COMPARATIVE STUDY OF SEISMIC ANALYSIS OF MULTI STORIED BUILDING WITH AND WITHOUT FLOATING COLUMN USING E TABS

Lokesh M[1], C H Veeresh[2], Venkatesh H[3], Shivashankar S P[4], N R Shwetha [5] Nayana B S [6]

[1,2,3,4,5]*Students, Department of Civil Engineering, RYMEC Ballari.*
[6]*Assistant professor, Department of Civil Engineering, RYMEC Ballari.*

---***---

Abstract - *In modern times the buildings are proving to be more and more complex as the purposes of the building are mixed use ones. There are different uses on different floors and hence the similar flow pattern of a structural grid is highly impossible. As when compared to residential, commercial and other type of structures there is a possibility of high variation in Structural design and the Architectural design.*

The necessity of different grid systems in the buildings had led to the existence of floating column. The position of the floating column in first floor or subsequent floors or any intermediate floors is based on the requirements of the Architectural design or Structural design.

In the present scenario, a structure of G+3 situated in Uravakonda, Ananthapur (AP) is considered for analysis which consists of a cellar, ground floor, first floor and second floor. Each floor is used for different purpose such as residential and commercial including features such as bank, mall, office, restaurant etc. The analysis is carried out for the seismic zone of ***zone2*** *with* ***4models*** *for the slabs, beams and columns.* ***ETABS*** *software is utilized for the complete analysis of all the models of the present project. The building models are analyzed and compared for the seismic zone as per IS 1893-2002 for static load analysis and response spectrum analysis.*

The comparison of results is carried out for storey displacement, storey shear, and base shear. The results are obtained and represented in the forms of graphs and tables for the seismic zone.

Key Words**:**

1. INTRODUCTION

The origin of the buildings probably began with simple forms of construction being used for shelter against sun, wind and rain.

As the old saying goes "NECESSITY IS THE MOTHER OF INVENTION", the necessity and desire for a better shelter grew amongst all to gather suitable materials for the shelter i.e. construction, And in parallel path better and unique construction skills are developed.

Although the construction is spreading in horizontal direction, due to the rapid increase in population, there is an urge for construction to increase in vertical direction also resulting in apartments, skyscrapers and other multi storied buildings.

Buildings nowadays are of two types of building systems,

a) Load bearing masonry buildings
b) Framed buildings

Load bearing masonry buildings: - The design of load bearing masonry wall are carried out as per **IS 1905-1980** (Indian standards code of practice for structural safety of buildings: Masonry wall (second revision). Load bearing brick wall. This type of system is suitable for buildings with maximum of four stories, and small building houses whose spans of beams are less and the slabs are cast of RCC and the walls are of load bearing brick masonry.

Framed buildings: - In these types of buildings the reinforced concrete frames are provided for beams and columns to carry and transfer the loads expected to be coming over it. The brick work for the walls is considered to be non load bearing wall where it plays a role of a filler material for the walls. In the framed buildings the slabs are of thickness 150 to 200 mm depending upon the loads coming over it. The walls provided in this type of building systems are possibly kept slender. This framed type of system is adopted for multi storied buildings where the number of stories is high or the loads expected on the structure is more.

1.1 FLOATING COLUMN:

The floating column is a vertical member which rest on a beam and doesn't have a foundation. The floating column act as a point load on the beam and this beam transfers the load to the columns below it.

There are a large number of projects which employ the application of floating columns for both structural and architectural point of view. By the introduction of floating column larger open space is available for various purposes such as parking, function hall or any other use.

The provision of floating column for a high rise structure in a seismically active zone is not advisable. Although the earlier structures designed and constructed with the application of floating column cannot be demolished, but can be strengthened at the bottom floor columns by retrofitting or by provision of bracing systems.

1.2 Advantages and disadvantages of floating columns

Advantages

I. By using floating columns large functional space can be provided which can be utilizing for storage and parking.
II. In some situations floating columns may prove to be economical in some cases.
III. The floating column is important for dividing the rooms and some portion can rise without whole area.

Disadvantages

I. Not suitable in high seismic zone since abrupt change in stiffness was observed.
II. Required large size of girder beam to support floating column.
III. Floating columns leads to stiffness irregularities in building.
IV. Flow of load path increases by providing floating columns. The load from structural members shall be transfer to the foundation by the shortest possible path.

