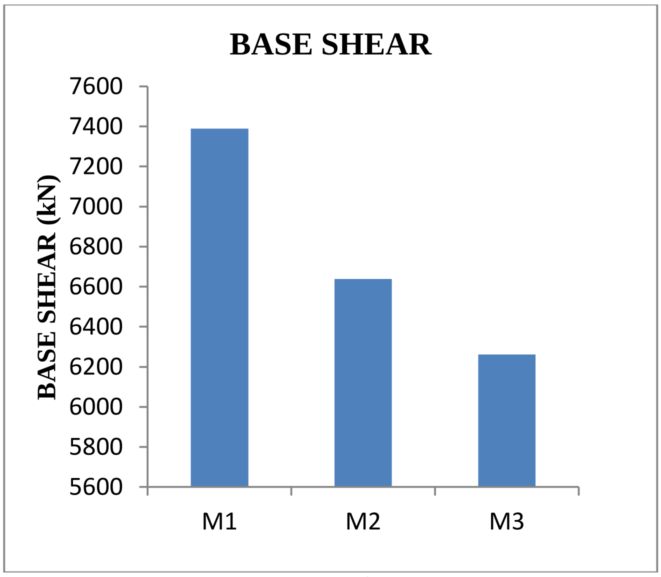

Fig.7 Comparison of Base Shear

A. Displacement

Table 4
Maximum Lateral displacements

R.C.C (M1)	COMPOSITE FULLY ENCASES STEEL SECTION (M2)	COMPOSITE PARTIALLY ENCASES STEEL SECTION (M3)
36.99	37.11	39.59

For composite fully encases steel section and R.C.C the Lateral displacements is nearly same. partially encases steel section lateral displacement is increased up to 6% compared with composite fully encases steel section.

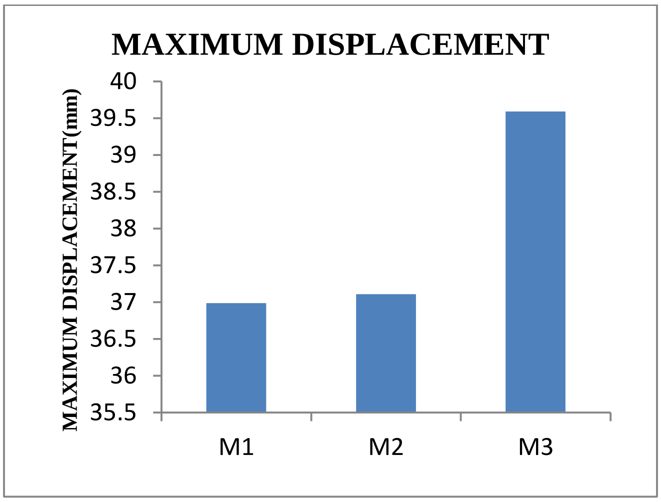

Fig.8 Comparison of Maximum Lateral Displacements.

A. Storey Drift

Table 5
Maximum Storey Drift

R.C.C (M1)	COMPOSITE FULLY ENCASES STEEL SECTION (M2)	COMPOSITE PARTIALY ENCASES STEEL SECTION (M3)
0.001513	0.00322	0.00534

For R.C.C, the minimum storey drift. And for fully and partially composite encases steel section, is within the limit and less than with infill model. Partially encases steel section lateral displacement is increased up to 40% compared with composite fully encases steel section

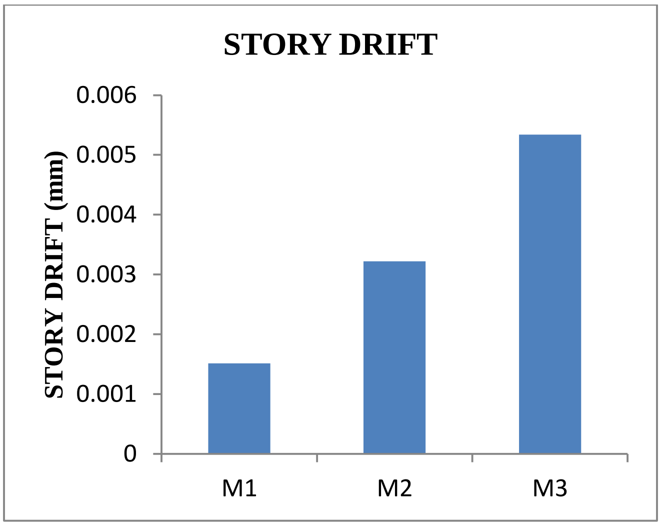

Fig.9 Comparison of Maximum Storey Drift

A. *Stiffness*

Table 6
Stiffness

R.C.C (M1)	COMPOSITE FULLY ENCASES STEEL SECTION (M2)	COMPOSITE PARTIALY ENCASES STEEL SECTION (M3)
16477958	7026036	6883996

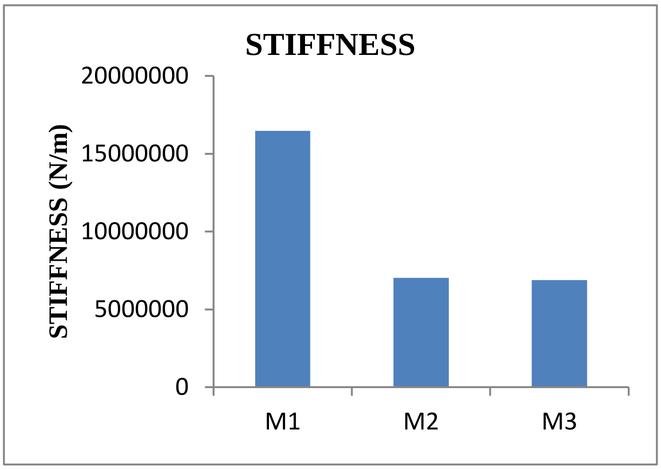

Fig.10 Comparison of Stiffness

From Fig. 10 it is clear that storey stiffness is higher in R.C.C building with infill. The two composite buildings are same stiffness.

VI. CONCLUSIONS

Analytical study has been conducted to understand the behavior of R.C.C and concrete encased columns in a structure. ETABS software is used to carry out the analysis. Comparison of conventional and composite design has done. And the following conclusion has been drawn from it.

- It is observed that the base shear is about 10% to 15% difference in both composite columns structure when compared to the structure with RC columns. Hence, conventional building can be considered superior than the composite building in terms of base shear.
- Storey drifts are higher that is 40% in the case of composite building. And drift for all building is within the limits as per IS code.
- The storey drift is maximum at second floor which may cause more damage to the floors above it, particularly in case of composite structure. But in conventional building, not much drift are observed in between successive floors, which makes it relatively safe.
- Comparing composite building with column fully and partially concrete encased steel sections, fully concrete encased steel sections column has better performance.

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