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SEISMIC BEHAVIOUR OF R.C.C BUILDING WITH AND WITHOUT FLOATING COLUMNS

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ABSTRACT:

The main purpose of the project is to study the seismic behaviour of R.C.C building with and without floating column,G+5 structures has been selected for carrying out the project work. The building models are generated using software STAAD. Pro 8V. Seismic behaviour of structures or buildings subjected to earthquake induced motions and vibrations. They are transferred to the structures from the soil. 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 at its lower level rests on a beam which is a horizontal member. Buildings with columns that hang or float on beams at an intermediate story and do not go all the way to the foundation, have discontinuities in the load transfer path.

KEYWORDS: Floating Column, Earthquake, Storey drift.

INTRODUCTION:

RCC buildings are more vulnerable to the lateral forces such as wind forces and seismic or earthquake forces, the effect of wind forces and seismic or earthquake forces is high with the increase in the height of the structures. As per IS: 1893-2002 seismic resistant design code book entire India is divided into four seismic zones namely zone II,III,IV and V where as zone II is the lowest intensity seismic zone and zone V is the highest seismic intensity zone. Wind pressures on a building or structure depends on the wind velocity in a location as per IS: 875-part-3 entire India is divided into different wind zones based on wind velocities 33m/s, 39m/s, 43m/s, 47m/s,50m/s,55m/s and also velocity of wind increases with height of the structure. The seismic behaviour of the irregular structures had shown failure modes in past earthquake affected regions/locations. Load path irregularity is in situations where large column free area is necessary for parking's, garages, commercial and architecture importance. The Load path irregularity is common in buildings such as multi functional structures were some storeys are used for commercial and residential purposes. The columns which start from the foundation are called as non floating columns and the columns start from the elevated level and are supported on beams called as floating columns shown in Fig1.

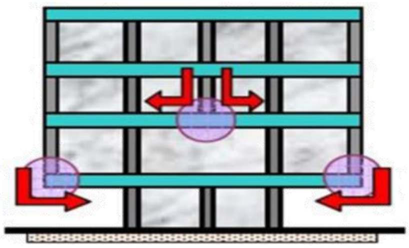


Fig 1

LITERATURE REVIEW:

Nikhil bandwal1, Anant pande2, Vaishali mendhe3, Amruta yadav4 made an investigation. To Study Seismic Behaviour of RC Building with Floating Columns by considering four buildings of G+6 heights in seismic zones IV,V Normal RC Building without any floating column, RC Building with External floating columns, RC Building with Internal floating columns, RC Building with Internal and External Floating columns. And concluded that Provision of (External Floating columns) may Increase displacements at various nodes. Critical load combinations were found, are 1.5(DL+EQX) or 1.5(DL+EQZ) Depending on position of floating columns. With the provision of Case 4 (External and Internal Floating columns) and case 3(Interna3l Floating Columns) may increase Axial Force Fx and Shear in z direction (Fz) at all floors. Though it is observed that When section properties in beam increases at that floor level, partially contributes axial force Fx increasing or decreasing at respective floors which can be Observed in zone IV and V in Intermediate Column. Significant co relationship is observed in between Case 2 and case 4 for Fz of the corner column also we observed the same effect for case 1 and case 3 too. It is observed that case 4 (Internal and External Floating columns) Increases the Mx and Mz Values at all floors for All zones. In all zones for case 2 (External floating columns), Torsion at ground floor increases, but thereafter floors, there is significant reduction in torsion occurs.

Badgire Udhav S.1*, Shaikh A.N.2, Maske Ravi G. 3 performed Analysis of Multi-storey Building with Floating Column To analyze RCC frame (G+10) with floating columns in different locations. To investigate the base shear & Drift between floating columns located in outer periphery (4 sides & 2 Sides). Modelling& Analysis of G+10 RCC building with floating columns located outer periphery (4 Sides) **(Case 2a)**. Modelling& Analysis of G+10 RCC building with floating columns located outer periphery (2 Longer Sides) **(Case 2b)**. Modelling& Analysis of G+10 RCC building with floating columns located outer periphery (2 Shorter Sides) **(Case 2c)** Seismic codes are different for a particular region or a country. In India, Indian standard criterion for earthquake resistant design of structures IS 1893(part 1): 2002 is the main code that provides outline for calculating seismic design forces. This force depends on the mass and seismic coefficient of the structures and the latter in turn depends on properties like seismic zone in which the structures lies, importance of the structure the soil strata, its stiffness and its ductility. Preliminary study is carried out on a building model comparing three cases. The difference in the probabilities of failure with floating column (Case 2b) is more than floating column (Case In Case2b and Case2c, column shears values are increasing or decreasing significantly depending upon position and orientation of column.

