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COMPARATIVE STUDY OF SEISMIC RESPONSE OF MULTI-STOREYED BUILDING WITH FLOATING COLUMN RESTING ON R.C.C TRANSFER GIRDER AND POST TENSIONING TRANSFER GIRDER

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Abstract: In present scenario, building with floating column is typical feature in the modern multi-storeyed construction in developing India. This type of construction is highly undesirable in buildings built in seismically active areas. Floating columns are supported by different types of transfer girders. The earthquake forces are developed at different floor levels in a building need to be carried down along the height to the ground by shortest path. Discontinuity due to floating column in this load transfer path results in poor performance of the building. In this paper comparison of seismic response of multi-storeyed building with floating column resting on R.C.C transfer girder and Post Tensioning transfer girder has been discussed for G+13 ,zone III ,situated in Pune. The response of building such as storey displacement storey shear, storey drift has been used to evaluate the results obtained using ETABS software.

Keywords: Floating column, R.C.C Transfer Girder, Post tensioning transfer girder, Seismic response, ETABS 16.0.0, etc.

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INTRODUCTION

1.1 General

Open first storey and floating column are typical features in the modern multi-storey constructions in urban India. A column is a structural member starting from foundation level. It transfers the load to the ground. Due to some architectural requirements / site conditions , some columns ends at its lower level known as floating column and rests on a Transfer Girder. The transfer girder is a horizontal member transfers the load to other columns below it. Transfer girders are heavily loaded deep beam. Floating columns provided in case where architect need different or large column spacing.

In multi storey building with floating column, one column grid for the lower level and different grid for the upper levels.

Depth of transfer beams varies from 1 m to 2m.Design of transfer beams of transfer floor directly helps or provides flexibility in different architectural arrangements like stilt, basements. Floating columns are highly disadvantageous in building built in seismically active areas.

One fundamental consideration in earthquake resistant design is a clear, direct and continuous load path. The earthquake forces developed at different floor levels in a building are brought down along the height to the ground through the shortest path, but due to floating column there is discontinuity in the load transfer path which results in poor performance of building. Structures with floating column are not included in IS codes because these structures cannot sustain

seismic forces and likely to get damaged Floating columns are competent enough to carry carry gravity loading but transfer girder must be of adequate dimensions (stiffness) with very minimal deflection. The transfer slab / floor are commonly used in multi storey buildings. The columns and walls terminating at the transfer level.

1.2 Floating Column

A column is a vertical structural member starting from foundation level and transferring load to the ground. The term floating column is also a vertical element which (Due to some architectural requirement /site conditions) some columns ends at its lower i.e its termination level rests on a beam which is a horizontal member. The beams transfer the load to the other columns below it. In multi-story building with floating column one column grid for the lower level and different for the upper level.

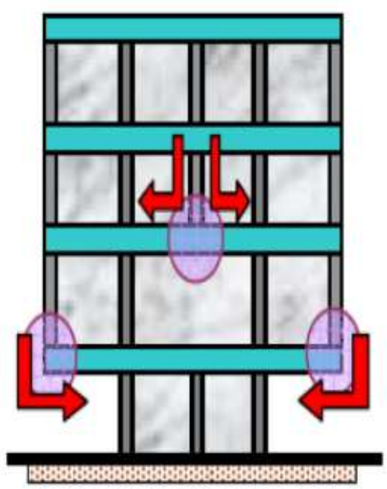

Figure 1. Floating Column

Figure 2. Floating Column provided with 1m transfer girder

1.3Transfer Girder

Floating columns rest on beams, these are known as transfer girder. Transfer floor consist of transfer girder. Which are different from regular structural beam. Depth transfer beams varies from 1m to 2m. The transfer girders have to be designed and detailed properly, especially in earthquake zones. The column is a concentrated load on the beam which supports it and transfer to the other columns below it. Lateral loads (wind load, earthquake) coming on buildings are transferred to the basement columns through beams.

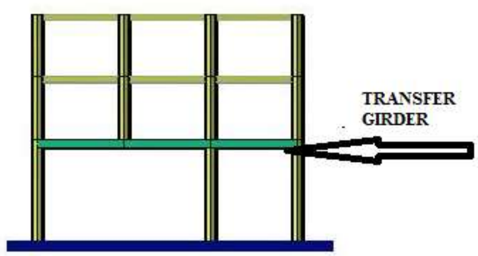

Figure 3. Transfer beam location

Figure 4. Transfer Girder of 1m

2. Methodology

Two types of structures were considered. That is multi-story building with floating column resting on R.C.C transfer girder and multi-storey building with floating column resting on PT transfer girder. Seismic analysis by response spectrum method is done in ETABS16.0.0. Based on seismic response most efficient structure was found.

