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Comparative Structural Analysis of Mono Column Building

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Abstract: ***The building plays a vital role in improving various activities. In the late world, prompt to action of peoples from one place to another is of great extent mainly for earnings. For aesthetic appearance, we create our building supported by a single column, for single-column & floor response of the structure under linear & dynamic loading, results are studied for deflection, bending moment, shear force, structural planning, and design is an art and science of designing with economy elegance and durable structure.***

From the above results it is observed that the Storey Stiffness(kN/m) for G+16 building is maximum in the case of conventional column building for all the zones, especially higher for zone-V. The value obtained is 160000 kN/m in the case of conventional column building (storey-1) in zone-V.

It is observed that the mono column building can be safely designed upto four storey upto the zone-III, while the maximum storey allowed for zone-IV and zone-V is two storey.

Keywords: mono column, Moment, storey drift, storey stiffness and time period

I. INTRODUCTION

Structure supported on a single column provides better architectural view compared to structure supported on many columns. They save ground space as requires less area for providing foundation and provides more space for parking. They are also unique. Single column structure can be made either by using RCC or Steel.

RCC structures are more common now days in India. Reinforced concrete as a structural material is widely used in many types of structures. It is competitive with steel if economically designed and executed. It has a relatively high compressive strength and better fire resistance than steel.

It has long service life with low maintenance cost. It can be cast into any required shape. Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and ductility.

The modeling and analysis of structure supported on a single column is done by using ETABS software. ETABS is a structural analysis and design computer program originally developed by Research Engineers International in Yorba Linda. Various ways of supporting a structure on one single column. Various steps involved in designing of reinforced concrete structure supported on a single column using ETABS.

II. REVIEW OF LITERATURE

Palaram Nikhil et. al. analyzed the design and analysis of RCC structure supported on single column. He presents structural modeling, stress, Bending moment, Shear force and displacement design considerations for a structure and it is analyzed using STAAO Pro.

E K Mohanraj, Kongu Engineering College, (2002) studied that Building plays a vital role for improving the various activities. A structure is said to be stable when it satisfies all stability requirements. Structures will be more stable when all the sides proportionally to balance the static and dynamic loads support it; the structure has supposed to be supported. For aesthetic appearance we create our building supported by a single column.

G. D. Dhawale et. al. carried out The comparative study on analysis of RCC Frame structure supported on a single column and multi-column is done in this project. This paper presents structural modelling, stress, bending moment, shear force and displacement, deflection design considerations for a structure and it is analyzed using STAAD-Pro.

III. MODELING

The modeling is carried out in the ETABS software, the modeling is carried out for the G+2 building, G+7 building and G+16 building for the seismic zone-II, III, IV and V. the parameters for the buildings are as follows.

Table1: Parameters for the buildings

Parameters	G+2 building	G+7 building	G+16 building
Plane dimensions	10x10 m	10x10 m	10x10 m
Total height of building	11 m (G+2)	29.5 m (G+7)	61 m (G+16)
Height of each storey	3.0m	3.5m	3.5m
Height of parapet	1m	1m	1m
Depth of foundation	1.5m	1.5m	1.5m
Size of beams	300x600mm	300x600mm	300x600mm
Size of transfer girders	600x1000mm	750x1200mm	900x1500mm
size of columns	450x450mm	600x600mm	900x900mm
size of mono columns	1000x1000mm	1500x1500mm	2000x2000mm
Thickness of slab	150 mm	150 mm	150 mm
Thickness of external brick walls	230 mm	230 mm	230 mm
Thickness of internal brick walls	No internal wall since office building is considered	No internal wall since office building is considered	No internal wall since office building is considered
Floor finishes	1.5 kN/m2	1.5 kN/m2	1.5 kN/m2
Live load at all floors	4 kN/m2	4 kN/m2	4 kN/m2
Grade of Concrete	M25	M25	M25
Grade of Steel	Fe500	Fe500	Fe500
Density of Concrete	25 kN/m3	25 kN/m3	25 kN/m3
Density of brick masonry	20 kN/m3	20 kN/m3	20 kN/m3

