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Comparative Analysis of Reinforced Cement Concrete Structure with Vertical Column and Y Shaped Column Using Staad Pro

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Abstract
Nowadays utility/floor area of Residential RC Structure is very costly. Any analysis and design approach which enhances the utility area of residential/commercial buildings is highly appreciable. Many researchers/design engineers attempted to achieve it. Strategies like floating columns, central core columns and cantilever beam structures are one of the usual techniques. In the present study Y shaped columns are adopted instead of conventional (rectangular or square) columns. In the presented study, 10 storied structures are considered for analysis and comparative study between regular and Y shaped columns. All the analysis and design work conducted using Staad Pro V8i version Software.

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I. Introduction

A Y-shaped concrete column is a type of column that has a Y-shaped cross section. The Y shape is created by two branches that extend from the top of the column. Y-shaped concrete columns are often used in buildings with large open spaces, such as stadiums and conventioncenters. They can also be used in buildings with heavy loads, such as hospitals and office buildings. Y-shaped concrete columns are made of reinforced concrete where the concrete provides strength and durability, while the steel reinforcement provides tensile strength. The Y shape of the column helps to distribute the load more evenly, which makes the column more efficient and reduces the amount of material needed.

The artistic change in the shape of columns to the requirements led to the tree type column concept. Thus, in the sense T-shaped, V-shape and Y-shaped columns arrived from the simplification of tree concept as shown in Figure. Concerned mainly about the columns the varied shape of the columns such as V-shape, Y-shape, T, L and cross shapes, trapezoidal column, spindle column etc. There are even more varieties of application of different shapes based on the architectural requirement. Also, the numbers of the columns are reduced it makes an ease and faster construction which is more beneficial. Therefore, an experimental approach is presented here to reduce the number of columns.

1. **Objectives of project:**

Structural Performance Comparison:

• Seismic Resistance: Evaluate the performance of both types of columns under seismic loading, focusing on displacement, base shear, story drift.

• Load Distribution and Transfer: Analyze how loads are distributed and transferred through the structure with both vertical and Y-shaped columns, considering the impact on beams and overall structural behavior. • Lateral Displacement: Compare the lateral displacements of structures with Y shaped and vertical columns, as Y-shaped columns may exhibit higher lateral displacements due to load concentration and cantilever beam effects.

Design and Architectural Benefits:

• Reduced Column Count: Investigate the potential for Y-shaped columns to reduce the number of columns required, leading to increased usable floor area and architectural flexibility.

• Aesthetic Considerations: Explore the architectural advantages of Y-shaped columns, such as their potential to create more open and visually appealing spaces.

Economic Considerations:

• Cost-Effectiveness: Evaluate the cost implications of using Y-shaped columns versus vertical columns, including material costs, construction time, and potential savings from reduced column count.

Material and Design Parameters: • Material Properties: Determine the material properties and design parameters used in the project, such as concrete strength, steel grade, and reinforcement details. • Design

Parameters: Analyze the design parameters adopted for both types of columns, including dimensions, spacing, and reinforcement details.

II. Literature Review

1. "Comparative Study of Reinforced Concrete Oblique Columns Y Shaped Columns and Vertical Columns for High Rise Structure by Using Etabs"- Mr. Akash Urf Hiralal Nandkishor Jaiswal, Dr. V. S. Rajamanya In this research paper they comparatively analyzed and studied the vertical column, Oblique column and Y shaped column with G+20 stories structure under seismic loading using Etabs Software. In this research they used previously researched and the objective of analysis to use the Y shape column in multistoried building for architectural purpose. The study has indicated that objectives of oblique columns and Y-shaped columns will achieve by proper planning and realistically. In the conclusion, Y-shaped columns can be used for architectural purpose by giving the pleasing appearance to inclined support members, which increases the aesthetic appearance of the structure.
2. "Comparative Study of Y-Shaped Columns with Conventional Rectangular Shaped Columns." - Shivaranjitha T H , Naveen Kumar In this research paper they used Etabs software or comparative studied Conventional column and Y shape column. The main objective of study to check the structural behavior of Y-shaped column compared to conventional structure and reducing the number of columns. In this study G+7 stories structure analyzed.in the conclusion they compared the Quantity of concrete for both the shape as well compare number of columns.

