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Seismic Analysis of High Rise Building with and Without Inserting Hybrid Tubular Beam And Column

Hit Popat, Mr. Aakash Suthar, Mr. Abbas Jamani
M. E. Student, Department of Civil Engineering, L. J. Institute of Engineering & Technology
Assistant Professor, Department of M.E Civil Engineering, L. J. Institute of Engineering & Technology
Assistant Professor, Department of M.E Civil Engineering, L. J. Institute of Engineering & Technology

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ABSTRACT: Earthquake has been the most effective natural disaster for the construction of high rise building from so long. So many researchers are still trying to minimize the seismic effect on structures by constructing Earthquake Resistant Structure (ERS).Now a Days, The Topic "Hybrid Tubular Structures" is in Trend to minimize the effect of earthquake. To secure a building against seismic effect of Earthquake, different parameters like Shear Force , Base Shear , Bending Moment , Deflection, Buckling etc. need to be analyzed. Here in this study, A model is going to be analyzed by comparing seismic effect of Earthquake on building with and without the use of Tubular members like Tubular Beam And Tubular Column by filling the concrete inside the elements.

In this study , different size of RCC Beam (like size of 300x300 mm, 300x450 mm and 350x350 mm) And different size of RCC Column (like size of 450x450 mm ,450x600 mm and 600x600 mm) are to be replaced with the same size of Hybrid Tubular Beam and Hybrid Tubular Column simultaneously with different shapes like Rectangular, Square and Circle (with the size of 300 mm dia., 350 mm dia. and 450 mm dia. With the thickness of 12 mm) and then analyze the different parameters like Max Storey Displacement , Max Storey Drift and Max Lateral Force due to the Earthquake.

KEYWORDS: Earthquake Resistant Structure (ERS) , Hybrid Tubular Structure , Concrete Filled Steel Tubular Beam , Concrete Filled Steel Tubular Column , ETABS 2018.

I. INTRODUCTION

1.1 General

As per the Indian Standard , High Rise Building is a building whose building height is greater than 75 feet or 23 meter , generally 7 to 10 storey building . Generally these kind of buildings are to be used for residential, commercial, institutional or hospitality purposes . In general these kind of high rise buildings are to be constructed in metropolitan cities , but now a days these king of buildings are to be constructed in urban cities too.

1.2 Composite Structure / Hybrid Structure

Hybrid / Composite Structure is a structure which has more beneficial advantages of architectural and structural techniques by using components made up from different hybrid materials.

In this time, Concrete and Steel are most used in construction of Buildings to the construction of bridge. Although concrete and steel have different properties , they are widely used in high rise building also. Steel is good in Tension which helps to increase the ductile properties of structure while Concrete is good in Compression which protects the structure against corrosion and thermal insulation effect. Similarly buckling of steel can be restrained by concrete.

Now a days, Composite Structure is in trend. To get maximum benefits from Concrete and Steel, Composite Structural Elements like Composite Beam Section and Composite Column Section are widely used .

1.3 Advantages of Hybrid / Composite Structure

- Light Weight Composition
- Faster Construction Time
- Low Maintenance
- Fire Resistant

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1.4 Tubular Section

A pipe is a tubular section or hollow cylinder, usually but not necessarily circular cross-section , mainly used to convey substances which can flow of liquid , gas etc.
In this study only Concrete Filled Steel Tubular Sections are Used.

