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Research Article

Comparative Study of Multi-Storeyed Rcc Frame by Considering Eccentricities of column loads

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Abstract

Reinforced concrete columns in building structures are subjected to combined axial loads and uniaxial or biaxial bending or both. In a geometrically nonuniform member, variation in cross sectional dimensions may be either continuous over the entire length of the member as in tapered members or may occur at discrete points as in stepped members, since neither axial load nor stiffness is constant along the column height the stability analysis of a stepped column is usually more complicated than that of a uniform column. The present study deals with the comparison of Concentric Non-Prismatic columns and Stepped columns under the effect of static and dynamic loads with the help of ETABS Software.

Keywords: *Non- Prismatic Columns, Stepped Columns, Column forces, Base Shear, Displacement, Inter-Storey Drift.*

1. Introduction

A Multi-Storeyed Building is a structure with multiple floors above ground. Multi-storeyed buildings aim to increase the floor area of the building without increasing the area of the land.

Multi-storeyed building, by virtue of its height, is affected by lateral forces due to wind or earthquake or both to an extent that they play an important role in the structural design.

Columns are the key structural elements for the seismic performance of buildings. If the axial load on the column is not concentric, that is, its line of action is not precisely coincident with the centroidal axis of the column; the column is characterized as eccentrically loaded.

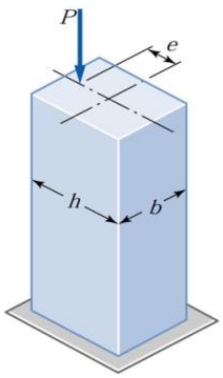
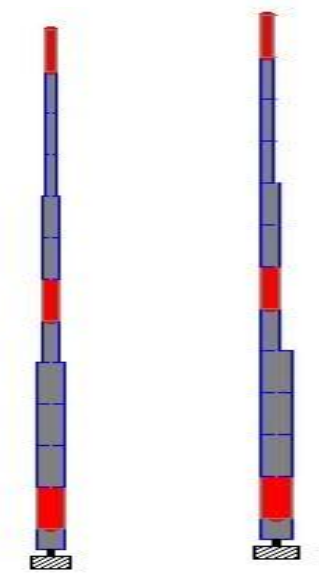


Fig.1 Eccentrically Loaded Column

The purpose of this work is to study the behavior of the column in different cases such as concentric non-prismatic columns and stepped columns with respect to the column forces and moments.



Case A Case B

Fig. 2 Case A) Concentric Non- Prismatic Columns Case B) Stepped Columns

2. Mathematical formulation

A (G+14) RCC structure has been considered for Analysis

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Table 1 Data for Analysis

Plan dimension	20m x 26m
Height of each Storey	3m
Slab thickness	150 mm
Wall Thickness	230 mm
Live Load	3 kN/m^2
Grade of Conc.	30 N/mm^2
Grade of Steel	500 N/mm^2
Location	Solapur city
Seismic Zone	III
Importance Factor	1
Type of Soil	Rock or Hard Soil
Earthquake load	As per IS-1893 (Part 1) - 2002
Damping Ratio	5 %

