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Analysis of RC Framed Post Tensioned Slab Structure to Evaluate the Performance of Floating Column with and Without Shear Wall in Irregular Building Using ETABS

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Abstract— this research aims to develop analytical study of post tensioned slab with floating column in irregular building. In present scenario buildings with floating columns are of typical feature within the fashionable multi storey construction practices in urban India. Such sorts of constructions are highly undesirable in building inbuilt seismically active areas. For this buildings are given floating columns at one or more storey. These floating columns are highly disadvantageous during a building inbuilt seismically active area. The earthquake forces that are developed at different floor levels during a building got to be carried down along the peak to the bottom by the shortest path. Deviation or discontinuity during this load transfer path leads to poor performance of the building. In this paper, analytical study of post tensioned slab to evaluate the performance of floating column at ground level or at alternative story for G + 10 story building without shear wall, shear wall at corner, shear wall at center, shear wall at external middle and combined shear wall are provided for stepped building is taken for study. The response of building like storey drift, storey displacement and storey shear has been wont to evaluate the results obtained using ETABS software.

Index Terms— Floating Column, ETABS, Post Tensioned Slab, Shear Wall, RC Frame, Storey Displacement, Storey Drift, Irregular Building.

I. 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 a point load on the beam and this beam transfers the load to the columns 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 rests on the beam. This means that the beam which supports the column acts as a foundation. That beam is called as a transfer beam. This is widely used in high storied buildings for both commercial and residential purpose. This helps to alter the plan of the top floors to our convenience. The transfer beam which supports the floating column, transfers the loads up to foundation. Hence this has to be designed with more reinforcement.

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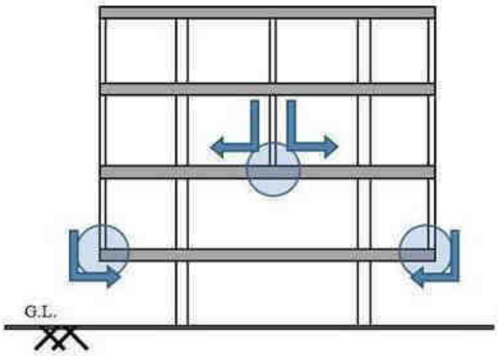

Fig.1 floating column at various positions

Absence of column at any level changes the load path and transfers the floating column load through horizontal beams below it, also mentioned as transfer girders. Therefore when floating column is to be necessarily provided special care should tend to the transfer girders and column below the floating column. In this present study, post tension slabs are used to evaluate the performance of floating column at ground level or alternative stories of regular building with and without shear wall under earthquake. Now a day multi-storey buildings constructed for the purpose of residential, commercial, industrial etc., with an open ground storey has become a common feature. For the sake of parking, the ground storey is kept free without any constructions, except for the columns which transfer the building weight to the ground. For a hotel or commercial building, where the lower floors contain banquet halls, conference rooms, lobbies, show rooms or parking areas, large interrupted space is required for the movement of people or vehicles. The columns which are closely spaced in the upper floors are not advisable in the lower floors. So to avoid this problem, floating column concept has come into existence.

II. MODELLING

A G+11 story building is taken for analysis with floating column in lower stories and a PT transfer Girder is additionally designed to know better the effect of varied seismic parameters just in case of high rise building. The analysis is completed for seismic zone II to see the utmost value of result parameters. The effect of change dimensions of beams & columns supporting floating column was also studied. Medium soil conditions were used for analysis. Model consists 5 m spacing in X direction and 6m spacing in Y direction. Several models are created, by deleting 90 floors and the associated columns from the base building that is keeping the mass of the building constant. Thus stiffness irregularities are introduced into the building and also floating column is introduced. And the storey displacement, storey drift, story shear, time period is compared for these models. Response spectrum analysis is carried out for the study.

We are considered a storey height of 3m, slab thickness of 180 mm. dead load and live loads are 2 kN/mm^2 and 5 kN/mm^2 respectively. **Earthquake load:** Earthquake load for the building has been calculated as per IS 1893:2002

i. Zone (Z) = II
ii. Response Reduction Factor (R) = 5
iii. Importance factor (I) = 1
iv. Rock and soil site factor (S) = 2
v. Type of Structures = 1
vi. Scale factor = 1.962

The following combination of loads with approximate partial safety factor satisfying the Indian Standard code provision. i.e., IS 456:2000, table 18, clause 18.2.3.1 and IS 1893:2002, clause 6.3.2.1 are as follows.

