Performance of Multi-storey Building by Using Floating Columns

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Abstract-Open spaces in building are highly desirable features are floating columns are used for that to provide more internal space and to make better looking building. These floating columns come with big risk since it can't stand any seismic load. In this study, static and dynamic analyses using response spectrum method have been carri ed out for multi-story building with and without floating columns. It was found that fundamental time period was increasing in floating column building. It was also found that lateral stiffness was decreasing in floating column building when the lost cross sectional area due to floating columns were distributed among ground floor columns then it was found that story displacement as well as fundamental time period decreased and lateral stiffness increased. The object of this present work is to compare the behavior of multi-storey buildings with vertical irregularities with or without floating columns.

Keywords: Floating column,RC Building,transfer Beam,Static Coefficient,Siesmic Load,

I. INTRODUCTION

Multi-stored buildings constructed for the purpose of residential, commercial, industrial etc., with an open ground stored is becoming a common feature. For the purpose of parking, usually the ground stored is kept free without any constructions, except 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. Closely spaced columns based on the layout of upper floors are not desirable in the lower floors of such buildings. For this purpose, floating column concept has come into existence. 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. The floating column is used for the purpose of architectural view and site situations.

METHODOLOGY

- **Seismic Base Shear**

According to IS 1893 (Part-I): 2016, Clause 7.5.3 the total design lateral force or design seismic base shear (V_b) along any principal direction is determined by

$$V_b=Ah*W$$
$$=h$$

Where,

Ah is the design horizontal acceleration spectrum W is the seismic weight of building.

- **Design Horizontal Acceleration Spectrum Value**

$$Ah = (z/2)*(I/R)*(sa/g)$$

Where,
Z = Zone factor seismic intensity

Table No 3.1. Seismic Zones of India

Seismic Intensity	Low	Moderate	Severe	Very Severe
Zone	II	III	IV	V
Z	0.10	0.16	0.24	0.36

Table No 3.2. Response Reduction Factor R for Building Systems

Sr. No.	Lateral Load Resisting System	R
1	Ordinary RC Moment Resisting Frame (OMRF)	3.0
2	Special RC Moment Resisting Frame (SMRF)	5.0
3	Ductile Shear Wall With SMRF	5.0

II. RESULTS AND DISCUSSION

➢ **Base Shear Results**

Table No 4.1.Base Shear Floating Column

Auto Seismic - IS 1893:2002				
Load Pattern	**User T**	**Coeff Used**	**Weight Used**	**Base Shear**
	sec		kN	kN
EQ+X	0.825	0.03165	35844.21	1134.50
EQ-X	0.825	0.03165	35844.21	1134.50
EQ+Y	0.825	0.03165	35844.21	1134.50
EQ-Y	0.825	0.03165	35844.21	1134.50

Table No 4.2.Base Shears without Floating Column

Auto Seismic - IS 1893:2002				
Load Pattern	**User T**	**Coeff Used**	**Weight Used**	**Base Shear**
	sec		kN	kN
EQ+X	0.825	0.03165	37604.17	1190.20
EQ-X	0.825	0.03165	37604.17	1190.20
EQ+Y	0.825	0.03165	37604.17	1190.20
EQ-Y	0.825	0.03165	37604.17	1190.20