This building is situated in zone III , Pune region. This is G+13 storey building. This building consist of 22 number of columns which supports 1m thick transfer slab and terminate at its 1st level. It also consist of 64 numbers of floating column which starts from transfer slab.

3. Modeling Details

Multi storey building with R.C.C transfer girder is designed and analysed in ETABS 16.0.0. PT transfer girder is designed ADAPT software and analysed in ETABS are analysed in 16.0.0.

Figure 5 shows the position of column at plinth level. These columns terminate at its 1st level. These columns support 1 m thick transfer slab and number of transfer girder. This 1m transfer slab support 64 floating columns. Sizes of columns which supports 1m thick transfer slab given in Table No.1.

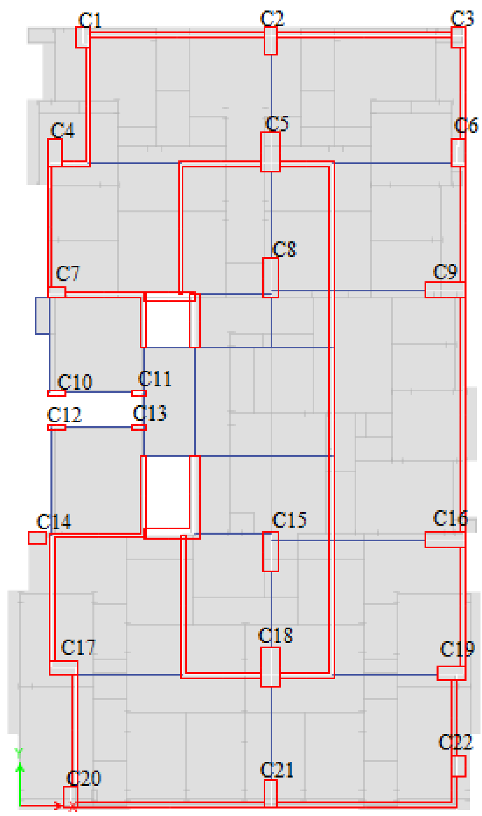

Figure 5 Column position at plinth level

Table 1 Column sizes

COLUMN NO	COLUMN SIZE
C1,C3,C20,C22	0.60 X 0.90
C2,C4,C6,C21	0.60 X 1.20
C17,C19	1.20 X 0.60
C5,C18	0.8 X 1.75
C7,C14,	0.75 X 0.50

C8,C15	0.70 X 1.75
C9,C16	1.75 X 0.70
C10,C12	0.75 X 0.23
C11,C13	0.60 X 0.23

Figure 6 shows the position of floating column. These 64 umber of floating columns starts from transfer floor and same throughout the height.

In this multi-story building with floating column one column grid for the upper level and different for the lower level.

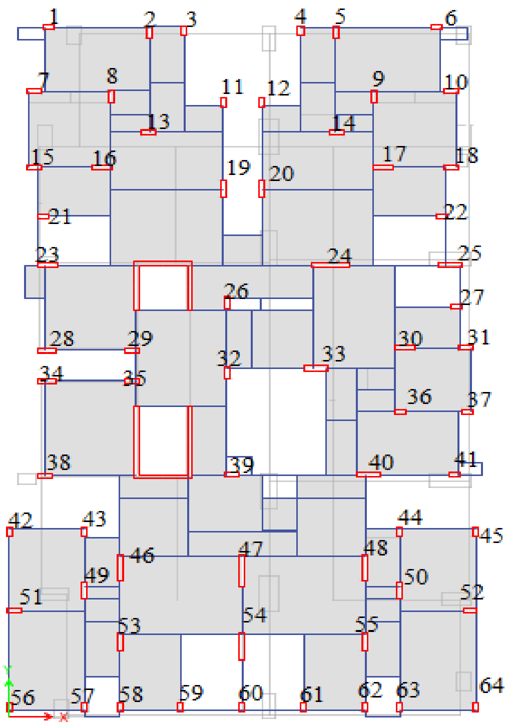

Figure 6 Floating column position

Table 2 Floating column sizes

COLUMN NO	COLUMN SIZE
C56,C57,C58,C59, C60,C62,C61,63, C64,C42,C43,C44, C45,C41,C36,C37,C21,C22,C11, C12,C1,C3,C4,C6,C27	450 X 230
C51,C52,C38,C39,C32,C31C, C26,C15,C18, C13,C14,C7,C8,C9,C10,C2,C5.	600 X 230
C53,C55,C30,C19,C20,C23, C16,C17,C49,C50	850 X 230
C40,C33,C25	1000 X 230
C54,C46,C48	1350 X 230
C47,C24	1600 X 230

Figure 7 and figure 06 shows the position of transfer girder with different sizes. Size of transfer girder is mentioned in Table No 3.