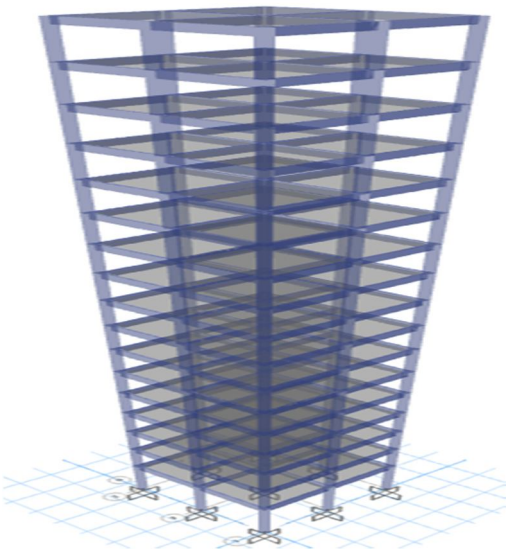

Fig.1 (a) Typical Elevation of conventional buildings

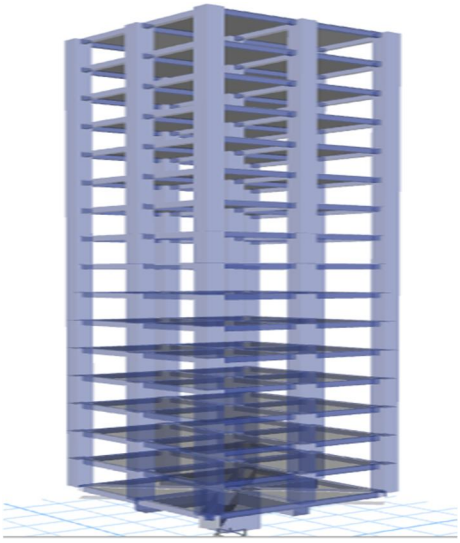

Fig.1 (b) Typical Elevation of Mono Column buildings

IV. RESULTS

The analysis is carried out in ETABS software and the results in terms of lateral displacement, storey shear, storey stiffness and axial force and other parameter is obtained as follows.

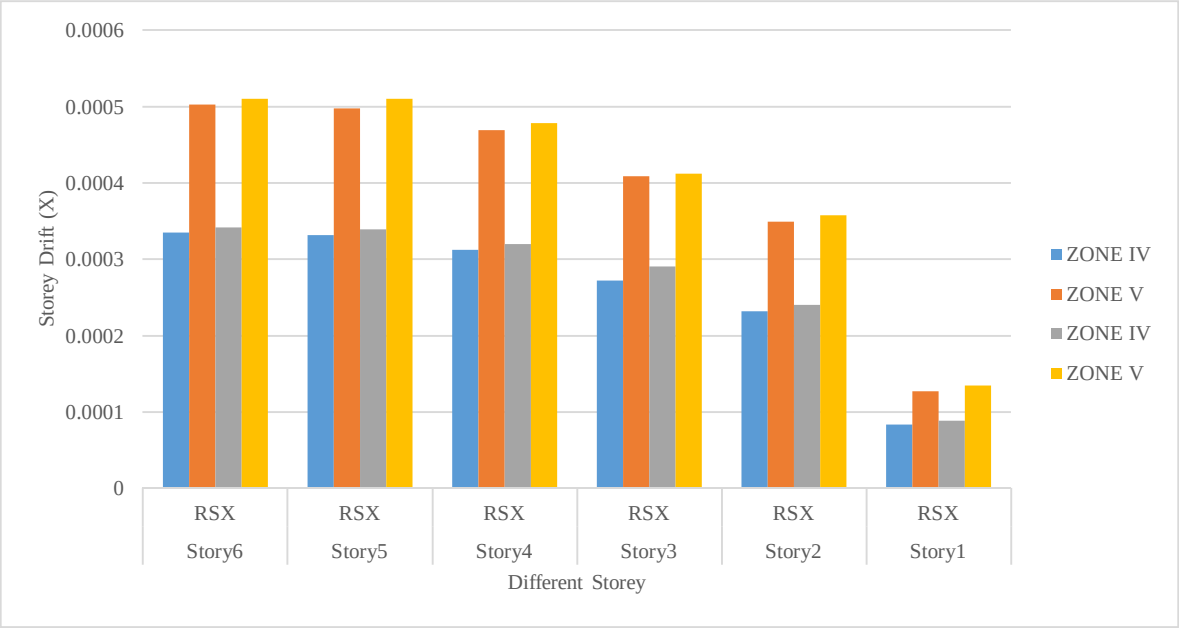

Fig. 2: Storey Drift (X - direction) Validation

The storey drift (X direction) was found to be validated with the research paper authored by Palaram Nikhil et al with some small variations.

