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Seismic Response Study of Different Shaped Column R.C. Frame Building

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Abstract - *Column plays very significant role in reinforced concrete framed structure as whole load is transmitted through column. When rectangular columns are used in building, columns can project out of the walls and corners which reduce visual outlook of building. Concrete buildings with especially shaped columns has been found out as a solution of this problem. Not only for aesthetical point of view but also for structural point of view, particularly shaped columns perform well. The purpose of this study is to evaluate the relative lateral load resistance capacity of structures with Square columns and structures with specially shaped columns. Two different buildings(3m Height & 4m Height of each story) are analysed with conventional Square columns and same structures are analysed with specially shaped (i.e. Circular, I-Shape & T- Shape) columns with same equivalent cross section area as of Square columns.*

Key Words: Earthquake, Different Column Shape, Response Spectrum Analysis, Story Drift, Displacement, Staad Pro.

1. INTRODUCTION

While designing any structural building, the only distress of the designer is the stability of the building and its performance under internal and external forces & Loads. These forces & loads mostly comprise of dead load of the structure, superimposed load, snow load, or some other loads due earthquake, wind etc. Increase in height more force will be generated in taller building. So, for repelling developed forces, high strength members of the structure are required. Column, being the vertical member, is the most important member in a structure as it transfers the whole loads & forces from all the other structural members to the foundations. Its shape, cross-section and the area of reinforcement will change with the total load acting on the structure. Shape & Size of column can change for any structure according to its purpose. After analysing the total load acting on it, column size and area of reinforcement shall be calculated. Unlike shapes behave differently under similar loading circumstances and other similar structural parameters, consequently, shape of a column should be chosen cleverly. Before, different scholars did different research work for analysing different types of buildings using Staad Pro software.

Numerous research papers include Analysis and Design of 3 storey structure subjected to seismic load using Staad Pro & Etabs Software Analysis of Multi-story structure subjected to gravity and seismic loads with changing Inertia, Comparison of percentage steel and concrete quantities of a R.C.C structure in different seismic zones, however, no one had carried out their research work related to the varying Shape of the column (i.e. rectangular, Circular, I, and T) with variable height & Equivalent cross section area of column of the building using Response spectrum method.

Conventional thinking is being accepted with the structural design that circular column is only superlative for giving architectural presences, but it's not always correct. Consequently, there is a need for discovery which shape of the column can be used for different storied buildings under same loading conditions and same parameters while safety and stability in picture regarding Earthquake and ground motion.

Therefore, different models (3m & 4m Height) were model with equivalent Cross section area of column and analysed in Staad Pro software for this research. R.C.C frame Building with varying height and different shape is taken and results for its Story Drift and their Base Shear are recorded and compared with each other.

2. GEOMETRY AND DESCRIPTION

Geometry modeled in Staad Pro software and following Shape of Column, Size of Column & loading parameter assigned as below.

2.1 Geometry & Loading Parameter

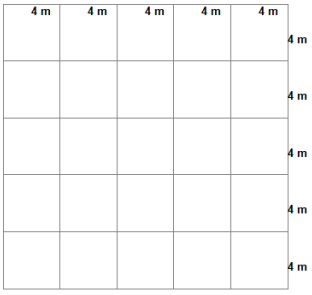

Fig -1: Plan View of Model-A & Model-B

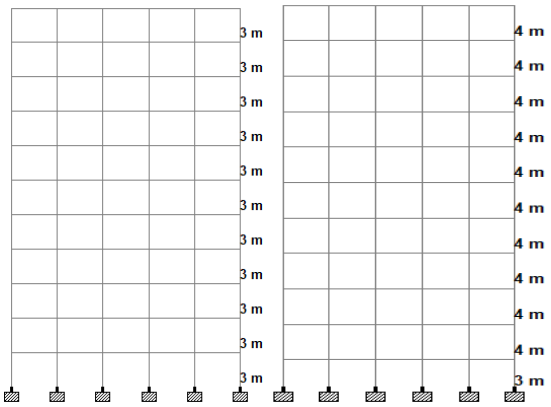

Fig -1: Elevation View of Model-A & Model-B

Table -1: Geometry & Loading Parameter

Sr. No	Description & Parameter	Model		
		A	B	
1	Total height of Building	33	43	Meters
2	Height of each story	3	4	Meters
3	Type of Construction	RC framed Structure		
4	Number of bay in X & Z-Direction	5		Nos.
5	Beam Size	300 x 600		mm
6	Wall load on Beam	14.5		kN / m
7	Parapet load on Beam	5		kN / m
8	Slab Dead Load	4.75		kN / m
9	Slab Live Load	3		kN / m
10	Seismic Zone	IV		
11	Period in X & Z Direction	0.604	0.805	Seconds
12	Support as base	Fix		
13	Reinforcement Grade	Fe500		
14	Concrete Grade	M25		
15	Analysis Standard	Indian Standards		

