Review Paper for High Rise Buildings with Floating Column and Its Effect on Seismic Analysis

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Abstract— Going from the recent advancement in construction, it has been trend to keep the lower floors mostly as parking areas or common party plot area in the residential high rise buildings. And to carry out the smooth parking or uniform functioning of the lower floors contractors/ engineers keep the lower floor with minimum or no partition walls/ columns as compared to conventional way of keeping close spaced columns. Hence they provide floating columns. This paper deals with the studies that have been carried out for seismic analysis on floating columns by various softwares in the yester years.

Key words: Dynamic Loading, Seismic Analysis, Floating Column, Structural Softwares, High Rise Buildings

I. INTRODUCTION

Due to recent advancement in the construction fields most of the high rise buildings have open ground/first storey. The main reason being is to allow parking space or common plot area. Hence they provide floating columns which disrupts the geometry which in turn disrupts the load transfer path. Also the total seismic base shear of the building depends on the distribution of stiffness and mass along the height of the building. Also when the building experiences any seismic energy the effect of the seismic force will greatly depend on the overall shape, size and geometry of the building. To safe guard the buildings during the event of seismic or earthquake it is quite necessary to bring down the forces to the ground without much disruptions. But due to floating columns (columns which do not go into the foundation) the seismic energy cannot be brought down quite effectively and the buildings collapses or suffers. (Bhuj Earthquake 2011, Gujarat).

In country like India where the people have tendency to make use of the maximum possible use of FSI (Floor Space Index) the contractors/ engineers provide hanging balconies on floating columns as the balconies are not included in the FSI. At times for the aesthetic view of the buildings the floating columns are provided. By providing floating columns at the edges or in the balconies the building becomes more prone towards resisting the lateral loads due to vertical disruptions.

II. LITERATURE REVIEW

Authors Pratyush Malaviya and, Saurav, in their paper "Comparative Study of Effect of Floating Columns on the Cost Analysis of a Structure Designed On Stadd Pro V8i" said that base joint of floating column should assumed as a pinned joint for analysis so it will fail in moment which will occur due to eccentricity. [1]

Also in another research Sabari S, Mr. Praveen J.V. on "Seismic Analysis of Multi-storey Building with Floating Columns" said that the time period of building with floating column increases due to decrease in stiffness. They also found that by incorporating floating column in their model of building there was increase of 7.92% in time period compared to the model of building without floating column. Thus due to this increase in time period the moment in column increases which leads to increase in requirement of steel to be provided in the member.[2]

Authors Podili jyorthi and Boppudi Bullibabu in their paper "Design and analysis of high rose building with floating columns" compared the three models of building (without floating columns, with floating columns and floating columns with bracings). They performed spectroscopic analysis on these 3 models and concluded that the multi-storey buildings with floating columns performed poorly beneath seismic excitation in floor drift, floor shear, time period and displacement. And there was improvement up to 100 percent to half hour in floor drift, storey shear, fundamental measure and displacement in the building with lateral bracings.[3]

Authors Konda Bala Chandra and JV Subba Rao in their paper "Dynamic Analysis of a building with and without floating columns" conducted a study on G+9 storey building in ETABS Software and on different soil conditions and found that as the mode number is getting increased the time period of the structure is getting decreased and frequency of the building is increasing. Also as the time period is decreasing the acceleration in X and Y direction is increasing, and at some points the acceleration became constant. They found that storey Displacement and storey Drift Performance is observed to be within the permissible limits in floating column building and is the preferable in Zone III, Medium Soil (Soil Type II). [4]

