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Critical Study of Behavior of RC Structural Frame with Floating Column

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Abstract: ***The infrastructural boom during last decade as resulted in construction of many high rise structures in all mega cities Due to the existence of architect and structural designer have provided floating column in many location in structure. The building become vulnerable to earthquake hazard due to improper way of flow of earthquake force to ground due to discontinuity in the form of floating column brought into structure floating column provided at some location result in close loop and redistribution of moment and forces may prove to be beneficial in restricting dimension of beam and column it may also help in achieving in desire economy. In this project analysis and design of a G+14 RC building is done by introducing the floating column in different conditions such as internal floating column, external floating column and alternate level floating column for determining parameter like displacement, forces and moments is done by using ETAB software***
Keywords: Floating column, Seismic coefficient method, Earthquake effect for various soil condition.

I. INTRODUCTION

A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which (due to architectural design/ site situation) ends at its lower level (termination Level) rests on a beam
which is a horizontal member. The beams can transfer the load to other columns below it such
columns where the load was considered as a point load. Theoretically such structures can be analyzed and designed. In practice, the true columns below the termination level are not constructed with care and more liable to failure.
Hypothetically, there is no need for such floating columns – the spans of all beams need not be nearly the same and some spans can be larger than others. This way, the columns supporting beams with larger spans would be designed and constructed with greater care complexities such as floating column at different levels. Hence proper understanding of the seismic behavior of floating column is studied and adequate checks should be carried out before designing the structure.

II. REVIEW OF LITERATURE

A. Overview

Literature survey related to the behavior of structures with floating columns was under taken to get acquainted with the latest measures and techniques adopted for the same. Technical articles published in the proceedings and other journals have been referred to determine the further scope of work and to understand the status of each project undertaken. It has been noted that many researches and academicians have worked on seismic analysis of structures with floating columns.

1) Normal floating column
2) External floating
3) Internal floating
4) With internal & external floating column.

Jessant n. Arleta, et.al [1] This paper highlighted the importance of explicitly recognizing the presence of the open first story's in the analysis of the building. The error involved in modeling such buildings as complete bare frames, neglecting the presence of infill's in the upper story's, is brought out through the study of an example building with different analytical models. This paper argues for immediate measures to prevent the indiscriminate use of soft first story's in buildings, which are designed without regard to the increased displacement, ductility and force demands in the first storey columns. Alternate measures, involving stiffness balance of the open first storey and the storey above, are proposed to reduce the irregularity introduced by the open first storey. The effect of soil flexibility on the above is also discussed in this paper.

C.M. Ravi Kumar et.al [2] discussed the performance evaluation of RC (Reinforced Concrete) Buildings with vertical irregularity. The study as a whole makes an effort to evaluate the effect of vertical irregularity on RC buildings, in terms of dynamic characteristics and identifies the influencing parameters which can regulate the effect on Base Shear, Time Period, Story Displacement & Story Drift. Also, the analysis has been carried out for various zones of India and soil conditions taken in to consideration.

S.K. Dubai et.al [3] The main objective of this study is to understand different irregularity and torsional response due to plan and vertical irregularity, and to analyze "T"-shaped building while earthquake forces acts and to calculate additional shear due to torsion in the columns. Additional shear due to torsional moments needs to be considered because; this increase in shear forces causes columns to collapse. So in design procedures this additional shear must be taken into account.

ReranNautical et.al [4] This paper aims to investigate the effect of a floating column under earthquake excitation for various soil conditions and as there is no provision or magnification factor specified in I.S. Code, hence the determination of such factors for safe and economical design of a building having floating column. Linear Dynamic Analysis is done for 2D multi storey frame with and without floating column to achieve the above aim i.e. the responses (effect) and factors for safe and economical design of the structure under different earthquake excitation.

Annul A. Patel .[5] In this paper comparative study of floating and non floating columns with and without seismic behavior. The Analysis and Design floating and non floating column by using software ETAB'S2015 and compares the result with STAD-pro V8i software. The aim of this paper work is compare the response of RC frame buildings with and without floating column under earthquake loading and normal loading. The study of various load in various earthquake zone of building and to the four cases, (RC building),

