The Study Of Vertical Geometry Irregularities With Floating Column

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Abstract- *In present scenario buildings with floating column is a typical feature in the modern multistory construction in urban India. Such features are highly undesirable in building built in seismically active areas. This study highlights the importance of explicitly recognizing the presence of the floating column in the analysis of building. Alternate measures, involving stiffness balance of the first storey and the storey above, are proposed to reduce the irregularity introduced by the floating columns.*

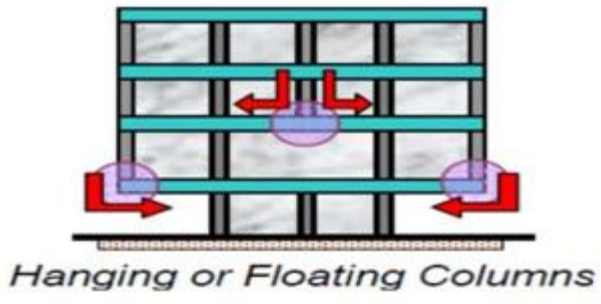
Keywords- Responce Spectrum Analysis,Seismic Static Analysis.

I. INTRODUCTION

Many urban multistory 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.

FLOATING COLUMN CONCEPT

A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which (due to architectural design/ site situation) at its lower level (termination Level) rests on a beam which is a horizontal member. The beams in turn transfer the load to other columns below it.



Hanging or Floating Columns

II. METHODOLOGY

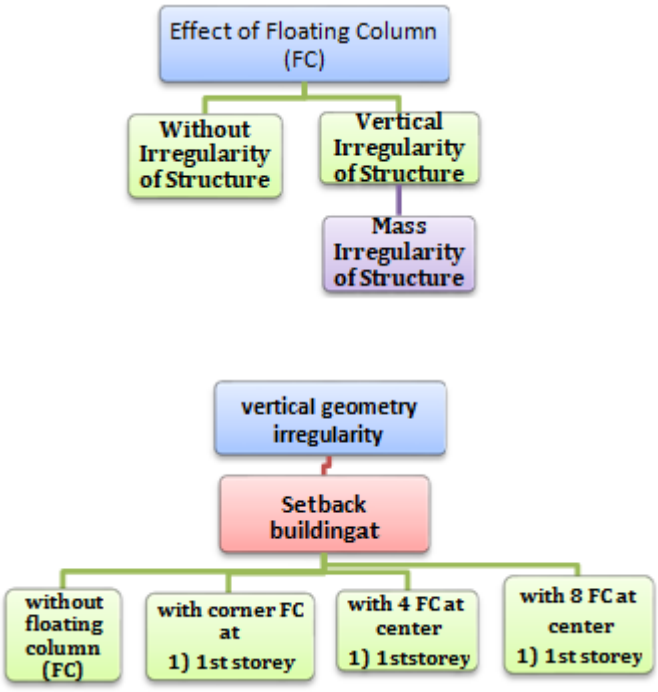
1) Review of existing literatures by different researchers.
2) Selection of types of structures.
3) Modeling of the selected structures.
4) Performing dynamic analysis on selected building models and comparison of the analysis results.

Table-1.1The building following specifications are adopted for study.

Live Load	2KN/m^2
Density of RCC considered:	25KN/m^3
Steel	HYSD 500
Thickness of slab	125mm
Depth of beam	450mm
Width of beam	230mm
Dimension of column	400x500mm
Density of brick masonry	20 kN/m^3
Thickness of outside wall	230mm
Thickness of inner partition wall	150mm
Height of each floor	3m
Plinth height	1 m
Depth of foundation	1.5m
Depth of footing	0.6
Weight of wall on external plinth beam (0.23m thick)	16.33 KN/m
Weight of wall on internal plinth beam (0.15m thick)	7.65 KN/m
Weight of wall on external floor beam(0.23m thick)	11.73KN/m
Weight of wall on internal floor beams (0.15m thick)	7.65 KN/m
Weight of wall on soft story floor external (0.23 thick)	18.63 KN/m
Weight of wall on soft storey floor internal wall (0.15 thick)	12.15 KN/m
Earthquake Zone	IV

Damping Ratio	5%
Importance factor	1.5
Type of Soil	Medium
Type of structure	Special Moment Resisting Frame
Response reduction Factor	5
Number of floor	18 floor
Number of modes	Each floor 3 no of modes
Type of diaphragms	Rigid
Modal combination	SRSS
Type of irregularity	vertical geometry irregularity
Location of vertical geometry irregularity	9th storey and 18th storey
Vertical geometry building	Setback type building from Is 1893-2016
Direction of lateral force	X direction
Load combination	All load combination are taken from IS 1893-2016
Type of support at base	Fixed

III. MODELING



Without Irregularity Case Overall Results

Case no	1	2	3	4
	Without FC(normal regular building)	**Corner FC at 1st storey**	**4 FC at center of 1st storey**	**8 FC at center of 1st storey**
Maximum Displacement mm	0.0247	0.0242	0.0249	0.0244
Base Shear KN	926.56	851.32	889.33	856.54
Natural Period sec	0.015	0.016	0.012	0.012
Frequency	64.61	62.94	81.90	82.29

There are different types of earthquake analysis methods calculation.

