NUMERICAL STUDIES OF RCC FRAME WITH DIFFERENT POSITION OF FLOATING COLUMN

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Abstract— This paper pertains of analytical studies carried out to evaluate the performance of RCC frame under different position of floating column. Building with column that hangs or floats on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer. The analysis has been carried out on a five storey RCC frame structure which has been analyzed. Analysis was carried out considering different positions of floating column by using STAAD pro. The effect of position of floating column was also studied. The bending moments are higher for all the floating column cases. The final maximum bending moments values are also influenced by the presence of floating column.

Key words—Floating column, frame, Maximum Bending moment, Seismic Force, STAAD. Pro V8i

I. INTRODUCTION

A column is supposed to be a vertical member starting from foundation level and suffering the load to the ground. The term floating column is also a vertical element which ends at its lower level rests on a beam which is a horizontal member. The beams in turn transfer the load to other column below it.

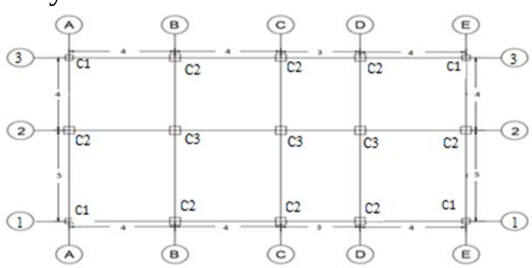
There are many projects in which floating columns are adopted, especially above the ground floor, where transfer girders are employed, so that more open space is available in the ground floor. These open spaces may be required for assembly hall or parking purpose. The column is a concentrated load on the beam which supports it. As far as analysis is concerned, the column is often assumed pinned at the base and is therefore taken as point load on the transfer beam. STAAD Pro, ETBS and SAP 2000 can be used to do the analysis of this type of structure.

Several researchers have contributed their significant work in this direction direction e.g., [Ambadkar and Bawner(2012), Chandrasekaran and Rao (2002) Joshi and Pathak (2013), Malaviya and Saurav (2014)]. Prasad and shekha (2014) reported that the behavior of building frame with and without floating column is studied under static load free vibration and forced vibration condition. 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. This will help us to find the various analytical properties of the structure and we may also have a very systematic and economical design for the structure. Sreekanth and Ramancharla etc.al (2014), studied the variations of the both structures by applying the intensities of the past earthquakes i.e., applying the ground motions to the both structures, from that displacement time history values are compared.

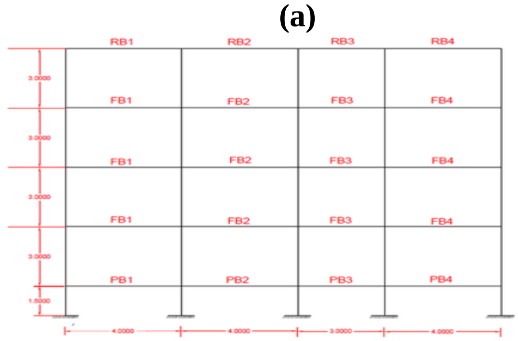
In this study an attempt has been made to evaluate the behaviour of RCC frame with floating column. The RCC frame was analysed and note down its shear force and bending moment. The effect of position of the floating on the frame is also studied and presented.

II. MODELLING

A five storey building was considered for analysis and then by using commercially available software STAAD Pro. Thereafter same frame was used for performing analysis to get shear force and bending moment by considering the different position of floating column. Fig. 1 shows the foundation plan and elevation of the frame considered for the analysis. Frame 1-1 and 2-2.



(a)



(b)

Fig. 1 Five storey frame considered for the analysis (a) foundation plan (b) elevation

There are many methods for the analysis but one of the most common approximations of floating column is Kani's. This method developed by Jasper Kani's of Germany. This is an excellent of slope deflection method, to analyze the building of five storeys only and dead load is taken into account.

The analysis of the frame was carried out using assumed loading input parameters. Live load on the roof and floor are 1.5 and 2 kN/m^2 respectively with slab thickness equal to 120 mm. Accordingly the dead loads were calculated and used in the analysis. Table 1 gives the initial assumed geometric properties of the five storey frame. By using STAAD Pro analysis was carried out to evaluate shear force and bending moment.