2.2 Size & Shape of Column

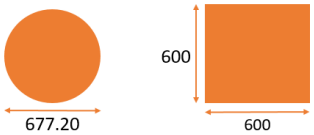

Fig -2: Circular & Square Shape Column

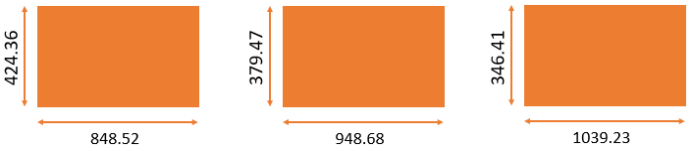

Fig -3: Rectangle-A, Rectangle-B, Rectangle-C Shape Column

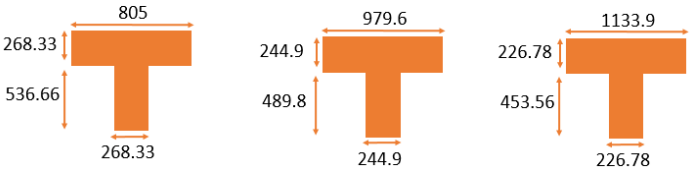

Fig -4: T-Shape-A, T-Shape-B, T-Shape-C Type Column

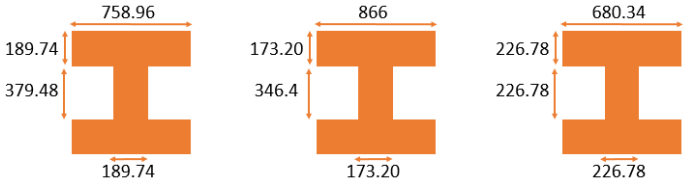

Fig -5: I-Shape-A, I-Shape-B, I-Shape-C Type Column

3. RESULT

3.1 Story Drift

Result of Maximum Story Drift of the frame structure with specially shaped column under response spectrum analysis with Staad Pro Software are shown as below.