Poona et.al [6] studied the response of a 10-storeyed plane frame to lateral loads is studied for mass and stiffness irregularities in the elevation. These irregularities are introduced by changing the properties of the members of the storey under consideration. Floor-mass ratios ranging from 1 to 5 are considered for mass irregularity. The mass irregularity is introduced at different storey levels—fourth and seventh levels. To introduce stiffness irregularity, the fourth and fifth story's stiffness's are reduced to 50% of that of other story's in the base frame. Other than the first-storey, other story's are also given similar stiffness irregularity. Moreover, the effects of floating columns as well as of unusually tall first storey on the dynamic response are also studied. Conclusions are derived regarding the effects of the irregularities on storey-shear forces, storey drifts and deflection of beams. It is found that the mass and stiffness criteria of the IS code results in moderate increase in response quantities of irregular structures compared to regular structures. Results of the numerical analysis indicate that any storey, especially the first storey, should not be softer than the story's above or below. Non-uniform mass distribution also contributes to the increased response of the buildings. The irregularities, if required to be provided, need to be catered to by appropriate and extensive analysis and design processes. Based on these findings, some guidelines are proposed to make buildings safer to seismic excitations.

Ravi Kumar C M et.al [7] studied two kinds of irregularities in the building models namely plan irregularity with geometric and diaphragm discontinuity and vertical irregularity with setback and sloping ground. These irregularities are created as per clause 7.1 of IS 1893 (part1)2002 code. In Oder to identify the most vulnerable building among the models considered, the various analytical approaches are performed to identify the seismic demands in both linear and nonlinear way. It is also examined the effect of three different lateral load patterns on the performance of various irregular buildings in pushover analysis. This study creates awareness about seismic vulnerability concept on practicing engineers.

V.K. Sedative et.al [8] studied a simple and efficient method of determining structural irregularity limits for structures designed using different analysis procedure as an example the methodology is applied to simple models of shear type structure with different amounts of mass irregularity located at different locations within the structure all designed in accordance with the Equivalent Static Method of NZS 1170.5, including *P*-Delta effects .these models were then analyzed using inelastic dynamic time history analysis for the 20 SAC 10 in 50 earthquake records for Los Angeles. The additional median inter storey drift responses due to mass irregularity was computed which can be limited to an acceptable level Irregularity limits for use in design can then be defined for a specified level of confidence.

Rivas Sameer Shah [9] The aim of this work is to compare the response of RC frame buildings with and without floating columns under earthquake loading and under normal loading. The primary aim of this work is the comparative study of floating column and non-floating columns with and without seismic behavior. Determination of seismic response of both the models by using response spectrum analysis in ETAB'S

Shirking M.K. [10] A Column is supposed to be a vertical member starting from foundation level and transferring the load to the ground the multistoried building with complexities will undergo large displacement waves increases when a floating column is provided in edge and middle than the outer face of the frame. The displacement values are less for lower zone and it goes on increases for higher zone.

Waykule.S.B. [11] is paper present the effect of stiffness of infill wall to the damage occurred in floating column building when ground shake. Modeling and analysis are carried out by non linear analysis programme in this paper find whether structure is safe or unsafe with floating column when build in seismically active areas and also find floating column building is economical or uneconomical.

III. OBJECTIVES

1) The objective of the present work is to study the behavior of multistory buildings with floating columns under earthquake excitations.
2) Seismic coefficient Method is carried out for the multi-storey buildings under different load combination.
3) To study of Internal floating columns & Alternate floor floating columns observation of displacement at various nodes.
4) To know the External floating columns observation displacement at various nodes.

A. Modeling of Structure

Modeling of the building is done as per proposed plan of the building as shown in figure 1.2. This is the plan for G+14 storied building

B. Details of Building

Sr.No.	Description	Dimension
1.	Length of building	24m
2	Width of building	24m
3	Storey Height of building	3m
4	Total height of building	45m
5	Dimension of column	0.400x0.450
6	Dimension of beam	0.230x0.300
7	Thickness of slab	150mm
8	Zone	III
9	Dead load on building.	1.5
10	Live load on building	1.2
11	Importance Factor	1
12	Response reduction factor a) For SMRF	5
14	Soil Condition	Hard Strata

IV. METHODOLOGY

In this project, a plan of G+ 14 story building is selected with introduction of floating column,

A. Structure and Cases Considered – Preliminary Analysis

To initiate the effect of floating column 4 different cases as detailed below were considered and for all these cases the structure was analyzed using ETAB, displacement, shear, bending moment and torsion at all floor levels in beam and columns near to floating columns was noted and documented. The observations are presented in tabular as well as graphical form.

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1) *Case 1:* In first case plan of G+14 building without floating column is taken this building is analyze and design by using software ETAB for four zones and comparative study on various parameters is done.

