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Comparison of Behavior of multi-storey building with RCC Column and Composite Column

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Abstract - Behavior of any building during the earthquake depends on its geometry, shape and size. The buildings which are having Regular Shapes buildings which are gave better performance in all aspects. The buildings having Irregular Shapes like 'U', 'V', 'H', '**+**' shapes etc. has experienced more damages compared to the building having Regular plan configuration. The Indian Standard code IS 1893 (Part 1): 2016 defines various structural irregularities. The code suggests a different approach of analysis for asymmetric structures.

The main objective of the study is to carry out the performance- based analysis to obtain performance levels of Regular and Irregular buildings for RCC Column and Composite Column with Same size in Regular Buildings and with reduction in Size of Composite Column compare to RCC Column in Irregular Buildings. I this study we can determined that how better or poor performance given by the Composite Column as Compare to RCC Column.

The various parameters Storey Displacements, Storey Drifts, Storey Stiffness and Storey Shears models are considered for comparison.

***Key Words*: Composite Column, Storey Displacements, Storey Drifts etc...**

1. INTRODUCTION

A column is a general term and it means a structural member that is subjected to axial loads, bending moments and shear forces and is a vital part of any structure and supports it. If this column made from Concrete and Reinforcement Bars that it's called RCC column, If this column is made of steel entirely, not just reinforced with steel bars then it is called Steel column.

But the Composite column is the combination of two traditional structural form of steel column and RCC column. It is developed by uses a combination of structural steel pipe, shape or tube, with or without Reinforcing Bars and Reinforced concrete to resists all types of Load and Moment

Types of Column system:

1 RCC Column
2 Composite Column [Steel Incased Column]
3 Composite Column [Concrete filled Steel Tube]

2. LITRETURE REVIEW

Dr. D.R. Panchal, M.F Hasanain studied that the comparison of seismic behaviour of multi-Storey Building with RCC and Composite Column in this study the design of multi-storey building is done by structure designing software like ETABS, SAP2000, and SAFE and derive the most suitable types of Column at the suitable place according to its cost and safety

Priya Darshni Patil & Pallavi Pasnur analyzed the Concrete filled steel tube members are ideally suited for all applications because of their effective usage of construction Materials. Application of CFST concept can lead to aesthetics view and reduced the Rebar steel compare to RCC column. Application of CFST concept can lead to 60% total saving of steel in comparison to a structural steel system concrete core enhances higher compressive strength, stiffness, damping and tensile strength by outer steel tube.

Syed Fahd Ali, S.A Bhalchandra A steel concrete composite column is a compression member, comprising either of a concrete encased hot rolled steel section or a concrete filled hollow section of hot rolled steel. At present there is no Indian standard code covering the design of composite column. The method of design in this report largely follows EC4, which incorporates latest research on composite construction. Indian standard for composite construction IS 11384-1985 does not make any specific reference to composite columns. This method also adopts the European bucking curves for steel columns as a basic of column design.

3. METHODOLOGY

The methodology of this study is in terms of comparison basis of various type of Column like RCC Column, Composite Column [SIC] and Composite Column [CFST] with Structural Building G+7, G+15, G+25, G+35, G+45 with Regular and Irregular Shape of Building. The study is intended to choose type of Column as per Indian standards and Euro codes. In this Study we analyze the Maximum Differences from various Load Combination like 1.5(DL+LL), Dead, EQX, EQY etc... In Parameters like Storey Displacements, Storey Drifts, Storey Stiffness, Storey Shears. The Study of this projects lead us to the results where we supposed to Use the composite Column or RCC Column. In Regular Shape building we analyze that how much we reduce the size of Columns by

replacing the RCC Column with Composite Column. In Irregular Shape building we analyze that how much we reduce the Storey Displacements and Storey Drifts etc... By using same size of RCC Column and Composite Column.

