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COMPARATIVE STUDY OF REINFORCED CONCRETE OBLIQUE COLUMNS Y SHAPED COLUMNS AND VERTICAL COLUMNS FOR HIGH RISE STRUCTURE BY USING ETABS

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ABSTRACT

RC columns for high-rise structures are compared in this research. RC floor space for homes is becoming more and more costly. Residential or commercial building utility improvement research and design is welcomed. It was attempted by a large number of designers and researchers. Cantilever beams and floating column structures are widespread. Oblique and Y-shaped columns are employed instead of rectangular or square ones in this study. Twenty-story structures are studied, and the comparison between oblique columns and vertical columns is made. For all analysis and design, ETABS 2016 is the preferred software platform. There is a greater displacement in the regular column compared to the other two. The displacement of a regular column is 26.68 percent more than that of a y-shaped column and 56.78 percent greater than that of an oblique column. The tale drift in a regular column is greater than in the other two. The y-shape column has an 18.91 percent greater tale drift than the oblique column, and a 50.16 percent larger narrative drift than the regular column. The base shear of a normal column is greater than the shear of a hollow column. Y shape column base shear is 47.21 percent greater than the regular column base shear, while oblique column base shear is 54.05. The regular column is longer than the other two. There is a 33.78 percent difference between the regular column and the oblique column when it comes to column time. The frequency of the regular column is greater than that of the other two. The frequency of a regular column is 33.69 percent greater than that of a y-shaped column and 54.64 percent higher than that of an oblique column. The usage of oblique columns and Y-shaped columns in architecture may enhance a structure's aesthetic appeal by providing slanted support components an attractive look.

Keywords: Columns, Oblique Columns, Y-Shaped Columns, Equivalent Static Method, Response Spectrum Method, Displacement, Storey Drift, Base Shear, Time Period, Frequency Etc.

I. INTRODUCTION

1.1OPENING REMARKS

Here, you'll learn about the many types of columns and how they're categorised by their structural properties and the materials they're made of.

This chapter also provides an overview of the dissertation's suggested structure.

1.2 COLUMNS

There are several different examples of major columns or pillars used in architecture and planning to transfer weight from above to those below. A compression member, therefore, is a column. Large spherical pillar (the shaft of the column) with capital and base or pedestal constructed of stone, or seeming to be made of stone, is often referred to as a "column." Posts are often little wooden or metal supports, while piers are obviously larger wooden or metal endorses with a hexagonal or other ou pas portion. Vertical members with an effective area more than three times that of their base A column is the smallest medial height that bears structural load. Beams or slabs are supported by columns, which carry their weights to the bottom or basement. Struts are the bent members that bear compression forces, such as frames and bridges. When the length of the line of a perpendicular stress component is less than three times the shortest side dimension, we call it a pedestal.

Columns may be built to withstand lateral stresses for wind pressure architecture. The word "column" is frequently used to refer to other compression elements that are subjected to comparable stresses. The higher portions of walls and ceilings are usually supported by columns. The term "column" in considered a key to a structural element with proportioned and ornamental characteristics. It is possible for a column to be used as a decorative feature, but it is also possible for it to have a structural function. The term "colonnade" refers to a series of columns that are connected together by a frieze..

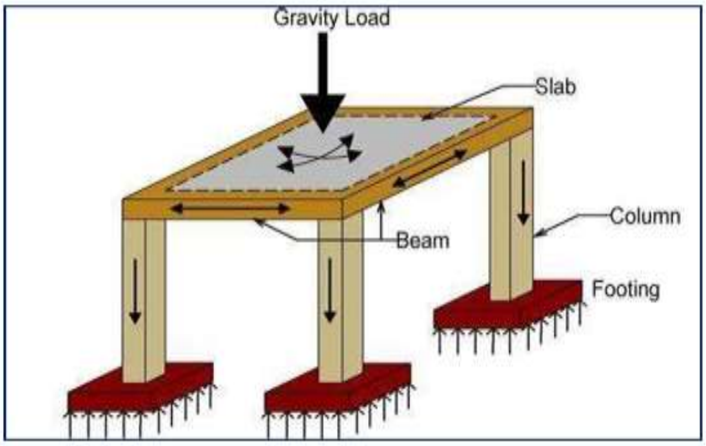

Figure 1: Columns

1.3 CLASSIFICATION OF COLUMNS

Chandeliers come in a variety of shapes and sizes and used in many portions of buildings. A structure is a hierarchical responsible for the physical system that mostly bears tensile stresses. Depending on the use, it might move weight from a frame or a ceilings to the floor or bases. A commonality of buildings is the presence of deflection along one of the other cross-sectional axes. Various kinds of poles used in infrastructure design will be described . finally.