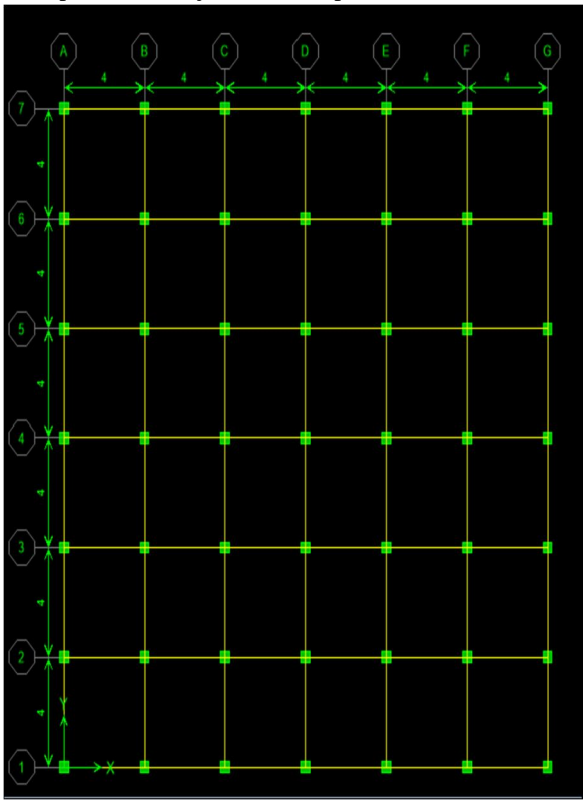

Fig. 1.1 Plan of Structure

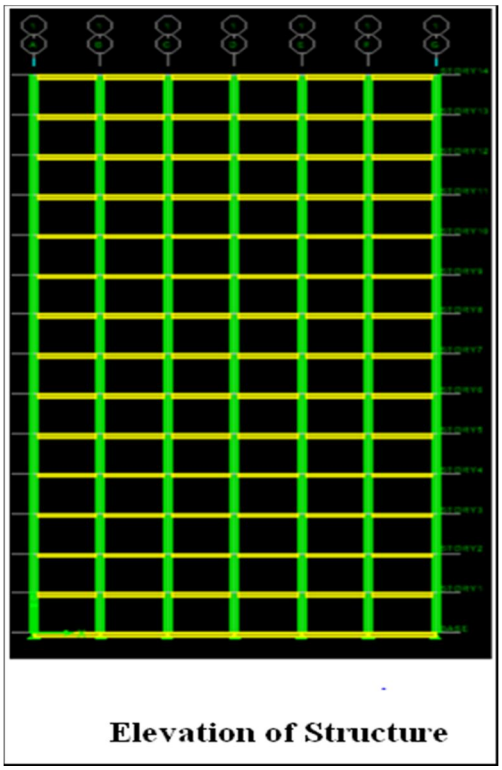

Fig. No. 1.2

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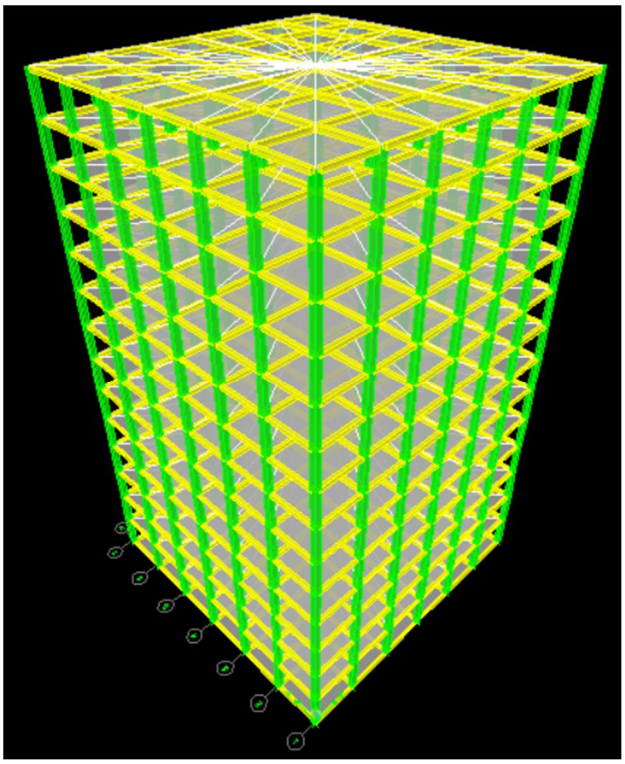

Fig. No. 1.3: 3-D View of Structure

2) *Case 2:* In Second case plan of Internal floating column is taken this building is analyze and design by using software ETAB for four zones and comparative study on various parameters is done.