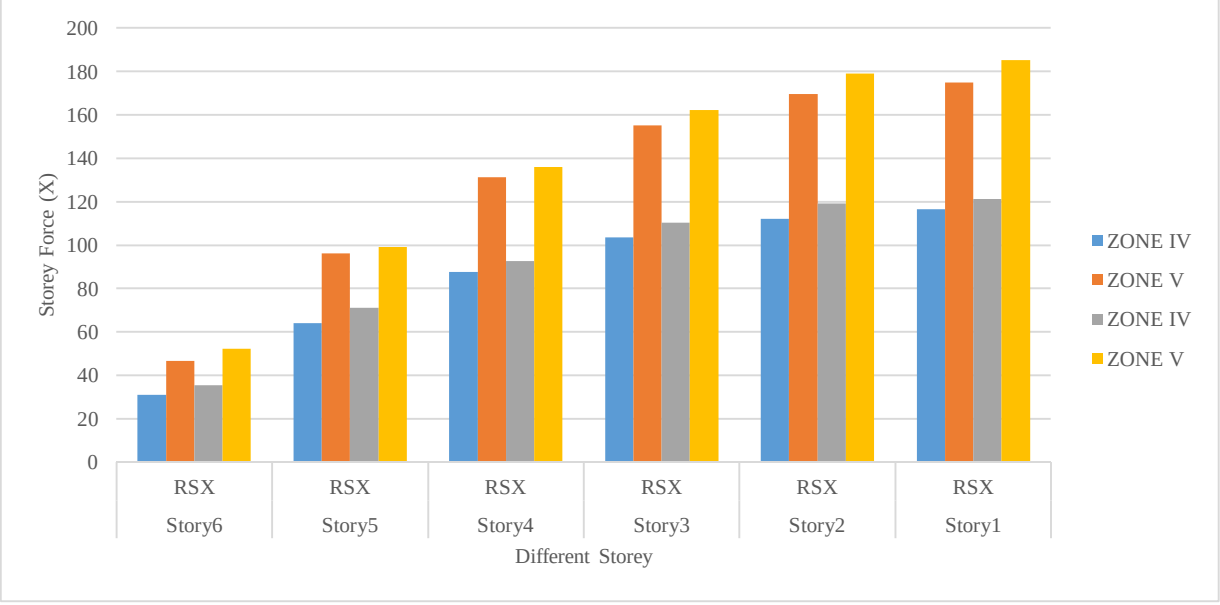

Fig. 3: Storey Shear (X - direction) Validation

The storey shear (X direction) was found to be validated with the research paper authored by Palaram Nikhil et al with some small variations because of some data is missing in the paper and assumed for results.

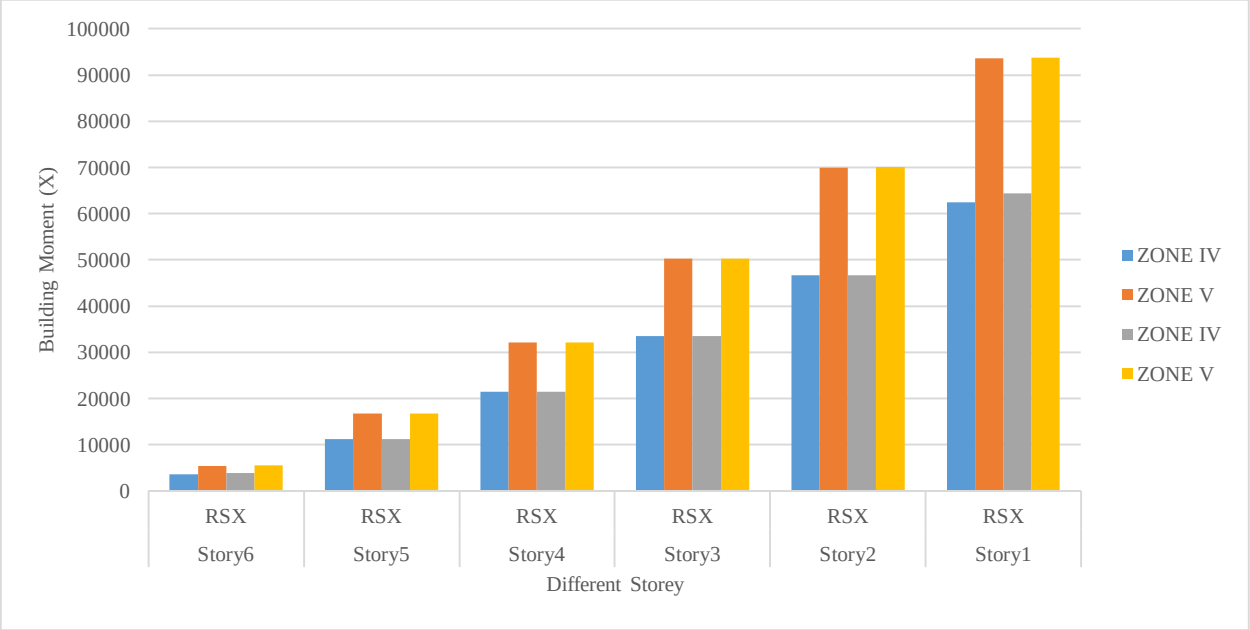

Fig. 4: Building moment (X - direction) Validation

The building moment (X & Y direction) was found to be validated with the research paper authored by Palaram Nikhil et al with some small variations.