There are a variety of criteria used to classify columns, including:

1. Based on Types of Reinforcement
2. Based on Types of Loading
3. Based on Slenderness Ratio
4. Based on Shape
5. Based on Construction Material

1.4 OBJECTIVE

The main purpose of analysis is to compare the response of the oblique columns Y- shaped columns and vertical columns under seismic loading. Following are the objectives of the present study:-

To analyse G+20 storied reinforced concrete (RC) structure under seismic loading with oblique columns.

To analyse G+20 storied reinforced concrete (RC) structure under seismic loading with Y-shaped columns.

Comparative analysis of oblique columns Y-shaped columns and vertical columns under seismic loading with respect to displacement, base shear, storey drift, frequency and time period.

Comparative study G+20 storied reinforced concrete (RC) structure with oblique columns Y-shaped columns and vertical columns under seismic loading with respect to displacement, base shear, storey drift, frequency and time period.

II. LITERATURE REVIEW

2.1 Opening Remarks

The analysis of the evidence includes some prior studies on inclined columns, Y-shaped paragraphs, and 3 columns, among other topics. The articles in this collection aid in the consideration of many factors that influence the research of this program and its outcomes. Using the above-mentioned variable characteristics, this paper serves as a road map for future study and aids in formulating a proper research strategy. Diagonal rows and Y-shaped columns may be found in the following literature: On the basis of the Elastic Modulus:

2.2 Literatures Reviewed

An ANN model was used to predict the maximum bending loads of W h inter columns, as Thuy-Anh N. et al. (2021) found. As a building inspector, it is essential to accurately assess collapsing strain. In this article, the Classifier method was used to forecast the crack pattern load of Y-shaped merge metal beams using a perceptron (ANN). Development / certification records were created using the findings of 57 breaking studies. The vertical diameter, column breadth, steel unequal angle thicknesses, the shape and size of the bonded steel sheet, and the overall aberrations follow the Ox and Oy dimensions were all taken into consideration. The result was the columns' maximum bending load. The correlation value (R), standard error (RMSE), and median variance were also used to measure the detection rate (MAE). ANN shape construction was central, followed by two studies on the most accurate models. It was the ANN model that generated the lowest MAE of 40.0835 and RMSE of 30.6669, while the third one had R = 0.98488, which was the greatest. The findings showed that using MAE and RMSE instead of the R criteria for evaluation was far more reliable and appropriate. Priority was given to the RMSE and MAE requirements, rather than the regression analysis. [1]

Sridhara K. S. et. al. (2021) studied seismic response of multi-storey building with oblique columns. In recent decades there are more complex structures that are challenging earthquake theories. The earthquake involves generating seismic waves which passes through earth crest and causes massive damage to the existing structures. The densely populated area in which the buildings are not perfectly modeled can be called as earthquake prone area where the small earthquake causes a disastrous effect. The columns where they are neither parallel to each other nor they are exactly vertical are known as oblique columns. The specialty of these oblique columns is that the angle which is greater than 90 degree will have increase in its plan as we move to higher floors whereas the angle of column which is less than 90 degree will have its plan decreased as we move to higher floors. The oblique restraint causes coupling action on the principal axes. In this present study it involves the study of oblique column effect on a model which has 30 floors in which Height of each floor is 3.2m. The width of each bay at base is 7 m. The columns are inclined at an angle of 80°, 82.5°, 85°, 87.5°, 92.5°. Here linear static and dynamic analysis is done and results are obtained. [2]

Nikha S. et al. (2020) investigated the seismic performance of oblique columns in increased structures. Today, many structural strategies are used to improve a structure's structural vulnerability. The technological innovation of "strong beam and firm section" is emphasised, and so the members in a seismic resistant construction play an important part in determining the total durability of the construction against with the influence of seismic loads. Asymmetric Columns are columns that are angled or turned at an angle and are both orthogonal nor at perpendicularly to a given line. The structural analysis of Values of x diagonal columns in balanced and unbalanced roof structures buildings was researched and contrasted in this article using ETABS 2016 software. The use of space attained by using a Y-shaped columns was also investigated. The optimal tilt angle of Y was examined. Deformation, inter - storey, and timespan of high rise construction with Y shaped were analysed with ordinary column structure using wavelet transform.