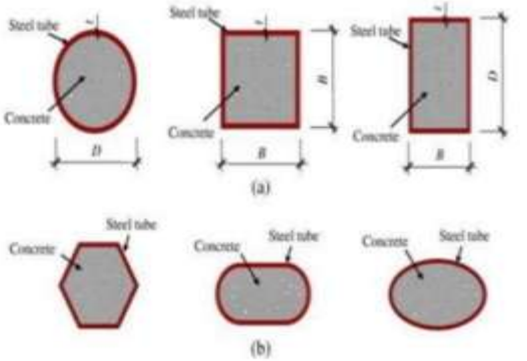


Fig.1 : Different Concrete Filled Tubular Sections

II. OBJECTIVE

1. To examine the model with the help of Etabs 2018 software whether it can be failed or sustainable by inserting tubular beams and columns.
2. Compare the following values of with and without used of tubular elements in high rise structure.
Max Story displacement
Max Story Drift
Max Lateral Force

III. LITERATURE VIEW

Stelios Vernardos , Charis Gantes (2019) **[1]** This paper discusses about the compressive strength of the specimen which is made from steel sheets. This specimen is made by cutting of steel sheets and their cold-forming to the desired cross-section shape , for the creation of inner and outer side of the tube. After that longitudinal welding is to be carried out and concrete is filled up in that specimen . After vibrations , axial compression test is to be carried out which results to know the actual strength of the specimen. Total 250 around models are to be checked with different sizes and shapes to compare the compressive behaviour of the members.

Chengzhi Wang , Tao Zhang , Pengfei Li (2018) **[2]** In this research paper, Concrete filled pile is to displacement with and without foundation by applying hydraulic jack.Following are some data used in research.
1. Thickness of outer steel tube = 1.2 mm
2. Thickness of inner steel tube = 1.6 mm
3. Diameter of outer steel tube = 150 mm
4. Diameter of inner steel tube = 165 mm
5. Length of column specimen = 800 mm
6. Foundation: 2.1m× 1.3m× 1 m.
7. Hydraulic Jack with limit load 200 KN

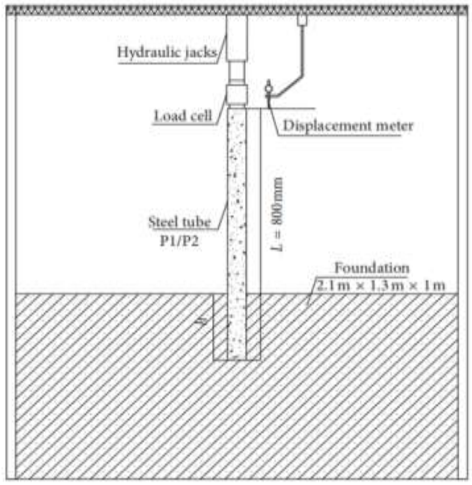


Fig.2 : Test Setup

Wei Xian , Wen-Da Wang , Rui Wang , Wensu Chen, Hong Hao (2020) **[3]** In this study, dynamic response of steel-reinforced concrete-filled circular steel tubular (SRCFST) members was experimentally studied under lateral impact loads. Eighteen SRCFST specimens were prepared and tested by the drop hammer impact test system. Various parameters, namely, cross-section of profiled steel, impact velocity and impact direction for I section profiled steel were considered to examine their influences on the failure mechanism, impact force, impact duration, displacement response and energy absorption. The diameter (D), thickness (t) and length (L) of the outer steel tube were taken as 165 mm, 3.5 mm and 1900 mm, respectively. The effective span (L0) of specimens was 1100 mm between two supports and the ratio of the span to the diameter was 6.67. The ratio of flange width to thickness should be less than 23 and the ratio of web height to thickness should be less than 96, as well as the sum of the distances from the left or right side of flange to outer edge of the concrete should be less than 1/3 of the section width of specimen .