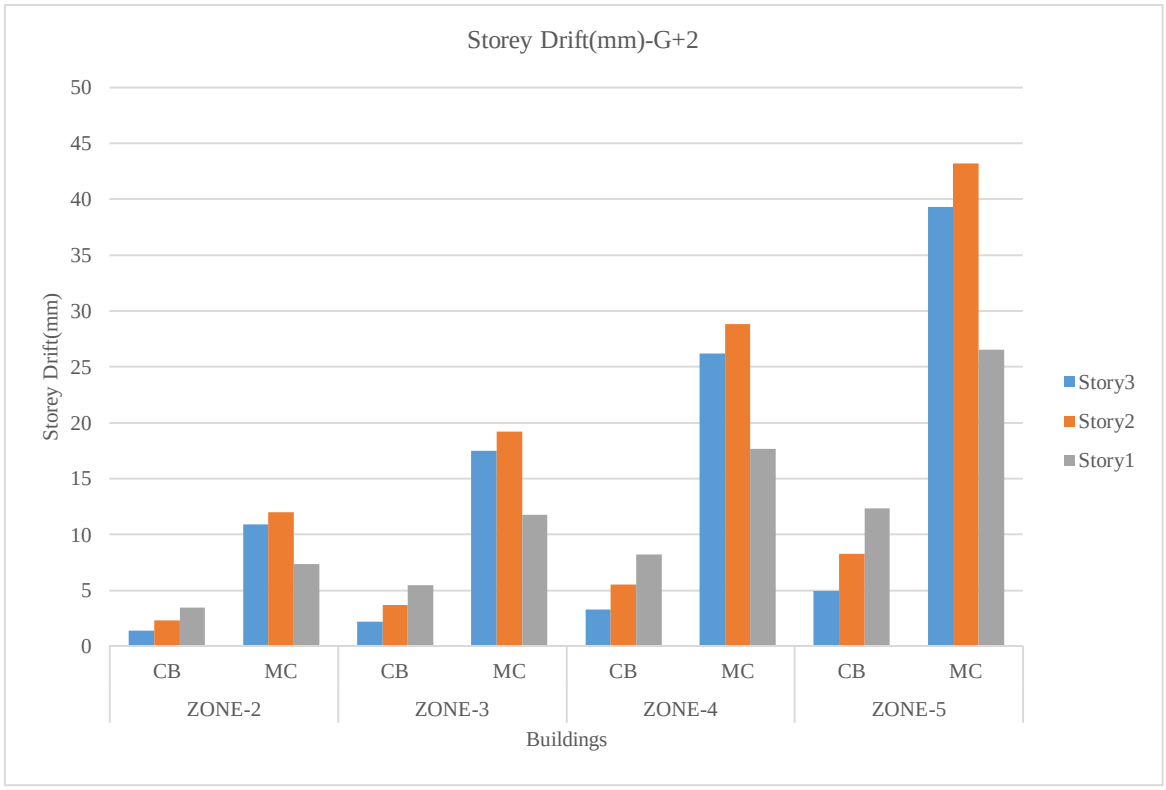

Fig.5: Storey Drift(mm) for G+2

From the above figure it is observed that the Storey Drift(mm) for G+2 building is maximum in the case of mono column building for all the zones, especially higher for zone-V. The value obtained is 43 mm in the case of mono column building (storey-2) in zone-V.

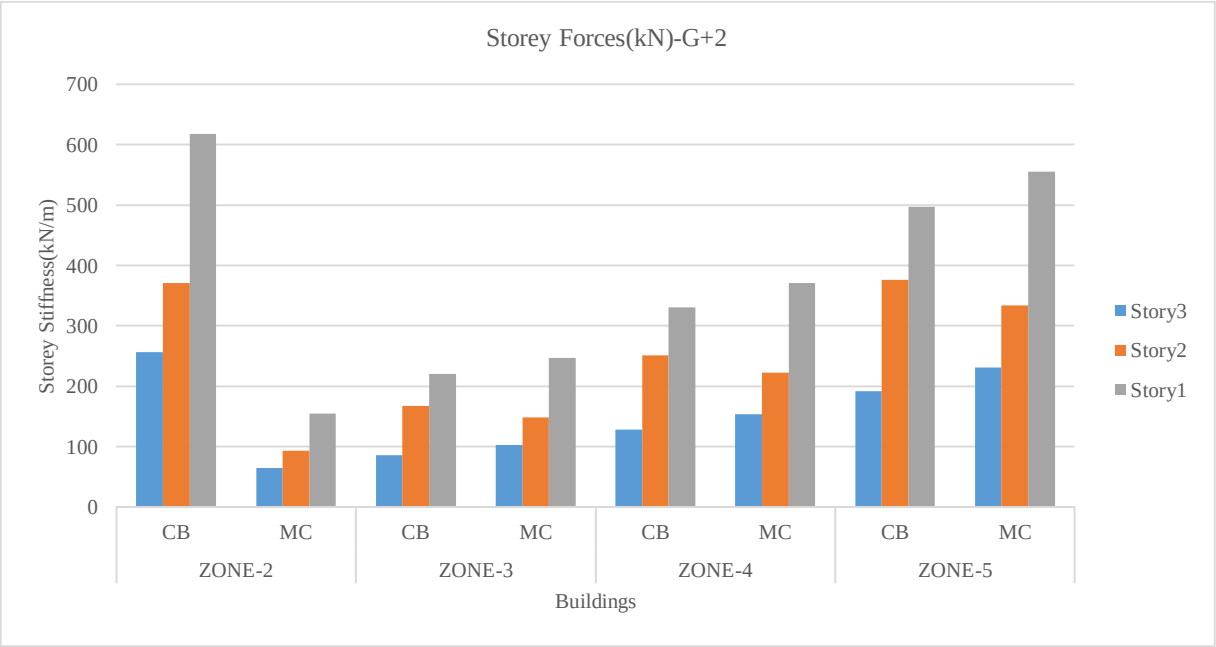

Fig.6: Storey Forces(kN) for G+2

From the above figure it is observed that the Storey Forces(kN) for G+2 building is maximum in the case of conventional column building for all the zones, especially higher for zone-II. The value obtained is 600 kN in the case of conventional column building (storey-1) in zone-II.

