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Review on Structural Analysis of Building Structure With Floating Column

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Abstract:

The floating column is generally used in high rise buildings which require parking space at the bottom. The current research reviews existing work in design and development of floating column for multistory buildings. The effect of floating column on structural stability is presented in various researches. The existing researches are based on use of both experimental and numerical techniques. The numerical techniques involve using FEA simulation packages like ETABS, Staad Pro etc.

Key Words: *Floating column, high rise structure, stability*

1. INTRODUCTION:

The floating column is a vertical member which rest on a beam but doesn't transfer the load directly to the foundation. The floating column acts as appoint load on the beam and this beam transfers the load to the column below it. The column may start off on the first or second or any other intermediate floor while resting on a beam. Usually columns rest on the foundation to transfer load from slabs and beams. But the floating column rest on beam. In modern times the buildings are becoming complex particularly the mix use ones. There are different uses on different floors and hence to follow it structural grid becomes difficult as columns on any floor would become a hindrance. Even in residential buildings when there is a parking on ground floor or lower stories or huge cantilevers are taken to exploit ambiguities in local bylaws for gaining more free spaces, the lower floors need column-free spaces for easy movement of vehicles; while on upper floors which are more in number of the columns have been designed based on room layout. They are also frequently used when there are shops on ground floor and residence on upper floors. Rather than finding an architectural solution one easily take recourse to floating columns and remove columns on lower stories, which is a dangerous proposal.

2. LITERATURE REVIEW

Patel T et al. 2017 [1] have done the comparison of various models with varying the position of floating columns, story-wise comparison, and comparison between models with and without increment of live load. The author has also done a comparative study for building with and without the effect of infill. The Model has been analyzed using SAP 2000 and Results were obtained in terms of vertical and horizontal Displacement. The study concluded that the Corner Position of Floating Columns should be avoided to have minimum Displacement. It is preferred to shift floating columns from corner to center of stiffness of floors to achieve Decrement in Vertical Displacement. Analytical Result of this study shows that after infill provisions, horizontal and vertical displacement reduces by 182.26% (max) and 140.03% (max) respectively.

Mandwale S. et al. 2020 [4] have done Response spectrum analysis of G+5 using ETABS 2016 software. The author has compared Normal Building and Building with FC. Columns were eliminated at outer edge on ground floor. Various Load combinations were taken as per Indian standard 456:2000.This Study concluded that the value of storey drift and time period were more in case of FC column building.

Chand D et al. 2021 [5] have done a comparative analysis of regular column structure with a floating column structure using ETABS software. Two models were modeled and three different cases were considered in each model. Some columns were floated at the corner and in another model it

was floated at the edge. The Author calculated Maximum Reactions, Maximum Story Displacement, maximum base shear, and Maximum Story Drift using Response Spectrum Analysis. The present research concluded that maximum storey displacement in the lateral direction was maximum in the case of the model which had floating columns on their edges. Also, the value of vertical reaction was increased with an increase in story height.

Pundir A et al. 2020 [6] have modeled G+15 and G+20 Steel structures with eight different cases. He has introduced Mass irregularity on the alternate floor of different models and compared their results. After placing the heavy mass, there was 7% decrease in maximum displacement was observed on the 13th floor as compared to the building having no mass. The bending moment was also increased by 15.8% on the 13th floor. He has also mentioned the increase in steel quantity due to the increment in mass. Similarly, he also calculated these parameters by placing heavy mass on the second and seventh floor. Hence this study concludes that an increase in the total weight of a building increases its lateral stability.

Vyas Y et al. 2020 [7] have done a literature survey on floating column buildings. Further Author concluded that FC affects the building parameter due to irregularity of structure. Maximum researchers in this Review have adopted shear walls to compensate for the effect of FC. It was also observed that Shear walls were effective below G+10 storey. She also concluded that FC creates more damage in ZONE IV& V. The effects were satisfactory in Zone III if extra techniques are used.

Sasidhar T et al. 2017 [8] carried out the static analysis of G+5 building in the zone II region. The analysis was done in 6 different cases depending on the position of removal of the column in a different storey. The resulting response was compared with the normal building using E-Tabs. They have also calculated and compared the steel requirement in different cases. In Case-1, 8 columns were floated on the second floor and the same thing was done in the other four models. After analysis, Case 1 had a maximum value of moment and shear as compared to other cases. Hence it was concluded that the 2nd floor is the optimum placement of floating column to minimize the requirement of shear and bending moments.

Sreadha A R et. al 2020 [9] carried out an equivalent static analysis of G+5 storey structure using ETABS 2016 software. The author has also compared it with response spectrum analysis. Three models were considered for analysis. Model -1 was the conventional model, Model-2 was introduced with FC at the outer edge of the first floor and in Model-3 FC were placed at the 5th floor at the outer edge. The results were taken for Zone 4 with medium soil conditions. The study concluded that if the floating column is shifted to a higher level, then storey displacement value increases. Hence FC should be avoided at a higher level in seismic areas.

Agawane P et al. 2021 [10] have done a literature survey of various researches done previously. Further, the author has observed that FC is dangerous in Seismic Areas but they can be used if the proper study is done during its design. The author has also concluded that Storey Displacement increases with the height of the building and hence story drift also increases. Due to the presence of a floating column, the base shear value also decreases.