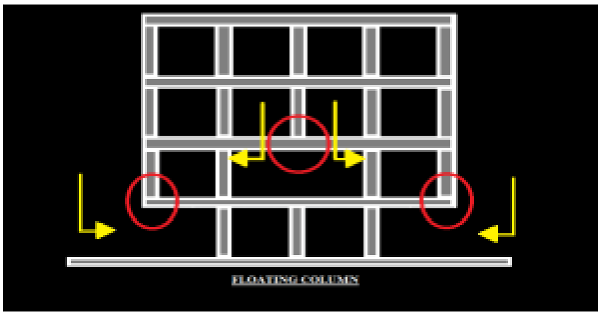


Fig-1 : Floating Column

2. Objectives

1) To compare the storey drift, storey shear and storey displacement for multi storey building with and without floating column using E tabs.
2) To study the behavior of multi storey building with and without floating column in various seismic zones.
3) To study the shifting of floating column from lower storey to higher storey of multi storey building.
4) Design and estimation of the building.

3. MATERIALS, METHODOLOGY AND MODELS

The design of the structural elements of the building should conform and satisfy the following Indian code for reinforced concrete design, published by the bureau of Indian standards, New Delhi.

All the countries have formulated and fixed various national building codes which represent certain guidelines for the design and construction of any structures in those respective countries. These codes are established and evolved by expert structural engineers who study, analyze and decide over the years of experience, and these codes are revised periodically to suit the current trends.

IS 456:2000 – plain and reinforced concrete is the code of practice.

3.1 Methods of analysis:

Analysis is carried out in Manual method by Kani's method and also by using software i.e. ETABS and are compared and seen that there is an error of 5 to 10%,

- Linear Static:
- Linear Dynamic:
- Non-linear Static:

Methods adopted

Linear Static:

The linear static analysis method is adopted for the building analysis in a seismic zone and is based on the assumption that the building is responding in its fundamental mode. The analysis method represents the behavior of the building during the earthquake ground motion; typically it's defined by a seismic design response spectrum analysis where a series of forces are acting on the building.

In the state where the behavior of the building is in its fundamental mode, the building should not twist and it should be a low rise structure.

Many building codes have extended the applicability of this method to make sure it holds good for the high rise structures with low levels of twisting.

To analyze the effects of a structure due to "yielding", the modification factors also known as reduction factors are used as an aid for many building codes that reduce the design forces.

Details of models analyzed in e tabs

Model 1 = Building without Floating Column

Model 2 = Building with Floating Column in Storey 1

Model 3= Building with Floating Column in Storey 2

MODEL 4 = Building with Floating Column in Storey

3.2 STRUCTURAL ANALYSIS

The architectural plans and elevation of the commercial complex are enclosed in annexure. Suitable sizes for beams and columns are assumed initially and the three dimensional structural frame corresponding to the commercial complex is taken. The bottom ends of the columns are assumed to be fixed for the purpose of analysis .tie beams are provided for the basement level to make the columns short and also to take the wall loads if any. The loads considered in the analysis are 1) dead loads 2) live loads and 3) earthquake loads. All these loads have been calculated as per IS 875. The live load assumed for floors and roof slabs are 3KN/m^2. The dead loads due to self weight, floor finishes and partitions are also calculated.

