Comparative Analysis Between Tube In Tube Structure And Conventional Moment Resisting Frame

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Abstract- *The project aimed to study the seismic behavior or performance of tube in tube structure and comparing it with Rigid Frame moment resisting frame structure. In order to study the seismic performance, a G+30 story structure with tube in tube structural system and other with Rigid Frame moment resisting system have been considered. Response spectrum Analysis has been carried out. All the modelling and analysis has been done using ETABS Software with standard procedure. Graphs and tables have been drawn in between different parameters for different conditions using Microsoft Excel to make the study more effective. After analyzing the models, the results of parameters like base shear reactions, story drifts, displacements, model time period, etc. are compared. Results obtained are for the systems modelled for this project as per the sizes and loads considered accordingly. By changing the sizes of beams and columns and the column orientation the results also change. which are discussed further in conclusions. From the modular investigation it can be inferred that, steel tube structures are more adaptable than regular steel moment resisting frame*

Keywords- Response Spectrum Analysis, Tube in Tube Structural System, Conventional Moment Resisting System,Base Shear Reactions, Modal Time Period, Story Drifts, Displacements, Etabs

I. INTRODUCTION

Due to limited area and increasing expansion of urbanization it is feasible to expand in vertical direction than in horizontal direction. And due to increasing vertical urbanization it is important to adopt to more stable structure. Here, tubular structure is one such structure, where the columns are placed at the periphery of the structure. Also, here Tube in Tube structure is used. Compared to conventional structure the tube in tube structure is more stable lateral loads, allows more interior space and helps save around 30% steel.The tube is a structural engineering system that is used in high-rise buildings, enabling them to resist lateral loads from wind, seismic pressures and so on. It acts like a hollow cylinder, cantilevered perpendicular to the ground The concept of the tube system is to create a hollow cavity within a building to resist lateral loads. This cavity can be made up of columns and beams that are tied together using a moment connection. The columns and beams of this assembly are designed to form a rigid frame that is adequate to support the building's exterior. This exterior structure allows the interior to be easily Tube in for gravity loads. The interior columns are typically not located at the core. The outer perimeter is typically spanned with beams or trusses. This method allows the perimeter tube to transfer some of the load to the interior, and increases its ability to resist overturning via lateral loads.

II. LITERATURE REVIEW

[1] **MrHojat Allah Ghashemi et.al** presented the design parameters variation on the tube action and shear lag behaviour of a typical reinforced concrete bundled tube building and enlightened about the optimal design approaches.

[2] **MrJignesha Patel et.al** The more lateral load capacity of frame tube structure over the framed structure is studied. Exterior tube carries all the lateral loading. Structurally, the framed-tube is superior to a rigid frame because the maximum lateral loading is on the exterior of the building. The interior structural system is a secondary system to carry only gravity loads only. The tube frame buildings left the interior floor plan relatively free of core bracing and heavy columns, enhancing the net usable floor area. The reduction of the material makes the buildings economically much more efficient.

[3] **NI WIN et.al** A comparative study of twelve-storied reinforced concrete building static and dynamic analysis of irregular reinforced concrete building have been analysed. He evaluated the difference between the results obtained by static and dynamic analysis

[4] **Ali et.al** presented the different lateral load resisting system and history of the development of the tall structure system. And by Explaining about the Sears Tower the 1st steel bundled tube Structure and the Chicago tower the 1st Concrete Tube Structure then the Tube structures of different shapes like square, rectangular, trapezoidal etc.

[5] **Mohammed Rizwan Sultan et.al** Presented Dynamic Analysis of Multi-Storey Building for Different Plan Shapes in high seismic zones. The lower base shear is getting in L shape building and the higher base shear is getting in Rectangular shape building. The irregular shape building has more deformation and hence regular shape building is prescribed. Results have been proved that C shape building is more vulnerable in comparison to all other shapes of buildings.

III. METHODOLOGY

1. Design a model of a G+30 building using the dimensions specified in the cad file for the beam, column and slab.
2. Comparative analysis between Tube in tube structure and moment resisting structure in high seismic zones.
3. Results are compared between the models with respect to Base shear, Displacement, Drift, Time period, Stiffness.

