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SEISMIC ANALYSIS OF MULTISTORY BUILDING WITH FLOATING COLUMN: A REVIEW

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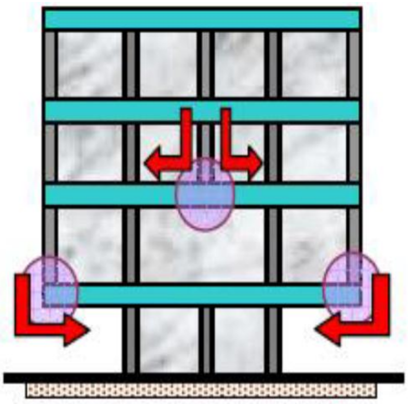
Abstract - *Modern multi-storey buildings are constructed with irregularities such as soft storey, vertical or plan irregularity, floating column and heavy loads. These type of structures have become a very common construction practice in urban India. It is observed that most of the RC structures with such irregularities constructed are highly undesirable in seismically active areas from the results of past earthquake studies. These effects occurred due to various reasons, such as non-uniform distribution of mass, stiffness and strength. This study explains the seismic analysis of a multi-storey building with floating column constructed in seismically active areas observing its reactions to the external lateral forces exerted on the building in various seismic zones using the software ETABS, STADD Pro and Sap2000. For analysis and study purpose there are few models will be developed in this study such that a multi-storey building that is G+12, G+14, G+16 buildings are considered and the models developed as multi-storey building with floating column where these floating column are present at different positions and at different height of the building analysing it at different zones as zone 5 to zone 2 as per codal provisions. Thus highlighting the alternative measures involving in improvising the non-uniform distribution in the irregular building such as multi-storied building with floating column, and recommended the safer design of such building in seismically active areas considering the results observed from storey drifts, story displacements, when compared to Response Spectrum method. Response Spectrum Analysis will be adopted which shows the best results.*

Key Words: Floating columns, ETABS analysis, Response Spectrum

1. INTRODUCTION

India is a developing country, where urbanisation is at the faster rate in the country including adopting the methods and type of constructing buildings which is under vast development in the past few decades. As a part of urbanisation multi-storey buildings with architectural complexities are constructed. These complexities are nothing but soft storey, floating column, heavy load, the reduction in stiffness, etc. Now a day's most of the urban multi-storey buildings have open first storey as an unavoidable feature. Accommodation of parking or reception lobbies is the primary use of these open first story in the multi-storey buildings constructed. But Conventional Civil Engineering structures are designed on the basis of strength and stiffness criteria. Usually the ground storey is kept free without any constructions, except the columns which transfer the building weight to the ground. This report adopt the multi-storey building with a architectural complexity i.e. the complexity of a multi-storey building with Floating column and the behaviour of the building in higher seismic zones is observed and considered some recommendations.



Hanging or Floating Columns

1.1 Floating Column

A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which at its lower level rests on a beam which is a horizontal member. Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path. The beams in turn transfer the load to other columns below it..The floating column is a vertical member which rest on a beam and doesn't have a foundation. The floating column act as a point load on the beam and this beam transfers the load to the columns below it. But such column cannot be implemented easily to construct practically since the true columns below the termination level are not constructed with care and hence finally cause to failure.

1.2 Earthquake Resistant Design

Generally these buildings with floating columns are usually designed for gravity loads and are safe under gravity loads but are not designed for earthquake loads. So these buildings are unsafe in seismic prone areas. Hence this study aims to create awareness about these issues in earthquake resistant design of multi-storeyed buildings with floating column. Stiffness, Strength and Ductility directly affect load deformation behaviour of buildings, while Seismic Structural Configuration affects these three virtues indirectly and Energy Dissipation Capacity is an overall consequence of all the four virtues of buildings. Unlike all other loading effects like wind loads, wave loads(excepting tsunami loads), blast loads, snow loads, imposed (live) loads and dead loads, earthquake shaking is the most severe, because it imposes displacement under the building, which is time varying and this in turn effects the lateral deformation in the building between base and upper elevations.

2. LITERATURE REVIEW

Arpit Shrivastav, Aditi Patidar [1] in 2018 observed that this paper deals with Seismic Analysis of Multistorey Buildings having Floating Columns in which three cases of multi-storey buildings are considered having 8 storey, 12 storey and 16 storey. All the three cases are considered having floating columns provided with and without shear wall, and also analysed for zone III, zone IV and zone V by using software STADD Pro. For all the cases considered drift values follow around similar path along storey height with maximum value lying somewhere near about the middle storey. For all the models considered displacement values follow around similar gradually increasing straight path along storey height. In all the models storey drift and displacement values are less for lower zones and it goes on increases for higher zones because the magnitude of intensity will be the more for higher zones.

