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Dynamic Analysis of RCC Frame Structure with floating Column

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ABSTRACT:In urban India floating column building is a typical feature in the modern multistorey construction. Floating columns buildings are adopted either for architectural aspect or when more free space is required in the ground floor. Such features are highly undesirable in seismically active area.

In the project studies the analysis of G+5, G+7, G+9, G+11 and G+13 storey building with floating column and without floating is carried out. The analysis is done by using Staad Pro V8i software by using Response spectrum analysis. The paper deals with the results variation in displacement of structure, base shear, Seismic weight calculation of building from manual calculation and Staad pro V8i. For building with floating column and building without floating column, finding the variation between the response parameters of earthquake and describe what happens when variation may be high or low.

The study is carried out to find whether the floating column structures are safe or unsafe when built in seismically prone areas, and also find out commercial aspects of floating column building either it is economical or uneconomical.

KEYWORDS: Floating column building, Normal building, Response spectrum analysis, Staad Pro V8i, earthquake effect.

I. INTRODUCTION

A typical Column is a vertical structural member which support to horizontal structural members by means of their weights, moments, shear force, axial load etc., to keep the structure in safe condition and transfer these loads to the ground. But now a days some columns are designed in such a manner that it does not reach to the ground, because of various architectural aspects. In those cases the columns transfer above loads as a point load on a beam. This type of column is termed as Floating column. This Point load increases to much bending moment on beam so that area of steel required will be more in such cases. While earthquake occurs, the building with floating columns damages more as compared to the building without any floating columns because of discontinuity of structure & load transfer path.

The overall size, shape and geometry of a structure play a very important roll to keep structure safe while earthquake occurs. As theory and practical study on buildings says that, earthquake forces developed at different floor levels in a building needs to be brought down along the height to the ground by the shortest path; any deviation of discontinuity in this load transfer path results in poor performance of the building.

In Earthquake analysis the main response parameters are storey displacement, Storey drift, storey shear. These parameters are evaluated in this paper and critical position of floating column building is observed. In this critical position the effect of increasing section of beam and column in irregular building and regular building has been observed.

The Response of a structure to the ground vibration is a function of the nature of foundation soil; materials, form, size and mode of construction of structure; and the duration and characteristics of ground motion. IS 1893 (part I):2002 specifies the various criteria for design of structure considering earthquake zones, type of structure, soil type, importance factor of structure, response reduction factor etc. The basic criteria of earthquake resistant design should be based on lateral strength as well as deformability and ductility capacity of structure with limited damage, but no collapse.

A. FLOATING COLUMN

The Columns whose lower end does not reach to the ground and transfers the above loading on a beam as a point load, such type of column are called as Floating Columns. Floating columns comes in use to provide more open space for assembly hall of parking purpose. The floating column building does not create any problem under only vertical loading condition but it increases vulnerability in lateral loading (earthquake loading) condition, due to vertical Discontinuity. During the earthquake the lateral forces developed in upper storeys have to be transmitted by the projected cantilever beams due to this the overturning forces are developed over the column of the ground floor.

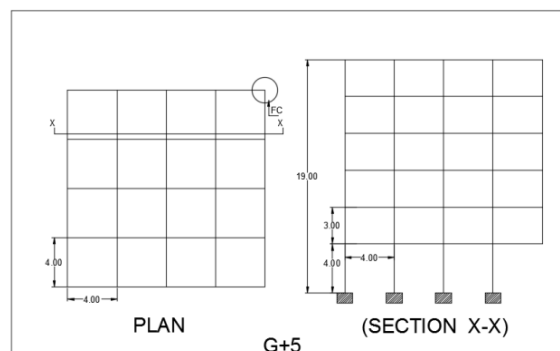


Fig. 1 G+5 Floating Column Building

A.1.OBJECTIVES

The objective of the present work is to compare the response and behaviour of multi-storey RC frame structure with and without floating column under seismic/earthquake excitation. The major objectives of the work are listed below:

1. The present study is done by using Staad pro v8i. The analysis is carried out by nonlinear Dynamic method (RESPONSE SPECTRUM ANALYSIS) in accordance with IS-1893-2002 (part-1), to study the performance levels and performance points of the building.
2. G+5 , G+7 , G+9, G+11, G+13 Building with and without floating column is to be analyse by using Static analysis.
3. To study the effect of floating column which is at corner of building and resting on two cantilever beams at the free tip end under seismic loading for severe seismic zone.
4. Comparisons of results for Storey Drift, Displacement, Base shear, Frequency and time period. Percentage difference between the results of building with floating column and building without floating column.
5. Commercial study of the aspects of floating column building.