3.3 E Tabs Figures

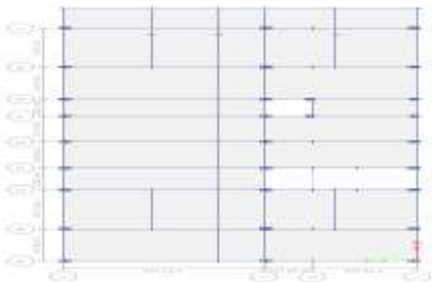


Fig-2 : Center Line Layout

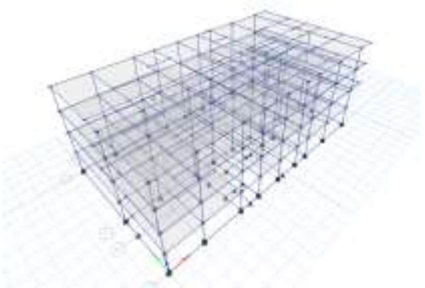


Fig-3 : 3D View

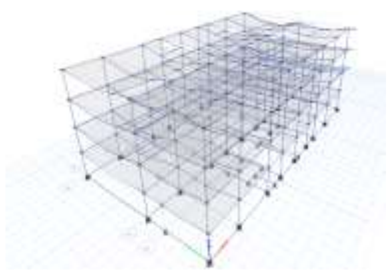


Fig-4 : Elevation view

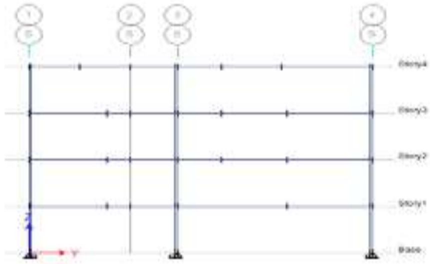


Fig-5 : Deformed shape of building

Fig-6 : Bending moment and shear force diagram of beam B51

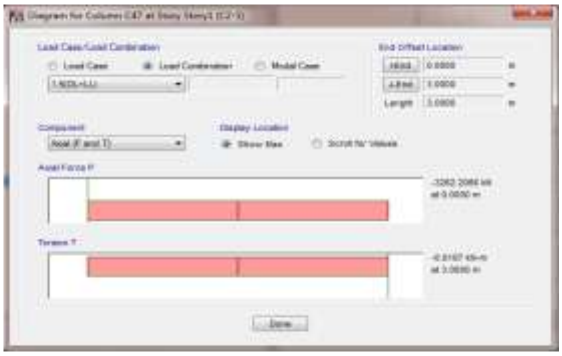


Fig-7 : Axial Force and Torsion Diagram of column C47

Fig-8 : Bending Moment and Shear force diagram of column C47

4. RESULT AND DISCUSSION

Model 1 = Building without Floating Column

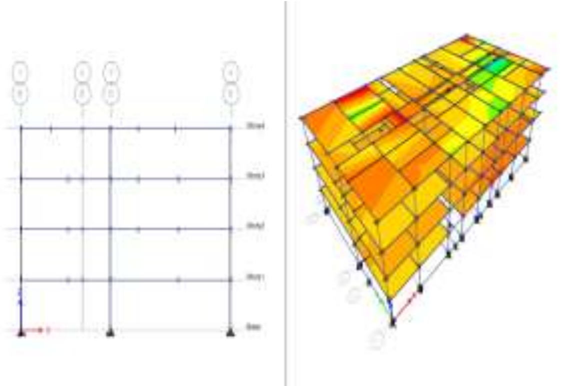


Fig-9 : Elevation and 3D view

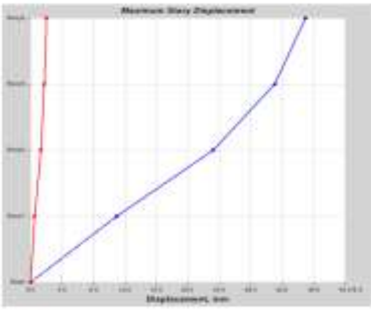


Chart-1 : Result graphs of storey displacement, for model 1

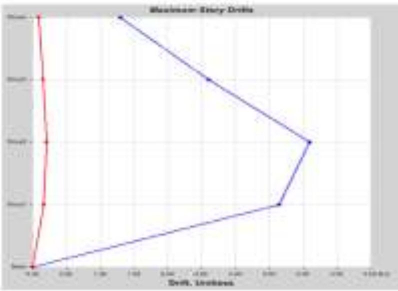


Chart -2 : Result graphs of storey drift, for model 1

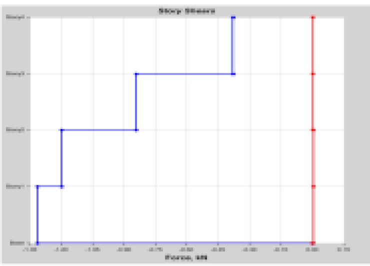


Chart -3 : Result graphs of storey shear, for model 1

Maximum Storey Displacement:

The maximum storey displacement is increasing with the increase in height of the building. "The Y-Axis of the graph represents the storey height and the X-Axis represents the displacement in mm". The maximum displacement in the models is represented as follows i.e.

