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Comparative Study on Tube in Tube Structure G+20 under Different Seismic Zones

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ABSTRACT: Tubular structures are the fresh concept which is widely used presently for the development in construction of tall structures. These methods are more efficient and are economical also. Amongst all following two types are: Tube in Tube structures, Braced frame structures.

In the types mentioned above, the exterior perimeter of columns are designed to resist lateral forces, where as the inner columns are designed to withstand gravity loads. In this dissertation, analysis and design of these structures have been done using STAAD Pro, a software package for the analysis and design of civil engineering structures. After the modelling the buildings have been analyzed, designed with specifications of IS – codes. Finally, graphs and tables have been plotted for different zones using MS – Excel and results are obtained.

KEYWORDS: Tube in tube, Base shear, Displacement, Storey drift etc.

I. INTRODUCTION

Due to the increase in population and their living standards, there is scarcity of huge space availability for construction, especially in urban areas. So it has become necessary to build the structures by increasing the length and decreasing its width.

Previously, only conventional method of construction was available, due to which the number of floors of the structures were unable to increase and were restricted to certain number of floors only. Hence there was a need of such a method of construction which should be able to fulfill all the structural requirements (viz. lateral loading, different loadings, etc.).

There are various types of structural construction systems available now which provides various safety factors to the structure: Rigid frame construction, Braced frame construction, Shear wall frame construction, Outrigger construction etc.

Now a day's tubular method of construction is commonly adopted due to its excellent resisting capacity of lateral loadings which results in safety of the structures. If it is referred to construction of tall buildings then tubular method is best suited. The various types are: Frame tube system, Braced tube system, Bundled tube system, Tube in tube (shear wall) system, Tube in tube with bracing system, Tube in tube mega frame system.

II. LITERATURE REVIEW

- 1) Sulaiman AL-SAF, Ibrahim Alameri, Waleed Abdullah Wasel, Amjad Basheer AL- KADASI² [2021] –This paper has mentioned the structure's behavior linearly and non-linearly way. Various loads like wind and seismic were determined on various stories i.e. 5th, 10th and 15th storey steel building with different bracing systems. Five structural configurations were used in this study viz. V-braces, inverted V-braces, single floor X-braces and multi floors with X-braces. The study resulted that X-bracing for 5th and 10th storey and V-bracing for 10th storey are the best suited.
- 2) HAO ZHANG, MING LIAN, MINGZHOU SU [2020]⁶ – Here the study is carried out on toughened steel frame tube structures where the links provided can be changed accordingly. These links were introduced to increase the resisting action against the seismic forces by the steel frame tube structures. Here 6 buildings of 30 stories were

designed with various layouts of shear links. Non linear dynamic analysis was carried out to testify the seismic behavior of high strength steel frame tube structure. It was concluded that toughened steel frame tube structure with changeable shear links was dependable to recover after the damage caused by the earthquake.

- 3) AKSHAY C. UMARE¹, SANDESH KANTE² [2019] –The construction of the high rise structures has increased which leads to the development of the nation. Due to increasing population and business has led to development of high rise buildings. High rise structures are different from that of low rise structures when subjected to seismic and wind loads due to its slenderness and because of the tall structures new difficulties arrive to the design engineers to design a building under lateral loading condition to increase the strength and stability of the structure bracings are provided. As the bracings have very high strength and stiffness bracings resist the huge loads and also stiffer structure resists the seismic force. In this project G+45 RCC the bundled tube structure is analyzed for RCC bare frame without bracing system and RCC bare frame with the bracing system. The results analyzed are displacement, base shear, axial load, storey drift. Comparing all the results calculated it is seen that for a building with X bracing in x – direction and diagonal bracing in z – direction gives good results.
- 4) BIPIN H NAIK¹, B S SURESH CHANDRA² [2017] –Here, the concept of frame tube and shear wall system has been used for the tall building. The concept used is for the purpose of its hardness which is required for resisting horizontal loads and to support the tube which are in vertical direction at the interior.