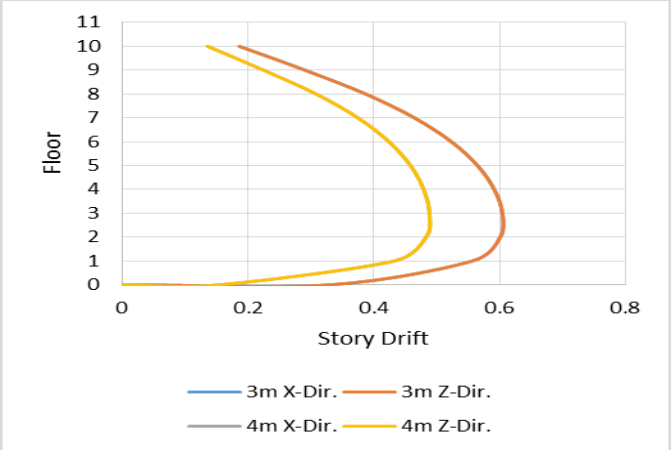

Chart -1: Circular Column Story Drift in Zone IV

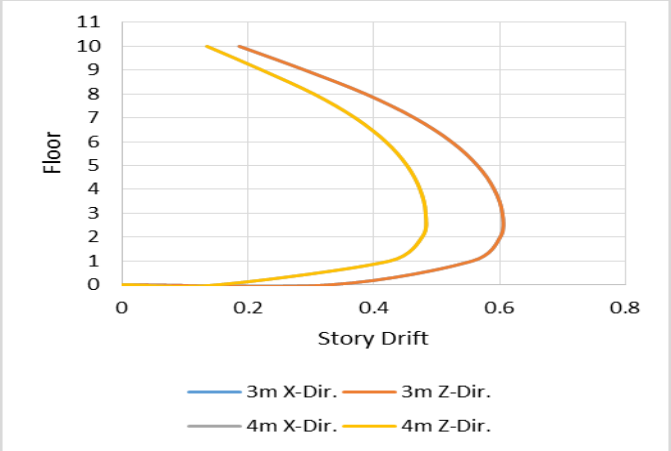

Chart -2: Square Column Story Drift in Zone IV

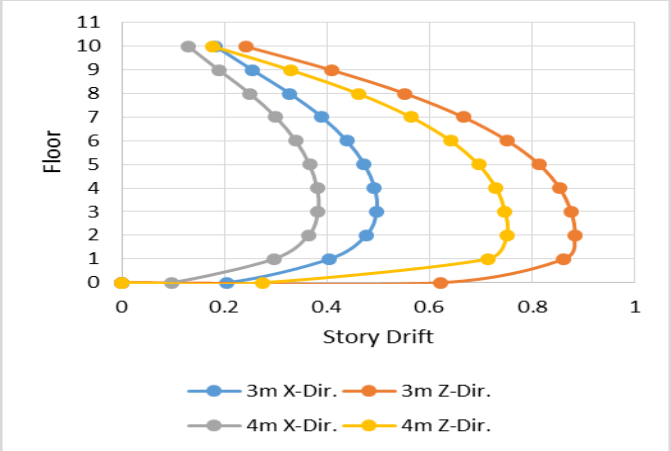

Chart -5: Rectangle-C Column Story Drift in Zone IV

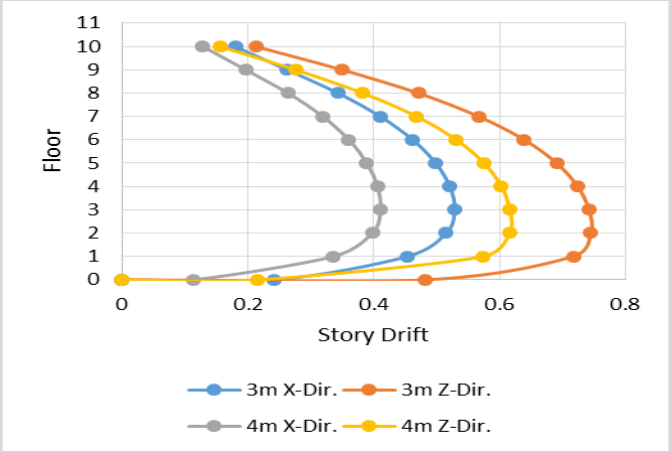

Chart -3: Rectangle-A Column Story Drift in Zone IV

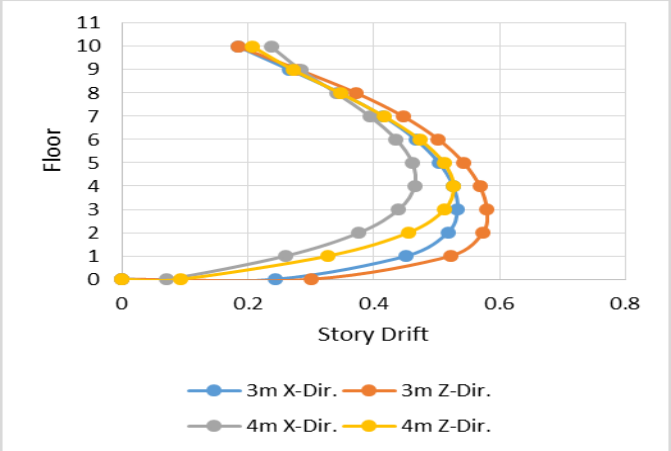

Chart -6: "I-Shape"-A Column Story Drift in Zone IV

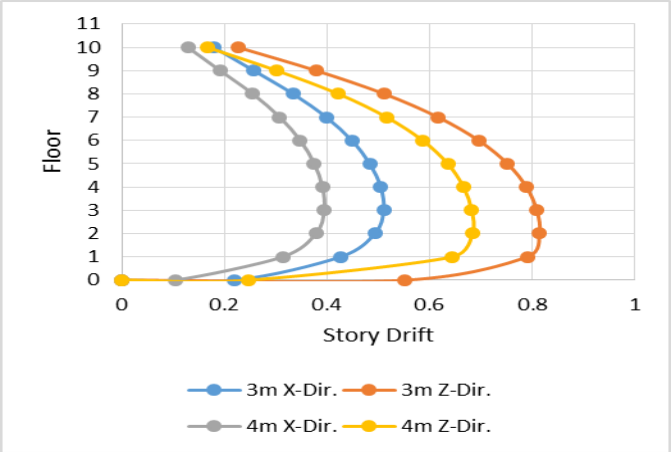

Chart -4: Rectangle-B Column Story Drift in Zone IV

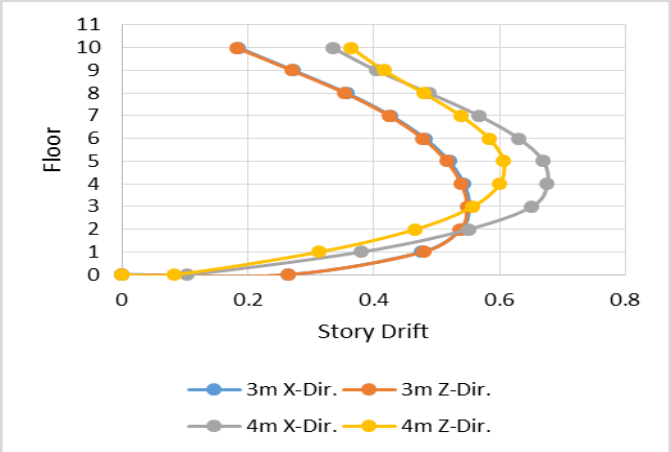

Chart -7: "I-Shape"-B Column Story Drift in Zone IV

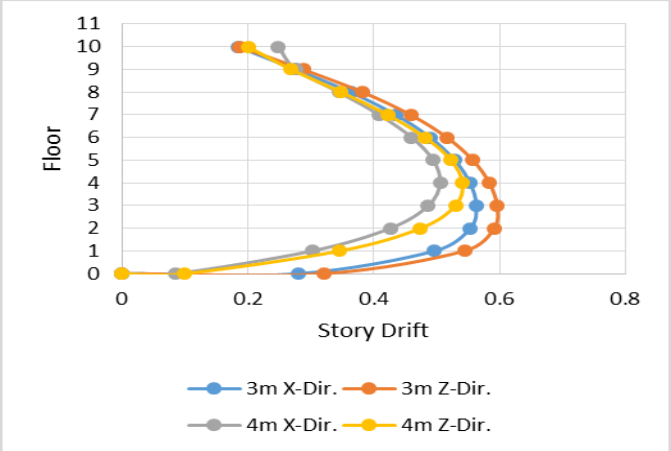

Chart -8: "I-Shape"-C Column Story Drift in Zone IV

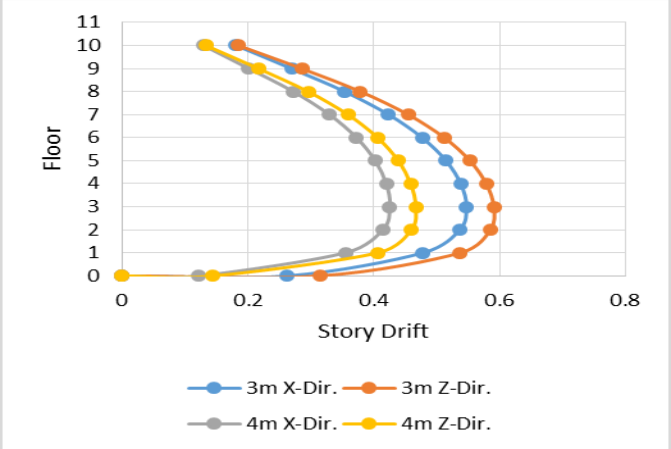

Chart -9: "T-Shape"-A Column Story Drift in Zone IV

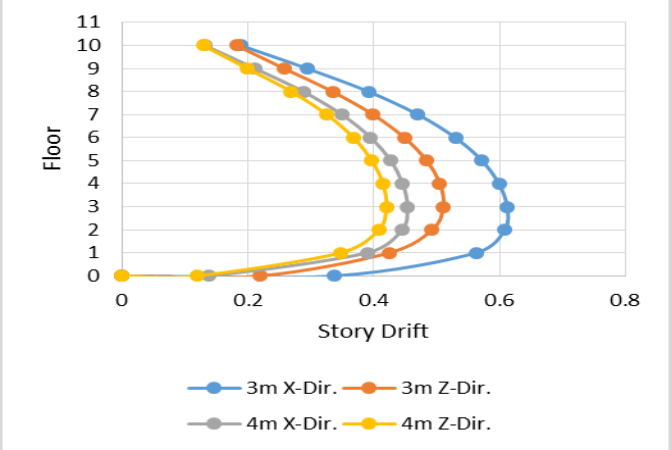

Chart -10: "T-Shape"-B Column Story Drift in Zone IV