III. Methodology

SEISMIC ANALYSIS: Seismic analysis is a major tool in earthquake engineering which is used to understand the response of buildings due to seismic excitations in a simpler manner. In the past the buildings were designed just for gravity loads and seismic analysis is a recentdevelopment. It is a part of structural analysis and a part of structural design where earthquake is prevalent. There are different types of earthquake analysis methods.

a) Equivalent Static Analysis
b) Response Spectrum Analysis
c) Time History Analysis

In this project the Equivalent static analysis method is used. EQUIVALENT STATIC ANALYSIS: The equivalent static lateral force method is a simplified technique to substitute the effect of dynamic loading of an expected earthquake by a static force distributed laterally on a structure for design purposes. This approach defines a series of forces acting on a building to represent the effect of earthquake ground motion, typically defined by a seismic design response spectrum. It assumes that the building responds in its fundamental mode. For this to be true, the building must be low-rise and must not twist significantly when the ground moves. The response is read from a design response, spectrum given the natural frequency of the building (either calculated or defined by the building code). The applicability of this method is extended in many building codes by applying factors to account for higher buildings with some higher modes, and for low levels of twisting. To account for effects due to "yielding" of the structure, many codes apply modification factors that reduce the design forces.

IV. Modelling And Analysis

In the present study we are investigating the behavior of different shapes of irregular high rise structure subjected to seismic and wind forces with and without different types of steel bracing systems which helps us to determine more feasible and effective type of steel bracing system by using STAAD.pro.V8i.SS5. The procedure of the above-mentioned investigation is described in this chapter of methodology.

Description of structure:

Models that have been prepared for present investigational study along with other parameters for G+9 building for all is represented in the Table No.

Model No.	SHAPE OF STRUCTURE	LENGTH(m)		SHAPE OF CLOCMN
		X	Z	
1	Square	15	15	Vertical column
2	Square	15	15	Y-Shape column
3	C	18	27	Vertical column
4	C	18	27	Y-Shape column
5	T	27	27	Vertical column
6	T	27	27	Y-Shape column
7	L	18	18	Vertical column
8	L	18	18	Y-Shape column

Geometrical Data:

- Floor to Floor Height: 3.0 m
- Total height of Structure: 31.2 m
- Type of building: commercial building
- Foundation or Plinth height: 3.2 m
- Column Size: 600mm X 600mm
- Beam size: 600mm X 600mm
- Slab thickness: 125 mm
- Wall thickness:

a) External wall: 230 mm
b) Internal wall: 150 mm

Earthquake Data:

(Based on Indian seismic Code, IS 1893:2002)

- Seismic Zone: Zone III (Table 2, IS1893(Part 1):2002)
- Seismic zone factor: 0.16 (Table 2, IS 1893(Part 1):2002)
- Response Reduction: Special RC Moment Resisting Frame (SMRF)

(Table 7, IS 1893 (Part 1):2002)

- Importance Factor: 1.5 (Table 6, IS 1893(Part 1):2002)
- Type of Soil: Medium Soil (Fig. 2, IS 1893(Part 1):2002)
- Damping Ratio: 5% (Table 3, IS 1893(Part 1):2002)
- Drift Factor: 0.004 x h = 0.2048

Loading Data:

Earthquake Loading:

- Earthquake Load: In X and Z direction i.e. EQX and EQZ

Dead Load:

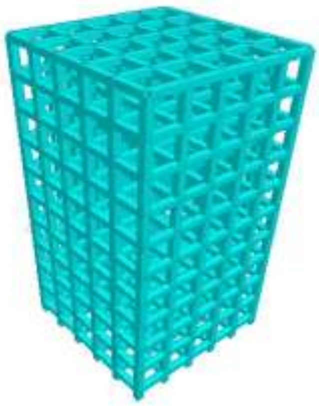
- Self-weight: Automatically defined by software.
- Wall Load:
- External Wall: 20 x 1 x 0.23 x 3 = 13.8 KN/m
- Internal Wall: 20 x 1 x 0.15 x 3 = 9 KN/m
- Parapet Wall: 20 x 1 x 0.15 x 1.2 = 3 KN/m
- Slab Load: 25 x 1 x 1 x 0.125 = 3.125 KN/m
- Floor Finish: 1.375 KN/m
- Live Load: 4 kN/m (Table 1, IS 875(Part 2): 1987)
- Roof Live Load: 2 kN/m (Table 8, IS 1893(Part 1):2002)