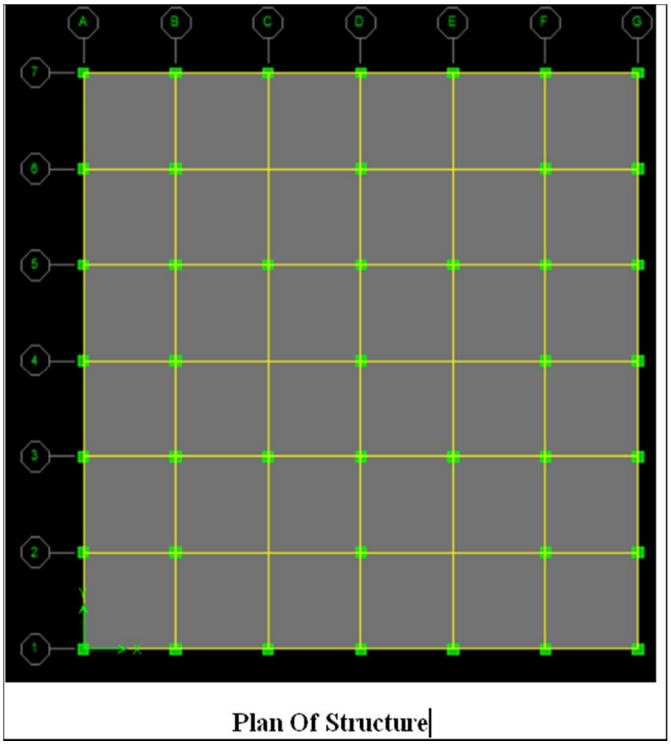

Fig. No. 1.4

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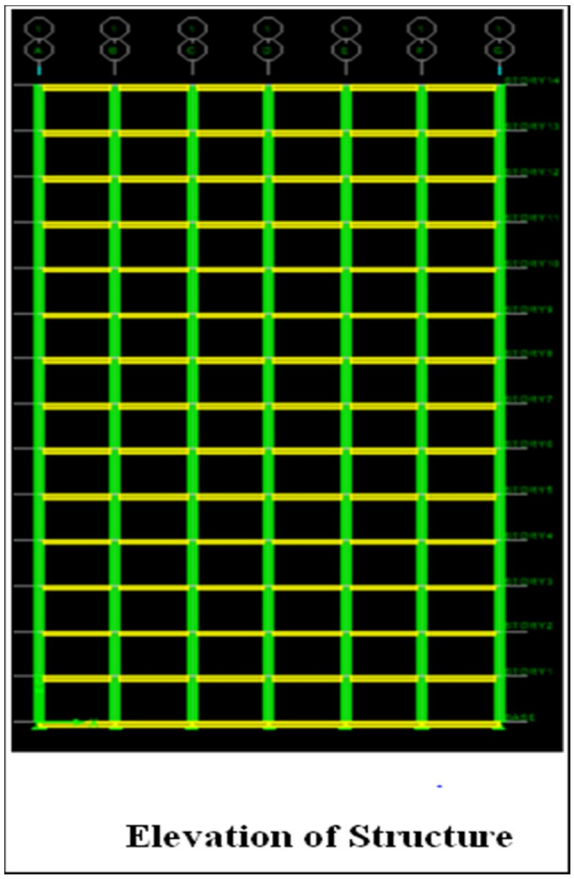


Fig. No. 1.5

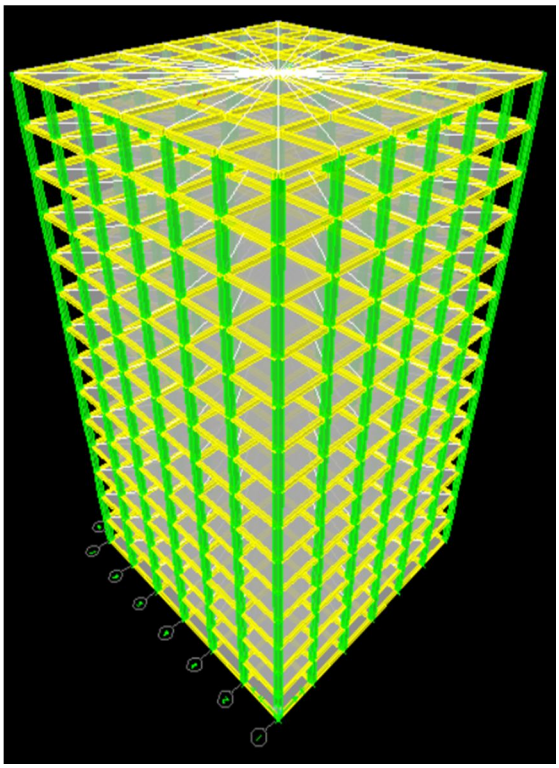
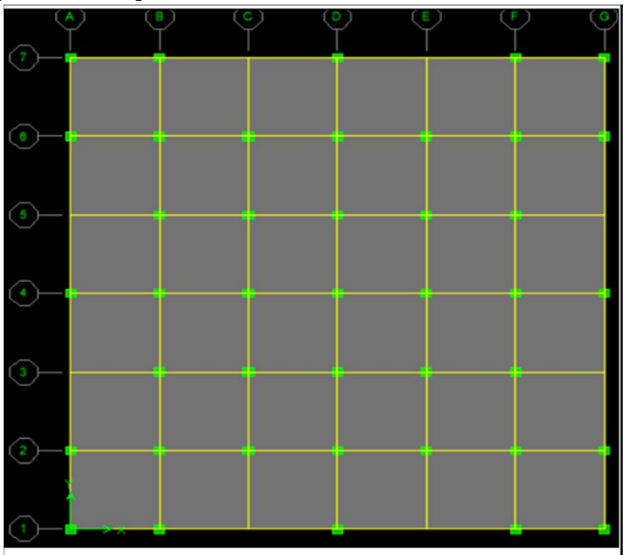