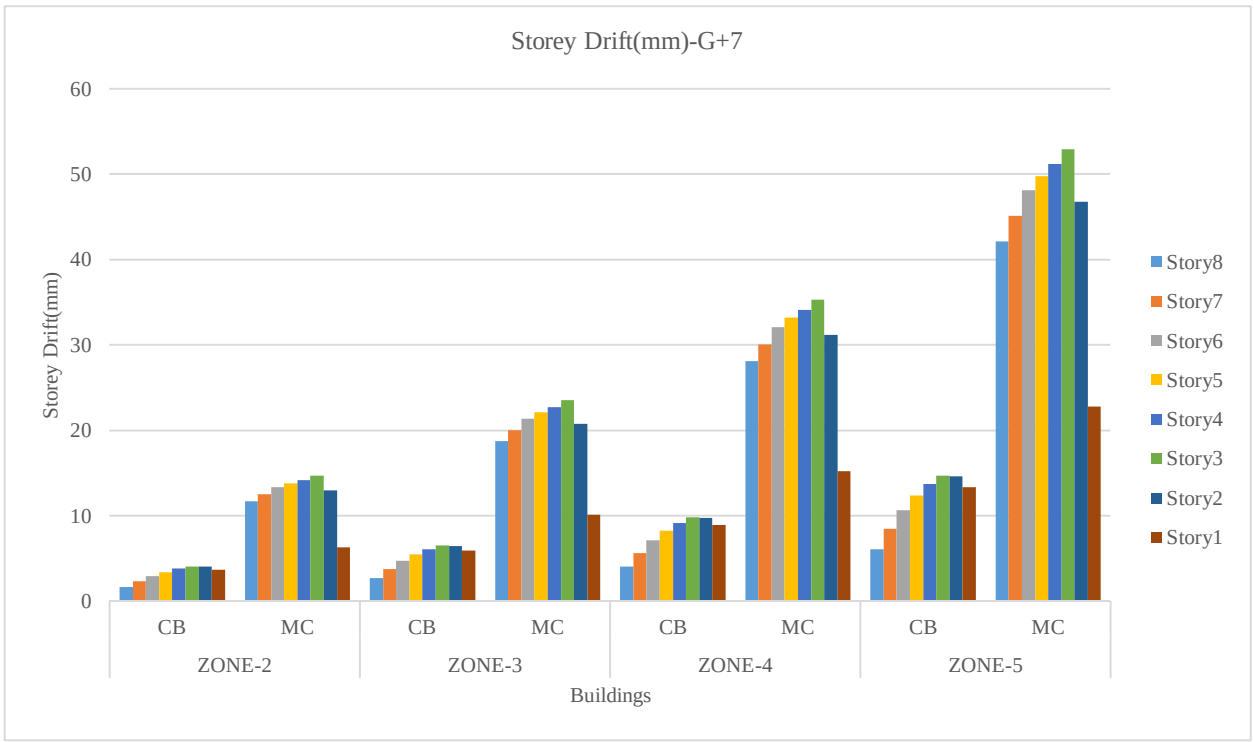

Fig.7: Storey Drift(mm) for G+7 building

From the above figure it is observed that the Storey Drift(mm) for G+7 building is maximum in the case of mono column building for all the zones, especially higher for zone-V. The value obtained is 55 mm in the case of mono column building (storey-3) in zone-V.

Fig.8: Storey Stiffness(kN/m) for G+7 building

From the above figure it is observed that the Storey Stiffness(kN/m) for G+7 building is maximum in the case of conventional column building for all the zones, especially higher for zone-V. The value obtained is 70000 kN/m in the case of conventional column building (storey-1) in zone-V.