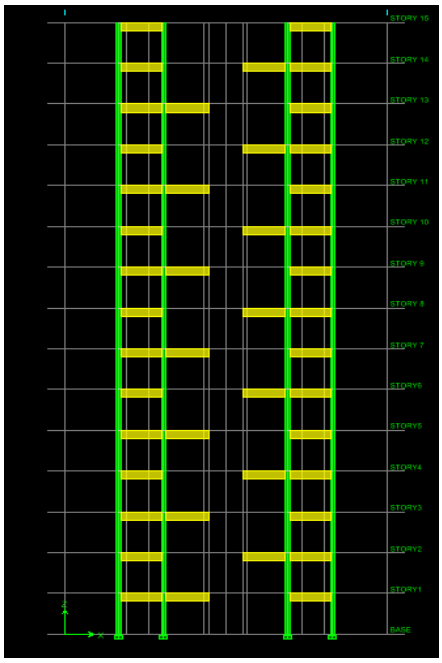

Fig. 3 Elevation of the structure

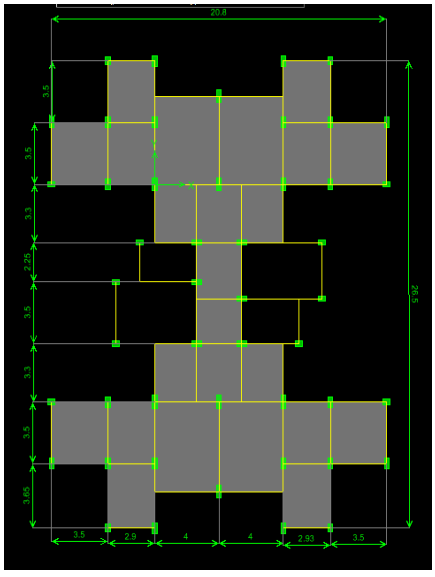

Fig. 4 Plan of the structure

Table 2 Variation of Displacement

Displacement (mm)		
Storey No.	Case A : Concentric Non-Prismatic Columns	Case B: Stepped Columns
15	15.58	15.75
14	15.08	15.26
13	14.33	14.53
12	13.36	13.57
11	12.34	12.57
10	11.19	11.45
9	9.94	10.20
8	8.71	8.961
7	7.44	7.69
6	6.14	6.36
5	4.90	5.08
4	3.67	3.83
3	2.48	2.58
2	1.40	1.43
1	0.48	0.49

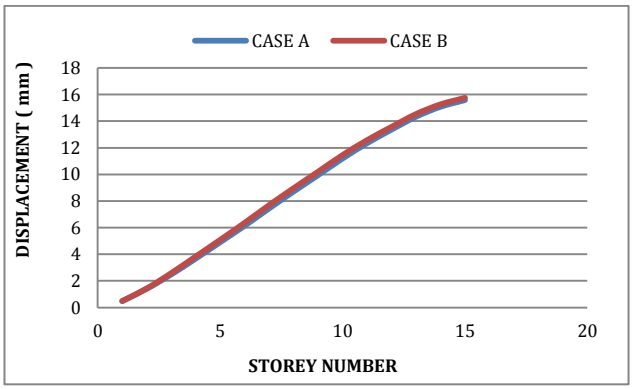

Fig. 5 Graph for Displacement v/s Storey Number

Table 3 Variation of Drift

Drift (mm)		
Storey No.	Case A: Concentric Non-Prismatic Columns	Case B: Stepped Columns
15	0.49	0.49
14	0.75	0.73
13	0.97	0.96
12	1.02	1
11	1.15	1.12
10	1.25	1.25
9	1.23	1.23
8	1.27	1.27
7	1.3	1.33
6	1.24	1.27
5	1.23	1.255
4	1.19	1.25
3	1.08	1.15
2	0.92	0.94
1	0.48	0.49

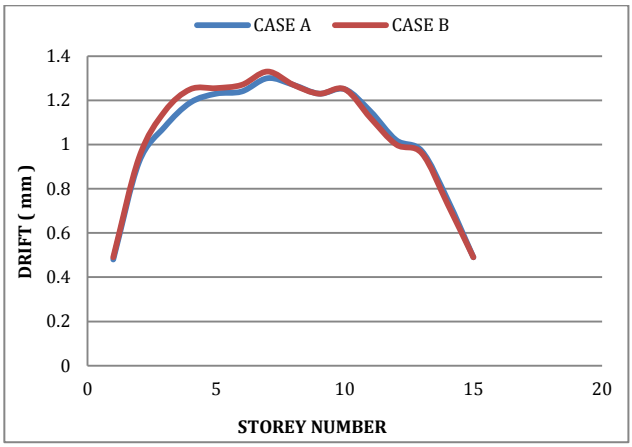

Fig. 6 Graph for Drift v/s Storey Number

Table 4 Variation of Column Axial Force

Axial Force (KN)		
Column	Case A: Concentric Non- Prismatic Columns	Case B: Stepped Columns
Corner column	2931.25	2930.23
Side column	4485	4484.71
Inner column	6499.48	6497.7

