Seismic Analysis of Floating Column

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Abstract: A column is a vertical structural member which transfer the load of beam to the footing. Due to spacious parking space, drive way, large parking space, Column of ground floor need to be omit. In such case column allow to float supporting by beam from first floor to fulfill the frame requirement. Frame is make in such way that beam transfer the load of column to the supporting column. In present scenario buildings with floating column is a typical feature in the modern multi-storey construction in urban India. There are many projects in which floating columns are adopted, especially above the ground floor. In high rise structure, to implement floating column at higher level, the transfer girders have to be designed and detailed properly, especially in wind and earthquake zones. Implementing floating column may effect on intact frame structure. This thesis will give idea about effect on stability of the building and increment or decrease of overall quantity of steel due to floating column. ETABS 9.5V has used to do the analysis of this type of structure.

Existing residential building comprising of G+15 structures has been selected for carrying out the project work. The above building models will be generated using software ETABS 9.5V and are analyzed using equivalent static method. The main purpose is to calculate the difference of steel requirements by designing conventional column and floating column for G+15 framed structure. This project will also aim to investigate the effect of a floating column under earthquake excitation for various soil conditions and as there is no provisions of magnification factor specified in I.S. Code, hence the determination of such factors for safe and economical design of a building having floating column.

Keywords: Term Floating Column, necessity of floating column, effect of floating column on building, analysis, steel cost comparision.

I. INTRODUCTION

As world giving challenge to the technology it is also giving challenge to the design of building structure. Every architect wants to implement his creativity in the building structure which challenge to structural designing. A ideal structure should fulfill all architects requirement without disturbing stability of the building in earthquake and wind load condition. Also, Design structure shall not be expensive so it can stand with normal price range in market.

To get spacious parking and to get more wider drive way below building, implementation of floating column becomes neccessary in building structure. This implementation may not effect much in low rise building but if definitely effect on high rise structure. Moreover, by implementing architects thought on building, structure should not get too much expensive so it can stand with other property of the market.

This research give brief idea about effect of floating column on building structure.

In international journal of scientific & engineering research, Mr. Pratyush Malaviya, Saurav, said in paper “Comparative Study of Effect of Floating Columns on the Cost Analysis of a Structure Designed On Stadd Pro V8i” that base joint of floating columns should assumed as a pinned joint for analysis so it will fail moment which is occur due to eccentricity.

Research paper by Sabari S, Mr.Praveen J.V. on Seismic Analysis of Multistorey Building with Floating Column said that study of intact structure and structure with floating column give the more governing result. Time period of building which has floating column is increase due to decrease in stiffness. He found that by incorporating floating column in Type 1 model there was 7.92% increase in time period compared to without floating column. As time period increase, Moment in column and beam get increase and it increase over all steel consumption of the building.

By studying such research paper it becomes necessary to workout increment in steel consumption by implementing floating column so it will give cost effective approach to modern building practice.

II. Analysis of 12 story building

A computational study was carried out using the Etab9.5.1 software. The model was used to study effect of floating column. There are 2 model has workout in which type 1 is intact structure and type 2 is same building with floating column.
Analysis is carried out of G+12 building by considering all earthquake and wind load combination and it checked for same load combination.

To remove torsion in 3rd mode, some column sizes are increase and remove the torsion successfully. Story drift has checked and it should be less than 12 mm for safe structure. Values are with in permissible limits. Max story drift of the intact structure is 0.00287 occur at point no 36 at terrace floor plan.

Now, Analysis carried out after removing column number 5 at ground floor to check the performance of the structure.

![Building plan](image1)

**Fig1. Building plan**

It is proposed building in Nasik have 12 floors. This plan is taken for study.

![Etab model of intact structure](image2)

**Fig2. Etab model of intact structure.**

Model was made by using M-20 grade concrete to beam and slab and M-25 to column. Seismic zone factor is considered as 0.16, response reduction factor is consider as 5. It is residential building so importance factor is considered as 1 as per IS1893. Time period is calculated by considering without infill condition. Hence stiffness of wall is not consider in this analysis.

![Plan showing floating column no. 5](image3)

**Fig3. Plan showing floating column no. 5**

Analysis is carried out after removal of column no C5 from ground level to 1st slab level. Major parameter is deflection and frequency of the structure.

Deflection of the point 5 shall be in permissible limit at 1st floor level.

![Deflection of point 5 at 1st floor level](image4)

**Fig4. Deflection of point 5 at 1st floor level.**
Deflection of the point 5 is 2.929mm which is in permissible limit. Increment in natural frequency is 0.89% which is not governing in deformed structure. Story drift of all floor are also in permissible limit i.e. Less than 12 mm. Hence structure with floating column is safe for earthquake and wind load with same column beam and slab sizes.

III. EFFECT ON REINFORCEMENT OF BUILDING

Area of steel required for all structural element has workout after checking performance of the building in earthquake and wind forces. Floating column do not affect on all column beam, in this analysis area of steel increase in column no C4, at bottom of C5, C7, C9, C12, C13, C16, C22, C31. Reinforcement also decreases in few column. Total increment in steel is 311.815 cm² in column and it is mostly due to earthquake and wind load combinations.

Reinforcement is also increase at top and bottom of the beam. Major increment is at the adjoining beam of floating column. Total increment in reinforcement at top of the beam is 200.429 cm². Total increment in bottom reinforcement of beam is 124.771 cm² and it is negligible in shear reinforcement i.e. 2.241 cm² Reinforcement in shear wall also remain intact after removing of C5 at ground level. Because it is away from C5 column. Reinforcement is increase in case of shear wall at adjoin to the floating column. In this plan it is safe from changes due to floating column. Overall increase in area of steel due to column beam and shear wall after implementing floating column is 639.256 cm²

IV. CONCLUSION

The research conducted included the analytical model of typical G+12 building structure. C5 column has removed from ground floor in type 2 model to analyze effect of floating column.

It is conclude from the analysis and comparison of both structure that reinforcement is increase by 639.256 cm² due to removal of the floating column. It incudes the increment in column beam and shear wall. If we take costing approach than weight of 639.256 cm² is approximately 4 ton. Today market price of steel is Rs.33 per Kg. Total cost of 5 Ton steel is Rs.16500/- only. Which is negligible as compare to over all cost of building. Hence, implementing floating column is not effect much more on over all cost of structure.

References


12. IS 456:2000: Plain and Reinforced Concrete Code of Practice