3.1 Analysis of structural system

ETABS software is used for the analysis of the proposed structural model. The models are analyzed by Static analysis method for zone III and Soil type II (medium or stiff soil). Considering the method of analysis used for the model the lateral load calculation is made by the software itself and then this calculation are applied to carry out analysis of these models. In the present study the structure is subjected to lateral loads and analysis is carried out by using the Response spectrum method of the structure.

4. MODELING

The Multi-story building is taken and designed and analysis is done for both Dead Load, Live Load and lateral (earth quake) loads. The models are analyzed by Static analysis method for zone III. As categorized by Indian Standard Code 1893:2016 for earthquake resistant structures. In the present study the structure is subjected to lateral loads and analysis is carried out by using the Static Analysis Method.

TYPE – 1: G+7 Regular Shape Building

TYPE – 2: G+15 Regular Shape Building

TYPE – 3: G+25 Regular Shape Building

TYPE – 4: G+35 Regular Shape Building

TYPE – 5: G+45 Regular Shape Building

TYPE – 6: G+7 Irregular Shape Building

TYPE – 7: G+15 Irregular Shape Building

TYPE – 8: G+25 Irregular Shape Building

TYPE – 9: G+35 Irregular Shape Building

TYPE – 10: G+45 Irregular Shape Building

4.1 Methodology:

1 The Buildings are assumed to be in Zone-III.
2 Analysis of Floors using ETABS 2017.
3 The buildings are being designed as per IS 456:2000 & IS 1893:2016.

4.2 Description of structure

Table 1: - Materials Properties of structures

SR.NO.	MATERIAL PROPERTIES	DATA
1	Concrete grade of column	M25
2	Concrete grade of beam	M20
3	Concrete grade of slab	M20
4	Grade of Rebar	Fe 415
5	Grade of Steel	Fe 345
5	Density of concrete	25 kN/m^3

Table 2: - Materials Properties of structures

SR.NO.	GRAVITY LOADS	DATA
1	Dead load	Default taken by ETABS
2	Live load	2 kN/m^2
3	Floor finish load	1 kN/m^2
4	Wall load(External)	13 kN/m^2
5	Wall load(Internal)	7.5 kN/m^2

SR.NO.	SEISMIC LOADS	Conventional Slab DATA
1	Seismic Zone Factor, Z	0.16
2	Importance Factor	1
3	Type of Soil	Medium
4	Response Reduction Factor	5

