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SEISMIC RESPONSE OF RC FRAMED MULTISTORIED BUILDING WITH FLOATING COLUMN

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Abstract: Columns rest on the beam without foundation are called floating column.They are used commonly in multi-storey buildings which are purposed to hold parking at ground floor or open halls at higher floors. Discontinuation within the load transfer path is seen in this column. Thus, they are designed for gravity loads. But these structures aren't designed for earthquake loads. In present scenario structures with floating column may be a common characteristic in urban India. However, in tectonic areas, this type of structure is not preferred due to discontinuity of load transfer path i.e. whole earthquake load on the structure is shared by the shear walls without any loads on the floating columns. This paper reviews the nature of a multi-storey building under quake forces with and without of floating columns. This analysis focusses the importance of specially identifying the presence of the floating column within the study of the structure, establish its correlation with the building without a floating column using designing software Extended three-dimensional analysis of building systems (ETABS). This paper also discusses the performance of structure having floating column in seismically active areas. Besides this various parameter such as maximum displacement, effect on number of storeys on drift, base shear is also studied.

Keywords: Floating columns, Equivalent static analysis, Storey displacement, Storey drift, Base shear, Etabs

I. INTRODUCTION

Many urban multistorey buildings in India today have open first storey as an unavoidable feature. This is primarily being adopted to accommodate parking or reception lobbies in the first storey. Whereas the total seismic base shear as experienced by a building during an earthquake is dependent on its natural period, the seismic force distribution is dependent on the distribution of stiffness and mass along the height. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path; any deviation or discontinuity in this load transfer path results in poor performance of the building. Buildings with vertical setbacks (like the hotel buildings with a few storeys wider than the rest) cause a sudden jump in earthquake forces at the level of discontinuity. Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey. Buildings with columns that hang or float on beams at an intermediate and do not go all the way to the foundation, have discontinuities in the load transfer path. In seismic engineering, the behaviour of reinforced concrete (RC) framed multistorey buildings with floating columns has garnered significant attention due to their distinct structural characteristics and potential vulnerability during seismic events. Floating columns, unlike traditional columns, redistribute axial loads to adjacent elements rather than directly transmitting them to the foundation. This redistribution can lead to complex dynamic responses, affecting the overall stability and performance of the structure under seismic loading.

Understanding the seismic behaviour of such buildings is crucial for ensuring their safety and resilience in earthquake-prone regions. This paper provides an overview of the seismic analysis conducted on RC framed multistorey buildings with floating columns. Through numerical simulations, analytical studies, and experimental investigations, this research aims to elucidate the dynamic response mechanisms, identify critical factors influencing structural performance, and propose effective design and retrofitting strategies.

II. LITERATURE REVIEW

Neha Pawar, Kuldeep Dabhekar, P.B. Patil, Isha Khedikar. "Effect of Floating Columns on Building subjected to seismic Forces "Civil Engineering Department, G H Raisoni College of Engineering Nagpur, Maharashtra, India This article

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provides an effect of floating columns on building subjected to seismic forces in recent trends, Floating column is used to occupy more spaces for functional requirement. Floating Column is that architectural feature which gives poor response to earthquake. Hence it should be avoided in earthquake prone zones. This review shows the responses of various studies done by Researchers. Comparison of result is done with respect to different parameters like bending moment, storey shear, displacement, time period etc. Authors have modelled various structures such as conventional Building, building with Floating Columns, building modelled with different solutions and their solution is compared. This review also focuses on the methodology to be adopted to have better seismic response of Building with Floating Column. Models of the frame are developed for multi-storey RC buildings with and without floating columns to carry out comparative study of structural parameters such as natural period, base shear, and horizontal displacement under seismic excitation. Results obtained depicts that the alternative measure of providing lateral bracing to decrease the lateral deformation, should be taken. The RC building with floating column after providing lateral bracing is analyzed. 2. Lallawmkimi, Pankaj Kumar. "Effect of Floating Column in High Rise Building" Department of Civil Engineering, Rajshahi University of Engineering & Technology, Rajshahi, Bangladesh. This article provides an effect of floating column in high rise building .The usage of floating columns for additional space is a recent trend that caters to functional needs. The architectural feature known as the floating column responds poorly to earthquakes. As a result, it should be avoided in areas prone to earthquakes. Earthquakes affect mostly where there is a weak structure; in modern buildings, apertures are widespread for lifts, lighting, and other architectural features. This review displays the results of numerous research studies. Different researchers used various floating column locations across the structure. The main goal of research conducted by various researchers is to compare structures with floating columns and without floating columns. The evaluation is done to see if the building is on the side that is safer or if it is subjected to lateral effects. This review on floating columns examines the behaviour on the structure as well as possible mitigation measures.