TABLE 1
Details of building models

Sr. No	Parameter	Specification
1	Live load on roof	1.5kN/m^2
2	Live load on floor slab	2 kN/m^2
3	Floor finish on slab	1.18 kN/m^2
4	Density of RCC	25 kN/m^3
5	Thickness of slab	120mm
6	Thickness of outside wall	230mm
7	Height of each floor	3m
8	Support condition	Fixed
9	Density of brick	18k N/m^3
10	Number of stories	5
11	Parpet wall height	900 mm
12	External thickness of plaster	12 mm
13	Density of plaster	20.4k N/m^3

14	Depth of foundation	1.5m B.G.L
15	Dimension of beam	300 x 300 mm
16	Dimension of column: Corner column	C1- 300 x 300 mm
	External column	C2- 400 x 400 mm
	Internal column	C3 – 400 x 450 mm

Table 2 gives the details of all the cases taken up for the analysis with consideration of different position of floating column.

TABLE II
MODELS OF FRAME 1-1

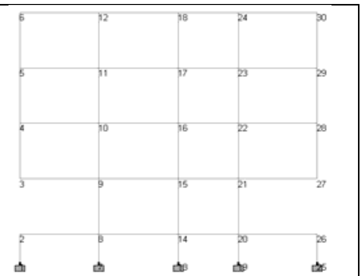
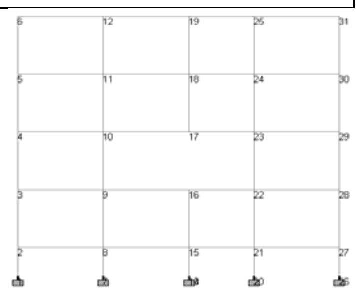
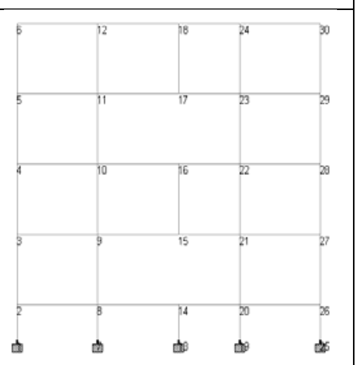
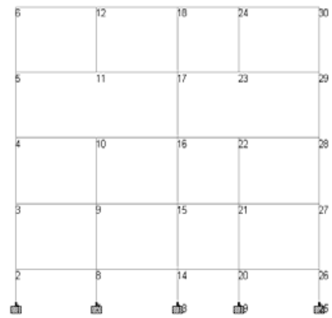
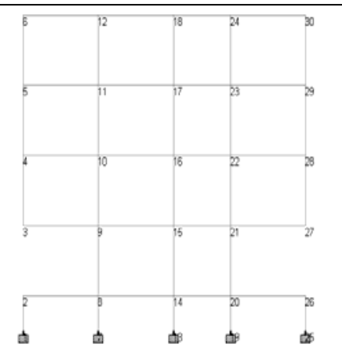
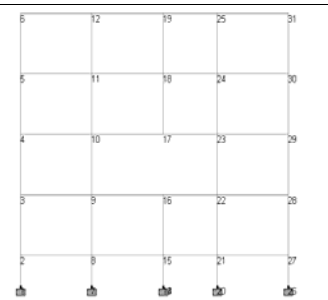
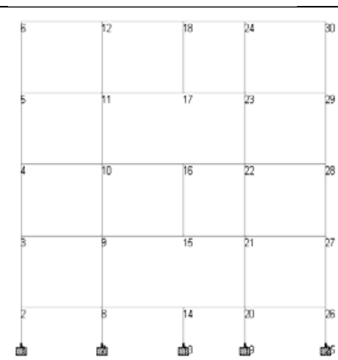
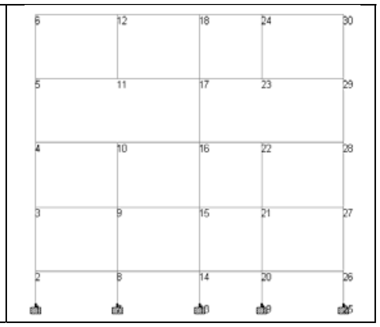
Mode l 1	Floatin g column located at ground floor on exterior frame	
Mode l 2	Floatin g column located at first floor on interior frame	
Mode l 3	Floatin g column located at ground floor and second floor on interior frame	
Mode l 4	Floatin g column located at second floor on middle frame	

Table 3 gives the details of all the cases taken up for the analysis with consideration of different position of floating column.