III. METHODOLOGY

3.1 Research, Utilization, and Designing

When the modelling is finished, ETABS creates and gives computer lateral forces for pressure, tectonic, pressure, and heating forces. Users have a limitless amount of load situations and configurations to choose from. Defined as " the ability approaches for characterisation of compressed and dynamic behaviour are then provided by analysis skills. Phase, comment, and timeline analysis are examples concerns. Dynamical inversion is explained by the P-delta effect. Develop capabilities will intelligently scale components, designs reinforce methods, and generally optimise the framework based on enveloping specifications.

3.2 Productivity, Usability, and Flexibility

The production and displaying options also were efficient and user-friendly. Phase, stress, and applied load drawings may be arranged into customisable studies and displayed in 2D and 3D perspectives with supplementary pieces of data Various local response choices are shown via detailed section cuts. Other widespread views display motionless displacing configurations or are suitable to moment response and show these features in their immobile forms.

With the help of ETABS, you may import physical concepts from other image manipulation programmes and convert them in a variety of formats for use in other software upgrades. SAFE, the floors and basement slab research methodology with thread (PT) capabilities, is one such exporting option. CSI coordinated the integration of SAFE and ETABS so that professionals could better investigate, evaluate, and improve the various ETABS layers.

ETABS has a broad variety of talents, but it may also be used to develop basic structures. ETABS is an amazing power answer for the most complex power poles to the far more simple 2D frames.

