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Comparative Study of Seismic Analysis of Multi-Story Buildings with Floating Columns on Differential Positions and Floors in ZONE IV and ZONE V

Shashank. R[1], Dr. R. Subhash Chandra Bose[2], Shivashankar K M[3]
[1]*Post graduation Student, Department of Civil Engineering*
[2]*Associate Professor, Department of Civil Engineering*
[3]*Assistant Professor, Department of Civil Engineering*

Abstract: ***In urban area nowadays commercial as well as residential buildings on its lower floors require large spaces for banquet hall, malls, parking area and for other amenities. For fulfilling these requirements floating columns are generally provided to gain ample space in building structure. As per IS Code 1893:2016 clause no-7.1. The criteria of providing floating column is prohibited, but there is no limitation and restriction for research work. This study highlights the seismic response of a building and to analyze the structure in which there will be less damages to the structure with the presence of the floating column. This study features the significance of unequivocally perceiving the presence of the drifting section in the examination of building. It deals with the software model which validate with literature studies with RC G+12 building model in seismic zone IV and V with different case studies and floating column is provided in columns exterior, interior and core columns consequently. Time history analysis method for seismic analysis of models, various seismic parameters such as time histor of floor displacement, inter storey drift, base shear, overturning moment are compared to find out the most optimized solution. An Evaluation package of ETABS 2016 has been utilized for analyzing the above Building Structure.***
To keep away from unfriendly impact of seismic power, substitute measures, including firmness equilibrium of the main story and the story above, are proposed to lessen the abnormality presented by the drifting sections by concentrating on various utilization of appropriate technique.
Keywords: Floating column, Storey stiffness, Storey displacement, Storey drift, Base shear, ETABS v16

I. INTRODUCTION

The population of India is expanding per year very rapidly. Because of more career opportunities available in urban areas and small cities, number of people residing under the city is also increasing. This leads to increase in need for commercial and other public sectors reinforced concrete buildings. Thusly, various metropolitan multistorey designs in India today have open first story as an obvious component. This is basically being taken on to oblige halting, gathering waiting rooms and working environments in the essential story. Because of absence of room, expanding populace and furthermore for tasteful view and utilitarian necessities, development of elevated structure in metropolitan urban communities are expected to have segment free space. Hence many high rise multistorey buildings are now built with vertical irregularities. Urban infrastructure had resulted in many irregular structures such as: 1. Load path irregularity 2. Plan irregularity 3. Vertical irregularity 4. Mass irregularity 5. Stiffness irregularity. And it is observed that most of RC structures with these kinds of irregularities are undesirable for seismic activity. As all know earthquake is most destructive of all-natural disaster and safety measures must be considered while construction. In this study we have chosen floating column irregularity which is stiffness irregularity comes under vertical irregularity.

II. LITERATURE REVIEW

Srinivas Srinivas Karri et Al (2020) Seismic behavior of RCC buildings with and without floating columns, concluded that Bending moment, shear force, Max support reaction with increase in seismic zone. Reinforced concrete building with Floating column shows greater value for storey drift than the building without floating column.

Mohd. Jamaluddin Danish1, Md et Al (2020) Seismic Analysis of Multi-Story Building with In filled Shear Wall Having Floating Column, It is an endeavor to concentrate on the presentation of multi-story supported substantial structure outline because of impact/arrangement of workmanship infill's and shear wall, 11th floor building models with G+15 story.

K.V. Sudheer1 et Al (2018) Plan and Analysis of a High-Rise Building with and without Floating Columns of a G+15 multi-story building with (ETABS) Software, This paper concentrates on the correlation and seismic investigation of the multistory structures with drifting segment and without drifting section. At last, examination and results in the tall structure, for example, story floats, story removal, and Base shear were displayed in this review. Plan and Analysis was completed by utilizing Extended Three Dimensional Analysis of Building Systems (ETABS) Software.

Kishalay Maitra et Al (2018) To concentrate on Torsional abnormality created According to area of drifting segment, They deduced in this paper that while drifting section is presented unsymmetrically then torsional anomaly exist, though while drifting segment is presented evenly then torsional anomaly doesn't exist.

Mounir Bouassida1 et Al (2019) To concentrate on Seismic reaction of G+ 10 celebrated improved concrete (RC) structure with changing ground slant as 0º, 5º, 10º, 15º as well as 20º with and without shear wall utilizing SAP2000, In this study The principal objective is to perceive the acts of the structure on slanting ground for the consequence of varying rise of the section in lower floor and furthermore various situations of shear walls and to concentrate on the presentation of shear wall on slanting ground.