Pradeep D., Chethan V R, at el [2] in 2017 observed that there are 2 models of buildings, building without floating column and building with floating column at different floor levels. Comparing seismic parameter such time period, base shear, storey displacement, storey drift for both models. Seismic analysis is done by linear static and linear dynamic method by using ETABS. Building with and without floating columns are considered for the analysis. All building frames had plan symmetry. Response spectrum analysis was conducted for each building located in hard soil and medium soil and corresponding story displacements, story drifts, and base shear were compared. According to results obtained, the storey shear force was found to be maximum for the first storey and it decreased to a minimum in the top storey. According to results obtained, it was found that building located in medium soil experience 25%larger base shear than building located in hard soil. The building with floating column at bottom stories experiences same base shear but has larger inter storey drifts when compared with the building with floating column at the periphery of the building. Building located in hard soil exhibits less displacement and drifts when compared with building located in medium soil. Building without floating column shows 35% lesser displacement when compared with the buildings with floating columns.

Isha Rohilla, at el [3] in 2015 refers, Seismic Response Of Multistory Irregular Building With Floating Column in which discussed the critical position of floating column in vertically irregular buildings for G+5 and G+7 RC buildings for zone II and zone V. Also the effect of size of beams and columns carrying the load of floating column has been assessed. The response of building such as storey drift, storey displacement and storey shear has been used to evaluate the results obtained using ETABS software. Floating columns should be avoided in high rise building in zone 5 because of its poor performance. Storey displacement and storey drift increases due to presence of floating column. Storey displacement increases with increase in load on floating column. Storey shear decreases in presence of floating column because of reduction mass of column in structure. Increase in size of beams and columns improve the performance of building with floating column by reducing the values of storey displacement and storey drift. Increasing dimensions of beams and columns of only one floor does not decreases storey displacement and storey drift in upper floors so dimensions should be increased in two consecutive floors for better performance of building.

A.P. Mundada and S.G. Sawdatkar [4] in2014 this paper refers Comparative Seismic Analysis of Multistorey Building with and without Floating Column **in** which the comparative study of seismic analysis of multi-storied building with and without floating columns. 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. The building considered is a residential building having G+7. The analytical models of the building include all the component that influence the mass, strength, stiffness and deformability of structure. In the modelling, material is considered as an isotropic material. The 3d building model generated in is shown in STADD Pro. A simplified probabilistic risk analysis (PRA) procedure is presented for the seismic reliability of G+7 storey RCC building by considering effect of with and without floating column in the modelling. The moment about X and moment about Z are compared by equivalent static analysis method. The above building models are generated using the software STAAD Pro 8Vi and are analyzed using equivalent static method.

Srikanth. M.K, at el [5] in 2014 refers Seismic Response Of Complex Buildings With Floating Column For Zone II AND Zone V in which the analysis of the building with floating column and also other complexities are considered for ten storey building at alternative location and also for low to higher zones. This study providing alternative measures involving stiffness balance of the storey where floating column provided and the storey above when other irregularities are also introduced in the stories. Finally analysis results such as storey drifts, storey displacements, storey shears of the high rise building are compared in the study using the software ETABS .The main objective of the study in this paper is to compare the seismic behaviour of the building having only floating column and floating column with other complexities in it where the location of the floating column are also varied to find the optimum position comparing the results obtained from zone II to V, thus the study is observed between the four types of models that is a floating column model, a floating column model with raised floor heights, a floating column model with heavy load at the floating column floor, and the last is a floating column with raised floor height provided with heavy load in that floor. The results obtained are in terms of lateral displacements, storey shears, storey drifts. It is concluded that, the displacement of the building increases from lower zones to higher zones, because the magnitude of intensity will be more for higher zones, similarly for drift, because it is correlated with the displacement. Storey shear will be more for lower floors, then the higher floors due to the reduction in weight when we go from bottom to top floors, and with this if we reduce the stiffness of upper floors automatically there will be a reduction in weight on those floors so in the top floors the storey shear will be less compared to bottom stories. The response of the building which is having only floating column will be less when compared to other. The multi-storey building with complexities will undergo large displacement then the model having only floating column. In all models the displacement values are less for lower zones and it goes on increases for higher zone.

3. CONCLUSION

Literature review presents the seismic behaviour of buildings with floating columns and without floating columns for different structural complexities. It was observed that, provision of floating columns at different locations affects the performance of building during earthquake also different parameters such as storey drift, storey shear, displacement increases. The displacement values are less for lower zones and it goes on increases for higher zone. Increase in size of beams and columns improve the performance of building with floating column by reducing the values of storey displacement and storey drift. It was also observed that, buildings with floating columns are not economical if designed as earthquake resistant. Provision of floating column is advantageous in increasing FSI of the building but is a risky factor and increases the vulnerability of the building.

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