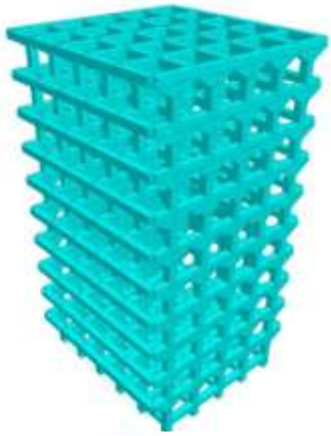
Load Combination based on IS 1893:2002

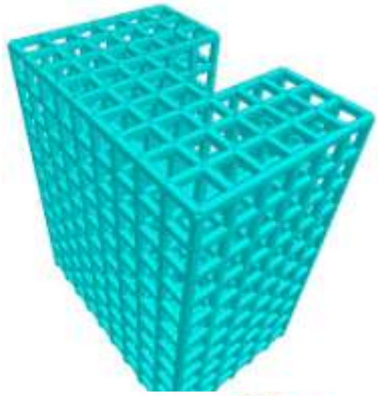
1.5 (DL + LL)
1.2 (DL + LL ± EQX)
1.2 (DL + LL ± EQZ)
1.5 (DL ± EQX)
1.5 (DL ± EQZ)
0.9 DL ± 1.5 EQX
0.9 DL ± 1.5 EQZ

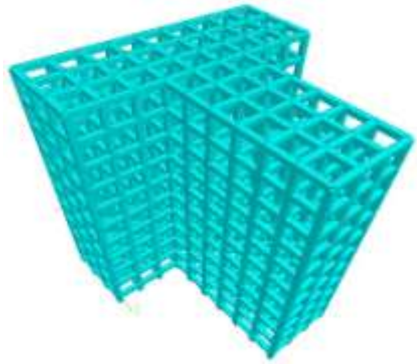
Analysis in STAAD.pro:

After computation of all of the above steps then final operation of analysis is carried out. The software studies the required data given and assumes some data automatically to analyze the structure.





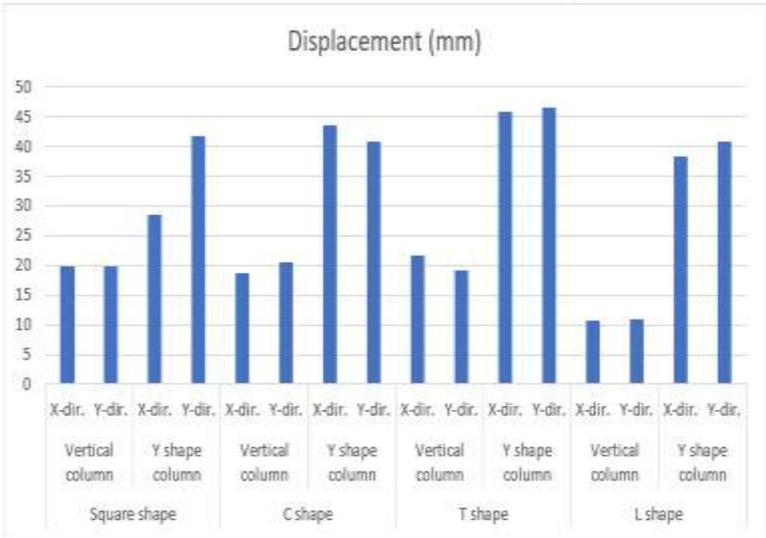




V. Result

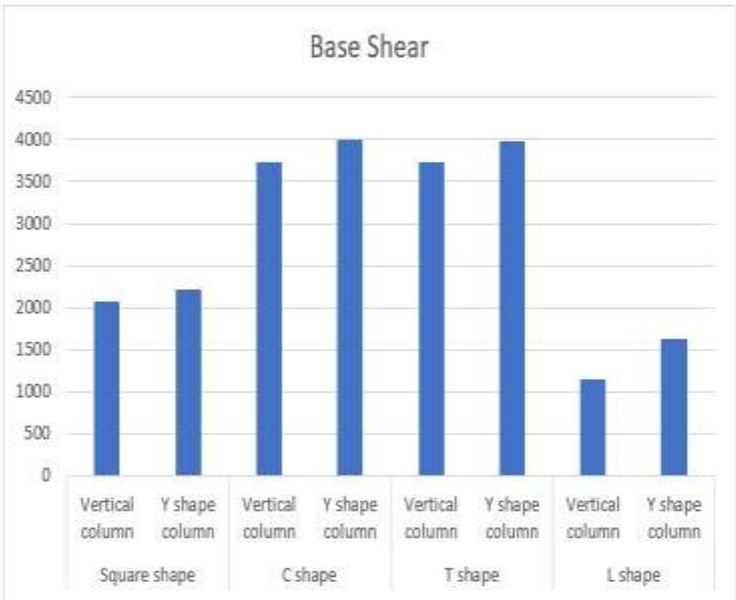
1. Comparison of lateral displacement (mm) in X and Y-direction for medium soil in mm

