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Comparative Analysis of Single Column and Multi Column Structure

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ABSTRACT: This research conducts a comparative examination of RCC Frame structures supported by single columns and multiple columns. Both the structures are analyzed in ETABS Ultimate 18.1.1. Geometric modelling, providing material properties and sectional properties, fixing supports and boundary Conditions, providing loads & load combination, and other processes are some of the steps involved in designing an RCC Frame structure supported on a single column and multiple columns using software. Dead load, Live load, Wind load were all taken into consideration in this study and mainly concentrated on wind loads. Comparison between RCC single column and RCC multi column is done on the basis of analytical data. Graphical comparison of deflection, Story drift, and story shear between single and multi column has been showed.

KEYWORDS: Single Column, Etabs, Structures, Multi column.

I. INTRODUCTION

Due to the increasing growth of the population and scarcity of land, construction technology and high rise commercial structure are rapidly developing. When compared to structures supported by multi columns, structures supported by a single column provide a greater architectural vista. As single column structures takes less space for foundation, they allow more space for parking. The project involves the research and design of a rcc structure supported by a single column. RCC or steel can be used to construct a single column structure. In India, RCC buildings are becoming more common. If it is made with cost effective design and construction, it can compete with steel. Its compressive strength is much higher than steel and is more fire resistant. It requires less maintenance and has long life service. Building modeling and structural analysis used to be done by hand, relying on generalizations and a grasp of the whole behavior of the structure. However, it appears to take a lot of time and be difficult for high-rise buildings. Computer gear and software for modeling and structural analysis are currently widely accessible. We must understand how the information learned in the classroom is used in these practical aspects of employment. When i started this assignment, we entered the real world to gather building methods and overcome the many construction challenges. Additionally, having appropriate understanding of the numerous software programmes needed for planning, analysis, and design. Since the 1990s, specialized software has been made available to help with structure design. Some examples are AutoCAD, STAAD-Pro, ETABS, Prokon, and Revit structure, which may help with sketching, analyzing, and designing structures with the greatest degree of precision. In this project, Plan for the single column structure and multicolumn structure is carried out in AutoCADD 2017. Analysis and modeling of structure has been carried out in ETABS 2018 software.

II. RELATED WORK

Ambati venu babu¹, Dr.Dumpa venkateswarlu²(2016) et al^[1]

This research looked at how a single column can sustain the entire construction while the other parts operate as cantilevers. To lower the structural beams cantilever span, two-third of the length was converted to simple support by using beams and ring beams. Staad pro (structural analysis package) is used to evaluate and design the structure, It uses the stiffness matrix approach. Under design purposes, the aforesaid structure was studied for several for several probable loading circumstances and the critical was chosen. According to this paper, the Office Building with Mono Column project underwent comprehensive examination and design before being finished. When planning and developing, we examine the most efficient use of space, and we guarantee that it will perform to its full potential.

Madireddy Satyanarayana¹ (2016) et al^[2]

He researched and designed a multistorey skyscraper based on a single column employing various code allowances. AUTO CADD 2010 is used to create a layout plan for the proposed project. The building has a ground floor and five floors, with one dwelling on each floor. The stairwell must be purchased individually. The planning is done in accordance with Indian standard code requirements. Te many textbooks are used to analyse the building frameworks. Many standard texts use this to calculate BM, SF, Drift, End moments, and foundations reactions. Additionally, each prominent and typical R.C.C. member has detailed structural drawings. All structural members coordinates are recorded for easy reference. He came to the conclusion from his research that the limit state approach of design should be applied. He carried both manual and software design work on the structure. He also employed the sp 16 and sp34 code provisions in our project.