A.2. METHODOLOGY

A building should possess four main attributes namely simple and regular configuration and adequate lateral Strength, stiffness and ductility for well performance in an earth quake. Buildings having simple regular geometry and uniformly distributed mass and stiffness in plan as well as elevation, suffer much less damage than buildings with irregular configuration. A building shall be considered as irregular for the purposes of this standard, if at least one of the conditions are applicable as per IS 1893(part1):2002

A. THE PROCEDURES FOR THE EARTHQUAKE ANALYSIS OF THE STRUCTURES:

- Linear Static Procedure
- Linear dynamic Procedure
 - ✓ Response Spectrum method
 - ✓ Time history method
- Nonlinear Static Procedure (Pushover analysis)
- Nonlinear dynamic procedure

As per IS-1893:2002, Methods Adopted are

- ✓ Equivalent Static Lateral Force (or) Seismic Coefficient Method

- ✓ Response Spectrum Method
- ✓ Time history method

Response Spectrum Method:

Response-spectrum analysis (RSA) is a linear-dynamic statistical analysis method which measures the contribution from each natural mode of vibration to indicate the likely maximum seismic response of an essentially elastic structure. Response-spectrum analysis provides insight into dynamic behaviour by measuring pseudo-spectral acceleration, velocity, or displacement as a function of structural period for a given time history and level of damping. It is practical to envelope response spectra such that a smooth curve represents the peak response for each realization of structural period. Response-spectrum analysis is useful for design decision-making because it relates structural type-selection to dynamic performance. Structures of shorter period experience greater acceleration, whereas those of longer period experience greater displacement. Structural performance objectives should be taken into account during preliminary design and response-spectrum analysis. Response spectra helps to obtain the peak structural response under linear range, which can use to obtain lateral forces developed due to earthquake, thus facilitates in seismic resistant design of structure.

A. PROBLEM STATEMENT

In accordance with IS-1893-2002 (part-1), to study the performance levels and performance points of the building. Building data used for modelling for G+5, G+7, G+9, G+11 and G+13 are tabulated below:

TABLE I
PROBLEM STATEMENT

Sr No.	Parameters	G+5 Building	G+7 Building	G+9 Building	G+11 Building	G+13 Building
1	Height of building	19 m	25 m	31 m	37 m	43 m
2	Floor height	3 m	3 m	3 m	3 m	3 m
3	Seismic Zone	V	V	V	V	V
4	Zone Factor (<i>Z</i>)	0.36	0.36	0.36	0.36	0.36
5	Importance Factor (<i>I</i>)	1	1	1	1	1
6	Response Reduction Factor (<i>R</i>)	5	5	5	5	5
7	Soil Type	Medium	Medium	Medium	Medium	Medium
8	Beam Size	300X450 mm	300X450 mm	300X450 mm	300X450 mm	300X450 mm
		230X350 mm	230X350 mm	230X350 mm	230X350 mm	230X350 mm
9	Column Size	450x450 mm	450x450 mm	450x450 mm	450x450 mm	450x450 mm
10	Spacing of columns	4 m	4 m	4 m	4 m	4 m
11	Slab Thickness	150 mm	150 mm	150 mm	150 mm	150 mm
12	Live Load	3kN/m ²	3kN/m ²	3kN/m ²	3kN/m ²	3kN/m ²
13	Floor Finish	1.5 kN/m ²	1.5 kN/m ²	1.5 kN/m ²	1.5 kN/m ²	1.5 kN/m ²
14	Material Properties (Concrete)	M30	M30	M30	M30	M30
15	Steel	Fe415	Fe415	Fe415	Fe415	Fe415

B. MODEL DETAILS

The structure must be modelled and analysed so that the values of the response parameters of earthquake are calculated with sufficient accuracy for design purpose. The acceptance criteria of result of response parameter may vary on whether static or dynamic non-linear analysis is used.

G+5, G+7, G+9, G+11 and G+13 RCC frame structures are modelled by using Staad Pro V8i software. The Building frames are special moment-resisting frame (SMRF). All details of size, properties are tabulated above.