1. 1.5[DL + LL]
2. 1.2[DL + LL + EQX]
3. 1.2[DL + LL + EQY]
4. 1.2[DL + LL - EQX]
5. 1.2[DL + LL-EQY]
6. 1.5[DL + EQX]
7. 1.5[DL + EQY]
8. 1.5[DL - EQX]
9. 1.5[DL - EQY]
10. 0.9DL + 1.5EQX
11. 0.9DL + 1.5EQY
12. 0.9DL - 1.5EQX

Structural elements dimensions in ETABS

TABLE 1: Structural Elements Dimensions

Element	**Dimension (mm)**
Common beam (bxd)	350x500
Transfer beam (bxd)	350x750
Common column	450x450
Column below transfer beam (bxd)	750 x 750

The 3-d view of the twin tower buildings with and without structural linking for stepped building generated by ETABS are shown in Fig.2 to Fig.6

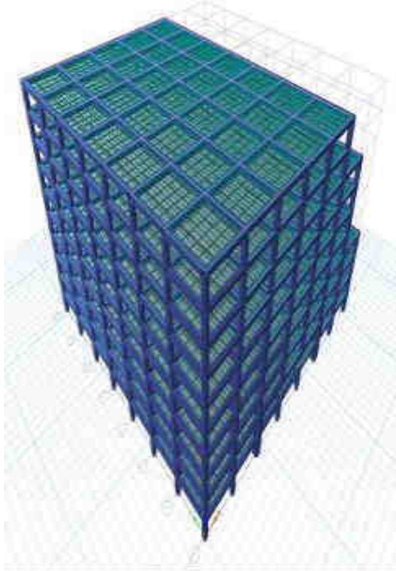

Fig. 2 Floating column without shear wall in stepped building

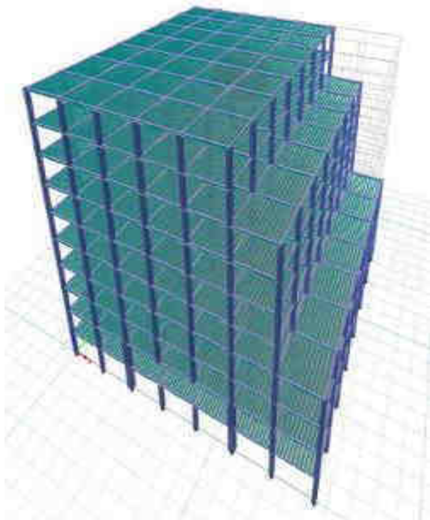

Fig. 3 Floating column with shear wall at center

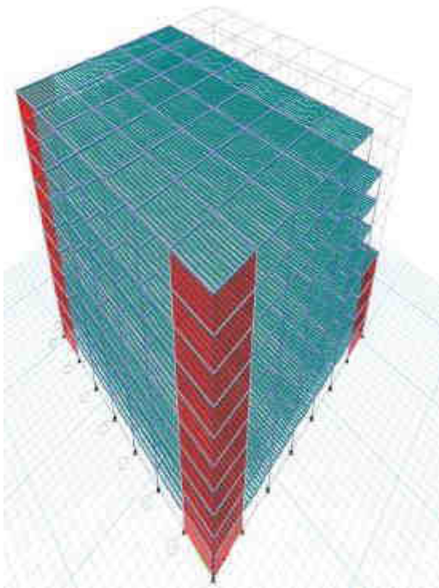

Fig. 4 Floating column with shear wall at corner

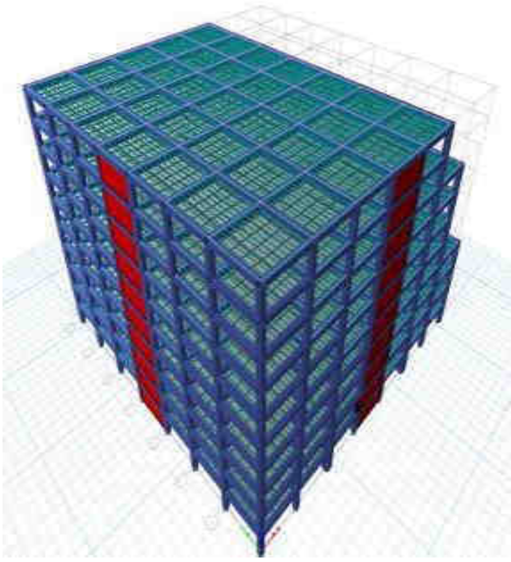

Fig. 5 Floating column with shear wall at external middle

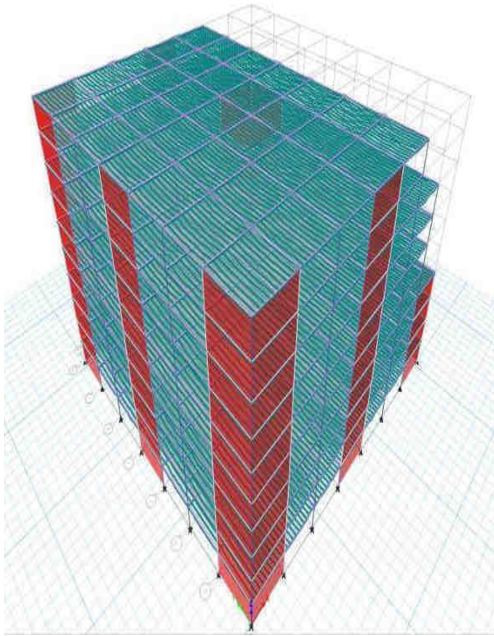

Fig. 6 Floating column with combined shear wall

III. ANALYSIS RESULTS

The linear dynamic analysis method is also called as Response spectrum method. In this techniques the ultimate response of a building during a tremor is found specifically from the quake responses (or design) range. The representation of the max responses of ideal SDOF frameworks having notable period and damping, during seismic tremor ground motion, the max response is plotted against the un damped natural period and for different damping values, and can be communicated regarding most extreme relative displacement or most extreme relative speed.

A. *Storey Displacement*

It is observed that the lateral displacements increases as storey level increases. Maximum storey displacement is at the roof and minimum at ground floor. The displacements are decreased by the addition of structural links and the change in position of structural link also affects the lateral displacement. Maximum displacement for all cases for stepped building with floating column at ground level and alternative storey are shown in Table II and Fig 7