Table: 01 Storey Displacement (mm)

SL NO.	STOREY	STOREY DISPLACEMENT(mm)			
		MODEL 1	MODEL 2	MODEL 3	MODEL 4
1	STOREY 1	11	11	11	11
2	STOREY 2	23	23	23	23
3	STOREY 3	31	31	31	31
4	STOREY 4	35	36	34	35

Maximum Storey Drift:

The maximum storey drift represents a spring action where the drift value increases and then decreases. "The Y-Axis of the graph represents the storey height and the X-Axis represents the amount of drift of storey from its initial position"; Storey drift value is Unit less.

Table: 02 Storey Drift

SL NO.	STOREY	STOREY DRIFT			
		MODEL 1	MODEL 2	MODEL 3	MODEL 4
1	STOREY 1	3.8	3.8	3.6	3.7
2	STOREY 2	4.1	4	4.2	4.1
3	STOREY 3	2.6	2.5	2.6	2.7
4	STOREY 4	1.25	1.25	1.25	1.25

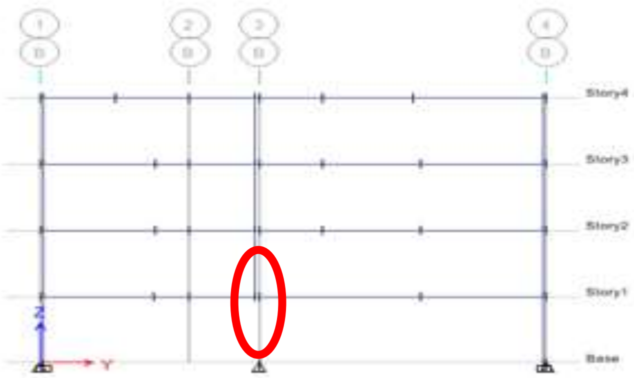
STOREY SHEAR:

The Storey Shear is the plane at which the storey is expected to cut or shear or break, "The Y-Axis of the graph represents the storey height and the X-Axis represents the amount of force in KN". Storey shear is expressed as FORCE and its unit is KN.

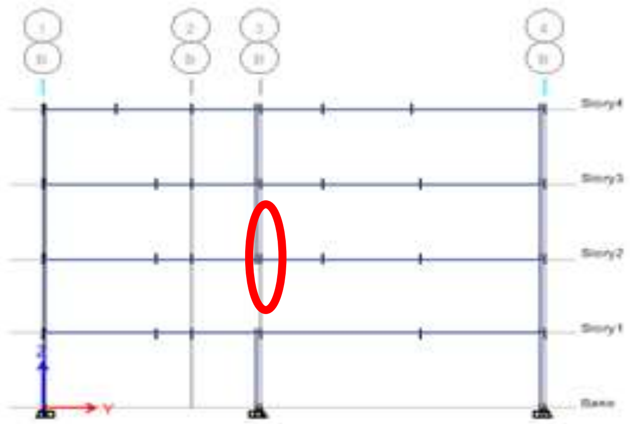
Table: 03 Storey Drift

SL NO.	STOREY	STOREY SHEAR (kN)			
		MODEL 1	MODEL 2	MODEL 3	MODEL 4
1	STOREY 1	-1.30	-1.28	1.30	1.30
2	STOREY 2	-1.20	-1.19	1.20	1.18
3	STOREY 3	-0.85	-0.85	0.85	0.85
4	STOREY 4	-0.38	-0.38	0.38	0.38

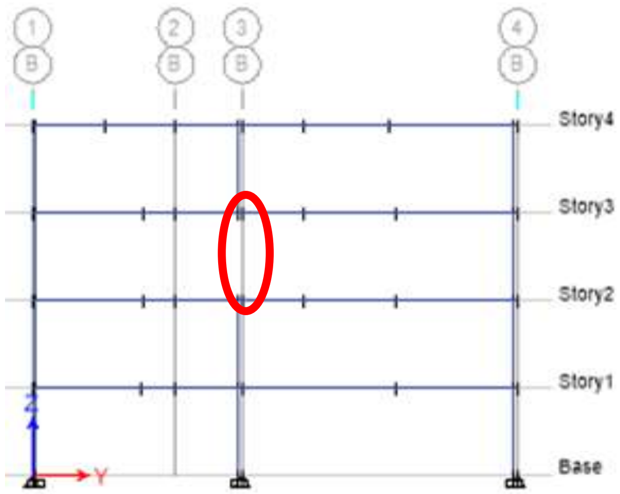
Model 2: Building with Floating Column in Storey 1