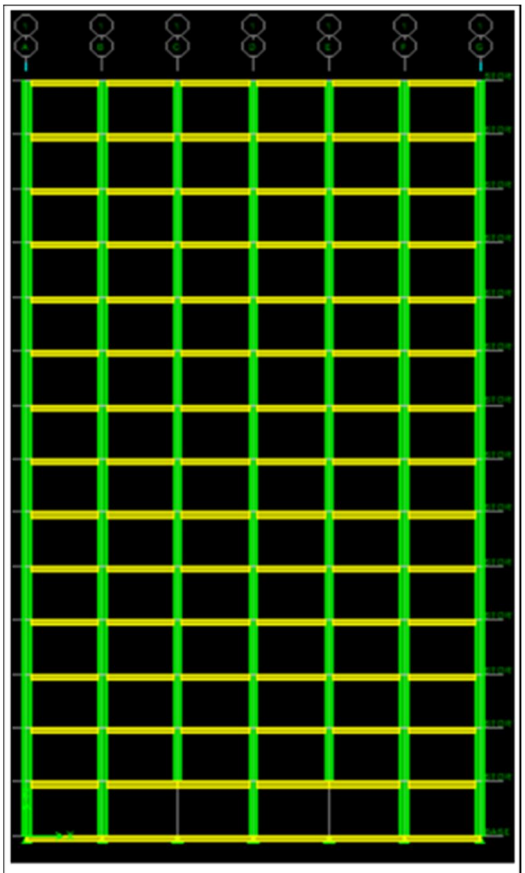
Fig. No. 1.6

3) *Case 3:* In Third case plan of External floating column is taken this building is analyze and design by using software ETAB for four zones and comparative study on various parameters is done.



Plan of Structure

Fig.No.1.7



Elevation of Structure

Fig.No. 1.8

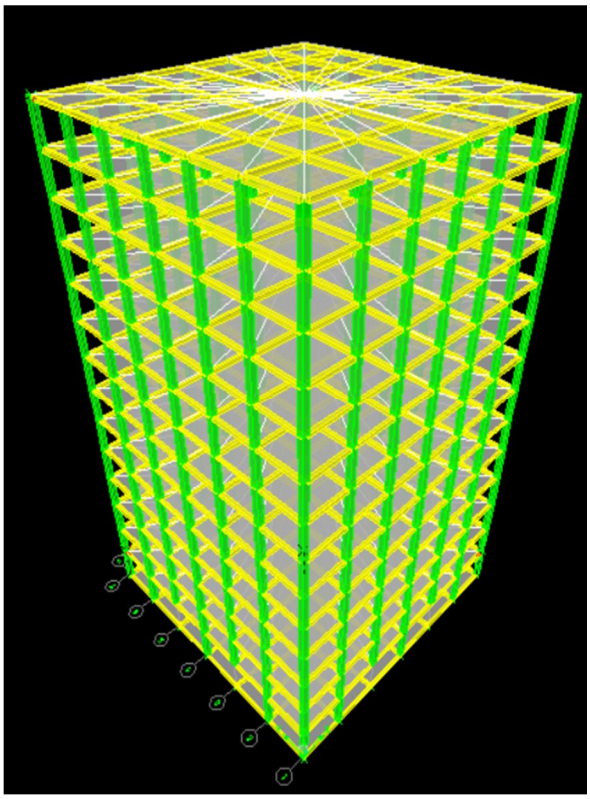
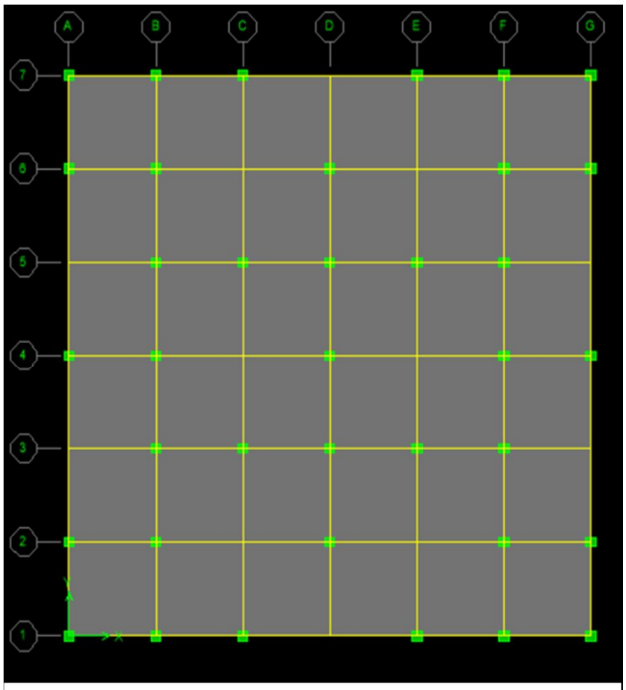