A. Objectives

The main objectives of the project are:

1) To figure out the seismic reaction of RC Building with Floating Column concerning different seismic zones and on various story of building.
2) Prepare software model of G+12 Structure on ETABS software. Analyze the structure for Seismic loading and wind loading
3) To find out the difference between Seismic parameters i.e. Base shear, Storey drift & displacement.
4) To contrast the exhibition of RCC building and without Floating Column concerning seismic boundaries.

B. Aim and Scope of the project

The importance of present research work is to study the performance of G+12 storey buildings for seismic zones IV & V for medium soil type position. To investigate the effect of such methods on the building structures, analytical models are considered in this study.

III. METHODOLOGY

To prepare and analyse models without floating column and with floating column on lower, middle and upper story at different location in ETABS 2016 with seismic zones IV & V and to compare the obtained results.

A. Description Of Model And Cases

For analytical study of building with floating column, different models are required to prepare accurate conclusion from more case studies.

Therefore, eight different types of models aremade in ETABS software.

1) Model - A: RC Building G+12 without Floating Column.
2) Model - B: RC Building G+12 with Floating column provided on the First floor at 4 corners of building.
3) Model - C: RC Building G+12 with Floating column provided on the first floor at interior core position of column.
4) Model - D: RC Building G+12 with Floating column provided on the Fifth floor at 4 interior corners of building.
5) Model - E: RC Building G+12 with Floating column provided on the Eleventh floor at 4 interior corners of building.
6) Model - F: RC Building G+12 with Floating column provided on the First floor at 4 corners of building with Y Shaped Column on ground Floor.

B. Time History Method

In time history examination, the primary reaction is registered at a no. of resulting time moments. As such, time narratives of the underlying reaction to a given information are gotten subsequently. A full time history will give a reaction of the design after some time during and after the use of a heap.

C. Building Details

- Number of bays in X direction = 4
- Number of bays in Y direction = 4
- Height of each storey = 3 m
- Number of storeys = 12
- Height of building = 38 m
- Size of beam = 0.375 m x 0.450 m
- Size of column = 0.400 m x 0.500 m
- Slab thickness = 0.150 m
- Thickness of the wall = 0.23m
- Fck = 20 mpa
- Fy = 415 mpa
- Live load = 3 KN / m2
- Zone factor [z] = 0.36
- Importance factor [i] =1.2
- Response reduction factor [r] = 5

D. Parameters Considered For The Building Design

Sr. No.	Description	Values
1.	Building type	RCC building
2.	No. of storeys	G+12
3.	Plan area	400 sq meter
4.	Plan dimensions	20 m X 20 m
5.	Height of building	39 meter
6.	Type	Residential
7.	Beam	0.250m x 0.450 m
8.	Column	0.45m x 0.45m
9.	Concrete grade	30 MPa
10.	Steel	415 MPa
11.	Dead load	10 KN/m
12.	Live load	2 KN/m
13.	Importance factor	1
14.	Zone factor	zone 5 (0.36)

E. ETABS Models

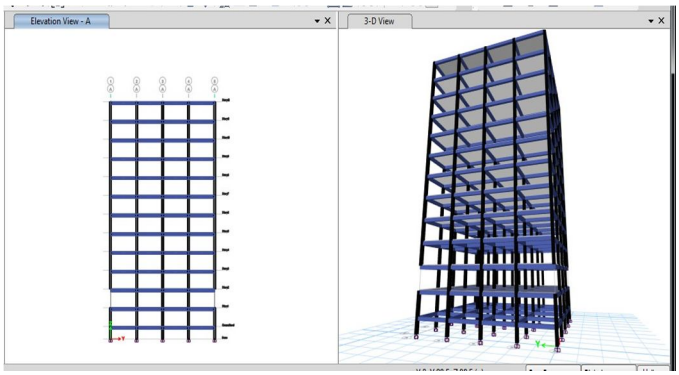


Figure 18 Model B- Building frame with Floating Column @ 1st Floor at 4 external corners

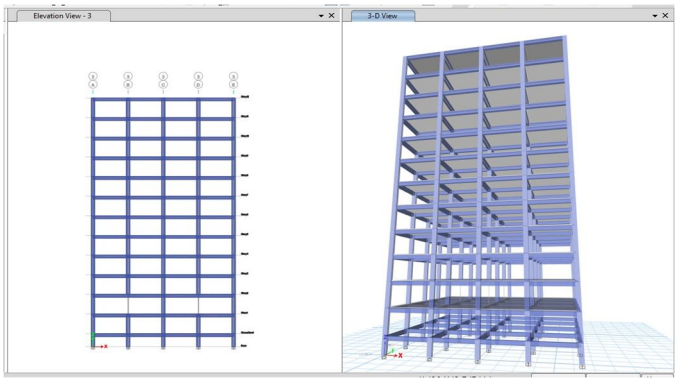


Figure 19 Model C- Building frame with Floating Column @ 1st Floor at interior position