TABLE IIII
MODELS OF FRAME 2-2

Model 1	Floating column located at ground floor on exterior frame	
Model 2	Floating column located at first floor on interior frame	
Model 3	Floating column located at ground floor and second floor on interior frame	

Model 4	Floating column located at second floor on middle frame	

IV. RESULT AND DISCUSSION

The performance of RCC frame considered in terms bending moments are significantly influenced by the position of floating column.

The bending moment significantly affected by the position of floating column .The maximum bending moment is found in Model frame 1-1. Table 4 gives the maximum bending moment in each floor. In comparison with all the cases, model 1 has shown maximum bending moment. This is due to the reason that by provision floating column on exterior side of ground floor.

Table IV: Maximum bending moment (kN-m) on each floor in column of frame 1-1

Condition of Floating Col.	Model A-1	Model A-2	Model A-3	Model A-4	Without floating col.
Storey level					
1	74.09	43.40	41.49	66.97	13.66
2	52.28	35.51	-26.04	38.04	13.02
3	54.75	-21.33	40.56	-11.75	-13.12
4	39.89	14.24	-25.04	12.97	-12.83
5	-22.47	-14.10	16.26	-14.08	-14.25

Table 5 gives the maximum bending moment values for all the cases with and without floating column.

Table V: Maximum bending moment (kN-m) on each floor in column of frame 2-2

Condition of Floating Col.	Model A-1	Model A-2	Model A-3	Model A-4	Without floating col.
Storey level					
1	-38.18	-21.49	-25.88	-21.59	-21.68
2	56.97	-23.53	-36.87	21.46	-21.05
3	75.74	-30.86	57.75	-20.06	21.35
4	71.28	50.12	-36.62	60.07	21.47
5	106.72	63.81	60.36	109.00	23.76

Figure 3 and 4 show the loading diagram from STAAD. Pro for model 2 from frame 1-1 and frame 2-2

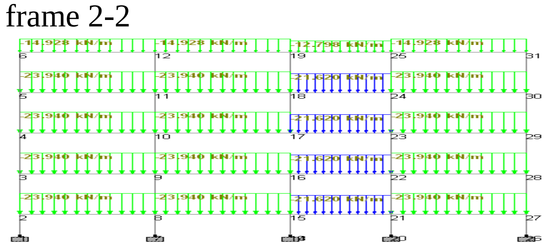


Fig.3 Loading diagram for model 2 from frame 1-1

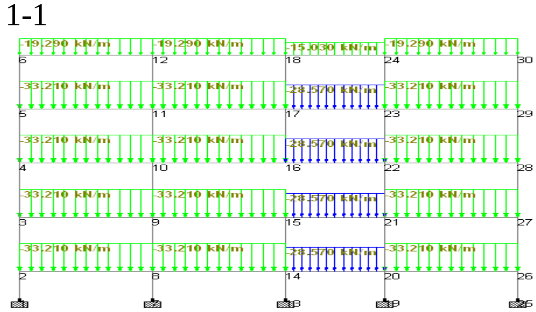


Fig.4 Loading diagram for model 2 from frame 2-2

Figure 4 and 5 show the bending moment diagram from STAAD. Pro for model 2 from frame 1-1 and frame2-2.

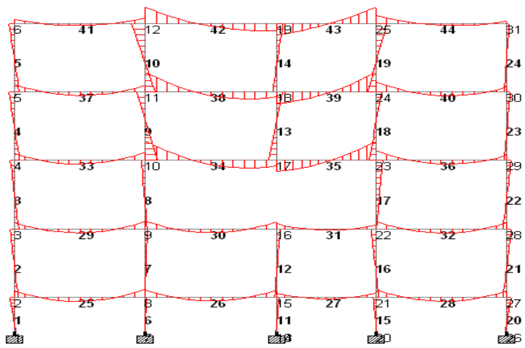


Fig.4 BMD for model 2 from frame 1-1

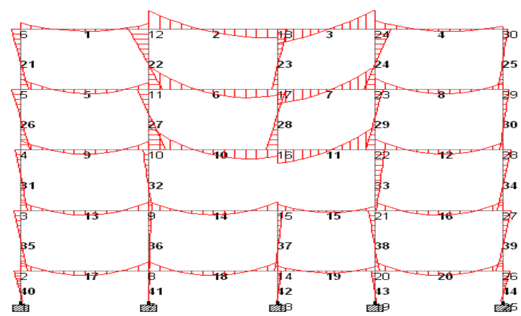


Fig.5 BMD for model 2 from frame 2-2

Table 6 and table 7 gives the shear force and bending moment values for the model 2 from frame 1-1 and frame 2-2.