Comparison of Displacement,Base shear,Frequancy, Time periods of Set Back Building.

	Displacement	**Base Shear**	**Frequancy**	**Time Periods**
Sr,no	1	1	1	1
Without F.C regular	0.0159	1032.7	63.99	0.016
Case no	1	1	1	1
Without FC Irregular	0.0247	926.56	64.61	0.015
% Diff.	55.34	-10.27	9.68	-6.25
Case no	2	2	2	2
Corner FC Irregular	0.0242	851.32	62.94	0.016
% Diff.	52.20	-17.56	-1.64	0
Case no	3	3	3	3
4FC at irregular	0.0249	889.33	81.90	0.012
% Diff.	56.60	-13.88	27.98	-25
Case no	4	4	4	4
8FC irregular	0.0244	856.54	82.29	0.012
% Diff.	53.45	-17.05	28.59	-25
Location of F.C	FC at 1st storey	FC at 1st storey	FC at 1st storey	FC at 1st storey

Observation

From the table percentage difference of vertical geometry irregularity building following points are observed.

IV. DISPLACEMENT

1.The modal displacement is increased up to 52.2% when St floating column are considered at corner of 1 storey, The modal displacement is increased up to 56.6% when 4 floating column are considered at center of 1ststorey, The modal displacement is increased up to 53.45 %when 8 floating column are considered at center of 1ststorey.

2.The modal displacement is increased when 4 floating column at center is considered as compared to 8 floating column at center, without floating column with setback building and corner floating column and without floating column normal regular building.

Base Shear –

1. The base shear is decreased up to 17.56%when floating column are considered at corner of 1ststorey, The base shear is decreased up to 13.88%when 4 floating column are considered at center of 1ststorey, The base shear is shear is decreased up to 17.05% when 8 floating column are considered at center of 1ststorey.

2. The base shear is decreased when 8 floating column are considered at center as compared to corner floating column, 4 floating column at center and without floating column normal regular building.

Frequency –

1. The frequency is decrease up to 1.64 % when floating column are considered at corner of 1ststorey, The frequency is increased up to 27.98 % when 4 floating column are considered at center of 1ststorey, The frequency is increased up to 28.59 % when 8 floating column are considered at center of 1ststorey.

2. The frequency is decreased when without floating column considered corner as compared to, 4 floating column at center, 8 floating column at center, without floating column vertical geometry irregularity set back building and without floating column normal regular building.

Time Periods –

1.The time period is no change 0 % when floating column are considered at corner of 1ststorey, The time period is decreased up to 25 % when 4 floating column are considered at center of 1ststorey, The time period is decreased up to 25% when 8 floating column are considered at center of 1ststorey,

2.The time period is decreased when 8th floating column at center and 4 floating column at center is considered as compared to corner floating column, without floating column with vertical geometry of building and without floating column normal regular building.

V. CONCLUSIONS

DISPLACEMENT –

1.As per result obtained in the table seen that, displacement for the case of 4 floating column at center is less as compared to corner floating column and 8 floating column at center. However, highest displacement value is observed when corner floating column is considered because of cantilever beams large stiffness acting on building as compared to other cases.

2. As per result obtained in the table it can be implied that the displacement of vertical geometry irregularity case is higher therefore, vertical geometry irregularity is not much preferable and must be provided under unavoidable.

Base Shear –

1. As per result obtained in the table seen that, Base Shear for the case of 8 floating column at center is less as compared to corner floating column and 4 floating column at center. However, highest base shear value is observed when 4 floating columns at center and corner floating column are considered.

2. As per result obtained in the table can be deduced that for reduction in the displacement there is an increased in base shear for all cases.

Frequency –

1. As per result obtained in the table the frequency for the case of 4 floating column at center and 8 floating column at center is higher as compared to corner floating column.

2. As per result obtained in the table it can be implied that the frequency of vertical geometry irregularity case is not much difference.

Time Periods –

1. As per result obtained in the table the time period for the case of 8 floating column at center 4 floating column at center are less as compared to corner floating column.

2. As per result obtained in the table it can be implied that the time period of vertical geometry irregularity case is not much difference.

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