Table 3 - Seismic Loads for G+7 Symmetric structures

4.3 ETABS Models

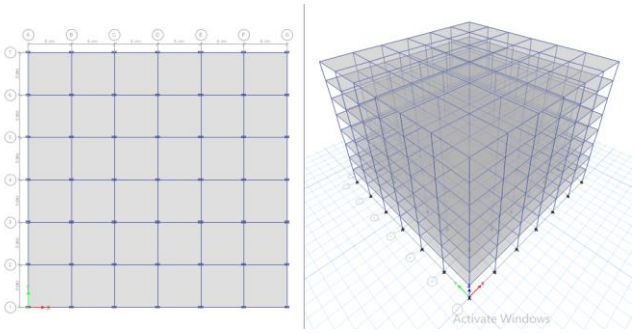

Fig -1: G+7 Regular Building Model in ETABS

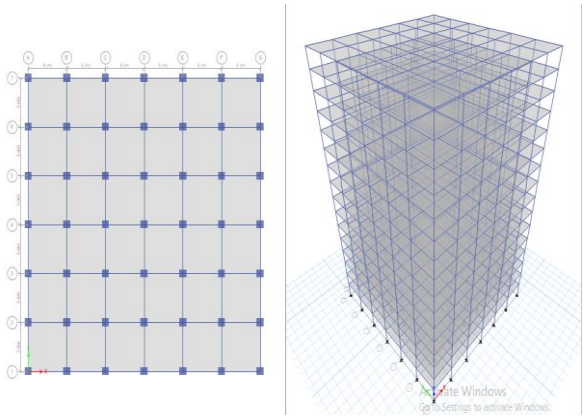

Fig -2: G+15 Regular Building Model in ETABS

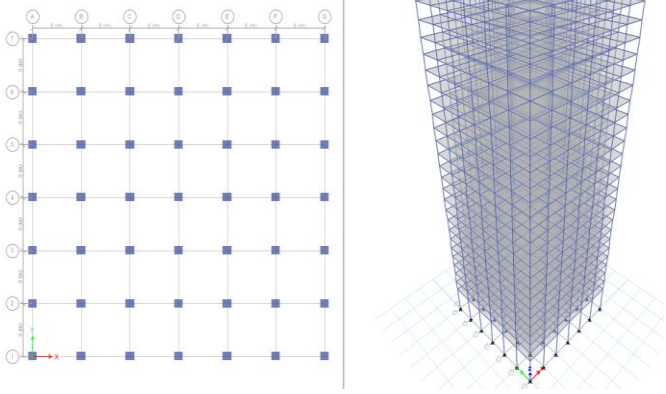

Fig.3: G+25 Regular Building Model in ETABS

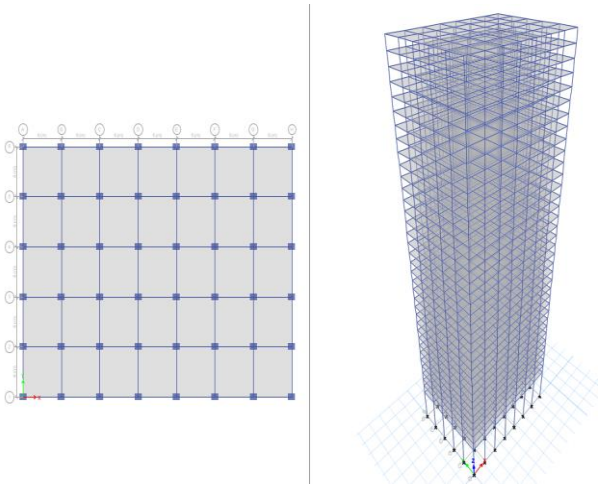

Fig.4: G+35 Regular Building Model in ETABS

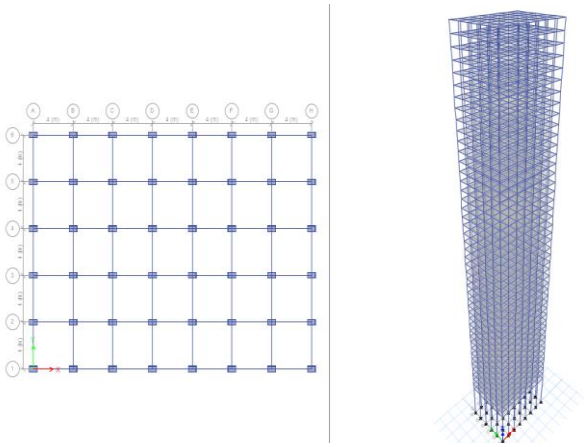

