A Review: Seismic Analysis of a Structure with Soft Storey and Floating Column

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Abstract: - In Urban area, multi storey buildings or commercial building are constructed by providing floating columns at ground floor as we need ample of open space or parking area in the lower floor. On the other hand, A typical soft story building is an apartment building of three or more stories located over a ground level with large openings, such as a parking garage or series of retail businesses with large windows. The study on behavior of structure having soft story and floating column is to be analyzed. Study tends to see if such kind of structure performs well in earthquake prone zones or not. An investigation is performed on analytical model of a multistorey building recognizing the presence of a floating column and soft storey using the software ETABS. To study the effect of earthquake on this kind of buildings, Equivalent static analysis and Response spectrum analysis have been considered. The parameters like storey drift, storey shear, buliding torsion, storey moment have been studied in detail.

Key Words: —*Soft Storey, Floating Column, Equivalent Static Analysis Method, Response Spectrum Analysis Method, ETABS.*

I. INTRODUCTION

The shortage of space is a growing issue nowadays due to increase in population for this there is a need of having column free space. The main reason floating column came into existence is to keep the ground storey open and is a peculiar part of modern multi storey buildings in India. On the other hand, A soft story building is a multi-story building in which one or more floors have windows, wide doors, large unobstructed commercial spaces, or other openings in places where a shear wall would normally be required for stability as a matter of earthquake engineering design. Both this feature adds structural load on the building which may lead to structural failure especially in the earthquake prone areas. Open ground storeys are poor systems because of the strength discontinuity along the height of column in building. If columns are weak, they'll show severe damage which may lead to building collapse which is very dangerous and at times fatal to mankind.

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II. LITERATURE REVIEW

2.1 Sreekath Gandla Nanabala, Pradeep Kumar Ramancharla, Arunakanthi E (2014)

This research Studies the analysis of a G+5 storey normal building and a G+5 storey floating column building for external lateral forces.

Studies the variation of the both structures by applying the intensities of the past earthquakes. The final conclusion is that do no prefer to construct floating column buildings. With increase in dimensions of all members also it is getting more displacements than a normal building and also the cost for construction also increased. So, avoid constructing floating column buildings.

2.2 Fahim M 2015

In this present work dynamic analysis of G+14 multistoried RCC building considering for Sumatra earthquake is carried out by time history analysis and response spectrum analysis and seismic response of such building are comparatively studied and modeled with the help of ETABS software.

2.3 Nikhil Varma,S.A.Bhalchandra (2016)

Performed push over analysis to yield performance level of building for design capacity (displacement) carried out up to failure, it helps determination of actual performance of the structure. To achieve this objective, two RC structures with

G+3 stories are analyzed and compared the base force and displacement of RC structure for earthquake forces by using ETABS 2015 analysis software. The additions of additives and other type of blended ashes may help in increasing the compressive strength of the cement. The curing time is also giving impact to the compressive strength. It is observed that, the longer the curing time, the higher the compressive strength.

2.4 Y.Abhinay (2017)

A residential building with 6 storey and 12 storey is analyzed with column, beams & slabs. The Buildings are analysed & designed with and without edge columns at base storey. The buildings are analysed in two earthquake zones according toIS 1893-2002 with medium soil. From the analysis it is noticed that floating columnis having more displacement than normal building and comparison of quantity of steel and concrete are calculated, from which it is to be identified that floating column building has 40% more quantity of rebar steel 42% more concrete quantity than normal building.

2.5 G Hemanth (2017)

To study the effect of vertically irregularity in building created due to parking or by some other instance. 6 mathematical Models of R.C framed structures are created in ETAB 2015 version. To study the effect of earthquake on this kind of buildings, Equivalent linear static method and linear dynamic i.e Response spectrum analysis have been considered. From this it conclude that the storey with floating column are very much flexible in transferring the inertia forces generated by seismic loading. The fundamental natural time period drastically reduces when we consider the impact of vertical and lateral stiffening elements.

2.6 Lashmi Baliga et al. (2017)

Modeled infill walls as equivalent diagonal strut and bracings are provided by considering different steel sections and whole performance is done through Equivalent static analysis method by using Etabs-15 software. They saw that provision of infill walls and concentric steel bracings decreases time period.

2.7 Roziana Ismail,Mohamad Zulharimi bin Zurimam,Izzul Syazwan Ishak (2018)

Analyzed different types of models using SAP 2000 computer software for strength of building. It showed that the maximum displacement value for soft storey with swastika shape shear wall provided at centre of building were the lowest value in all three analysis ESA, RSA, THA and the lowest displacement in all direction, there are longitudinal, transverse and z axis compared with another models.