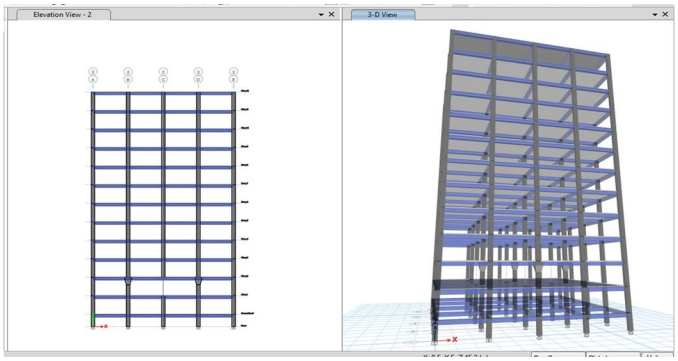


Figure 22 Model F- Building with Floating Column @1st floor and with Y-Shaped column

IV. RESULTS AND DISCUSSIONS

A. *Matlab Calculations*

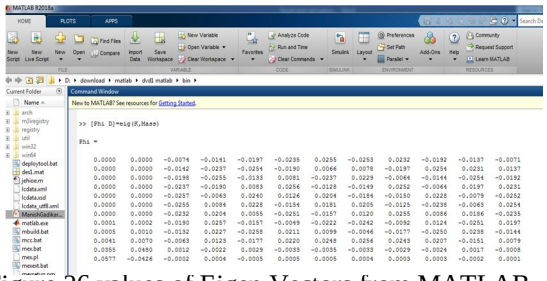
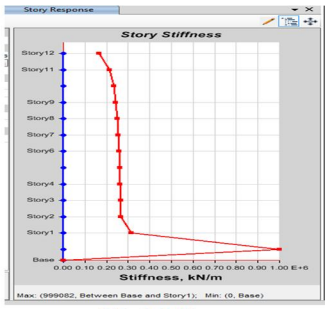


Figure 26 values of Eigen Vectors from MATLAB

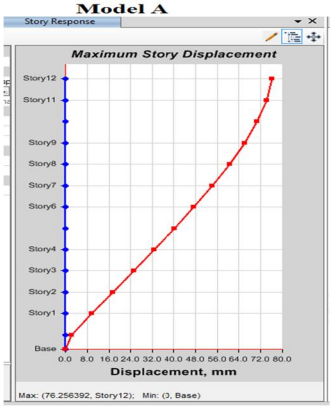
Sr. No.	Eigen values
ω^2_{11}	88.6
ω^2_{22}	489.7
ω^2_{33}	1576.7
ω^2_{44}	1628.8
ω^2_{55}	1628.8
ω^2_{66}	1710.4
ω^2_{77}	1814.6
ω^2_{88}	1932.5
ω^2_{99}	2054.5
$\omega^2_{10\text{-}10}$	2272.3
$\omega^2_{11\text{-}11}$	2351
$\omega^2_{12\text{-}12}$	2400.8

Sr.No.	Seismic parameters	Model B values	Model C Values.
1.	Base Shear	2268.67 kN	2836 kN
2.	Max. Storey drift	0.0031	0.0037
3.	Max. Storey Stiffness	99.90×10^4 kN/m	99.81×10^4 kN/m
4.	Max. Storey Displacement	104.47 mm	96.52 mm

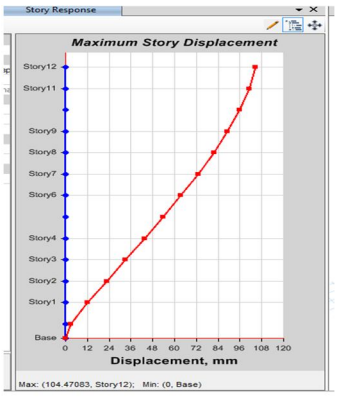
Model A



Model B



Model A



Model B

V. CONCLUSION

1) Building frame without floating columns gives better performance and shows greater values of seismic parameters such as base shear, storey stiffness, storey drift and displacement as compared to building with floating column.

2) When floating column is located at corner or extreme point of building plan, it shows worse performance of RCC building under seismic lateral load.