Fig. No. 1.9: 3-D View Of Structure

4) *Case 4:* In Fourth case plan of G+14 building alternate floor floating column is taken this building is analyze and design by using software ETAB for four zones and comparative study on various parameters is done.



Plan of Structure

Fig.No.1.10

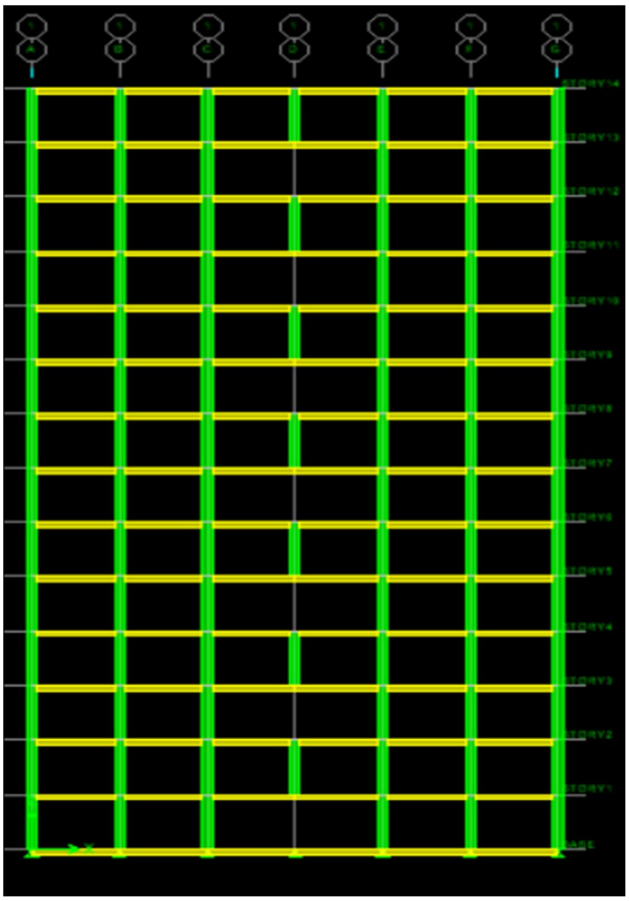


Fig.No.1.11 Elevation Of Structure

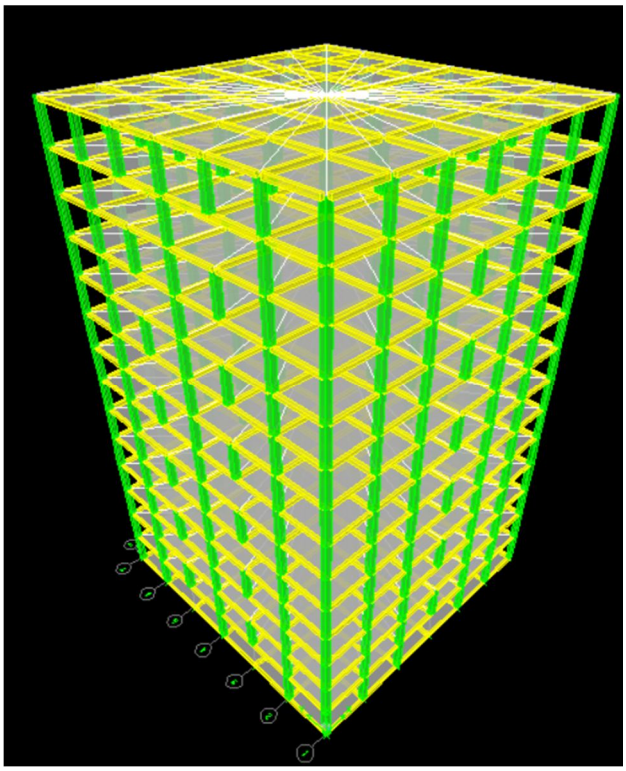
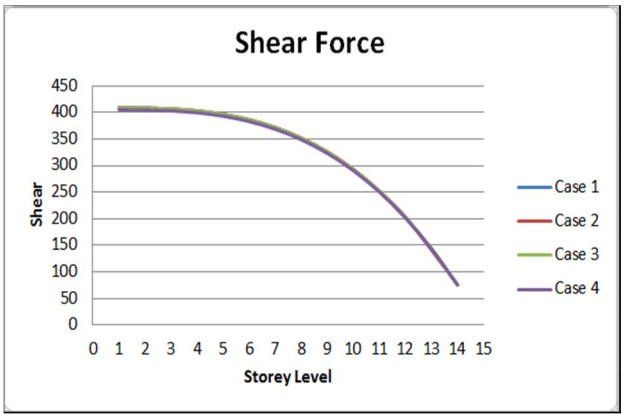


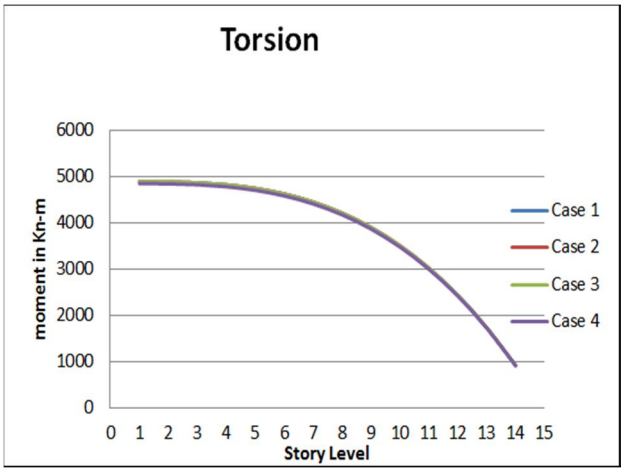