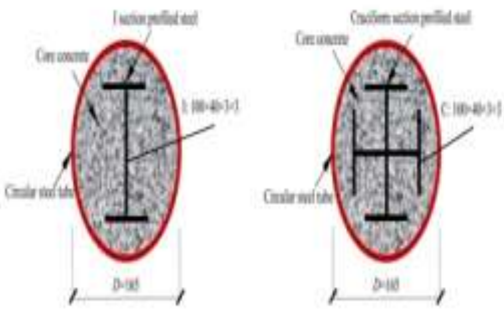


Fig.3 : Cross Section and Dimension of Specimen

Dr. K. Chandrasekhar Reddy & G. Lalith Kumar 2 (2019) **[4]** G+30 Residential Building has been analyzed with following data:
1.Building type : Residential building
2. No. of storeys : G+30
3. Building shape : Rectangular
4. Geometrical details
a. Ground floor : 2.5m
b. Floor – Floor height : 3m
c. Building Dimension : 30 m x 24 m
5. Material details
a. Concrete grade : M30
b. Steel grade : HYSD reinforcement of Fe415
c. Bearing capacity of soil : 200 KN/m2
6. Type of construction : R.C.C Framed structure

Fig.4 : Comparison of drifts x and y of the structure in zone 5

Ketan Patel , Sonal Thakkar (2012) **[5]** iSteel – concrete composite columns are used extensively in modern buildings. Extensive research on composite columns in which structural steel section are encased in concrete have been carried out. In-filled composite columns, however have received limited attention compared to encased columns. In this paper a comparative study of 10, 20 and 30 storey Concrete Filled Steel Tube (CFT), R.C.C. and Steel building is done. Comparison of parameters like time period, displacement, base shear and load carrying capacity is done with steel and R.C.C structures. Result shows CFT building is good in load carrying capacity with small cross section of column.

IV. METHODOLOGY

1.5 Building Plan and Dimension Details

Design Considerations:
1. Building Dimension = 30m x 240
2. M30 grade concrete for Slab
3. M35 grade concrete for beam and column
4. Fe415 grade for Rebars
5. Fe345 grade for Steel Sections
6. Longitudinal Bars and Transverse bars = 20 mm dia.
7. Tie Bars = 10 mm dia.
8. Slab Thickness = 150 mm
9. Beam Size = 300x300 , 300x450 , 350x350 (in mm)
10. Rectangular Column Size = 450x450 , 450x600 , 600x600 (in mm)
11. Circular Column Size = 300 , 350 , 450 (in mm)
12. Tubular Outer Thickness = 12mm

Fig.5 : Plan of G=30 Building

Fig.6 : Elevation of G+30 Building

1.6 Building Plan and Dimension Details

- Dead load = 1.5 kN/m2
- Live load = 2 kN/m2

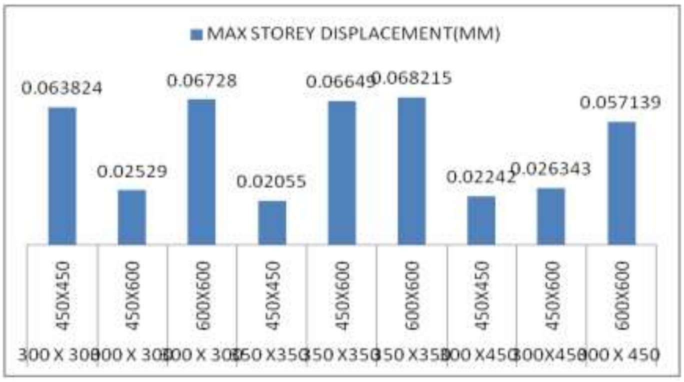
V. SEISMIC ANALYSIS OF BUILDING

Seismic parameters are considered as per IS 1893 (Part 1):2002

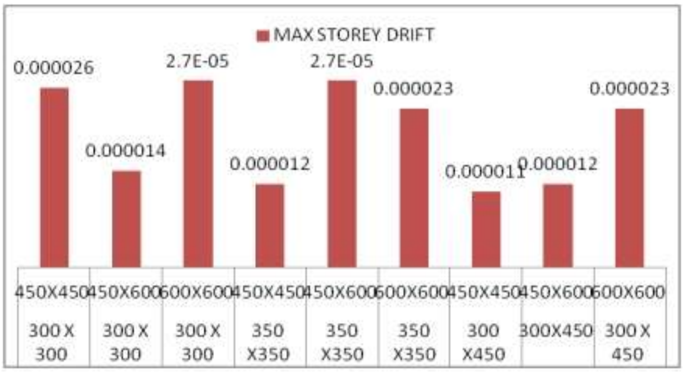
- Soil type= II
- Seismic zones = V
- Importance factor = 1
- Building type = SMRF
- Response reduction factor: 5
- Special section used for the design of tubular beam and column.