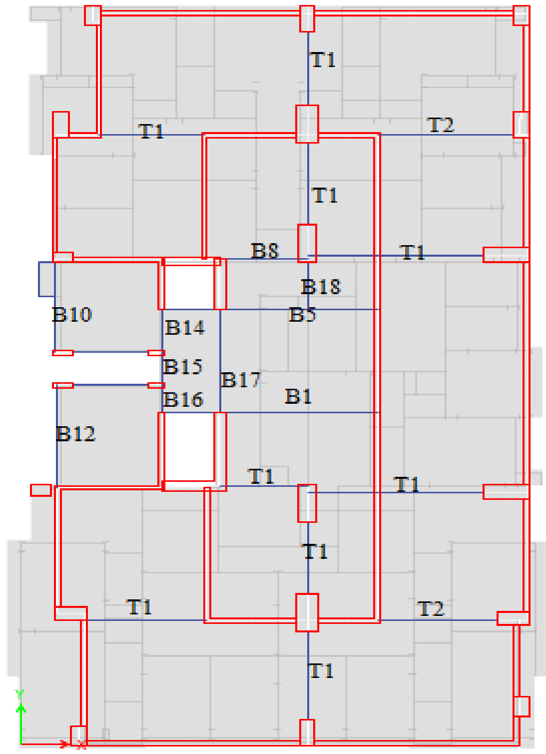

Figure 7. R.C.C Transfer Girder position

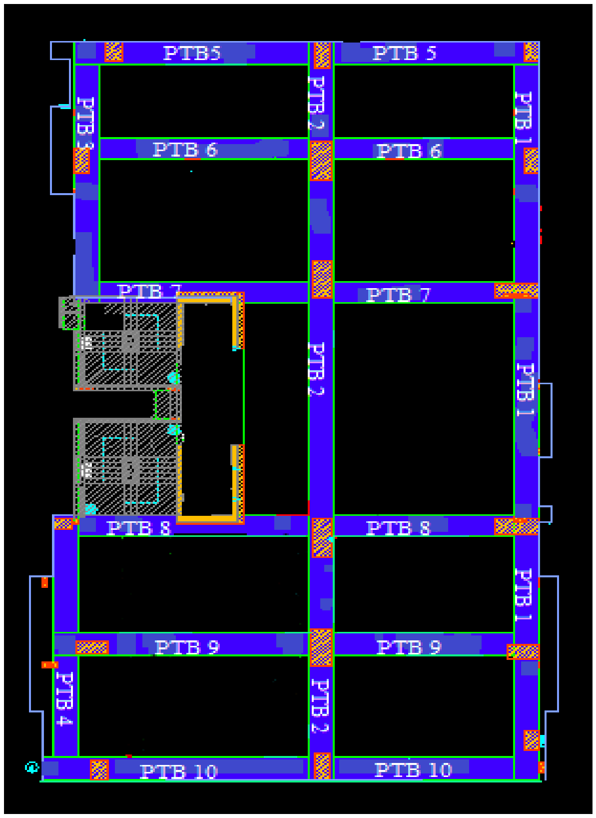

Figure 8. Post Tensioning Transfer Girder position

Table 3 Transfer Girder sizes

BEAM NO	BEAM SIZE (MM)		BOTTOM FULL	TOP FULL	REMARKS
	D	B			
T1	600	300	3-12	3-10	Hidden Beam
T2	600	300	3-12	3-12	Hidden Beam
B1	600	230	2-25	3-16	Hidden Beam
B5	600	230	2-25	3-16	Hidden Beam
B8	450	230	2-12	2-10	Hidden Beam
B10	600	230	2-16	2-10	Hidden Beam
B14	450	200	2-12	2-10	Hidden Beam
B15	450	200	2-12	2-10	Hidden Beam
B18,	450	200	2-12	2-10	Hidden Beam
B16	450	200	2-12	2-10	Hidden Beam
PT Beam	1000	1000	2-25+ 4-16	2-25+ 4-16	Hidden Beam