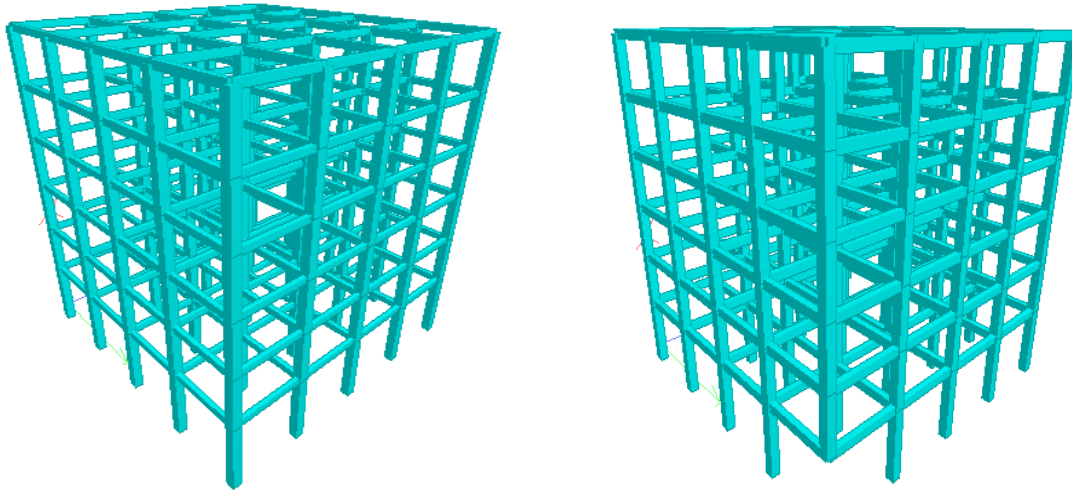


Fig.2 G+5 Building model without any floating column. Fig.3 G+5 Building model with floating column

II.RESULTS AND DISCUSSION

Non-linear Dynamic Analysis involves significantly more effort to perform and should be approached with specific objectives in mind. Analysis was carried out by Staad pro V8i on SMRF building with floating column and without floating column, and following results were obtained:

By Dynamic analysis result it is found that the torsional effect on building without floating column is negligible as compared to building with Floating column in earthquake excitation. Also the number of storeys are increasing the torsional effect on floating column building is slightly reduces. In small height floating column building the torsion is going to increase so that overturning effect is occurring in such building. To avoid or minimise this effect the stiffness of column and beam have to increase to a large extent, and structure becomes too heavy and uneconomical. So Floating column should not provide in corners in case of small height building too.

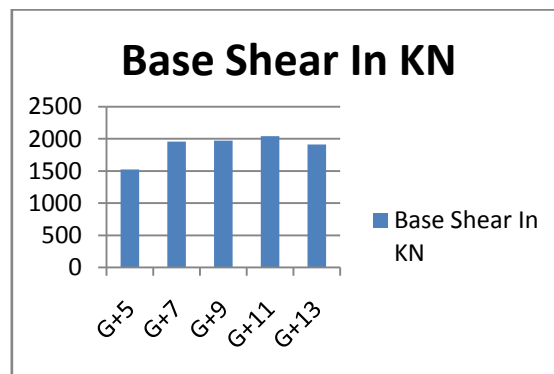


Fig.4 Comparison of base shear

Base shear is calculated manually and the values are shown in Fig.4 by graphical representation for the building without floating column. The difference between base shear of G+9, G+11 & G+13 is very less because of the design

horizontal seismic coefficient A_h . In the Floating column building the base shear is lower as compare to ordinary moment resisting frame as the mass of concrete in column is less.

The nodal displacement is minimum in the building without floating columns with uniform distribution of stresses at all columns and beams, while in building with floating column the nodal displacement is increases, which results uneconomical structure with heavy mass.

After analysis of the building with and without floating column it is found that the displacement more in floating column building as compare to building without floating column.

TABLE II
BEAM AND COLUMN SIZE CASES

Case I	Beam size (0.3x0.45)
	Column size (0.45x0.45)
Case II	Beam size (0.23x0.35)
	Column size (0.45x0.45)
Case III	Beam size (0.3x0.45)
	Column size (0.4x0.45)