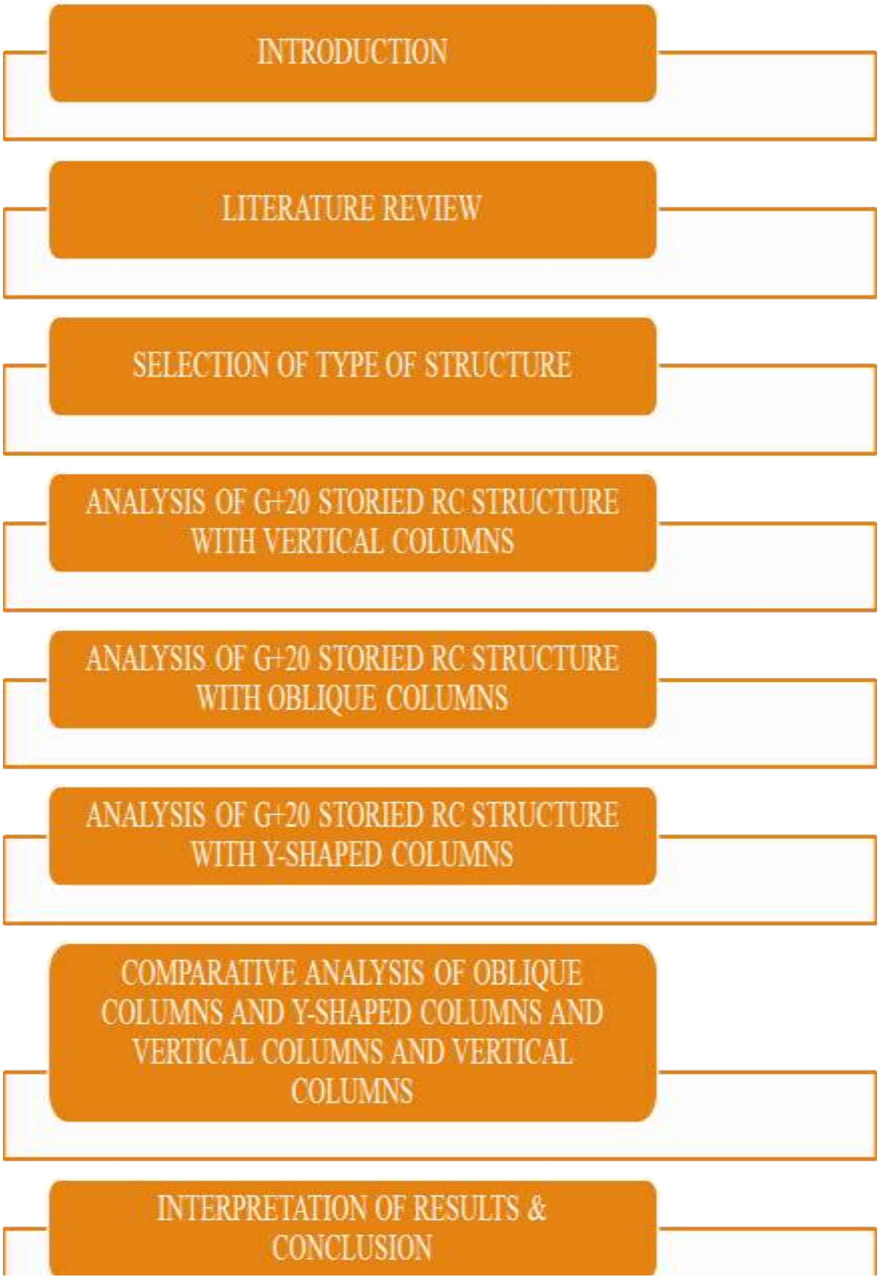

Figure 2: Layout of the Project

3.3 Oblique or Inclined Columns

Slanted columns are not parallel and are employed in several building projects for aesthetically and functional purposes. The structure of larger segment, weights, and deflections in larger segment are all examined. A became a required component that is susceptible to axial load in the entirety of its length that has some or no action. It is a camber if another part is angled. However, all of these sections have one similar theme: people are all compressed and are classified as struts pieces. Because of community growth and progress, innovative technology in the building sector is quickly developing. One of the most important metal structures of all time, too, has gone thru many adjustments in construction to achieve a distinct aesthetic vision. Panels are no anymore perpendicular, according to the new notion. It could be bent. Oriented columns are derived from the domain of design building elements downward load laden piers, and they may be used in both inflexible and supported frameworks.

When considering an inclined column (strut), the forces it is exposed to are axial compression, moments, and shear, which may be determined using any frame analysis approach.

3.4 Y-shaped Columns

In general, these cells are commonly employed in civil infrastructure. The viaduct was built to support the passive structural load as well as the active load of driving, and the pressure being finally transferred to the pillar. The Y-shaped poles may be utilised for structural applications by providing a nice aspect to sloping put trust, increasing the bridge's visual quality. Economy in beam bottom architecture may be realised as the volume of members is decreased.

Figure 3: Y-Shaped Column

3.5 Seismic Analysis Methods

Vibratory analysis is a very important method in seismology that is used to better explain the reaction of structures to seismic action. Previously, structures were only planned for base shear, and geotechnical engineering is a relatively new invention. It is a component of stress design and structural in areas where earthquakes are common.

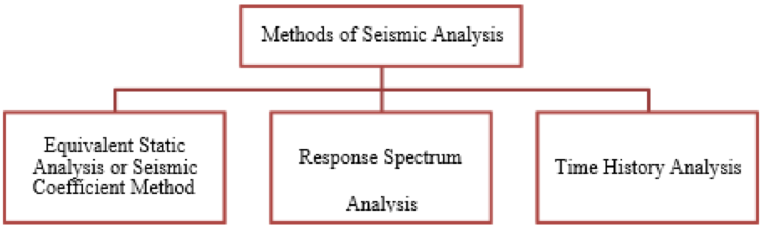

Figure 4: Methods of Seismic Analysis

There are several earthquakes monitoring methodologies. Among those employed in the endeavor are:

1. Static Analogue Assessment or Vibration Sensitivity Methodology
2. Response Spectrum Analysis
3. Time History Analysis\

IV. PERFORMANCE ANALYSIS

4.1 Configuration of the Models

Structures are modelled in the present research that used the numerical simulation programme ETABS. The facility's calculations comprise all aspects that impact the bridge's density, rigidity, elasticity, and high compressibility. The fundamental structure of a house is made up of timbers, arches, and a slab. Non-structural factors that have little effect on model curriculum are not modelled. Modelling are submitted to different loads and acoustic susceptibility assessment. It is suggested to investigate the efficacy of slanted columnar, Y-shaped editorials, and two vertical. The beam and section are represented by two curved line elements with six degrees of freedom at each node. The slab is represented by four nodded area pieces.