Table 1: Preliminary data

Type of Structure	Tube in Tube Structure	Moment Resisting Structure
No. of Stories	G+30	G+30
Height of each story	3m	3m
Total Height of building	150m	150m
Main beam size	230 x 600 mm	230 x 600 mm
Secondary beam size	200 x 450 mm	200 x 450 mm
Exterior column size	300 x 800 mm	300 x 800 mm
Interior column size	900 x 900 mm	300 x 900 mm
Thickness of outer wall	0.23m	0.23m
Thickness of inner wall	0.15m	0.15m
Grade of reinforcing steel	Fe 500	Fe 500
Density of concrete	M40	M40

Table 2: Load Parameters

Dead load	Self-weight of slab, beam, column, footing, wall, parapet wall
Live Load	For intermediate floor = 1.5 kN/m2, For terrace floor = 2 kN/m2
Floor Finish	For intermediate floor = 1 kN/m2, For terrace floor = 3.75 kN/m2

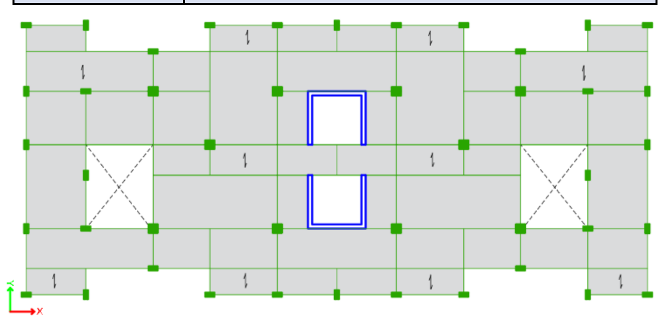

Fig1: Tube in Tube system plan

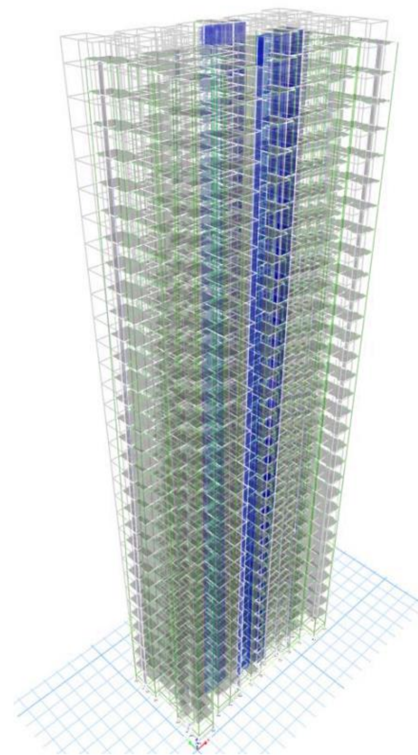

Fig2: 3d view Tube in Tube system

IV. RESULTS

Table 3: Base shear of Rigid Frame system

Name	Z	Site	I	R	Period	Coeff	Wt (kN)	Base Shear
EQX	0.16	II	1.2	5	1.53	0.0170	248622.70	4223.26
EQY	0.16	II	1.2	5	2.16	0.01208	248622.70	3096.07

Table 4: Base shear of Tube in tube system

Name	Z	Site	I	R	Period	Coeff	Wt (kN)	Base Shear
EQX	0.16	II	1.2	5	1.53	0.0170	253958.72	4334.22
EQY	0.16	II	1.2	5	2.16	0.01208	253958.72	3070.07