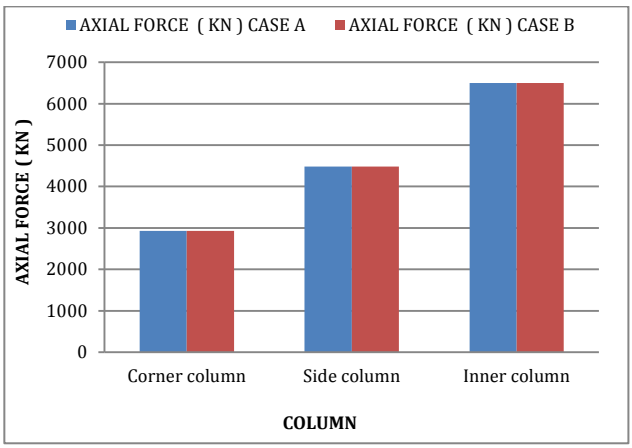

Fig. 7 Graph for Column Axial Load

Table 5 Variation of Column Moments

Column Moments (KN-m)		
Column	Case A: Concentric Non-Prismatic Columns	Case B: Stepped Columns
Corner column	65.4	90.1
Inner column	42.4	61.02
Side column	25.58	39.93

Table 6 Variation of Base Shear

Base Shear (KN)	
Case A: Concentric Non-Prismatic Columns	Case B: Stepped Columns
892.31	892.62

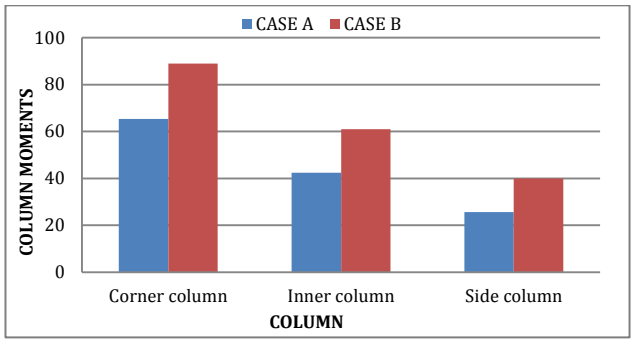

Fig. 8 Graph for Column Moments

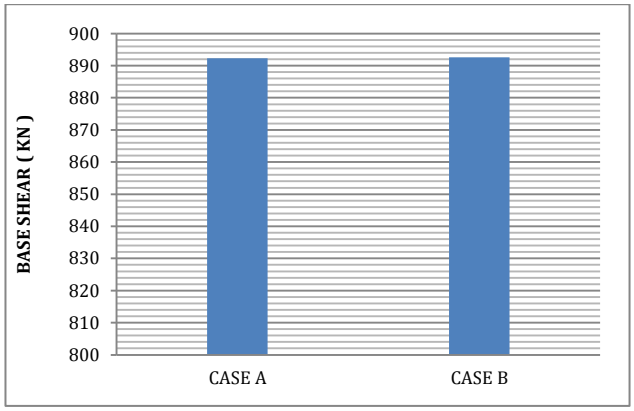

Fig. 9 Graph for Base Shear

Conclusion

[1] Displacement of Concentric Non- Prismatic Columns is similar to that of Stepped Columns.
[2] Inter-Storey Drift of Concentric Non- Prismatic Columns is similar to that of Stepped Columns.
[3] Column Axial Force of Concentric Non- Prismatic Columns is similar to that of Stepped Columns.
[4] Moments of corner column of Stepped Columns increased by 38% as compared to Concentric Non – Prismatic Columns.
[5] Moments of inner column of Stepped Columns increased by 44% as compared to Concentric Non – Prismatic Columns.
[6] Moments of side column of Stepped Columns increased by 56% as compared to Concentric Non – Prismatic Columns.
[7] Base Shear for Concentric Non- Prismatic Columns is similar to that of Stepped Columns.

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