III. METHODOLOGIES

General: - The study is carried out on a building with and without floating columns. The plan layout of the building is shown in the figure. The building considered is a residential building having G+7.

Modelling of Building –The building is modelled using the software STADD Pro. V8i. The analytical models of the building include all the component that influence the mass, strength, stiffness and deformability of structure. The building structural system consists of beam, column, slab, wall, foundation retaining wall, elevator, and staircase. The non-structural elements that do not significantly influence the building behaviour are not modelled. Beams and columns are modelled as two nodded beams. The floor slabs are assumed to act as diaphragms, which ensure integral action of all vertical load resisting elements. The wall load is uniformly distributed over beams. Walls are considered to be rigidly connected to beams and columns. The modelling of the wall is discussed in the section in the modelling; material is considered as an isotropic material. The 3d building model generated in is shown in STADD Pro.
Building without Floating Column. Total building consists of 2 phases. 1st phase consists of lower two storey provided for parking purpose.2nd phase is of residential flats from 1st floor to 7th floor. Phase1: Description of Normal Structure Upper and lower ground is provided car parking for Nearly 15 cars can be parked on each parking floor. Structure consists of 20 columns arranged in systematic manner. Lower parking is at basement and upper parking is at ground level. Built up area is 2000 sq.m. and height of each floor is 3 m. The building consists of 20 columns and total height of the structure is 24m.

Building with Floating Column Total building consists of numerous floating columns at different levels. 2 Floating columns from each storey except for ground storey are floating.
Phase1: Locations of Floating columns This phase is also for parking as in building without floating column but placements of columns are changed.
Phase 2: Designing and loading of Building Building is subjected to various forces such as DL, LL, EQ, WL in 'X' & 'Z' direction the loads are applied as per IS codal provisions and also load combinations are applied as given below. For the analysis purpose two models have been considered namely as:
MODEL 1 – Building in which floating columns do not exist it has all the columns connected to the soil and load transfer mechanism is conventional.
MODEL 2 – Building in which floating columns are located at upper stories. Following cases have been considered under this model based on the location of floating columns
Case 1: - Corner columns on second floor at exterior frame of the building are provided as floating column.
Case 2: - Alternate columns along shorter edge on the inner sides is provided as floating columns.
Case 3: -All columns in the centre of building at fourth storey are provided as floating column
Case 4: -Alternate columns present on the edges on inner side of the building are provided as floating columns.

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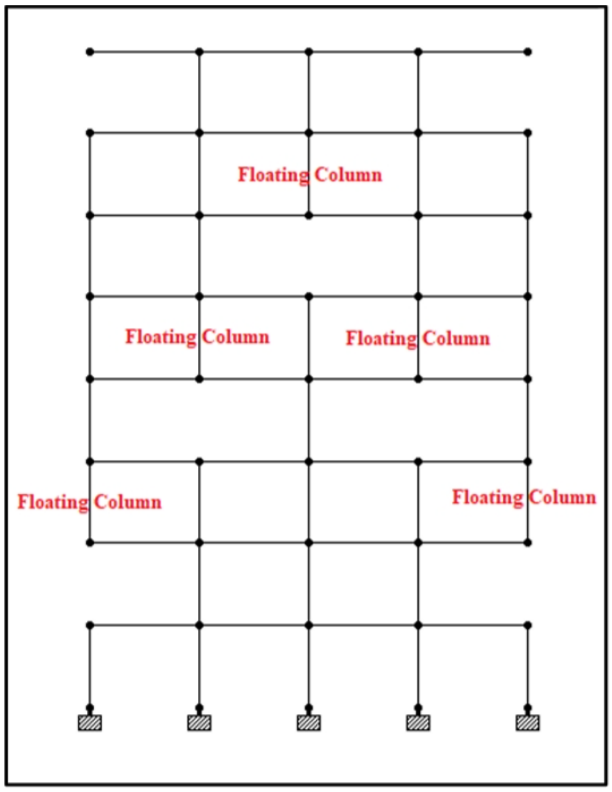

IV. CONCLUSION

1. There are no major effects on the building due to presence of floating columns at different levels except when floating columns are provided in central portion of the building.
2. In seismic analysis the base shear seems to be constant in all cases, The base shear value is found to be increased by 7% in building with floating column than normal structure.
3. The fundamental natural time period increases by 40% in case of floating column.
4. The presence of floating column on inner sides shows more deflection as compared to the deflections when floating columns are provided on outer sides of building.
5. Storey drift variation in floating column is 48% more than non-floating columns building. 6. Displacement on comparative graphs shows 37.5 % increase that might prove to be critical.

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