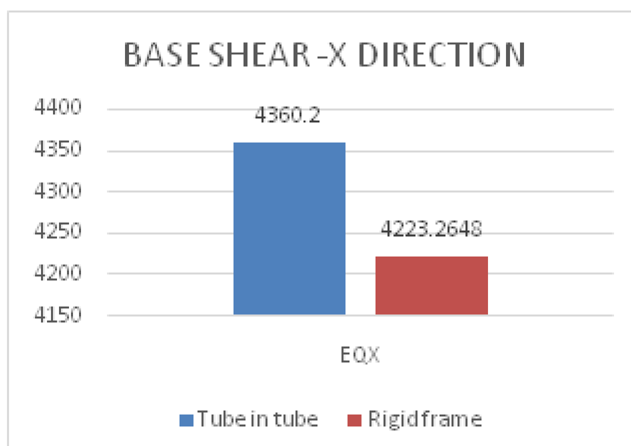

Fig3: Story drift x direction

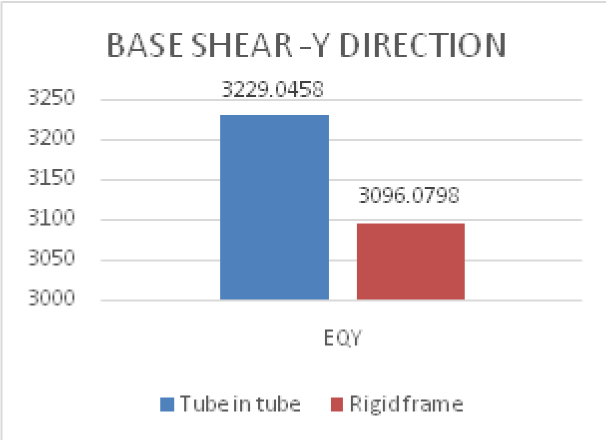

Fig4: Story drift y direction

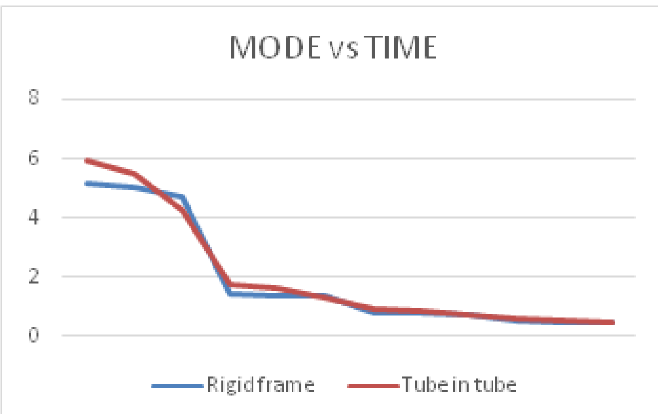

Fig5: Mode v/s time period plot

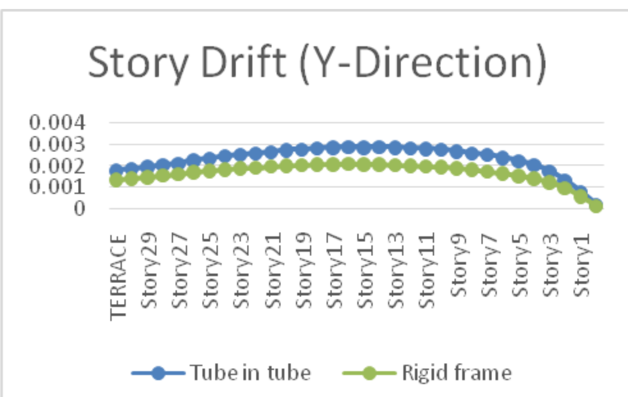

Fig6: Story Drift Y direction

Table 5: Mode v/s time period plot

Mode	TIME PERIOD	
	Rigid Frame	Tube in Tube
1	5.2	5.968
2	5.057	5.530
3	4.73	4.320
4	1.434	1.799
5	1.4	1.680
6	1.420	1.356
7	0.809	0.929
8	0.785	0.860
9	0.750	0.735
10	0.530	0.590
11	0.515	0.562
12	0.490	0.490

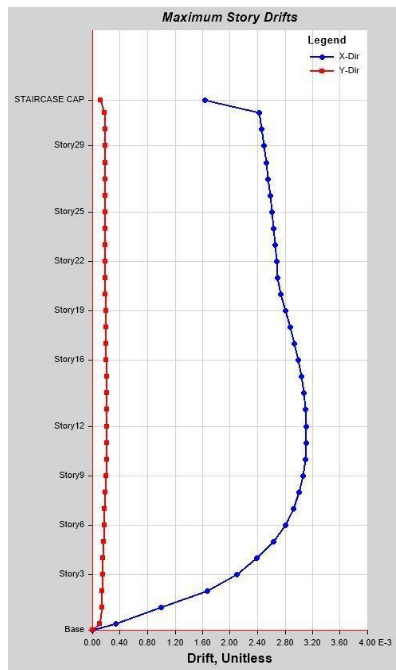

Fig7: Max Story Drift

V. CONCLUSION

After the response spectrum analysis of the buildings with Tube in tube structural system and Rigid Frame system, few parameters are discussed for the comparison. The following conclusions are made

1. By comparing the results, it is concluded that the base shear reaction in Tube in tube system is slightly greater than the Rigid Frame system.
2. By comparing the results, it is concluded that the time period of Tube in tube structural system is greater than that of Rigid Frame system.

3. By comparing the results, it is concluded that the Model mass participating ratio of Rigid Frame system for the 12th mode is slightly greater than that of the Tube in tube system.
4. By comparing the results, it is concluded that the Model load participation ratios, the acceleration of Tube in tube system in dynamic analysis is slightly more than that of Rigid Frame system.
5. By comparing the results, it is concluded that the story drifts for Rigid Frame system are less than the story drifts obtained for Tube in tube structural system.
6. Story drifts for response spectrum load cases are slightly less than that on the normal EQX and EQY load cases.

VI. ACKNOWLEDGMENT

It is with immense pleasure that I express my sincere sense of gratitude and humble appreciation to Dr. Atul B. Pujari, for his invaluable guidance, whole-hearted co-operation, constructive criticism and continuous encouragement in the preparation of this thesis. Without his support and guidance, the present work would not be possible.

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