K.V. Sudheer1 Dr. E. Arunakanthi2 made Design and Analysis of a High-Rise Building with and without Floating Columns In this thesis a G+15 High-rise building with and without floating column in which some storey's are considered for commercial purpose and remaining storey's are for residential purpose. It should withstand against all potential loading conditions and fulfills the task for which it is built. It should also ensure that the structure will be designed economically. Safety necessities must be met so that the structure will able to serve its purpose· with the minimum cost. The analysis and design of the super structure was done by using ETABS which has been recognized as the industry standard for Building Analysis and Design Software and the comparison and seismic analysis is done by applying all the loads and combinations and to find whether the structure is safe or unsafe with floating column The study presented in the paper compares the difference between normal building and a building on floating column. The following conclusions were drawn based on the investigation 1) By the application of lateral loads in X and Y direction at each floor, the lateral displacements of floating column building in X and Y directions are more compared to that of a normal building. So the floating column building is unsafe for construction when compared to a normal building 2) By the calculation of storey drift at each floor for the buildings it is observed that floating column building will suffer extreme storey drift than normal building. The storey Drift is maximum at 5th and 6th storey levels in both the cases. 3) The building with floating columns experienced more storey shear than that of the normal building. This is due to the use of more quantity of materials than a normal building. So the floating column building is uneconomical to that of a normal building 4) The final conclusion is that do not prefer to construct floating column in buildings unless there is a proper purpose and functional requirement for those. If they are to be provided then proper care should be taken while designing the structure

Nakul A. Patil, Prof. Riyaz Sameer Shah made Comparative Study of Floating and Non-Floating Columns with and Without Seismic Behavior- A Review This work includes the analysis and design of the floating column and non floating column structures by using software ETABS-2015 and compares the result with STAAD-Pro v8i Software. In the present investigation, an attempt has been made to compare the seismic behavior of multi-storied structures with complexities. The displacement of the building increases from lower zones to higher zones, because the magnitude of intensity will be more for higher zones, similarly for drift, because it is correlated with the displacement. The maximum value of Displacement and Drift are more for the models with increased height.

OBJECTIVES:

To analyse RCC frame (G+5) with and without floating columns in different zones.

1. Modelling and analysis of G+5 RCC Building without floating column
2. Modelling and analysis of G+5 RCC Building with external floating columns
3. Modelling and analysis of G+5 RCC Building with internal floating columns

The above buildings are generated using the software STAAD. Pro 8Vi and are analysed using equivalent static method

METHODOLOGY:

In the present study three G+5 structure models with foundation depth of 2m and bay widths length and width directions of 4m each, support conditions are assumed to be fixed at the bottom or at the supports/footings. The structures having length = 8x4 = 32m, width = 4x4 =16m and height = 20m. The structures modelled in STAAD. Pro structural analysis and design software by considering various loads and load combinations by their relative occurrence are considered the material properties considered are M30 grade concrete and Fe415 reinforcing steel bars with and without floating columns to determine the severity effect of floating and non floating columns.

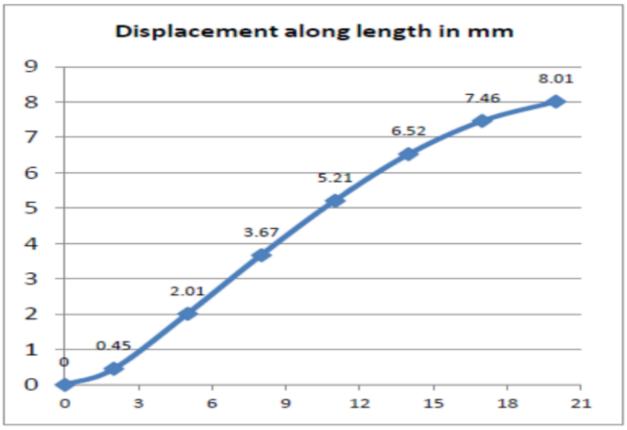
RESULTS AND DISCUSSION:

Table 1.1

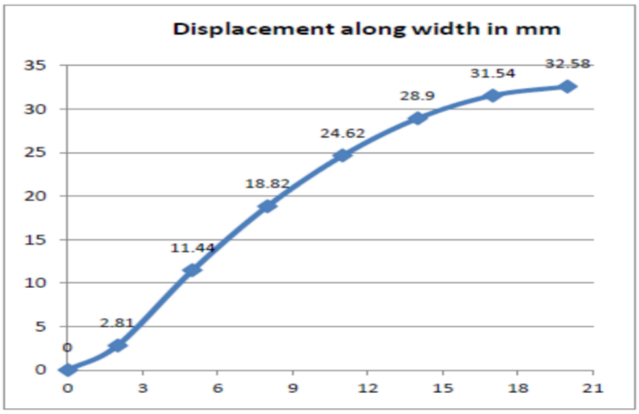
Height of structure(m)	Displacement along length, mm
20	8.01
17	7.46
14	6.52
11	5.21
8	3.67
5	2.01
2	0.45
0	0

Table 1.2

Height of structure(m)	Displacement along width, mm
20	32.58
17	31.54
14	28.90
11	24.62
8	18.82
5	11.44
2	2.81
0	0



Graph 1.1



Graph 1.2

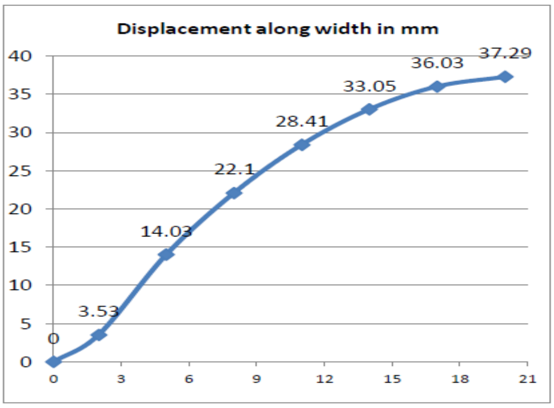
From the table 1.1the height of the structure where we do not have any floating columns at 2 m the displacement along length is 0.45mm at 5 m the displacement along length is 2.01mm at 8 m the displacement along length is 3.67mm at 11m displacement along length is 5.21mm at 14m displacement along length is 6.52mm at 17 m displacement along length is 7.46mm at 20 m displacement along length is 8.01mm,and it is represented by graph 1.1where we can see very clearly as the height increases displacement From the table 1.2the height of the structure at 2 m the displacement along width is 2.81mm at 5 m the displacement along width is 11.44mm at 8 m the displacement along width is 18.82mm at 11m displacement along width is 24.62mm at 14m displacement along width is 28.90mm at 17 m displacement along width is 31.54mm at 20 m displacement along width is 32.48mm and it is represented by graph 1.2

Table 2.1

Height of structure(m)	Displacement along length, mm
20	7.91
17	7.69
14	7.05
11	6.02
8	4.63
5	2.85
2	0.74
0	0

Table 2.2

Height of structure(m)	Displacement along width, mm
20	37.29
17	36.03
14	33.05
11	28.41
8	22.10
5	14.03
2	3.53
0	0



Graph 2.1

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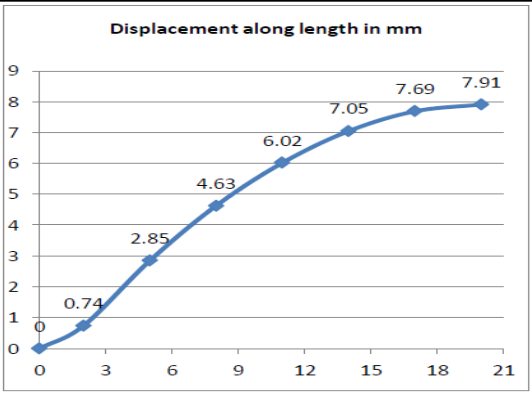


Graph 2.2

From the table 2.1 the height of the structure at 2 m the displacement along length is 0.74mm at 5 m the displacement along length is 2.85mm at 8 m the displacement along length is 4.63mm at 11m displacement along length is 6.02mm at 14m displacement along length is 7.05mm at 17 m displacement along length is 7.69mm at 20 m displacement along length is 7.91mm, and it is represented by graph 2.1