In this paper, rcc G + 20 storey structures with slanted columns, Y-shaped columns, and connecting lines located in zone V (increasingly harsh range) are studied. Details of models are shown below:

1. Model 1: G + 20 storied RC structure with vertical columns
2. Model 2: G + 20 storied RC structure with Oblique columns
3. Model 3: G + 20 storied RC structure with Y-shaped columns

Table 1: Structural Data for both Models

Sr. No.	Description	Specifications
1	Type of Structure	G + 20 Storied RC Structure
2	Structure Type	Plan Regular Structure
3	Plan Dimensions	12 m X 12 m
4	Total Area	144 sq. m
5	Bay Width in Longitudinal Direction	4 m
6	Bay Width in Transverse Direction	4 m
7	No. of Bays in Longitudinal Direction	3 bays of 4 m length
8	No. of Bays in Transverse Direction	3 bays of 4 m length
9	Height of Building	70.2 m (G + 20 Storey)
10	Height of Each Storey	3.2 m
11	Plinth Height	1.2 m
12	Depth of Foundation	2 m
13	Size of Beams	230 mm X 450 mm
14	Size of Columns	C1 = 300 mm X 600 mm C2 = 450 mm x 450 mm
15	Thickness of Slab	150 mm
16	External Wall thickness	200 mm
17	Internal Wall thickness	100 mm
18	Height of Parapet Wall	1 m
19	Density of Concrete	25 kN/m3
20	Concrete Grade	M30
21	Grade of Steel	Fe 500
22	Unit Weight of Concrete	25 kN/m3
23	Unit Weight of Steel	78.5 kN/ m3
24	Density of Brick Masonry	20 kN/ m3

The plan of model of G+20 storied RC Structure with oblique columns Y-shaped columns and vertical columns is as follows:

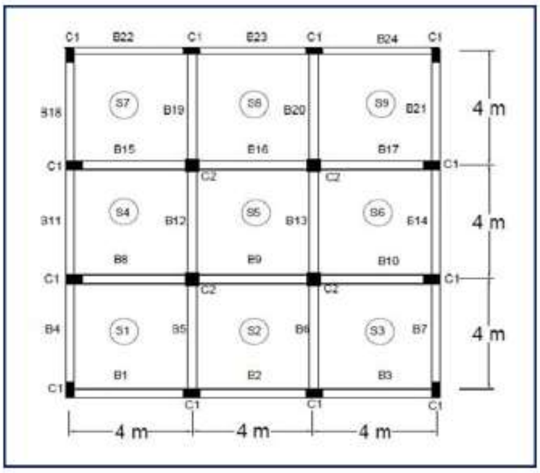

Figure 5: Plan of Model 1 and Model 2

- Model 1: G + 20 Storied RC Structure with Oblique Columns

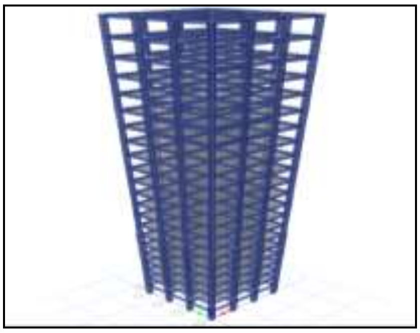

Figure 6: Rendered View of Model 1: G+20 Storied RC Structure with vertical Columns

- Model 1: G + 20 Storied RC Structure with Oblique Columns

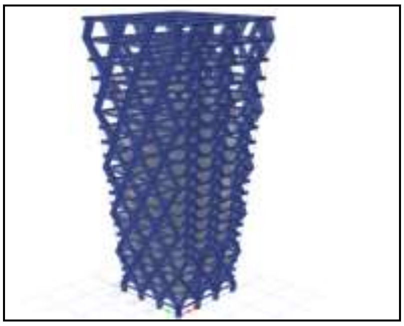

Figure 7: Rendered View of Model 1: G+20 Storied RC Structure with Oblique Columns