III. OBJECTIVES

1. To determine the action of lateral forces on the structure with tube in tube system.
2. To calculate the lateral displacement, storey drift and base shear of the structure with tube in tube and tube in tube with bracing system.
3. To summarize the advantages of tube in tube under different geometry using the obtained results.
4. To identify the most susceptible structure amongst the models which are considered under seismic action.
5. To identify the effect of the lateral loads on the building with tube in tube system.
6. To summarize the advantages of tube in tube under different geometry using the obtained results.

IV. METHODOLOGY

1. In the current research a 20 storied building is considered, measuring 36m x 18m along X and Y direction using AutoCAD.
2. This research work is carried out to study the comparison of the actual behavior of the tall structure with and without tube in tube system concept under different seismic zones.
3. Modeling of G+ 20 structures using STAAD PRO for the mentioned systems and analyzing the same to check the difference of behavior of structure.
4. After checking the behavior after analyzing, it is represented in terms of table and graphs.

V. RESULTS

- A. **BASE SHEAR:** The design seismic load applied to each floor level is called base shear. The result of zone II is shown below.

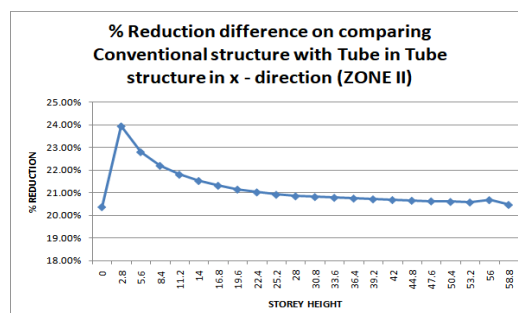


Fig.1. % Reduction difference on comparing Conventional structure with Tube system in x - direction (ZONE II)

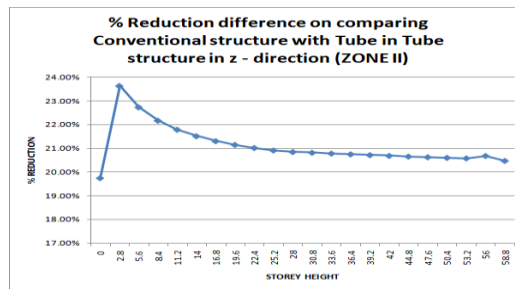


Fig. 2. % Reduction difference on comparing Conventional structure Tube system in z - direction (ZONE II)

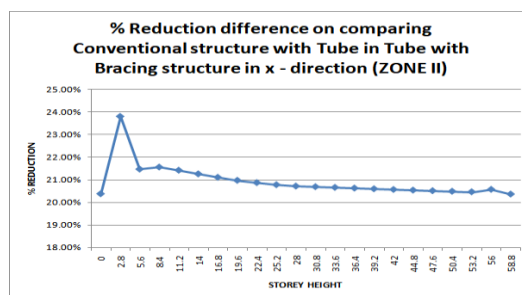


Fig. 3. % Reduction difference on comparing Conventional structure with Tube with bracing system in x - direction (ZONE II)

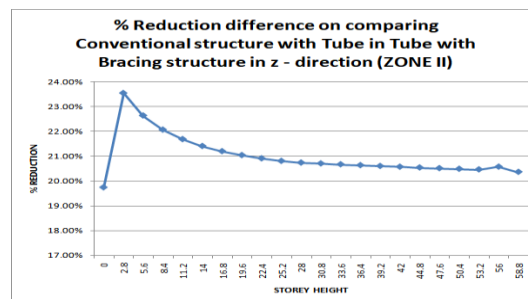


Fig. 4. % Reduction difference on comparing Conventional structure with Tube with bracing system in z - direction (ZONE II)

B. **DISPLACEMENT**: Storey displacement can be defined as the total displacement of the storey with respect to the ground. The values of storey displacement for zone II is shown below:

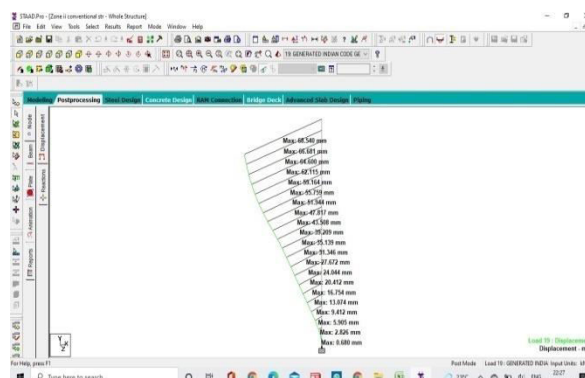


Fig. 1. Displacement result of conventional structure in x - direction for ZONE II

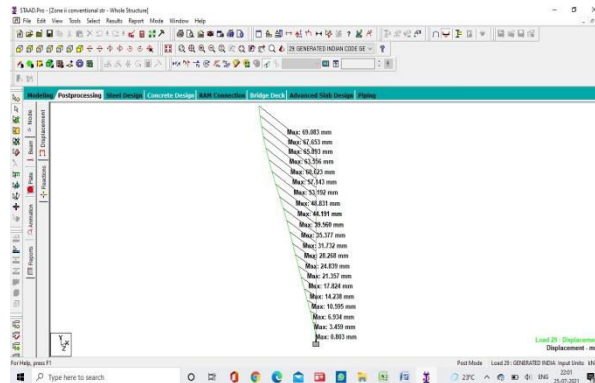


Fig. 2. Displacement result of conventional structure in z – direction for ZONE II

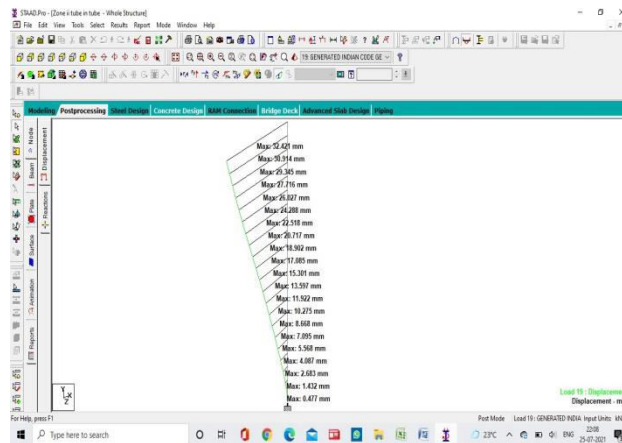


Fig. 3. Displacement result of tube structure in x – direction for ZONE II

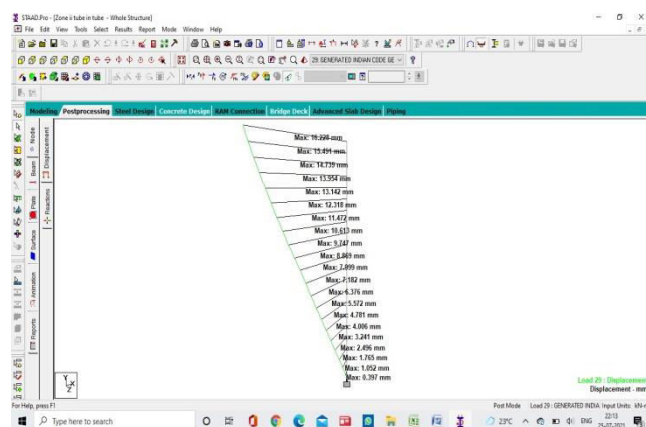


Fig. 4. Displacement result of tube structure in z – direction for ZONE II

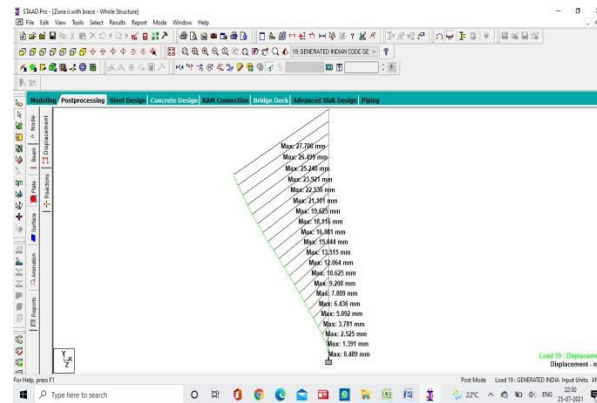


Fig. 5. Displacement result of tube with bracing structure in x – direction for ZONE II