Shape of building			Displacement (mm)
Square shape	Vertical column	X-dir.	19.78
		Y-dir.	19.76
	Y shape column	X-dir.	28.61
		Y-dir.	41.75
C shape	Vertical column	X-dir.	18.72
		Y-dir.	20.59
	Y shape column	X-dir.	43.51
		Y-dir.	40.77
T shape	Vertical column	X-dir.	21.7
		Y-dir.	19.07
	Y shape column	X-dir.	45.88
		Y-dir.	46.51
L shape	Vertical column	X-dir.	10.63
		Y-dir.	10.96
	Y shape column	X-dir.	38.3
		Y-dir.	40.92



2.Comparison of base shear in X and Y direction for medium soil in KN

Shape of building		Base Shear
Square shape	Vertical column	2075.96
	Y shape column	2219
C shape	Vertical column	3729.88
	Y shape column	3996.83
T shape	Vertical column	3729.88
	Y shape column	3971.53
L shape	Vertical column	1143.75
	Y shape column	1625.07



VI. Conclusion

As compare to vertical column, in Y shape column the lateral displacement increases byAs follows

1. in square shape building the lateral displacement in X-direction increase by 69.13% and in Y-direction 47.32%.
2. in C shape building the lateral displacement in X-direction increase by 43.02% and in Y-direction 50.50%.
3. in T shape building the lateral displacement in X-direction increase by 47.29% and in Y-direction 41.00%.
4. in L shape building the lateral displacement in X-direction increase by 27.75% and in Y-direction 26.78%.
5. Minimum Displacement is occurring in square shape of building.
6.. . the Base shear in all shape of structure increases in Y shape column as compare to vertical column are 6.89% in Square,7.15% in C shape, 6.08% in T shape and 42.08% in L shape of structure.

7.The base shear in all structure increases in Y shape column as compare to vertical column, in square shape structure the base shear increases by 6.789%, in C shape increase by 7.15%, in T shape increase by 6.08% and in L shape 42.08%.

8.The analysis reveals that the base shear significantly increases in Y-shaped columns compared to vertical columns, with notable variations across different structural shapes, particularly highlighting a substantial 42.08% increase in L-shaped structures.

9.In conclusion, the analysis demonstrates that Y-shaped columns lead to increased lateral displacement and base shear across various structural shapes, with the most significant impact observed in L-shaped structures. Importantly, while all structures remain within the acceptable limits for storey drift.

References

[1]. "Comparative Study of Reinforced Concrete Oblique Columns Y Shaped Columns and Vertical Columns for High Rise Structure by Using Etabs"- Mr. Akash Urf Hiralal Nandkishor Jaiswal, Dr. V. S. Rajamanya

[2]. "Earthquake Analysis of Reinforced Concrete Oblique Columns and Y-Shaped Columns using ETABS: A Comparative Study" - Prof. Dr. P. L. Naktode1, Yogesh R. Pawar, Shubham V. Sarode,Sujay S. Khairnar, Bhavesh S. Chaudhari, Vaibhav M. Bedse.

[3]. "Comparative Study of Y-Shaped Columns with Conventional Rectangular Shaped Columns." -Shivaranjitha T H , Naveen Kumar

[4]. "Comparative analysis of reinforced concrete oblique column and Y shaped columns by using Etabs."-Harshada Ashok Targe, Utkarsha Dilip Bhadan, Gauri Madhav Derle, Sakshi Sandip Mane, Sayali Satish Bahalkar

[5]. IS 1893 (Part 1) : 2002, "Criteria for Earthquake Resistant Design of Structures", Part 1 General Provisions and Buildings, Fifth Revision, Bureau of Indian Standards, New Delhi.

[6]. 8) IS 456: 2000, Plain and Reinforced Concrete – Code of Practice, Fourth Revision, Bureau of Indian Standards, New Delhi.

[7]. 9) IS 875 (Part 1): 1987, "Code of Practice for Design Loads for Building and Structures", Part 1 Dead Loads – unit weight of building materials and stored materials, second revision, Bureau of Indian Standards, New Delhi.

[8]. 10) IS 875 (Part 2): 1987, "Code of Practice for Design Loads for Building and Structures", Part 2 Imposed Loads, second revision, Bureau of Indian Standards, New Delhi.