Table VI : Bending moment of model 2 from frame 1-1

Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
1	1 LOAD CAS	1	215.470	-13.206	0.000	0.000	0.000	-6.003
		2	-215.470	13.206	0.000	0.000	0.000	-13.806
2	1 LOAD CAS	2	169.566	-8.649	0.000	0.000	0.000	-12.690
		3	-169.566	8.649	0.000	0.000	0.000	-13.258
3	1 LOAD CAS	3	123.027	-8.577	0.000	0.000	0.000	-13.857
		4	-123.027	8.577	0.000	0.000	0.000	-11.876
4	1 LOAD CAS	4	76.574	-11.002	0.000	0.000	0.000	-16.791
		5	-76.574	11.002	0.000	0.000	0.000	-16.215
5	1 LOAD CAS	5	27.983	-10.713	0.000	0.000	0.000	-15.829
		6	-27.983	10.713	0.000	0.000	0.000	-16.309
6	1 LOAD CAS	7	528.539	1.506	0.000	0.000	0.000	1.042
		8	-528.539	-1.506	0.000	0.000	0.000	1.218
7	1 LOAD CAS	8	430.871	2.309	0.000	0.000	0.000	1.618
		9	-430.871	-2.309	0.000	0.000	0.000	5.309
8	1 LOAD CAS	9	333.521	-6.188	0.000	0.000	0.000	-5.139
		10	-333.521	6.188	0.000	0.000	0.000	-13.426
9	1 LOAD CAS	10	209.064	-20.540	0.000	0.000	0.000	-35.514
		11	-209.064	20.540	0.000	0.000	0.000	-26.107

Table VII : Bending moment of model 2 from frame 2-2

Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
1	1 LOAD CAS	6	17.991	39.473	0.000	0.000	0.000	28.617
		12	-17.991	37.687	0.000	0.000	0.000	-25.046
2	1 LOAD CAS	12	53.297	71.979	0.000	0.000	0.000	88.859
		18	-53.297	5.181	0.000	0.000	0.000	44.736
3	1 LOAD CAS	18	38.040	-32.080	0.000	0.000	0.000	-72.049
		24	-38.040	77.170	0.000	0.000	0.000	-91.826
4	1 LOAD CAS	24	9.909	45.320	0.000	0.000	0.000	40.684
		30	-9.909	31.840	0.000	0.000	0.000	-13.723
5	1 LOAD CAS	5	1.043	70.421	0.000	0.000	0.000	51.971
		11	-1.043	62.419	0.000	0.000	0.000	-35.968
6	1 LOAD CAS	11	-5.680	101.685	0.000	0.000	0.000	113.698
		17	5.680	31.155	0.000	0.000	0.000	27.361
7	1 LOAD CAS	17	-11.052	-18.281	0.000	0.000	0.000	-70.657
		23	11.052	103.991	0.000	0.000	0.000	-112.752
8	1 LOAD CAS	23	-0.295	71.538	0.000	0.000	0.000	54.238
		29	0.295	61.302	0.000	0.000	0.000	-33.766
9	1 LOAD CAS	4	-5.648	67.645	0.000	0.000	0.000	47.169
		10	5.648	65.195	0.000	0.000	0.000	-42.267
10	1 LOAD CAS	10	-24.430	102.002	0.000	0.000	0.000	112.106

V. CONCLUSIONS

The analysis proves that floating columns are harmful for the structures and it is important to have simpler and regular shapes of frames as well as uniform load distribution around the building. Therefore, as far as possible irregularities in a building must be avoided.

Two frames of the building i.e. frame 1-1 and frame 2-2 is analysed using software and KANI's method and the results are found to be nearly same. There are various methods of analysis of multi-storey building frame. The methods like KANI's and Moment Distribution method are iterative in nature hence give more accurate answers where a substitute method isvery approximate hence not followed. Matrix method isused in the form of software because programming of these is based on matrix methods.The results concluded on providingdifferent position of floating column is that there is increase in bending moment when floating condition is provided of model 1 to model 4 and bending moment is least in normal RCC frame.

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