Fig. No. 1.12

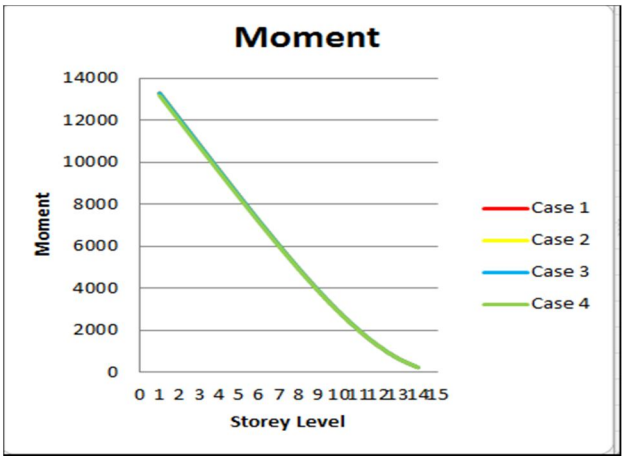
V. RESULT AND DISCUSSION

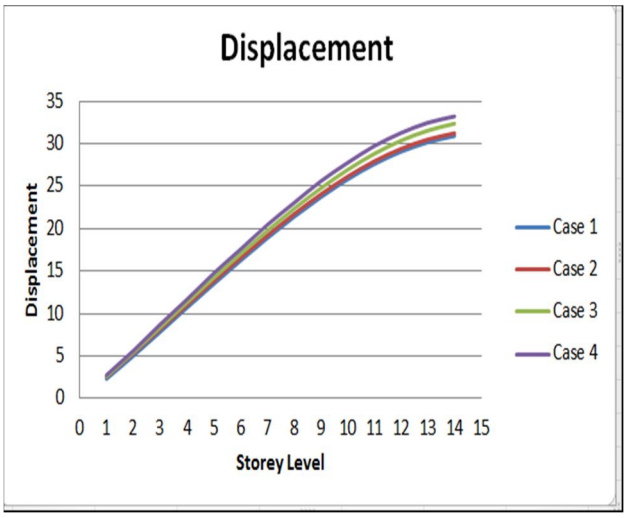
1) Shear Force in X- Direction (Vx)
2) Moment in X – direction (Mx).
3) Torsion in X- Direction (T)
4) Displacement in X Direction.(Ux)

In ETAB necessary precautions is taken to take adequate zone factor and response reduction factors depending upon case For comparisons beams and columns near to floating column are selected.