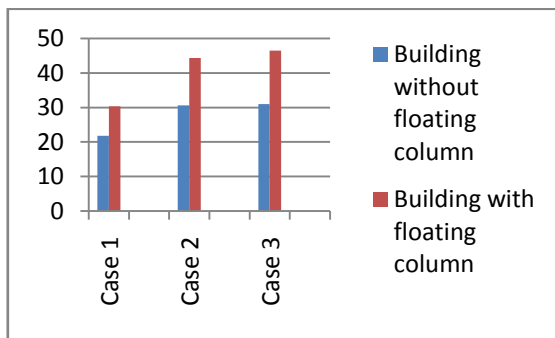


Fig.5 Displacement graph for G+5 Building

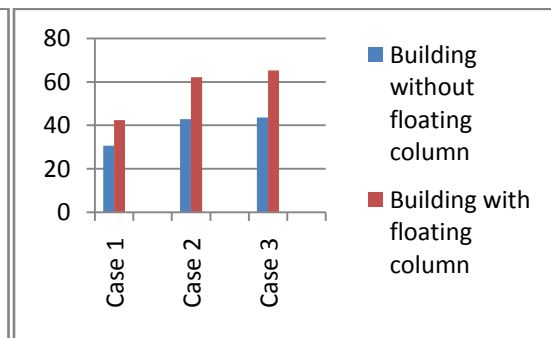


Fig.6 Displacement graph for G+7 Building

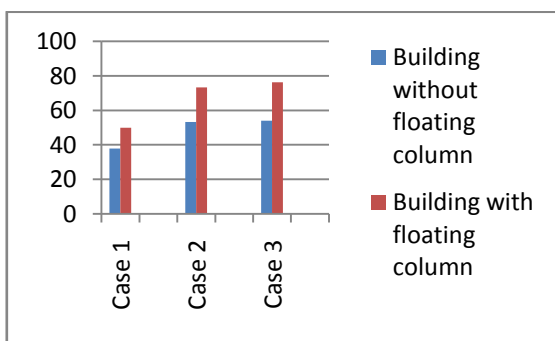


Fig.7 Displacement graph for G+9 Building

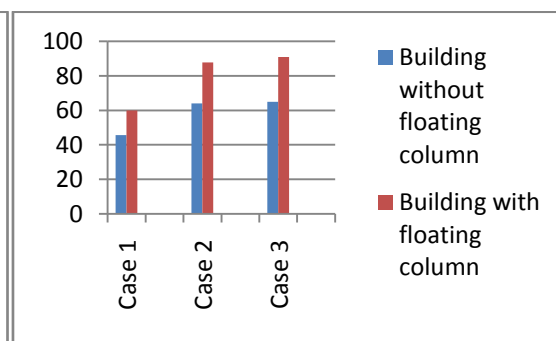


Fig.8 Displacement graph for G+11 Building

In the above displacement graph the x axis showing the cases of beam sizes and Y-axis showing the displacement values in mm. From the above graph it is found that the displacement in floating column building is increases upto 20-30%.

III. CONCLUSION

The Study presented in the paper compares the difference between building with and without floating column. The following conclusions were drawn based on the investigation.

1. From the response spectrum analysis it is noticed that the floating column building is having more displacements than a building without any floating column. So Floating column building is unsafe than a normal building.



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2. After the analysis of building, it is found that quantity of steel and concrete have to increase in floating column building to keep it safe in earthquake excitation. So Floating column building becomes uneconomical as compare to normal building
3. By the lateral stiffness calculation at each floor for the structure it is observed that the building with floating column will make the soft storey effect very worse while the normal building without any floating columns have less soft storey effect. So the floating column building is unsafe.
4. The Torsional effect in earthquake excitation is more in floating column building as compare to normal building, as a result overturning effect occurs in floating column building and structure becomes unsafe.

From the above analysis it is concluded that floating column building should not be prefer in severe seismic prone area. When we increase the sizes of beam and column than the structure gives more displacement in floating column building as compare to normal building. Due to increase in sizes the cost of construction increases so that the building with floating columns becomes uneconomical. So construction of floating column building should be avoided.

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REFERENCES

- [1] Rohilla I., Gupta S.M., Saini B., "Seismic Response of Multi-Storey Irregular Building with Floating Column", IJERT, eISSN: 2319-1163 | pISSN: 2321-7308.
- [2] Bhensdadia H., Shah S., "Pushover analysis of RC frame structure with floating column and soft storey in different earthquake zone", IJRET, eISSN: 2319-1163 | pISSN: 2321-7308
- [3] Nanabala S. G., Ramancharla P.K., Arunakanthi E., "Seismic Analysis of A Normal Building and Floating Column Building" IJERT, ISSN: 2278-0818, Vol. 3 Issue 9, September-2014.
- [4] Sabari S, Praveen J. V., "Seismic Analysis of Multistorey Building with Floating Column" International Journal of Civil and Structural Engineering Research, Vol. 2, Issue 2, pp: (12-23), Month: October 2014- March 2015.
- [5] Srikanth M K, Holebagilu Y. R., "Seismic Response of Complex Buildings With Floating Column For Zone II And Zone V", IJOER, Vol.2, Issue.4, 2014
- [6] Agrawal Pankaj, Shrikhande Manish (2015), "Earthquake Resistant design of Structures", PHI learning private limited, New Delhi.
- [7] "Criteria for earthquake resistant design of structure", Part 1: General provision and buildings, IS 1893:2002, Bureau of Indian Standard

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