2.8 Bala Krishna et al. (2019)

considered residential building having G+9. Height of each storey is kept same as other prevalent data. It was observed that that building with floating column has less base shear as compared to a building without floating column. It was also observed that as floating column shifts from bottom storeys towards top storeys value of base shear decreases.

2.9 Mohammed Abdul Wasay, Suraj Baraik (2019)

Seismic analysis is a major tool in earthquake engineering; this is used to understand the response of buildings due to seismic excitations in a simpler manner. Response Spectrum Analysis was used. Assumptions were made to study the seismic effect on different position of floating column for a six storied RC framed building. The resistance of soft storey with corner floating column is minimum when compared to other types of models and is maximum in soft storey without floating column. Hence, it can be concluded that soft storey with corner floating column is not suitable for earthquake prone areas.

2.10 Pravin Avhad & DurgeshTupe (2020)

This paper studies the analysis of a G+5, G+10, G+15 storey normal building and a G+5, G+10, G+15 storey floating column building with soft storey and structure was assumed to be situated in earthquake Zone III. This analysis is done by use of Etabs 2015. It was observed that in building with Soft Storey cum Floating column Structure (SSFC) has less frequency as compared to regular structure and displacement is more as compare to regular structure. The maximum storey drifts are more in Floating Column Structure than without Floating Column Structure.

III. OBJECTIVES

The various objectives of the project are:

- To study the seismic behavior of multi storied building with floating column and soft storey.
- To analyze the changes in the structural functionality of the multi storey building with floating column and soft storey.
- Determination of seismic response of the models by using the method of Response spectrum analysis and Equivalent ststic analysis in ETABS software.

- For building models the following parameters have been studied storey drift, shear value, building torsion, storey moment, time period.
- To check the difference in quantity of steel and concrete by comparing it to traditional building without floating column and soft storey.
- To determine which structure is superior, floating column or soft storey in higher earthquake zone.

IV. Modelling Of Building

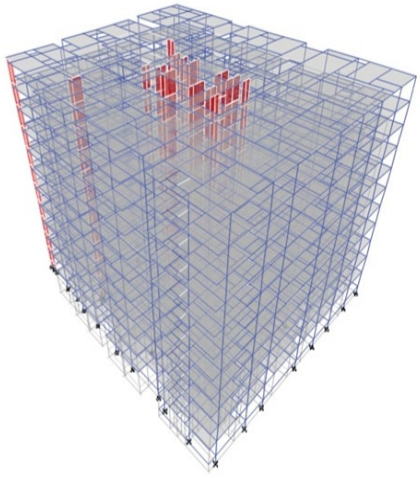
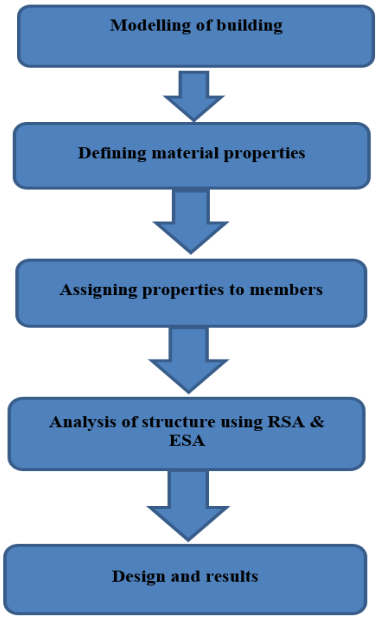


Fig.1. G+11 Storey Building with Floating Column and Soft Storey Building

V. Methodology



The proposed methodology of the project is as follows:

- Design and analysis of a structure with soft storey and floating column using the software *ETABS.*
- Apply the proper parameters required. Then analyze then building model in ETABS via Equivalent Static Analysis method and Response Spectrum Analysis method.
- Design the same for earthquake prone area.
- Check the seismic response demands to check whether building is safe or not along with its feasibility.

VI. Conclusion

From above literature, it was observed that building structures with floating column comes out with less base shear as compared to ones without floating column. Displacement factor for floating column building observes out to be more than compared to without floating column building. Storey drift was found to be more for building structures with floating column as compared to building without floating column. From dynamic analysis point of view it was observed that floating column at different location results into variation in dynamic response. Buildings with floating column observed out to have more time period as compared to building without floating columns. It was also found that as shift of floating column starts towards top of the building it results out in increasing time period which is majorly because of decreased lateral stiffness of the building. As we increase the number of storey's the inter storey drift also increases. The storey drift is more for the floating column buildings because as the columns are removed the mass gets increased. From the study of all above literature review it was observed that there is still a lot of study required to make sure that provision of floating column in building to be safe from earthquake point of view or not.

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