Authors Y.Abhinay, Dr. H.Sudarasana Rao and Dr. Vaishali Ghorpade in their paper "Comparison on seismic analysis of a floating column building and normal building" conducted a study in ETABS 13 and found that by the application of lateral loads in X and Y direction at each floor, the displacements in building with floating columns (Case 2) and building with floating columns but with changed dimensions (Case 3) in X and Y directions are less than the normal building (case 1) but displacement of Case 2 and Case 3 building in Z-direction is more compared to that of a Case 1 building. Hence they found that the buildings with floating columns are unsafe for construction when compared to a Normal building. They also found that the lateral stiffness at each floor in case 3 will suffer extremely soft storey effect. While performing time history analysis they noticed that the buildings in case 2 and case 3 are having more displacements values than compared to building in case 1.After the analysis of

buildings, comparison of quantity of steel and concrete are calculated, from which it is to be identified that Case 3 (Floating column) building has 40 % more quantity of rebar steel and 42 % more concrete quantity than Case 1(Normal) building. So the Floating column building is uneconomical to that of a normal building. [5]

Jayesh Rathi (2017) carried out the comparative study on normal multi-storeyed building and building with floating columns. For that he considered ten storey building and used ETABS software for finding out various structural responses such as Storey Displacement, storey Drift, Storey Shear and Time period. From his study he concluded that:

1) Storey displacement increases with introduction of floating column.
2) Storey drift increases with increase in storey displacement since they are directly proportional to each other.
3) Storey forces are less in the building with floating column compared to normal building as number of columns are less.
4) Time period is more for the building with floating column compared to normal building. [6]

Sukumar Behera (2012) studied the behaviour of multi-storey building with and without floating column under different earthquake excitations. He kept the PGA of both earthquake as 0.2g and kept constant duration of excitation. From the study he concluded that with increase in ground floor column the maximum displacement, inter storey drift reduces. The base shear and overturning moment varies with change in dimensions of column. [7]

Badgire Udhav (2015) carried out the analysis of multi-storey building with floating column. For his analysis he considered G+10 structure in STAAD software. He considered three Case 1, Case 2 and Case 3 as "Modelling & Analysis of G+10 RCC building with floating columns located outer periphery (4 Sides)", "Modelling & Analysis of G+10 RCC building with floating columns located outer periphery (2 Longer Sides)", "Modelling & Analysis of G+10 RCC building with floating columns located outer periphery (2 Shorter Sides)" respectively. From his study he concluded that the failure of building of Case 2 ("Modelling & Analysis of G+10 RCC building with floating columns located outer periphery (2 Longer Sides)") has more probability as compared to Case 3 ("Modelling & Analysis of G+10 RCC building with floating columns located outer periphery (2 Shorter Sides)"). [8]

Mundada (2014) studied the architectural drawing framing drawing of the building having floating column. The author considered existing residential building of G+7 for the study of load distribution on the floating column and various effects due to it. In the study the author studies three cases i.e. Building without floating column, Building with floating column and building with floating column with strut. From his studies he concluded that the failure of building with floating column is more prone than compared to building without floating column. He also found that if a building has strut as floating column then that building is less prone to failure as compared to the building with floating column. [9]

Sabari (2014) has done analysis of RCC framed structures having different stiffness and keeping the base of the building frame fixed. The author did time history analysis using FEM package SAP2000. By changing column size the author carried out dynamic analysis and concluded that with increase in column size, the maximum deflection and inter storey drift are reduced. [10]

III. CRITICAL REMARKS

From the literature review and research that has been conducted on the floating column in high rise buildings the following remarks can be made:

- Floating columns should be considered as pin joint in analysis.
- Time period of building with floating column increases due to decrease in stiffness.
- Mode number is getting increased as the time period of the structure is getting decreased.
- As the time period is decreasing the acceleration in X and Y direction is increasing.
- Floating column building and is the preferable in Zone III, Medium Soil (Soil Type II).
- Floating column building is uneconomical to that of a normal building.
- It is to be identified that Floating column building has 40 % more quantity of rebar steel and 42 % more concrete quantity than Normal) building.
- Storey displacement increases with introduction of floating column.
- RCC building with floating columns located outer periphery (Longer Sides) has more failure probability as compared to floating columns located outer periphery (Shorter Sides).
- If a building has strut as floating column then that building is less prone to failure as compared to the building with floating column.

IV. FURTHER STUDIES

- Unsymmetrical floor plans can be analysed for floating columns.
- The ratio of soft storey can be studied for a building with partial floating columns.
- More studies can be carried out for the studying different mode shapes and mode number of the buildings.

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