3) Whereas building with floating column located at interior location of building plan gives relatively lesser values for displacement and storey drift with comparatively more stiffness.

4) The worse seismic effect due to presence of floating column in R.C building primarily depend on position of floating column on particular floor. Similarly, when floating column provided on upper storey it reduces the worse seismic effect, which means when floating column is provided on lower storey it shows more storey displacement and drift, but when it is provided on 11^{th} floor or at high elevation it shows less storey displacement and storey drift.

5) Because of floating column, stiffness of RC frame structure gets reduced. Therefore, when Y- shaped column are provided below the beams which are just adjacent to transfer beams, it increases the stiffness of that storey level and hence help to reduce the storey displacement.

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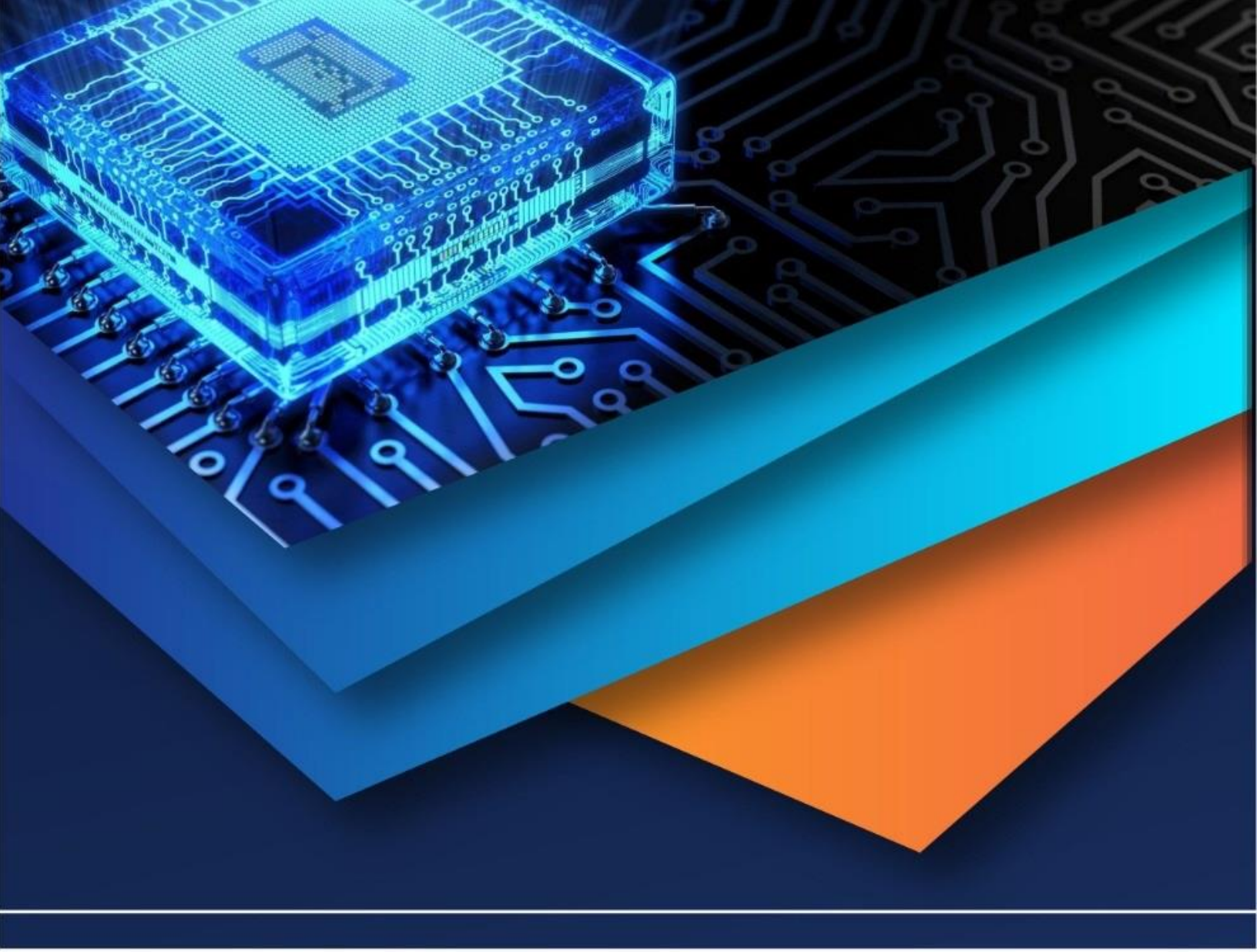

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