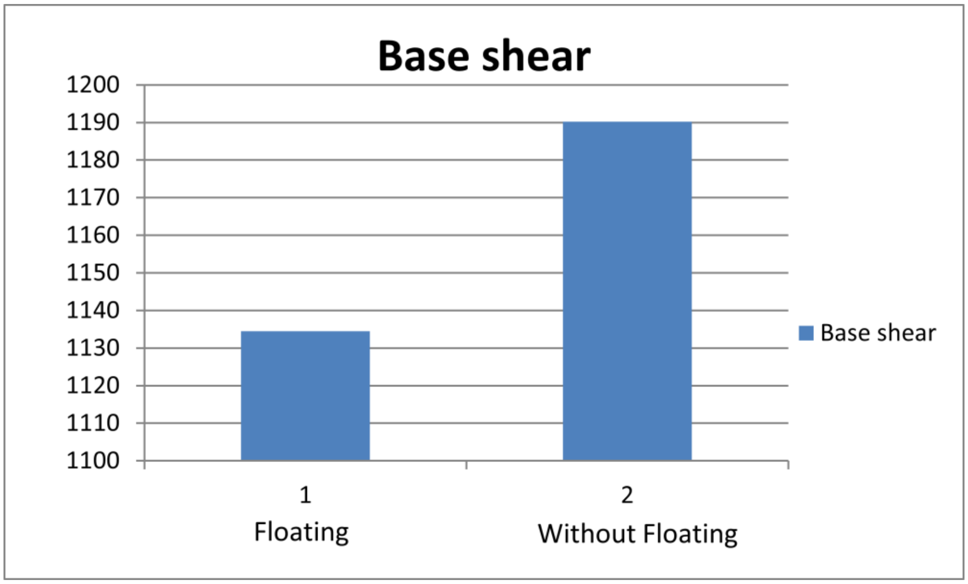

Figure No. 4.1: Base Shears without Floating Column

- **Earthquake Displacement Results**

Table No 4.3.Earthquake Displacement in Floating Column

Diaphragm Center of Mass Displacements				
Story	Diaphragm	**Load Case/Combo**	**UX**	**UY**
			m	m
Story11	D1	1.2(DL+LL+EQ+X)	0.01104	-0.00088
Story10	D1	1.2(DL+LL+EQ+X)	0.01012	-0.0009
Story9	D1	1.2(DL+LL+EQ+X)	0.00911	-0.0009
Story8	D1	1.2(DL+LL+EQ+X)	0.00799	-0.00085
Story7	D1	1.2(DL+LL+EQ+X)	0.00677	-0.00076
Story6	D1	1.2(DL+LL+EQ+X)	0.00549	-0.00065
Story5	D1	1.2(DL+LL+EQ+X)	0.0042	-0.00051
Story4	D1	1.2(DL+LL+EQ+X)	0.00296	-0.00037
Story3	D1	1.2(DL+LL+EQ+X)	0.00182	-0.00023
Story2	D1	1.2(DL+LL+EQ+X)	0.00088	-9.1E-05
Story1	D1	1.2(DL+LL+EQ+X)	0.00022	-8E-06
Base	D1	1.2(DL+LL+EQ+X)	0	0

Table No 4.4.Earthquake Displacements without Floating Column

Diaphragm Center of Mass Displacements				
Story	Diaphragm	**Load Case/Combo**	**UX**	**UY**
			m	m
Story11	D1	1.2(DL+LL+EQ+X)	0.00964	-0.00208
Story10	D1	1.2(DL+LL+EQ+X)	0.00882	-0.0019
Story9	D1	1.2(DL+LL+EQ+X)	0.00793	-0.00172
Story8	D1	1.2(DL+LL+EQ+X)	0.00696	-0.00151

Story7	D1	1.2(DL+LL+EQ+X)	0.00592	-0.0013
Story6	D1	1.2(DL+LL+EQ+X)	0.00484	-0.00108
Story5	D1	1.2(DL+LL+EQ+X)	0.00375	-0.00087
Story4	D1	1.2(DL+LL+EQ+X)	0.0027	-0.00066
Story3	D1	1.2(DL+LL+EQ+X)	0.00173	-0.00044
Story2	D1	1.2(DL+LL+EQ+X)	0.0009	-0.00025
Story1	D1	1.2(DL+LL+EQ+X)	0.00028	-8.3E-05
Base	D1	1.2(DL+LL+EQ+X)	0	0

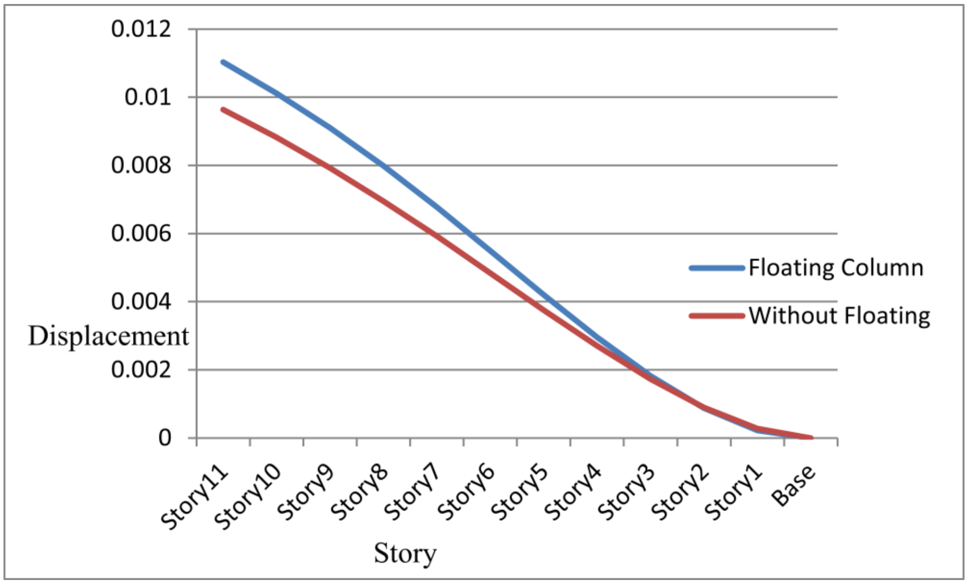

Figure No. 4.2: Earthquake Displacements without Floating Column

- **Wind Displacement Results**

Table No 4.5.Wind Displacement Floating Column

Diaphragm Center of Mass Displacements				
Story	Diaphragm	Load Case/Combo	UX	UY
			m	m
Story11	D1	WL+X	0.00538	-0.00024
Story10	D1	WL+X	0.00484	-0.00027
Story9	D1	WL+X	0.00427	-0.00029
Story8	D1	WL+X	0.00369	-0.00029
Story7	D1	WL+X	0.00309	-0.00028
Story6	D1	WL+X	0.00248	-0.00026
Story5	D1	WL+X	0.00188	-0.00023
Story4	D1	WL+X	0.00132	-0.00018
Story3	D1	WL+X	0.00082	-0.00013
Story2	D1	WL+X	0.0004	-6.5E-05