VI. RESULTS

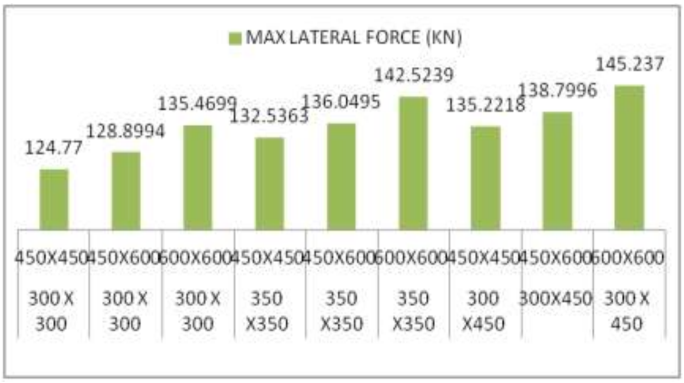
6.1 RCC Structure



Graph -1: Result of Max Storey Displacement for RCC Structure

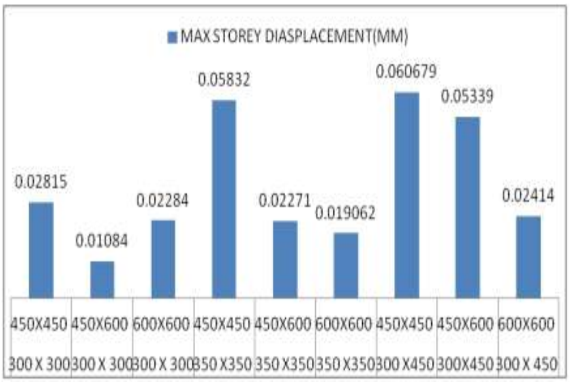


Graph -2: Result of Max Storey Drift for RCC Structure

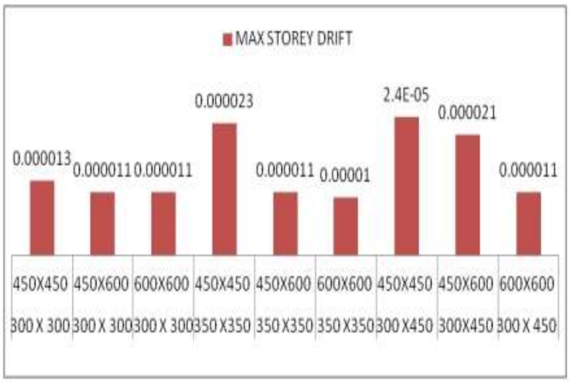


Graph -3: Result of Lateral Force for RCC Structure

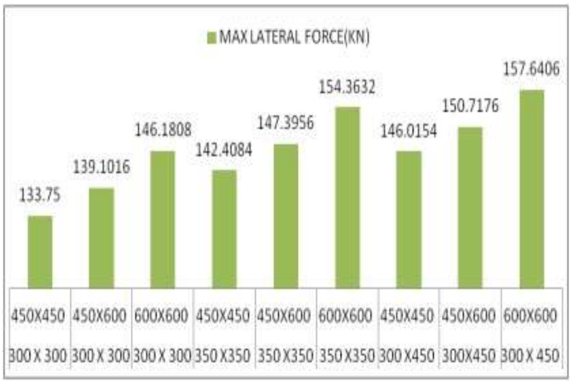
6.2 Tubular Section



Graph -4: Result of Max Storey Displacement for Hybrid / Composite Structure by inserting Rectangular / Square Tubular Beam and Column