Sanas P et al. 2020 [11] analysed a G+14 RC building by introducing FC at the internal part, external edge, and at an alternate level. Author calculated forces, displacement, and moments using E-Tabs software. This study summarizes that Internal FC and external FC increased torsion values at all floors. By provision of alternate floor Floating columns, there was a decrement in torsion values. With the provision of Internal FC there was an increment at the moment at the column at the edge but a decrement at the moment at the intermediate column. Whereas results were opposite in the case of alternate floor FC.

Mandwale S et al. 2020 [12] have done Review on Analysis of Multi-storey Building with and without Floating Columns. Here Author concluded that FC is good for more Space Index and Architectural view. They also studied that shear wall structure gives lesser displacement and more strength as compared to FC structures. FC is uneconomical in seismic areas.

Shaik L M et al. 2020 [13] studied a six-story reinforced cement concrete structure with and without floating Columns. Comparisons were made by considering the external and internal placement of the Floating column. Seismic Analysis was done for zones II, III, IV, and V in India. He has modeled 3 buildings using STAAD Pro Software. First Building was without a Floating Column, a second building with external floating columns starts from the first floor and Third Model was a structure with internal floating columns starts from the first floor. Further, it was concluded that wind stacking was 32.6 mm in Model-1, 37.3 mm in Model-2, and 36.1 in Model-3. As compared to Model-1, maximum help responses were expanded by 80.2% in Model-2 and 33.3% in Model-3 in seismic region-5. The result shows that story float was within limits in model-1, whereas results were objectionable for Model-2 and Model-3.

Raghunandan et al. 2020 [14] have done pushover analysis using software ETABS2015. Floating columns were at the outer edges, interior part, and corner of the building. These models were compared with regular column buildings. In the Non-Floating column building, the bending moment in the X direction was 10.68 KN-m in Top story of the C2 column.

Whereas the value decreased to 9.69 in the case of an internal floating column. Lateral displacement at the top story of models with the floating column was 67.28mm and 69.71mm which was greater as compared to conventional model floating

Sukumar Behera et. al. [15] In this paper involve stiffness balance of first storey and the storey above are studied to reduce irregularity occurs due to presence floating column. To study response of structures under different earthquake excitation having different frequency content keeping the PGA and time duration factor constant they develop FEM codes for 2D frames with and without floating column. The behavior of building frame with and without floating column is studied under static load, free vibration and forced vibration condition. The finite element code has been developed in MATLAB platform. The time history of floor displacement, inter storey drift, base shear, overturning moment are computed for both the frames with and without floating column. The dynamic analysis of frame is studied by varying the column dimension. It is concluded that with increase in ground floor column the maximum displacement, inter storey drift values are reducing. The base shear and overturning moment vary with the change in column dimension.

Holebagilu et. al. [16] In this paper study is all about to compare the behavior of a building having only floating column and having floating column with complexities. High rise building is analyzed for earthquake force. for that purpose created four models and analyzed for lower and higher seismic zones for medium soil condition. analysis was carried out by using extended 3 dimensional analysis of building system ETAB version 9.7.4 software. results are presented in terms of Displacement, soft storey, storey drift for these four models and tabulated on basis of linear seismic analysis.

Prasad et. al. [17] The behavior of building frame with and without floating column is studied under static load, free vibration and forced vibration condition. The results are plotted for both the frames with and without floating column by comparing each other time history of floor displacement, base shear. The equivalent static analysis is carried out on the entire project mathematical 3D model using the software STAAD Pro V8i and the comparison of these models are been presented. This will help us to find the various analytical properties of the structure and we may also have a very systematic and economical design for the structure.

Sawadak et. al. [18] In this paper study is done for architectural drawing and the framing drawing of the building having floating columns. For comparision G+7 existing residential building with and without floating column are taken for carry out entire project work. by using STAAD ProV8i 3D 3 model are created .equivalent static analysis of these model are done by using STAAD Pro V8i .Different parameters such as axial load ,moment distribution, importance of line of action of force and seismic factors are studied for models. This will help them to find the various analytical properties of the structure and also have a very systematic and economical design for the structure.

Siddarth shah et. al. [19] In this study an attempt is made to reveal the effects of floating column & soft story in different earthquake zones by seismic analysis. For this purpose Push over analysis is adopted because this analysis will yield performance level of building for design capacity (displacement) carried out up to failure, it helps determination of collapse load and ductility capacity of the structure. To achieve this objective, three RC bare frame structures with G+4, G+9, G+15 stories respectively will be analysed and compared the base force and displacement of RC bare frame structure with G+4, G+9, G+15 stories in different earthquake zones like Rajkot, Jamnagar and Bhuj using SAP 2000 14 analysis package.

3. CONCLUSION

From the existing researches it is evident that floating columns can improve stability of structure subjected to seismic loads and high wind loads. However, the lateral stability of building structure is dependent upon the thickness, reinforcement and material grade of floating column. From the FEA analysis conducted on G+6, G+ 9 buildings the small column thickness resulted in higher story drift and is therefore should be avoided.

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