Fig. 5: G+45 Regular Building Model in ETABS

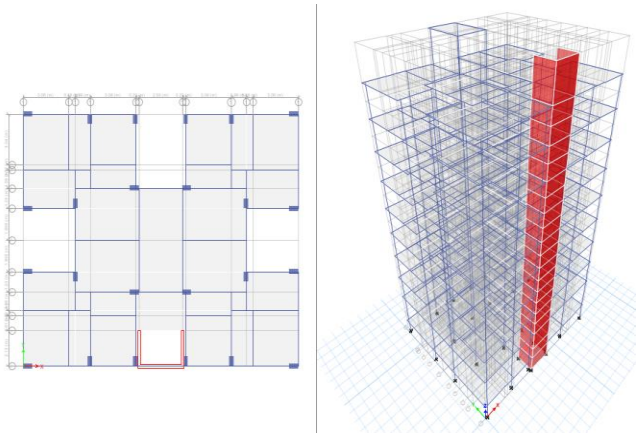

Fig. 6 G+7 Irregular Building Model in ETABS

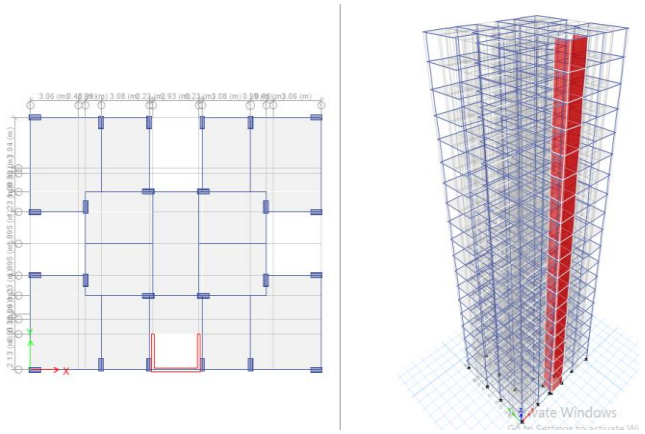

Fig. 7 G+15 Irregular Building Model in ETABS

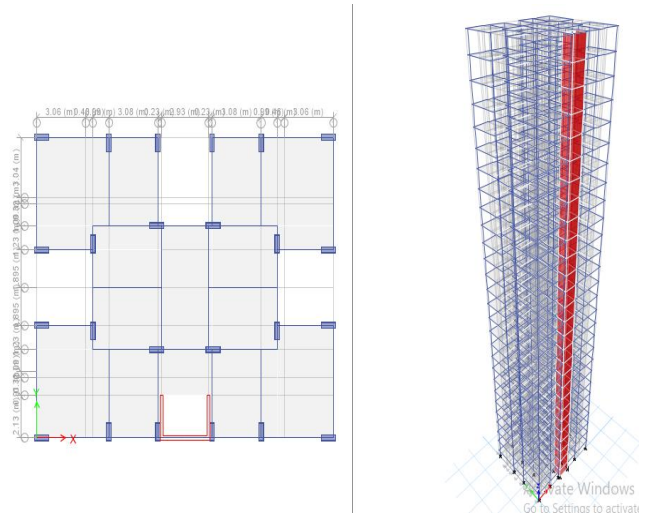

Fig. 8 G+25 Irregular Building Model in ETABS

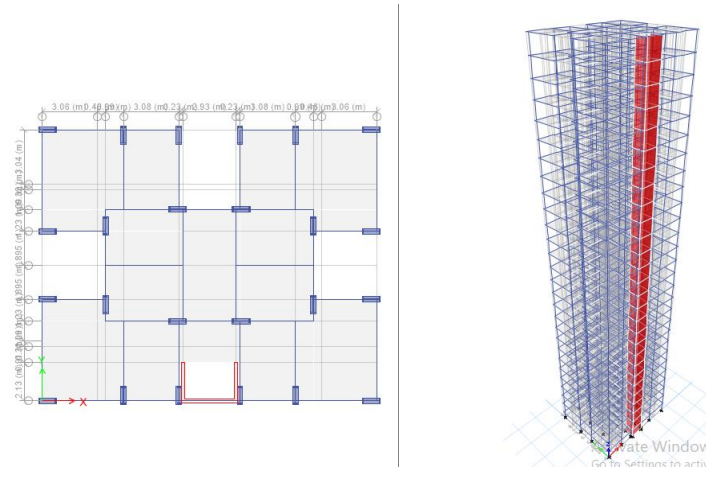

Fig. 9 G+35 Irregular Building Model in ETABS

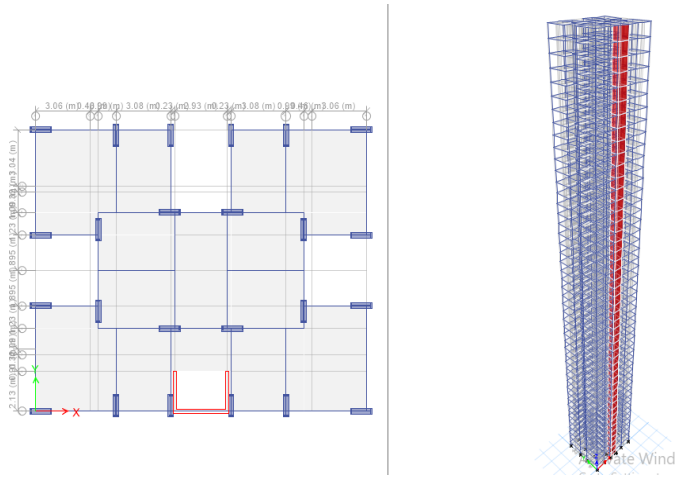

Fig. 10 G+45 Irregular Building Model in ETABS

5. RESULTS

- The result is derive as difference of % as compare to RCC for both type of Composite Column like Steel Incased Column SIC & Concrete filled Steel tube CFST.
- The result is in Graphs Show the result of Parameters like Storey Displacements, Storey Drifts, Storey Shears, Storey Stiffness derive as difference of % as compare to RCC for both type of Composite Column like Steel Incased Column SIC & Concrete filled Steel tube CFST.