Badikala sravanthi¹, Dr. k.rajesekhar² (2016) et al^[3]

In this project, an RCC structure supported on a single column is designed and analysed. RCC single column and multi column structures are compared in terms of cost. This work investigates the structural modelling of a structure, stresses, BM, SF and displacement engineering factors using STAAD pro. In static analysis, the influence of plan geometry is crucial. Maximum stress, bending moment, shear force and displacement data are shown. The acting loads that were examined in this study are self weight, floor load, wind load and earthquake. In these situations, floor load was applied perpendicular to the RCC structure. The conclusion of this research is that a single column construction may successfully handle all loads, including earthquake and wind loads. When compared to multi-column structures single-column structures are 20% more expensive. Even though its costs a little more, Compared to a multi-column building, a single column building offers a superior architectural view and more open ground area

III. METHODOLOGY

A. Problem statement

Using the software ETABS, a G+6 story model of single column is constructed, then analysis and configuration are carried out. The building's dimensions are 12 m x 12 m. Structure is analysed for dead load, live load and wind loads. Comparative Analysis of single column and multi column structure is done.

B. Physical parameters of Building

Span of the structure is 12m having 4 bays at 3m each

Width of the structure is 12m having 4 bays at 3m each

Height of the structure is 25.5m

Table 3.1 Specifications of single column structure

Description	Unit
Stories	G+6
Height of stories	First-4.5m, Second-6m, Remaining story- 3m
Grade of concrete	M40
Grade of steel	HYSD 550
Slab thickness	125 mm
Single column	(3x3) m
Primary column	(0.7x0.7) m and (0.95x0.7) m
Beams	(3x2)m, (1.3x0.95)m, (0.95x0.65)m

C. Modelling in Etabs

The following details the entire study and design process:

- Define the geometry of the structure - Define grids, Number of stories, similar stories.
- Define the materials property - Define grade of steel and concrete.
- Define the sectional property - Define dimensions of members like beam, column, walls and slab etc.
- Assigning the supports - Assign supports to the joints.
- Define load cases
- Define load combinations
- Assign particular loads on the structure members
- Check for error and warning
- Analyse the structure and later design it based on the considerations.

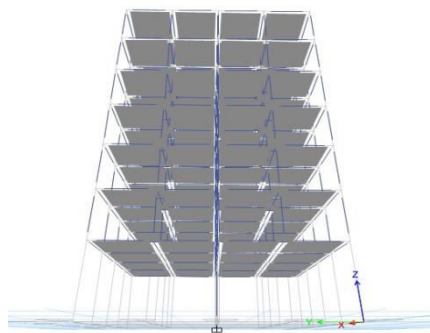


Fig 1. 3D view of single column structure

IV. EXPERIMENTAL RESULTS

A. The graph shows deflection if single column and multi column structure under wind load in X-direction and maximum deflection at 22m of single column structure is 10.68mm and multi column is 0.42mm. This shows single column structure deflects more than multicolumn

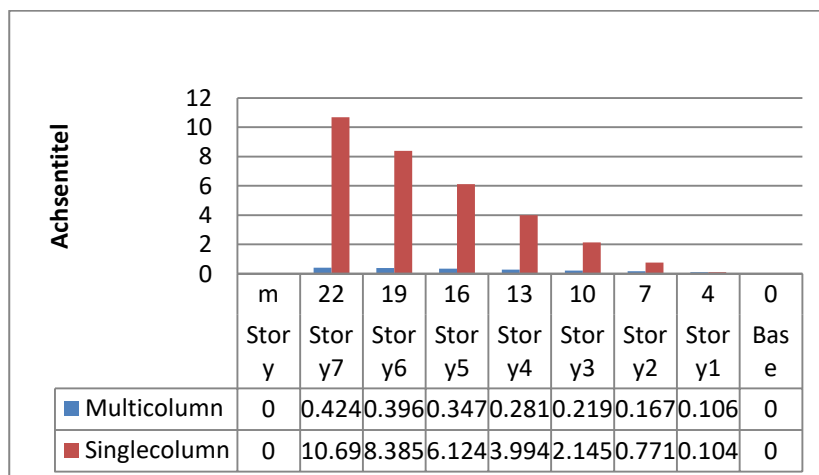


Chart A. Graphical representation of single column and multicolumn displacements

B. The graphical representation of story shear of single column and multi column structure is shown below. Story shears decreases with increase in the height of the structure. The maximum story shear for single column structure is 232.9KN at story 1 and minimum story shear is 18.17KN at story 7. For multicolumn structure max story shear is 198.9KN and min is 14.1KN