- **Model 2: G + 20 Storied RC Structure with Y-shaped Columns**

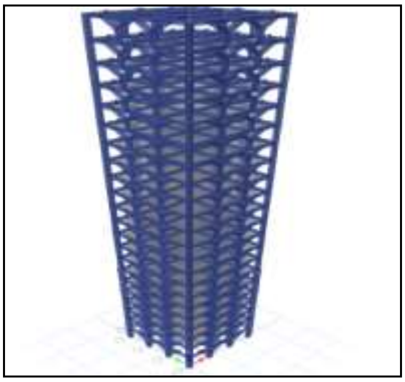

Figure 8: Rendered View of Model 1: G+20 Storied RC Structure with Y-shaped Columns

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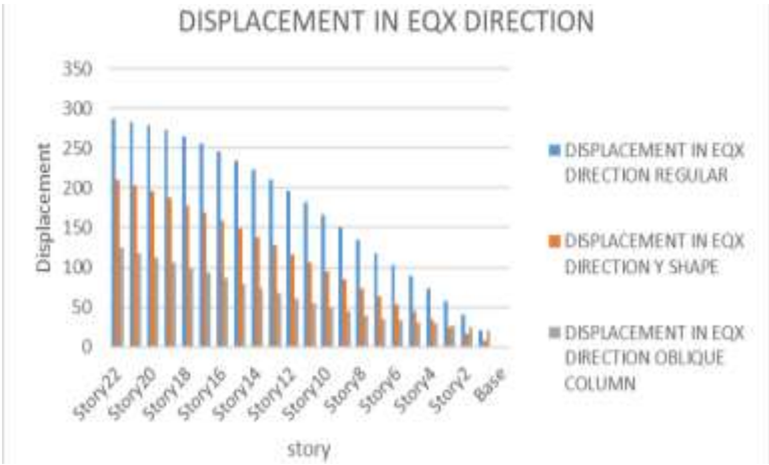
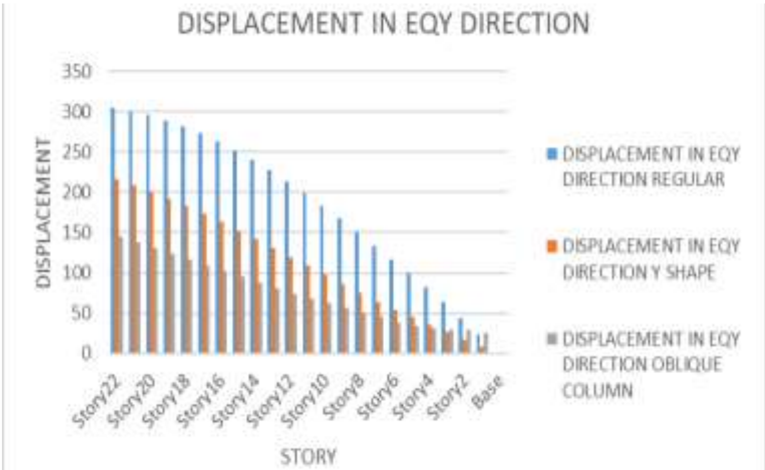
V. RESULT AND DISCUSSION



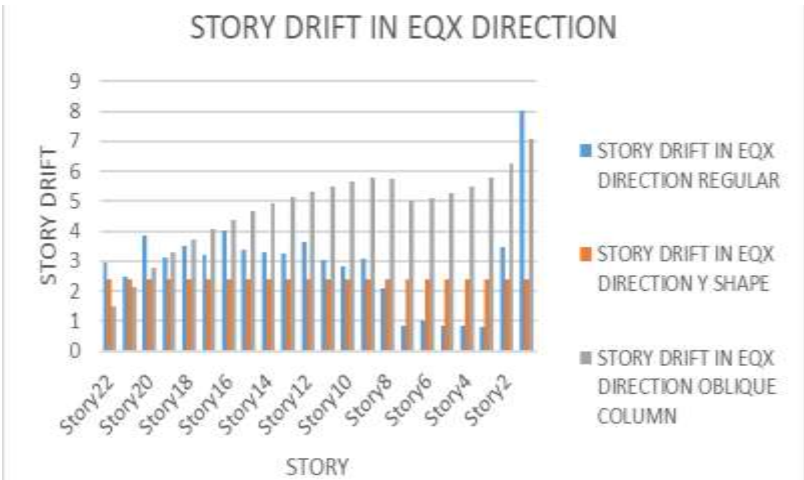
Graph 1: Displacement in EQX Direction

Above graph shows displacement in EQX direction for regular column, Y shape column, oblique column. As we can see that regular column has the higher displacement than the other two. Regular column displacement is higher that y shape column by 26.68 % and oblique Column by 56.78 %