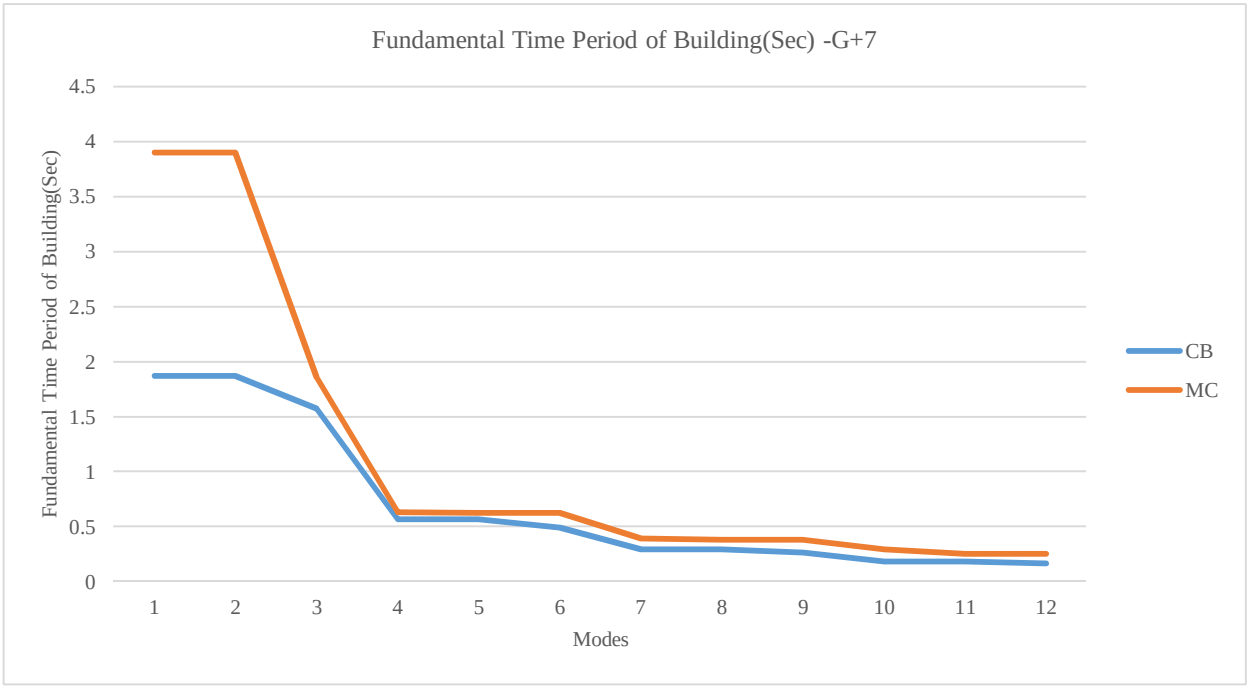

Fig.9: Fundamental Time Period of Building(Sec) for G+7 building

From the above figure it is observed that the Fundamental Time Period of Building(Sec) for G+7 building is maximum in the case of mono column building. The value obtained is 3.8 sec in the case of mono column building for the case mode-1.

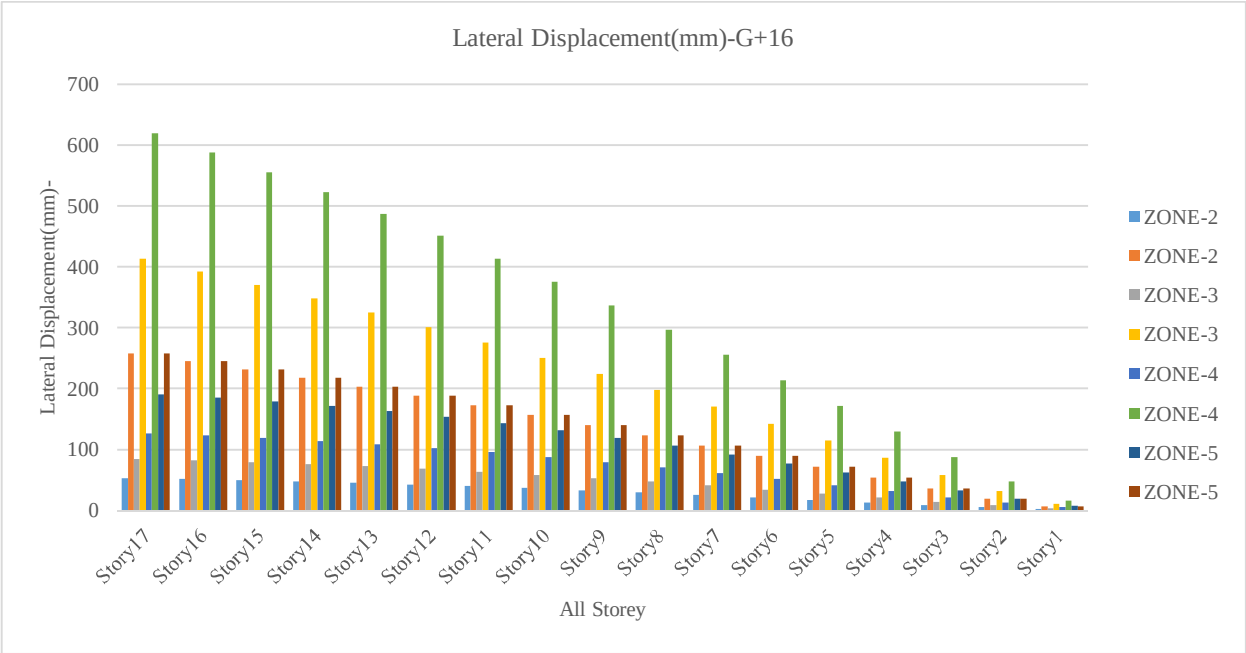

Fig.10: Lateral Displacement(mm)-G+16 building

From the above figure it is observed that the lateral displacement for G+16 building is maximum in the case of mono column building for all the zones, especially higher for zone-IV. The value obtained is 610 mm in the case of mono column building (storey-17) in zone-IV.