Graph -5: Result of Max Storey Drift for Hybrid / Composite Structure by inserting Rectangular / Square Tubular Beam and Column



Graph -6: Result of Max Lateral Force for Hybrid / Composite Structure by inserting Rectangular / Square Tubular Beam and Column

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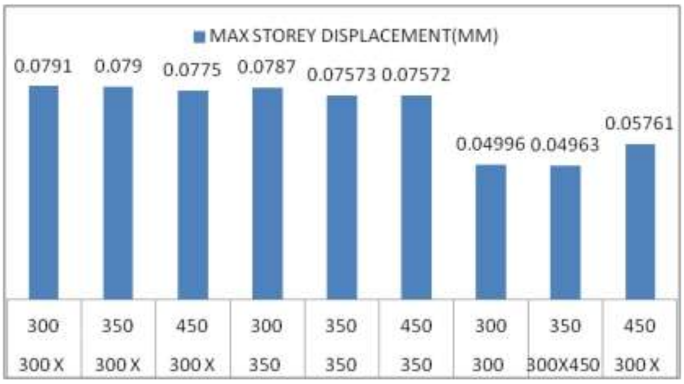
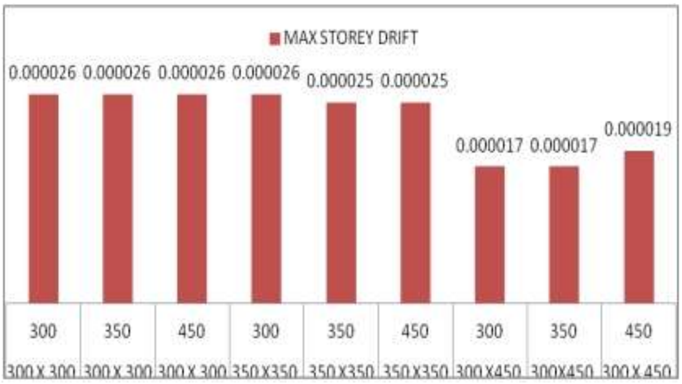
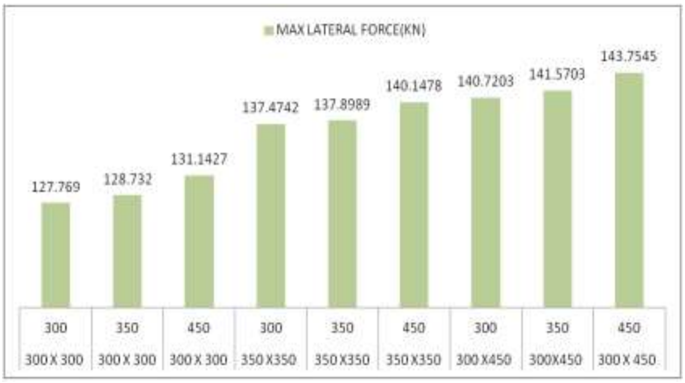
6.3 Tubular Section



Graph -7: Result of Max Storey Displacement for Hybrid / Composite Structure by inserting Rectangular / Square Tubular Beam and Circular Tubular Column



Graph -8: Result of Max Storey Drift for Hybrid / Composite Structure by inserting Rectangular / Square Tubular Beam and Circular Tubular Column



Graph -9: Result of Max Lateral Force for Hybrid / Composite Structure by inserting Rectangular / Square Tubular Beam and Circular Tubular Column

VII. CONCLUSIONS

1. Hybrid Tubular Structure gives more stability against the Conventional RCC Building.
2. As per the results obtained , Hybrid Tubular Section with Rectangular / Square Tubular Beam and Column having low Storey Displacement and also gives better performance against the lateral force as compared to the conventional RCC elements used in G+30 building.
3. As per the results , Compared to Hybrid Tubular Circular Column , Hybrid Tubular Rectangular / Square Column is more stiffer and having Less value of Storey Drift.

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