Graph no 2- Displacement In EQY Direction

Above graph shows displacement in EQY direction for regular column, Y shape column, oblique column. As we can see that regular column has the higher displacement than the other two. Regular column displacement is higher that y shape column by 29.16 % and oblique Column by 52.18 %



Graph 3: Story Drift in EQX Direction

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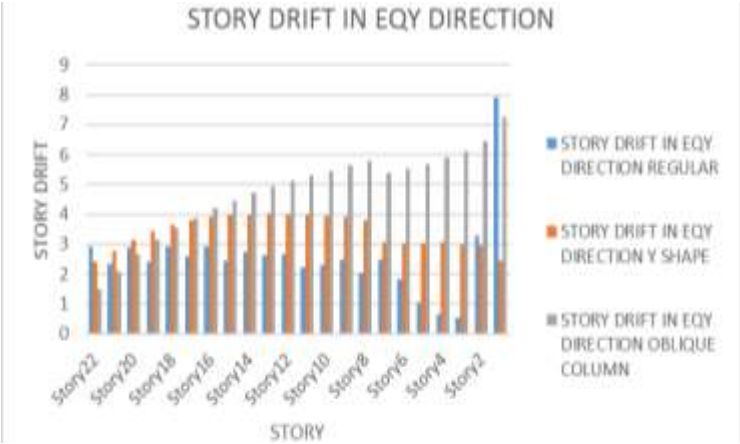
Above graph shows Story Drift in EQX direction for regular column, Y shape column, oblique column. As we can see that regular column has the higher story drift than the other two. Regular column story drift is higher that y shape column by 18.91 % and oblique Column by 50.16 %

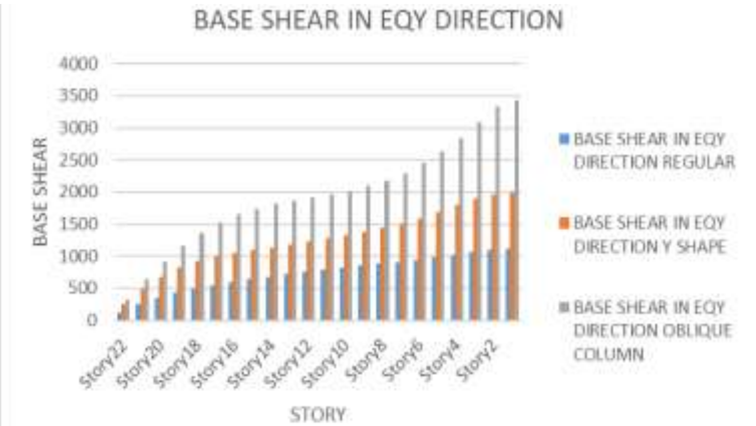


Graph 4: Story Drift In EQY Direction

Above graph shows Story Drift in EQY direction for regular column, Y shape column, oblique column. As we can see that regular column has the higher story drift than the other two. Regular column story drift is higher that y shape column by 17.99 % and oblique Column by 48.97 %

Graph no 5- Base Shear in EQX Direction

Above graph shows base shear in EQX direction for regular column, Y shape column, oblique column. As we can see that regular column has the higher base shear than the other two. Regular column base shear is higher that y shape column by 47.21 % and oblique Column by 54.05 %