Table 4 Schedule of PT Transfer Girder

BEAM NO	BEAM SIZE (MM)		TENDON UNIT	NO. OF TENDONS	REMARK
	D	B			
PT B1	1000	1000	12s	04	Hidden Beam
PT B1	1000	1000	7s	04	Hidden Beam
PT B1	1000	1000	7s	02	Hidden Beam
PT B1	1000	1000	7s	03	Hidden Beam
PT B1	1000	1000	7s	03	Hidden Beam
PT B1	1000	1000	7s	03	Hidden Beam
PT B1	1000	1000	7s	03	Hidden Beam
PT B1	1000	1000	7s	03	Hidden Beam
PT B1	1000	1000	7s	03	Hidden Beam
PT B1	1000	1000	7s	04	Hidden Beam
PT B1	1000	1000	7s	04	Hidden Beam

4. Results and discussion

Seismic analysis is the calculation of the response of structure to earthquake. It is part of the process of structural design.The response of building such as storey displacement, storey shear, storey drift has been used to evaluate the results obtained using ETABS 16.0.0 software.

1) Time Period

Time period of building with floating column resting on R.C.C transfer girder and post tensioning transfer girder is given below.

Table 5 Time Period

Building with	Transfer Girder	
	R.C.C	Post Tensioning
Time Period	1.748	1.716

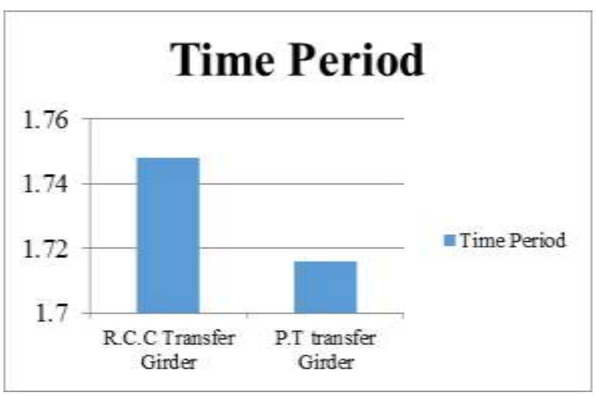

Figure 9. Time period of R.C.C transfer girder and P.T transfer girder

2) Storey Displacement

Storey displacement is total displacement of all storeys with respect to base of building.

Storey displacement of building with floating column resting on R.C.C transfer girder and post tensioning transfer girder is given below.

Table 6 Storey Displacement

Storey No.	Displacement (mm) of (R.C.C Transfer Girder)	Displacement (mm) of (P.T Transfer Girder)
base	0.000	0.000
Plinth	0.020	0.056
2	0.900	0.810
3	2.000	1.940
4	3.300	3.120
5	4.600	4.380
6	5.900	5.660
7	7.300	6.950
8	8.600	8.220
9	9.800	9.450
10	11.00	10.62
11	12.10	11.73
12	13.20	12.77
13	14.10	13.71
Terrace	15.00	14.56

Storey displacement of R.C.C transfer girder and P.T transfer girder graphically shown as below.

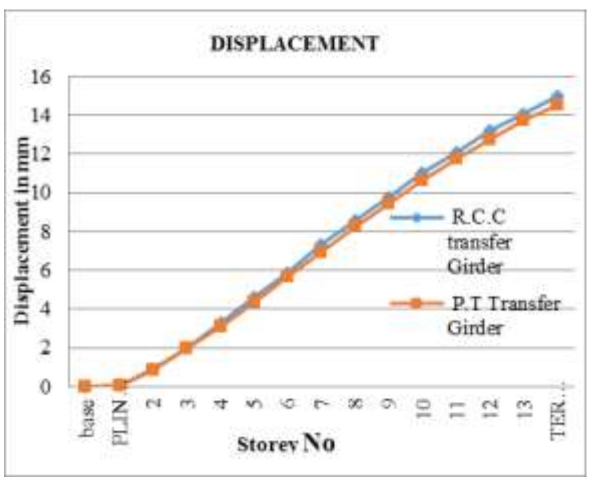

Figure 10.Storey displacement of R.C.C transfer girder and P.T transfer girder

This graph shows that displacement of storey of Building with floating column resting on R.C.C transfer girder is 1.82% greater than displacement of storey Building with floating column resting on P.T transfer girder.

3) Storey Shear

Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure.

Storey shear of building with floating column resting on R.C.C transfer girder and post tensioning transfer girder is given below

Table 7 Storey Shear

Storey No.	Story Shear (kN) of (R.C.C Transfer Girder)	Story Shear (kN) of (P.T Transfer Girder)
base	1250.260	1333.33
Plinth	1250.260	1333.33
2	1247.736	1330.34
3	1221.340	1303.68
4	1168.023	1249.65
5	1094.635	1175.16
6	1013.031	1091.53
7	935.764	1010.80
8	870.260	939.929
9	813.600	876.380
10	753.520	808.510
11	673.160	720.430
12	558.165	598.070
13	401.250	434.460
Terrace	196.910	224.142

Storey shear of R.C.C transfer girder and P.T transfer girder graphically shown as below.