TABLE II: Comparison of Maximum Displacement

Shear wall type	Maximum displacement of Stepped building	
	Floating column at ground level	Floating column at alternative storey
Case 1	20.144	19.813
Case 2	12.975	12.65
Case 3	14.316	13.473
Case 4	14.651	13.773
Case 5	9.303	8.006

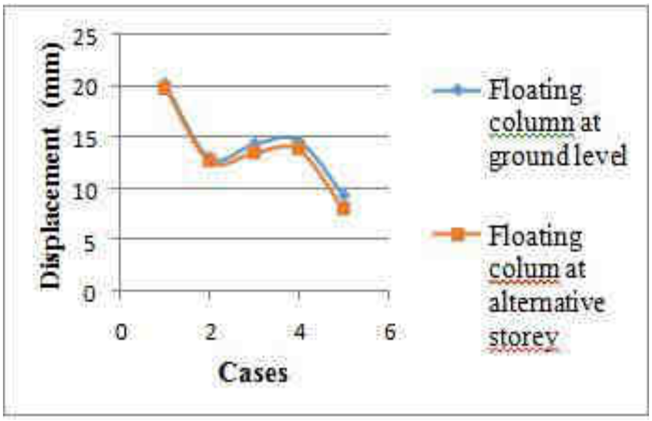

Fig. 7 Comparison of Maximum Displacement

By comparing the maximum displacement values of stepped building with floating column at ground level and floating column at alternate storey it can be seen that the maximum displacement is for case 1 building with floating column at ground level and minimum displacement value is for case 5 building with floating column at alternative storey. Maximum displacement and minimum displacement values are 20.144 mm and 8.006 mm

B. *Storey Drift*

It is observed that storey drift increases as height of building increases up to middle of the building and then it decreases as height of the building increases. Maximum storey drift for all cases for stepped building with floating column at ground level and at alternative storey are shown in Table III and Fig 8 By comparing the maximum storey drift values of stepped building with floating column at ground level and floating column at alternate storey it can be seen that the maximum storey drift is for case 1 building with floating column at ground level and minimum drift value is for case 5 building with floating column at alternative storey. Maximum and minimum storey drift values are 0.00075 and 0.000419.

It is observed that regular case 5 building with floating column at alternative storey has less storey drift when compared with other buildings

Table III: Comparison of Maximum Drift

Shear wall type	Maximum drift of Stepped building	
	Floating column at ground level	**Floating column at alternative storey**
Case1	0.00075	0.000712
Case 2	0.000776	0.00069
Case 3	0.000577	0.000531
Case 4	0.000615	0.000572
Case 5	0.000506	0.000419

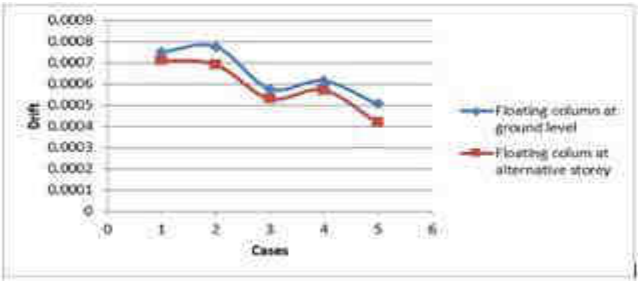

Fig. 8 Comparison of Maximum Drift

C. Time Period

Time period of stepped building with floating column at ground story and alterative story are shown in Fig 9