Graph 6: Base Shear in EQY Direction

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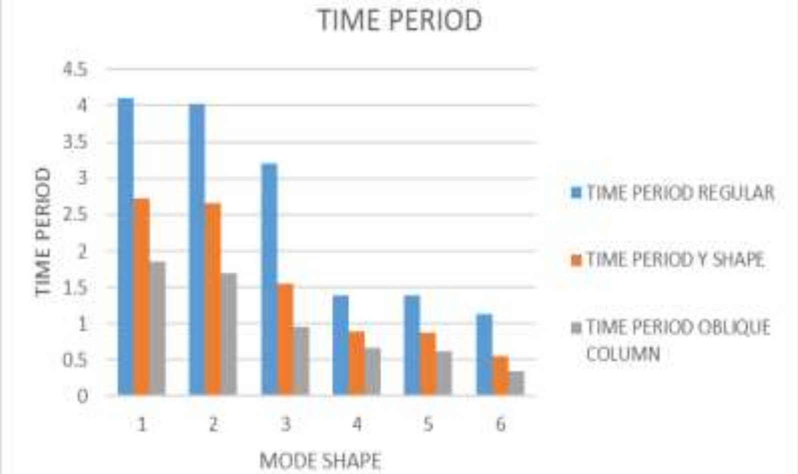
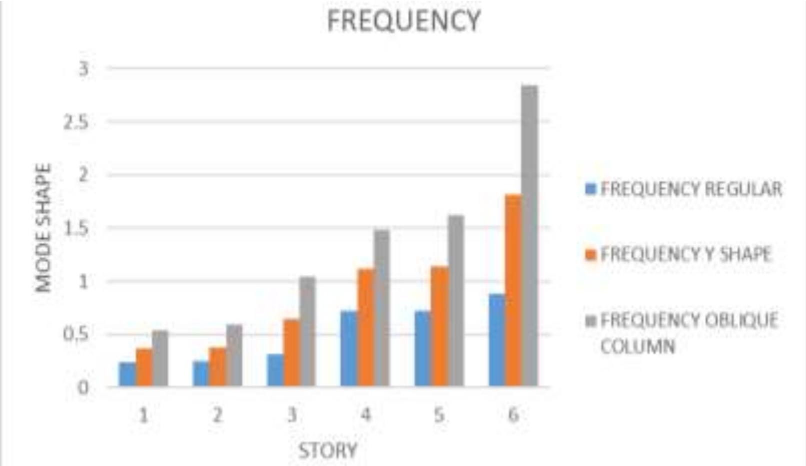
Above graph shows base shear in EQY direction for regular column, Y shape column, oblique column. As we can see that regular column has the higher base shear than the other two. Regular column base shear is higher that y shape column by 48.30 % and oblique Column by 58.88 %



Graph 7: Time Period

Above graph shows time period for regular column, Y shape column, oblique column. As we can see that regular column has the higher time period than the other two. Regular column time period is higher that y shape column by 33.78 % and oblique Column by 54.71 %



Graph 8: Frequency

Above graph shows frequency for regular column, Y shape column, oblique column. As we can see that regular column has the higher frequency than the other two. Regular column frequency is higher that y shape column by 33.69 % and oblique Column by 54.64 %

VI. CONCLUSION

5.1 Opening Remarks

The objective of this research was to analyse oblique columns Y-shaped columns and vertical columns for high-rise structure. The study has indicated that objectives of oblique columns and Y-shaped columns will achieve by proper planning and realistically.

The following summarizes the results and conclusions.

5.2 Conclusion of the Project

- Regular column has the higher displacement than the other two. Regular column displacement is higher that y shape column by 26.68 % and oblique column by 56.78 %
- Regular column has the higher displacement than the other two. Regular column displacement is higher that y shape column by 29.16 % and oblique column by 52.18 %

- Regular column has the higher story drift than the other two. Regular column story drift is higher that y shape column by 18.91 % and oblique column by 50.16 %
- Regular column has the higher story drift than the other two. Regular column story drift is higher that y shape column by 17.99 % and oblique column by 48.97 %
- Regular column has the higher base shear than the other two. Regular column base shear is higher that y shape column by 47.21 % and oblique column by 54.05 %
- Regular column has the higher base shear than the other two. Regular column base shear is higher that y shape column by 48.30 % and oblique column by 58.88 %
- Regular column has the higher time period than the other two. Regular column time period is higher that y shape column by 33.78 % and oblique column by 54.71 %
- Regular column has the higher frequency than the other two. Regular column frequency is higher that y shape column by 33.69 % and oblique column by 54.64 %
- The oblique columns and 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.

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