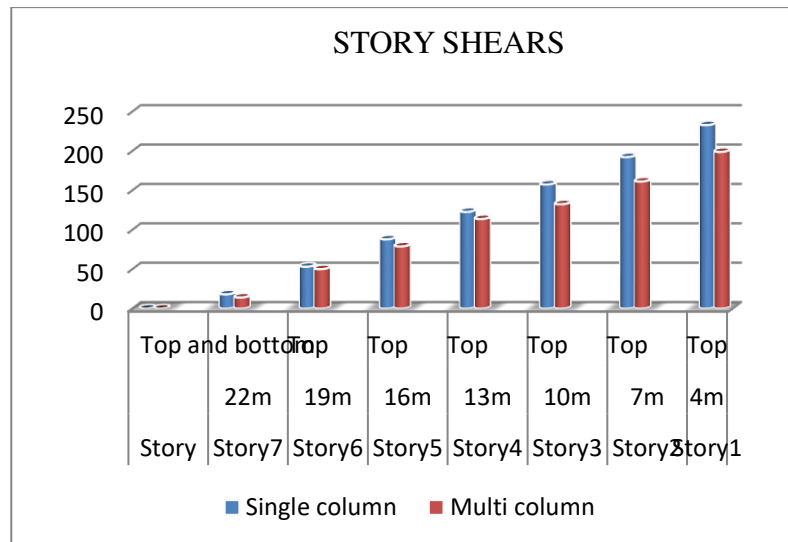


Chart B. Graphical story shears of single column and multi column structure

C. The above figure shows graphical representation of story drifts for single column and multicolumn structure for wind loading conditions for X-direction. Story drift for single column structure is more than multicolumn structure.

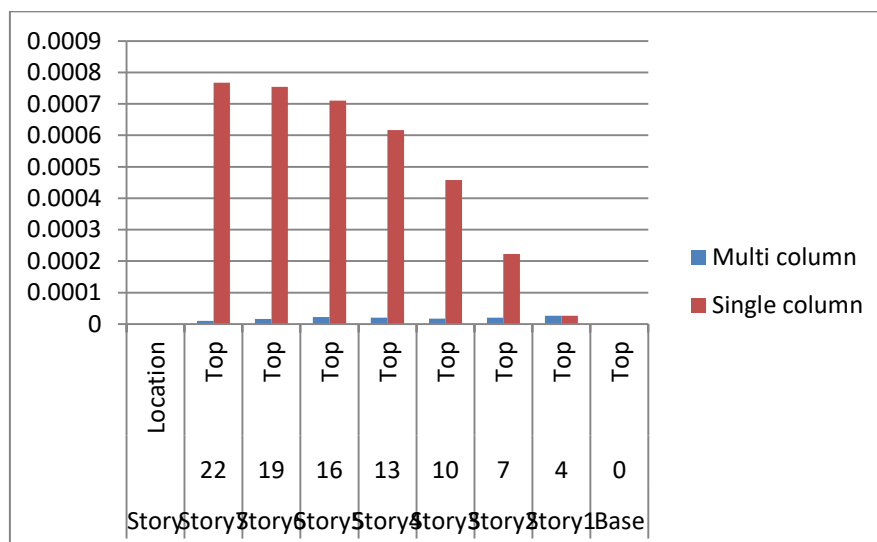


Chart C. Graphical story drift of single column and multi column structure for X direction



V. CONCLUSION

1. All loads, including dead loads, live loads, and wind loads have been successfully engineered to withstand single column structures.
2. Although more expensive than multi-column structures, single column structures offer a superior architectural vista and more open ground.
3. This software analysis performed calculates the bending moment, shear force, deflections, end moments, and base reactions.
4. When compared to a multi-column building, single column buildings have higher deflection values.
5. The story shears for single column buildings are significantly higher than those for multi column buildings.

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