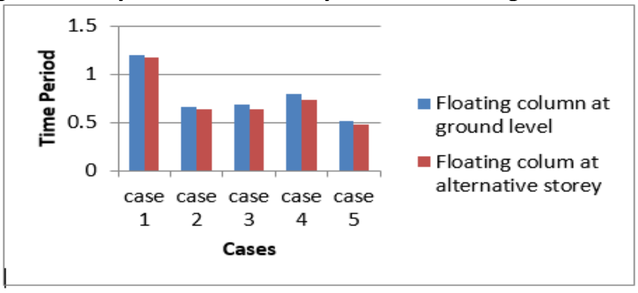

Fig 9 Time Period of Stepped Building with Floating Column

By comparing the time period values of stepped buildings with floating column at ground level and floating column at alternate storey it can be seen that the more time period is for stepped case 5 building with floating column at ground storey.

D. ***Base Shear***

Base shears of stepped building with floating column at ground story and alterative story are shown in fig 10.

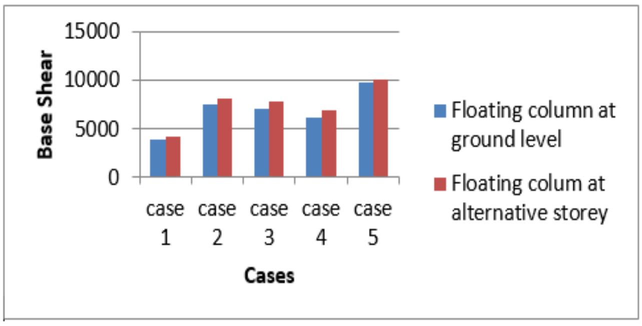

Fig.10 Base Shear of Stepped Building with Floating Column

By comparing the maximum base shear values of stepped buildings with floating column at ground level and floating column at alternate storey it can be seen that the more base shear value is for floating column at alternative storey with combined shear wall.

CONCLUSION

Seismic behaviour of G +10 storey stepped buildings with floating column either at ground level or at alternative story were analysed using ETABS. Ten cases were modelled with stepped building for different shear at different positions. Buildings without shear wall, with shear wall at centre, corner, external middle and combine were taken for this study. The buildings are studied for different parameters like storey drift, storey displacement base shear and time period. Maximum displacement is for case 1 building with floating column at alternative level. Minimum displacement value is for case 5 building with floating column at alternative storey. Maximum storey drift is for case 1 building with floating column at ground level. Minimum drift value is for case 5 building with floating column at alternative storey. More base shear value is for regular case 5 building with floating column at alternative storey.

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REFERENCES

1. Abhishek Arora "Alternative Approach to Soft Storey in Seismic Analysis of R.C.C Building Structures" SSRG-International Journal of Civil Engineering, page 40-45, (2015)
2. Alfa Rasikan, M G Rajendran "Behavior of Buildings with and Without Shear Wall", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol. 3, Issue 2, March -April 2013, pp.480-485, (2013).
3. Ankit kumar and Durgesh Nandan Verma "Effect of Floating Column on Irregular Buildings Subjected to Lateral Loads" International Journal of Creative Research Thoughts.:657:661, (2018).
4. Badgire Udhav S., Shaikh A.N., Maske Ravi G "Analysis of Multistorey Building with Floating Column", International Journal of Engineering Research. Volume No.4, Issue No.9: 475-478, (2015).
5. Dr. Dubey S.K. and P.D. Sangamnerkar "Seismic Behavior of Asymmetric RC Buildings", International Journal of Advanced Engineering Technology IJAET/Vol.II/ Issue IV, (2011).
6. Haitham Kannas, Mahmoud Alhassan, Abdallah M. S. Wafi, "Cobiax and post-tension slabs: A comparative study based on the construction duration time and cost", International Journal of Advanced Engineering, Sciences and Applications (IJAESA), Vol. 1 No. 4, (2020)
7. Jabbar, S., F. Hejazi, and H.M. Mahmod (2016), "Effect of an Opening on Reinforced Concrete Hollow Beam Web Under Torsional, Flexural, and Cyclic Loadings", Latin American Journal of Solids and Structures, 2016. 13(8): p. 1576-1595.
8. Kandukuri Sunitha, Mr. Kiran Kumar Reddy (2017), "Seismic Analysis of Multistorey Building with Floating Column by using Tabs", International Journal of

Engineering Technology Science and Research. ISSN 2394 – 3386 Volume 4, Issue 8: 933-943

9. Mohammed Rizwan Sultan, D. Gouse Peera "Dynamic Analysis of Multi-storey building for different shapes", International Journal of Innovative Research in Advanced Engineering (IJIRAE), Issue 8, Volume 2, August 2015.
10. N.Elakkiyarajan, G.Iyappan And A Naveen, "Seismic Analysis of Multistory Building with Floating Column", International Conference On Progressive Research In Applied Sciences, Engineering And Technology: 42–48, (2018)