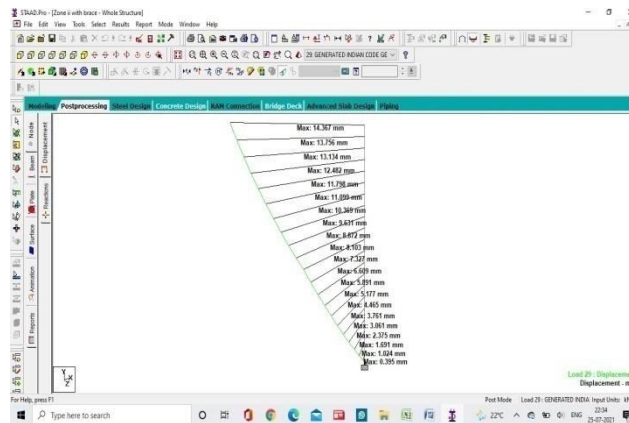


Fig. 6. Displacement result of tube with bracing structure in z – direction for ZONE II

- C. **STOREY DRIFT**: Storey drift is defined as the difference in displacement amongst two consecutive stories divided by the height of that storey. The result of zone II is shown below:

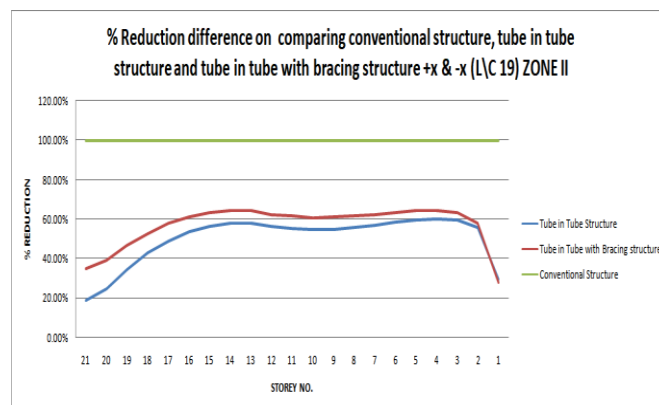


Fig. 1. % reduction difference on comparing conventional structure with tube structure and tube with bracing structure in x – direction ZONE II

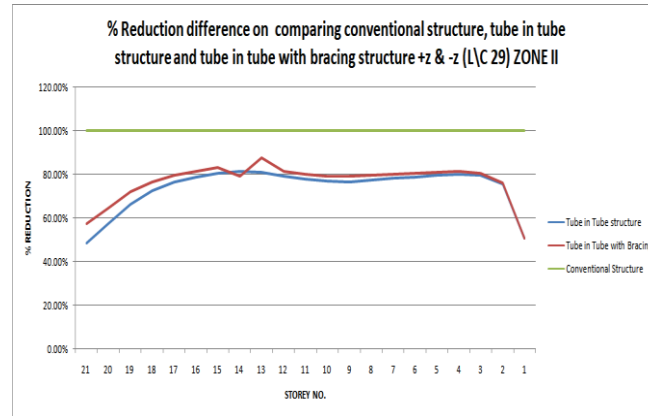


Fig. 2. % reduction difference on comparing conventional structure with tube structure and tube with bracing structure in z – direction ZONE II

VI. CONCLUSION

- Tube in tube structural system can be considered as a better option for lateral load resisting system in terms of base shear, storey displacement and storey drift.
- Displacements and storey drifts on each floor are observed to be reduced when compared with conventional structure.
- As per the analysis done in this project for the given structure the base shear of the building is reduced by 20 – 25% for selected beam properties, column properties and shear walls for all zones
- The results also conclude that for the given structure the storey displacement is reduced by 40 - 80% for certain properties of beam, column and shear wall.
- The results also conclude that for the given structure the storey drift is reduced by 40 - 80% for certain properties of beam, column and shear wall.

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