Model 3= Building with Floating Column in Storey 2



Model 4 = Building with floating column in storey 3



Discussion

- It is observed that the STOREY DISPLACEMENT in all the 4MODELS increases with the increase in height of the building. The maximum and minimum displacements are found to be in the MODEL2 and MODEL3 respectively.
- It is observed that the STOREY DRIFT in all the 4MODELS is HIGH at STOREY2 and reduces as the height of the building increases. The minimum drift values are observed at the STOREY4 as 1.25 for all the 4MODELS.
- It is observed that the STOREY SHEAR in the MODELS 1 & 2 are NEGATIVE with maximum and minimum values of -1.30 & -0.38 respectively. Similarly, It is observed that the STOREY SHEAR in the MODELS 3 & 4 are POSITIVE with a maximum and minimum values of 1.30 & 0.38 respectively
- But this study of analysis is carried out in order to understand the degree of acceptability for the provision of floating in the structures where there is a need for floating column either in architectural or structural point of view.
- But in the case of existing structures the bottom storey columns are to be strengthened by retrofitting and by bracing systems.

SCOPE FOR FUTURE WORK

The study of buildings with floating columns can be extended for future study in a wide variety of conditions amongst which few are as follows:

- When the building is located in different soil conditions.
- When the buildings are located in highly terrain areas.
- Types of loads and loading combinations.

- Depending upon the height of the building and number of floors. .
- Depending upon seismic zones where the building is expected to stand.
- Types of materials used as alternative for construction (Steel or Composite Sections).
- Comparison with various manuals methods for analysis.
- Comparison with various software's for analysis such as CYPE, STAADPRO, and SAP etc.

The study can also be carried out in the different analysis methods such as TIME HISTORY and PUSH OVER ANALYSIS.

5. CONCLUSION

In the present scenario of analyzing of various models for the multistory building with and without floating column. The parameters are considered based upon the gravity condition for the live load, dead load and dynamic loads, and the seismic parameters such as storey displacement, storey drift and base shear.

Analysis is carried out in Manual method by Kani's method and also by using software i.e. ETABS and are compared and seen that there is an error of 5 to 10%,

- Storey displacement increase 5 to 10% for a model with floating column when compared to a model without floating column.
- Storey drift increase 5 to 10% for a model with floating column when compared to a model without floating column.
- Base shear decrease 5 to 10% for a model with floating column when compared to a model without floating column.

Hence from the above models and their analysis it is to be concluded that the provision of floating column for the building in high seismic prone areas is to be avoided as far as possible.

REFERENCES

- "Study Behavior Of Floating Column For Seismic Analysis Of Multi Storey Building Using E Tabs" By Ms. Waykule And Mr. Kadam
- "Seismic Analysis Of Multi Storey Building With Floating Columns Using E Tabs " By Ms. Pradeep, Mr. Chethan, Ms.Ashwini
- "Seismic Analysis Of Rc Building With Floating Columns Using Non Linear Static Analysis" By Mr. Mohamed Aqeeb Ulla, Mr. Krishna Murthy
- "Analysis Of Floating Column Building Of Composite And Rcc Beam Girders With Rcc Frame Structure Using E Tabs" By Ms. Jayashri Sarode
- "Study Behavior Of Seismic Evaluation Of The Multi Storied Building With Floating Column" By Mr. Sk Shmabanu
- "Comparative Study Of Floating Column Of Multi Storey Building Using Sap" By Ms. Waykule S B
- "Seismic Analysis Of Multi-Storey Building With Floating Column Using Etabs" By Mr. Pradeep
- IS 456 – 2000 for RCC and PCC design
- Design of Reinforced cement concrete by S S BHAVIKATTI
- Soil mechanics by B C PUNMIA
- SP 16 for reinforcement details
- IS 875 PART (1,2,3) – 1987 for load
- IS 2720-PART(9)-1992 for dry density moisture content relation of soil
- IS 2720-PART(13)-1986(Reaffirmed 1997) for direct shear test of soil
- IS 6403- 1981 (Reaffirmed 2002) for bearing capacity of soil
- E TABS software for analysis of buildings
- NBC rules and regulations