VI. CONCLUSION

A. With the provision of internal floating columns, it may increase in shear force at all floors.
B. It is observed that due to internal floating column tensional values at all floor increases.
C. Provision of Internal floating column and Alternate columns may increase displacement at various nodes.
D. Provision of External floating columns may decrease displacement at various nodes.
E. Provision of floating column increases torsion in beam at all floors.
F. It is observed that due to provision of Alternate floor floating columns there is reduction in the Torsion values.

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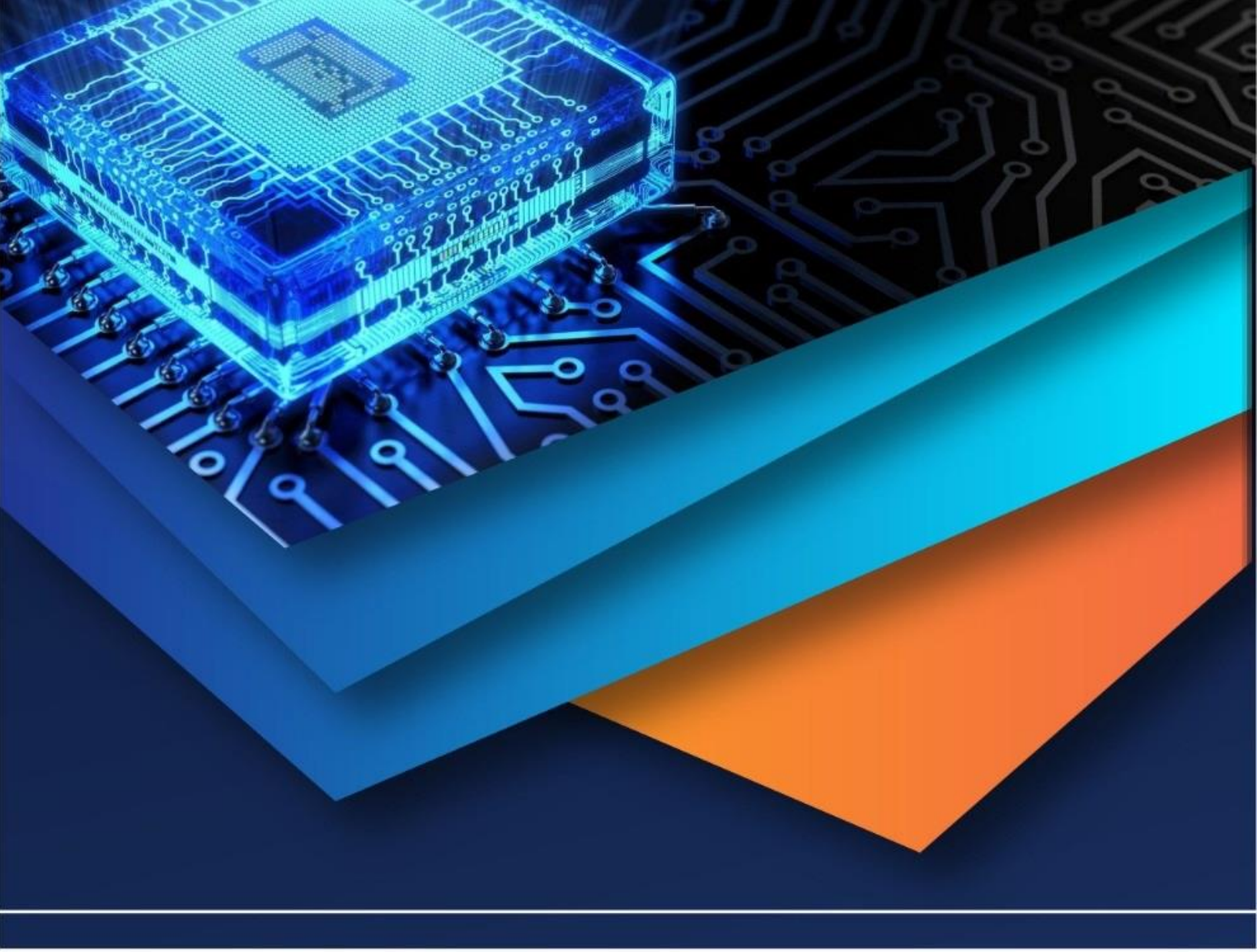

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