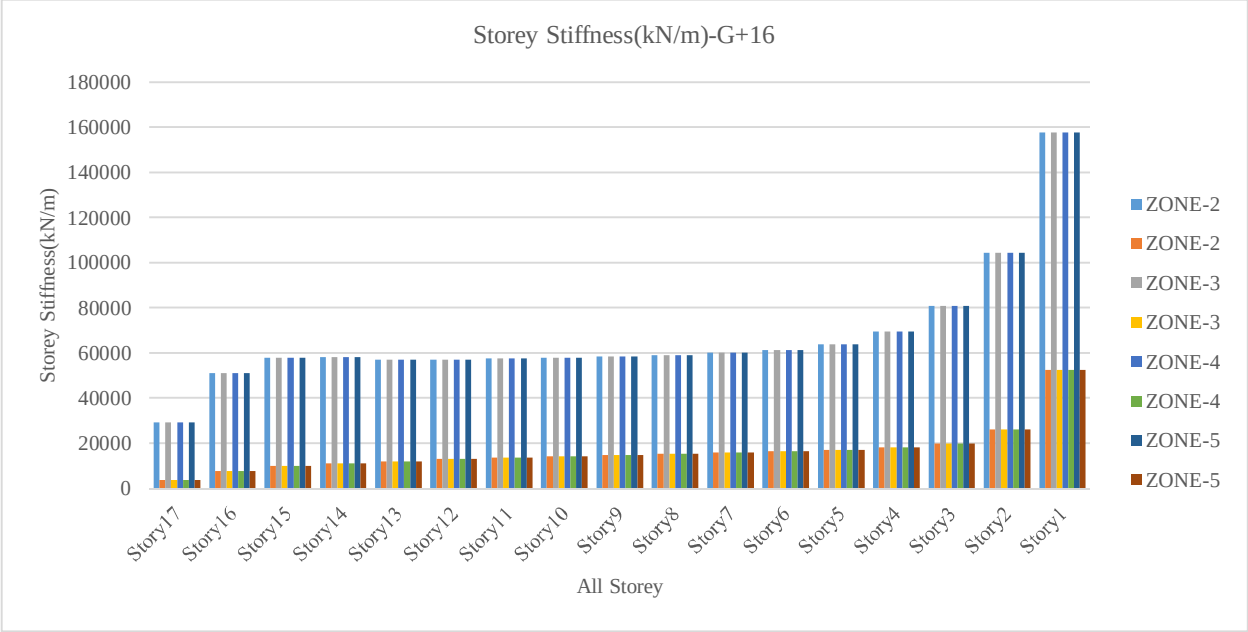

Fig.11: Storey Stiffness(kN/m)-G+16 building

From the above figure it is observed that the Storey Stiffness(kN/m) for G+16 building is maximum in the case of conventional column building for all the zones, especially higher for zone-V. The value obtained is 160000 kN/m in the case of conventional column building (storey-1) in zone-V.

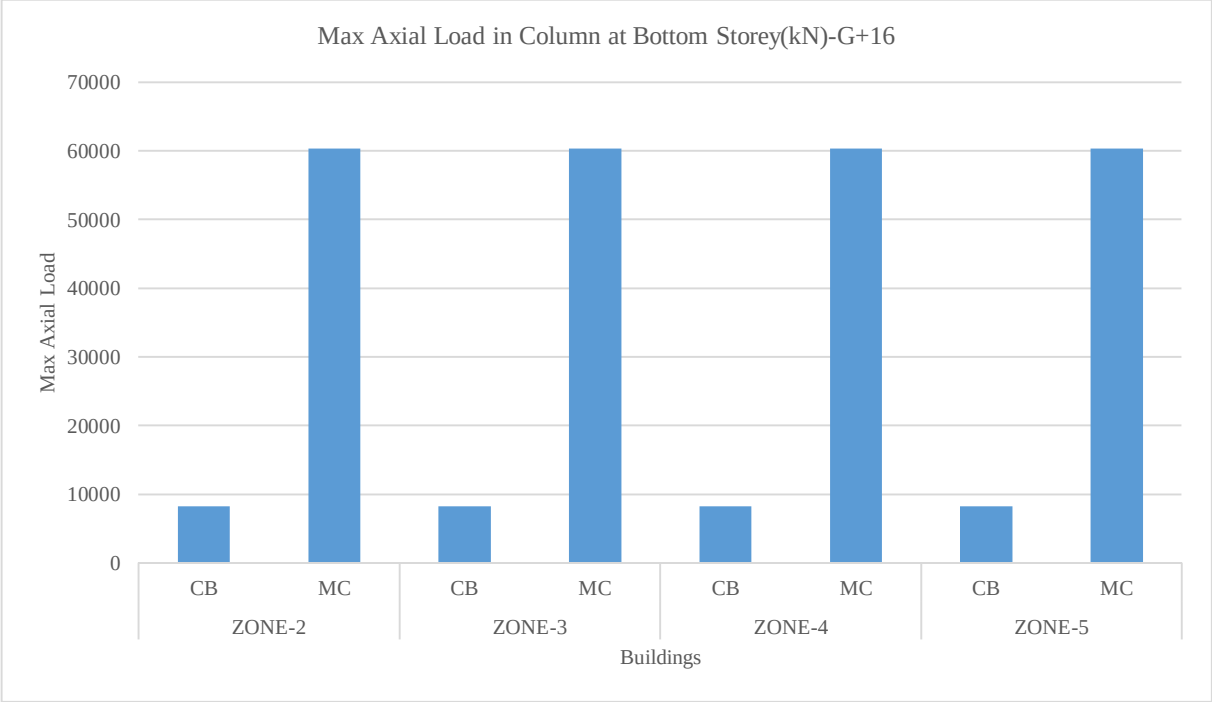

Fig.12: Max Axial Load in Column at Bottom Storey(kN)-G+16 building

From the above figure it is observed that the Max Axial Load in Column at Bottom Storey(kN) for G+16 building is maximum in the case of mono column building for all the zones, especially higher for zone-V. The value obtained is 60000 kN in the case of mono column building in zone-V.

V. CONCLUSION

The conclusions from the above study are as follows:

A. The From the above results it is observed that the lateral displacement for G+2 building is maximum in the case of mono column building for all the zones, especially higher for zone-V. The value obtained is 110 mm in the case of mono column building in zone-V.