5.1 Story Displacement

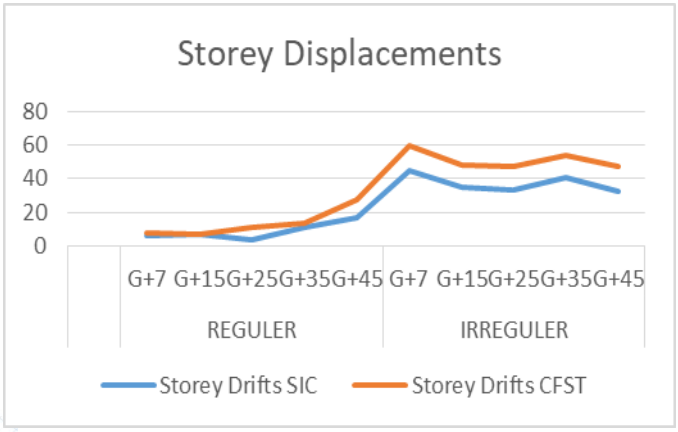

Fig. 11. Diff. in % of Displacement as Compared to RCC Column of SIC & CFST

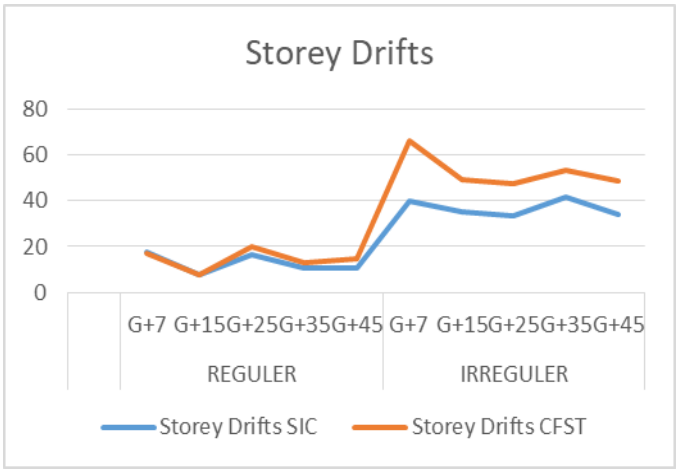

Fig. 12: Diff. in % of Drift as Compared to RCC Column of SIC & CFST

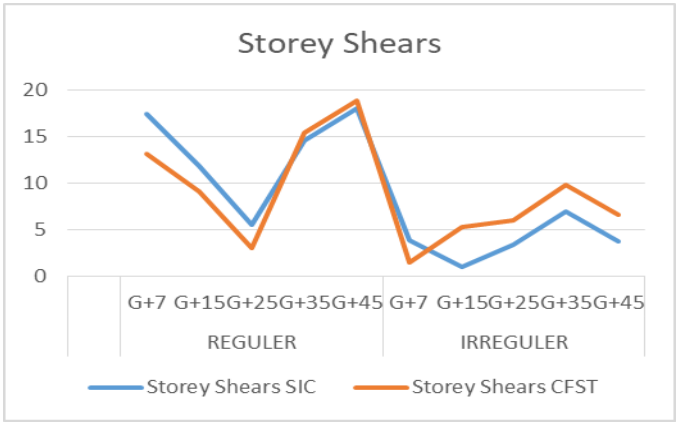

Fig. 13: Diff. in % of Shears as Compared to RCC Column of SIC & CFST

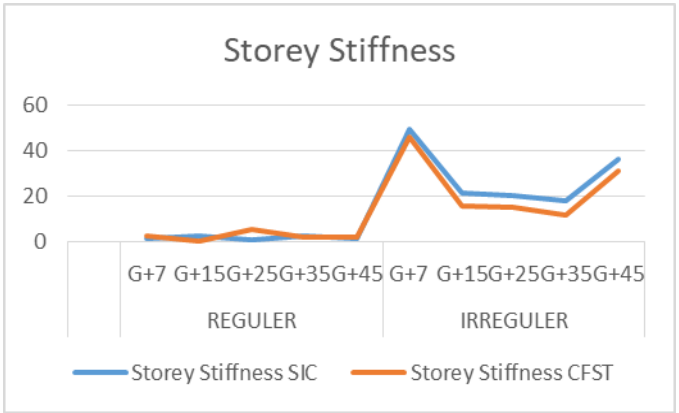

Fig. 14: Diff. in % of Stiffness as Compared to RCC Column of SIC & CFST

6. CONCLUSIONS

- The use of Composite Structure in high-rise building given good result in every parameters like Storey Displacement, Storey Drifts, Storey shears and Storey Stiffness etc….
- The Composite Column have less Dimensions as Compare to RCC Column, So its Reduced Space Consumption at Basement Parking and Bottom Floors, Which become beneficial for us.
- The Composite Column Providing good Aesthetic View in Building and also in Residential Bungalow.
- The Composite Column frame built the Light-weight Structure as Compare to RCC frame Structure. So it gives the light foundation as compared RCC Building. So its result into less Cost.
- The Use of Composite Column is Reduced the Concrete Consumption.
- In analysis of Regular Building, We replaced the RCC Column with Composite Column about 30-50% less Cross Section Area, so it's give batter performance than RCC Column with less margin in every Parameters.
- In analysis of Irregular Building, We replaced the RCC Column with Composite Column with same Cross Section Area, so it's give batter performance than RCC Column with Very High margin in every Parameters.
- The Cost difference between RCC and composite Column is still Suspense because Some Study Shows that the Composite Column has less Cost, Where some study said that Composite Column is 30-40% Costlier than RCC Column.
- But we can see that the Composite Column have less Dimension so its Reduced Concrete Consumption, its Provided light Footing, its Reduced work Period etc…So we can say that its beneficial in Overall Costing.
- The Use of CFST Composite Column give better performance in more aspects than the SIC Composite Column but its Costlier than SIC Composite Column. So the Choice of which type of Composite Column should be provided is up to Condition or selection of Builder.
- The Selection of Column from RCC and Composite is depending upon various factors like Costing, availabilities of working labour, the Experienced of this types of Works etc… So the providing of

Composite Column or RCC Column should be provided is up to Condition or selection of Contractor, Builder etc.

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