Figure 11.Storey shear of R.C.C transfer girder and P.T transfer girder

This graph shows that Base Shear of Building with floating column resting on P.T transfer girder is 13.82 % greater than Building with floating column resting on R.C.C transfer girder.

4) Storey Drift

Storey drift is the maximum displacement of one level relative to other level.

Storey drift of building with floating column resting on R.C.C transfer girder and post tensioning transfer girder is given below.

Table 7 Storey Shear

Storey No.	Story Drift (mm) of (R.C.C Transfer Girder)	Story Drift (mm) of (P.T Transfer Girder)
base	0.000	0.000
PLINTH	0.000016	0.000027
2	0.000216	0.000205
3	0.000393	0.000353
4	0.000424	0.000409
5	0.000450	0.000433
6	0.000460	0.000447
7	0.000463	0.000451
8	0.000458	0.000448
9	0.000448	0.000440
10	0.000432	0.000426
11	0.000408	0.000405
12	0.000376	0.000378
13	0.000339	0.000344
Terrace	0.000302	0.000300

Storey drift of R.C.C transfer girder and P.T transfer girder graphically shown as below.

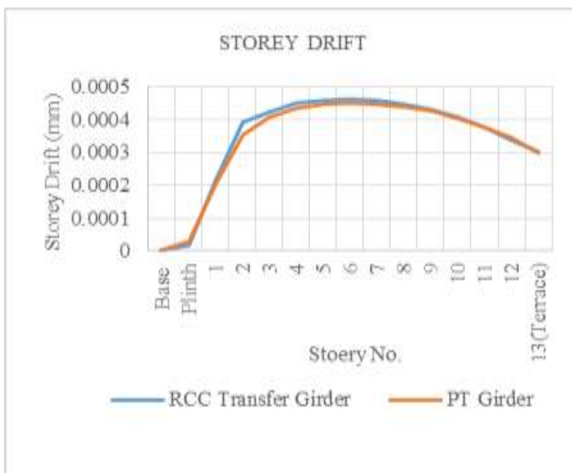

Figure 12. Storey drift of R.C.C transfer girder and P.T transfer girder

This graph shows that storey drift of Building with floating column resting on R.C.C transfer girder is 0.66 % greater than Building with floating column resting on P.T transfer girder.

5. Conclusion

This paper has described a comparative study of seismic response of multistoried building with floating column resting on R.C.C transfer girder and P.T transfer girder.

The most valuable outcomes obtained from this study are as follows:

- Time period of building with floating column resting on R.C.C transfer girder is 1.86% greater than building with floating column resting on P.T transfer girder.
- Displacement of storey of Building with floating column resting on R.C.C transfer girder is 3.021% greater than displacement of storey Building with floating column resting on P.T transfer girder.

- Base Shear of Building with floating column resting on P.T transfer girder is 13.82 % greater than Building with floating column resting on R.C.C transfer girder.
- Storey drift of Building with floating column resting on R.C.C transfer girder is 0.664 % greater than Building with floating column resting on P.T transfer girder.Which is negligible.

REFERENCES:

1. IshaRohilla (2015) “Seismic Response of multi-storey irregular building with floating column”, Vol.4, Issue.3, IJERT –March 2015
2. K M Pathan, SayyadWajed Ali, Hanzala T Khan, M S Mirza, MohdWaseem“Construction Stage Analysis of RCC Frames”
3. Mahesh N. Patil ,Yogesh N. Sonwane (2016) “Guidelines for planning , analysis , design and stability of Transfer Girders”, International Journal of Science and Research, Volume 5, Issue 3, March-2016
4. NishantDubey, Ranjan S. Sonparote, RatneshKumar“Effect of Construction Sequence Analysis on Seismic Performance of Tall Buildings” Volume 2,April – June, 2015
5. P Malaviya, S. Mourya, M. patel : “Comparative Study Of Effect Of Floating Columns On The Cost Analysis Of A Structure Designed On Staad Pro V8i” Volume-2, Issue-3, May-June, 2014,
6. Sagupta R. Amin , S.K.Mahajan (2015) “Analysis of multi storied RCC Building for Construction Sequence Loading” , International Journal of modern Trends in Engineering and Research, Volume 2, Issue 7, July -2015