B. From the above results it is observed that the Storey Drift(mm) for G+2 building is maximum in the case of mono column building for all the zones, especially higher for zone-V. The value obtained is 43 mm in the case of mono column building (storey-2) in zone-V.

C. From the above results it is observed that the Storey Stiffness(kN/m) for G+7 building is maximum in the case of conventional column building for all the zones, especially higher for zone-V. The value obtained is 70000 kN/m in the case of conventional column building (storey-1) in zone-V.

D. From the above results it is observed that the Storey Forces(kN) for G+7 building is maximum in the case of mono column building for all the zones, especially higher for zone-V. The value obtained is 1050 kN in the case of mono column building (storey-1) in zone-V.

E. From the above results it is observed that the Storey Stiffness(kN/m) for G+16 building is maximum in the case of conventional column building for all the zones, especially higher for zone-V. The value obtained is 160000 kN/m in the case of conventional column building (storey-1) in zone-V.

F. From the above results it is observed that the Fundamental Time Period of Building(Sec) for G+16 building is maximum in the case of mono column building. The value obtained is 8 sec in the case of mono column building for the case mode-1.

G. It is observed that the mono column building can be safely designed upto four storey as the permissible displacement is 119 mm (H/500) upto the zone-III, while the maximum storey allowed for zone-IV and zone-V is two storey.

H. The storey drift which is allowed observed to be 14 mm (0.004 times storey height), maximum two storey is allowed for zone-V.

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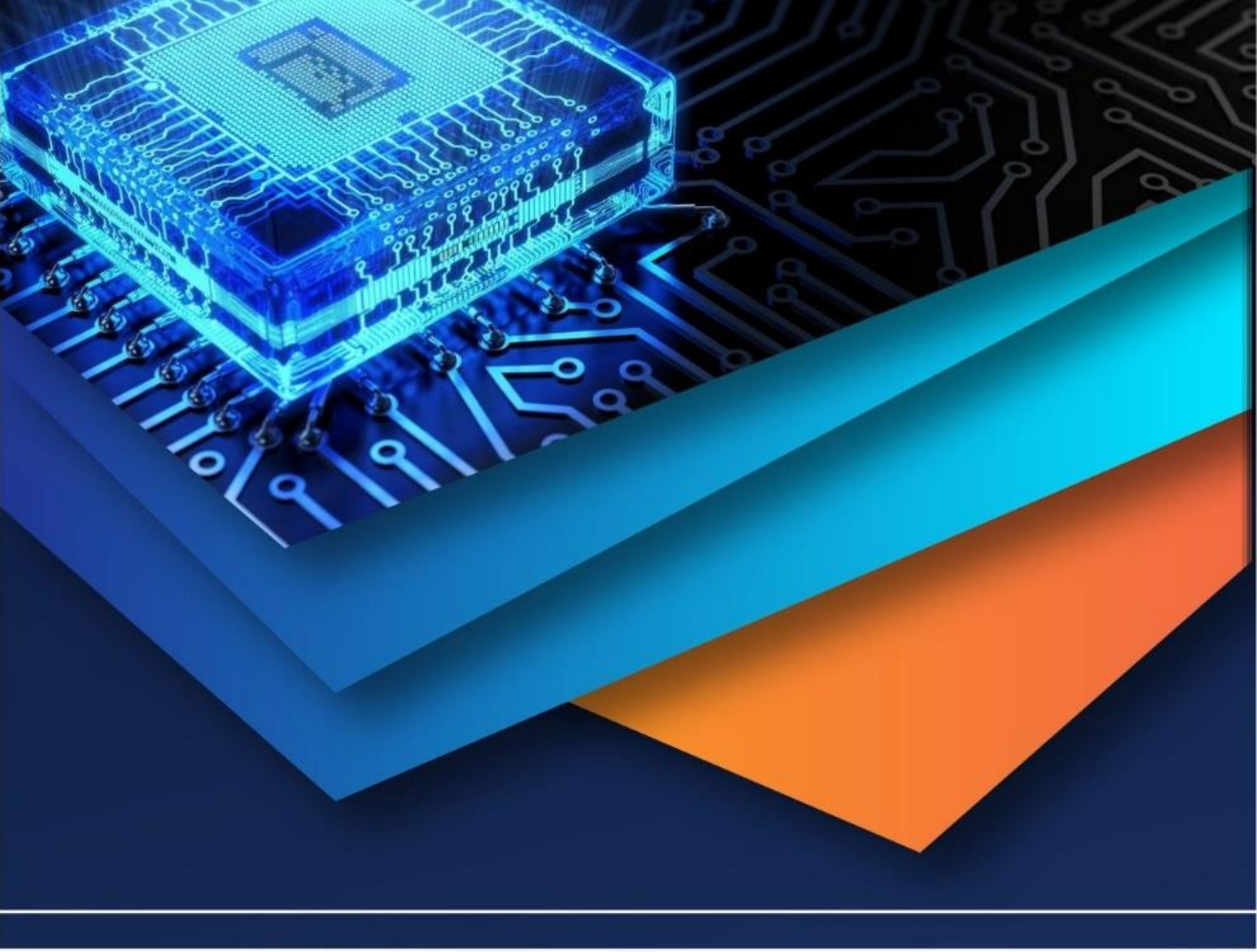

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