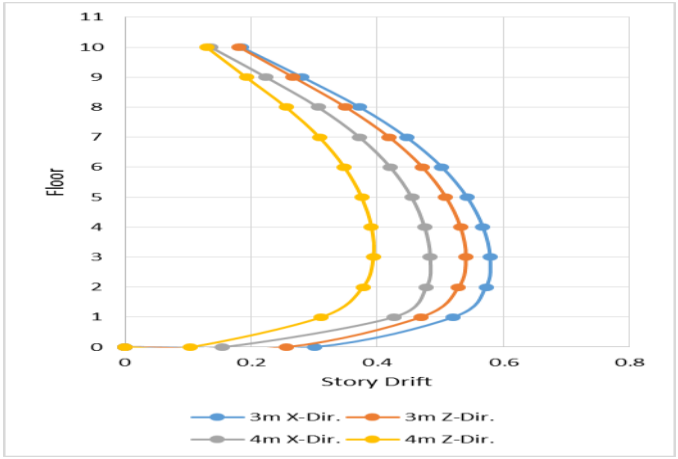

Chart -11: "T-Shape"-B Column Story Drift in Zone IV

3.2 Base Shear

Result of Maximum Base Shear of the frame structure with specially shaped column under response spectrum analysis with Staad Pro Software are shown as below.

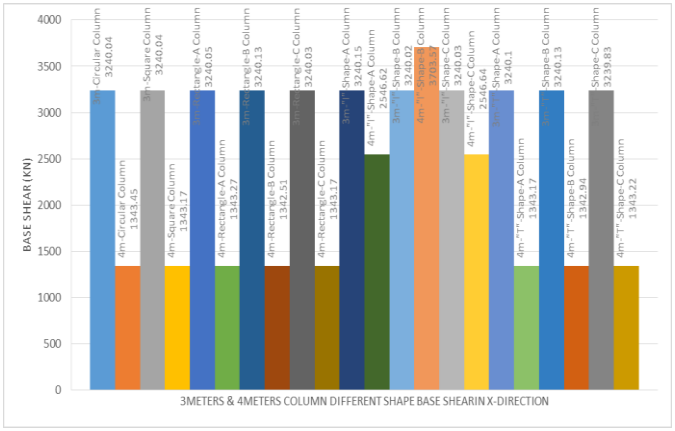

Chart -12: 3m & 4m height Different Shape Column Base Shear in X-Direction

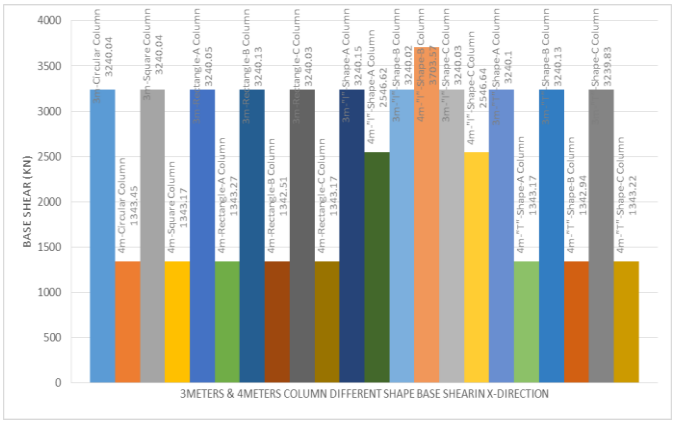

Chart -12: "3m & 4m height Different Shape Column Base Shear in Z-Direction

4. CONCLUSIONS

In the present study analysis of G+9, 3m & 4m heighted Different framed structure is carried out with various shape of column with equivalent cross section area. Based on analysis and result for all models considered, following conclusion are drawn.

1. Base Shear over all less in 4m Height of each story building compare to 3m each story height of building for all type of different shaped column for both X-Direction & Z-Direction.
2. 4m Heighted column Base Shear Remain Same exclude "I-Shape" column, there is huge difference in base shear compare to other column. A & C type of "I-Shape" Column has minimum base shear but B type of "I-Shape" has maximum base shear for both X-Direction & Z-Direction.
3. 3m heighted different shaped column nearly same base shear compare to 4m heighted column.
4. 3m height column Story Drift is more Compare to 4m height column Story Drift overall except "I-Shape" Column.
5. "I-Shape" B type Column only, 4m Height column story drift is more than 3m height column story drift. In both X-Direction & Z-Direction.
6. Circular & Square Column Shape column contain same drift and Base Shear in both Direction X-Direction & Z-Direction.
7. Obstruction will be created by the offset of columns in case of specially shaped column structures.

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