Story1	D1	WL+X	0.00011	-1.1E-05
Base	D1	WL+X	0	0

Table No 4.6. Wind Displacements without Floating Column

Diaphragm Center of Mass Displacements				
Story	Diaphragm	**Load Case/Combo**	**UX**	**UY**
			m	m
Story11	D1	WL+X	0.0036	-0.00019
Story10	D1	WL+X	0.00327	-0.00019
Story9	D1	WL+X	0.00292	-0.00019
Story8	D1	WL+X	0.00255	-0.00019
Story7	D1	WL+X	0.00217	-0.00018
Story6	D1	WL+X	0.00178	-0.00017
Story5	D1	WL+X	0.00139	-0.00015
Story4	D1	WL+X	0.00101	-0.00013
Story3	D1	WL+X	0.00065	-0.0001
Story2	D1	WL+X	0.00035	-6.3E-05
Story1	D1	WL+X	0.00012	-2.3E-05
Base	D1	WL+X	0	0

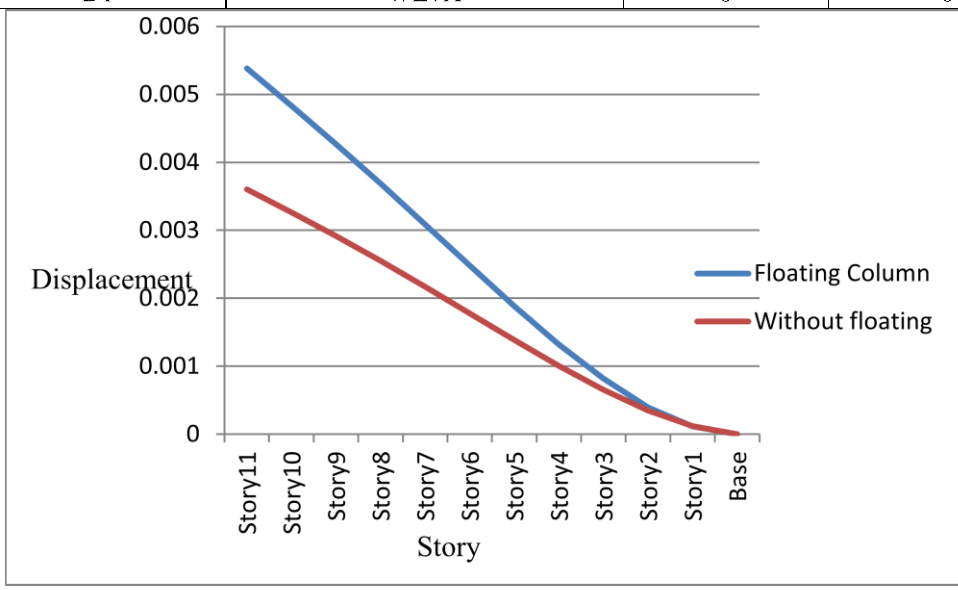

Figure No. 4.3: Wind Displacements without Floating Column

III. CONCLUSION

The variation in seismic behavior of multi-storey building having floating column with different elevation has been analyzed with Seismic coefficient method using ETABS. Floating column has been introduced in both regular and irregular frame models. Vertical geometric irregularity with vertical setbacks has been taken along with floating column. Floating column has been provided at different positions to find the most adverse position in regular buildings and irregular buildings. The effect of increase in size of beams and column on response of only irregular building frames with floating column has been analyzed. The response of various regular and irregular frames has been analyzed in terms of storey displacement, storey drift, and wind displacement.

- ✓ The storey displacement increases with increase in height of frame model. The increases in storey displacement are maximum.
- ✓ In G+10 regular models, the increases in storey displacement are maximum at upper floors.
- ✓ The maximum increase in storey drift in G+10 regular models is in the floor having floating column.
- ✓ In G+ 10 regular models, the storey drift response has not changed much with the presence of floating column at position in upper floors.
- ✓ Floating column provided at in first floor is most critical and to be analyzed carefully.
- ✓ In multi-storey framed building, displacement and drift of the building increases from lower zones to higher zones as the magnitude of intensity of earthquake will be more for higher zones than lower zones.

IV. REFERENCES

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