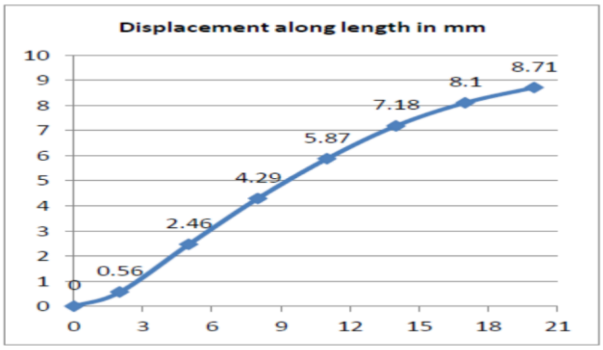
From the table 2.2the height of the structure at 2 m the displacement along width is 3.53mm at 5 m the displacement along width is 14.03mm at 8 m the displacement along width is 22.10mm at 11m displacement along width is 28.41mm at 14m displacement along width is 33.05mm at 17 m displacement along width is 36.03mm at 20 m displacement along width is 37.29mm and it is represented by graph 2.2

Table 3.1

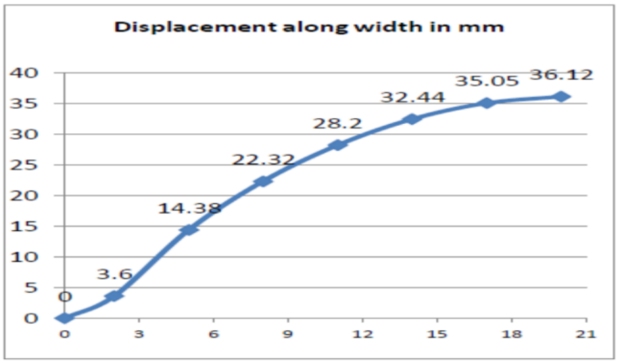
Height of structure(m)	Displacement along length, mm
20	8.71
17	8.1
14	7.18
11	5.87
8	4.29
5	2.46
2	0.56
0	0

Table 3.2

Height of structure(m)	Displacement along width, mm
20	36.12
17	35.05
14	32.44
11	28.20
8	22.32
5	14.38
2	3.60
0	0



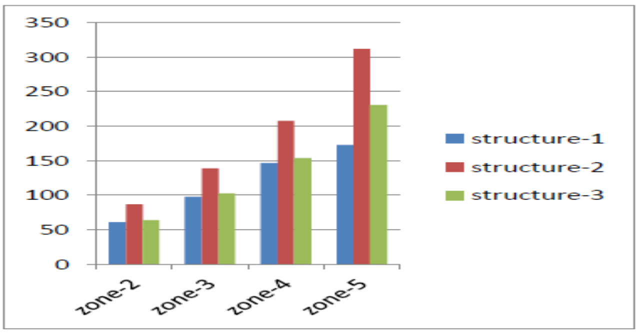
Graph 3.1



Graph 3.2

From the table 3.1 height of the structure at 2 m the displacement along length is 0.56mm at 5 m the displacement along length is 2.46mm at 8 m the displacement along length is 4.29mm at 11m displacement along length is 5.87mm at 14m displacement along length is 7.81mm at 17 m displacement along length is 8.10mm at 20 m displacement along length is 8.71mm, and it is represented by graph 3.1

From the table 3.2the height of the structure at 2 m the displacement along width is 3.60mm at 5 m the displacement along width is 14.38mm at 8 m the displacement along width is 22.32mm at 11m displacement along width is 28.20mm at 14m displacement along width is 32.44mm at 17 m displacement along width is 35.05mm at 20 m displacement along width is 36.12mm and it is represented by graph 3.2



Graph 4.1

From structure-1 we can say that the support reaction at zone-2 is 61.05 kN , zone 3 is 97.89kN,zone 4

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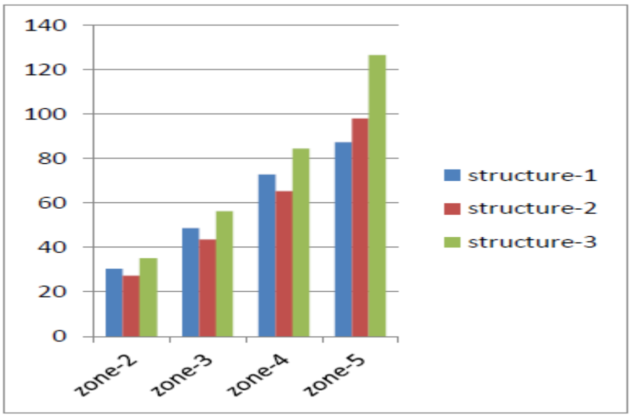
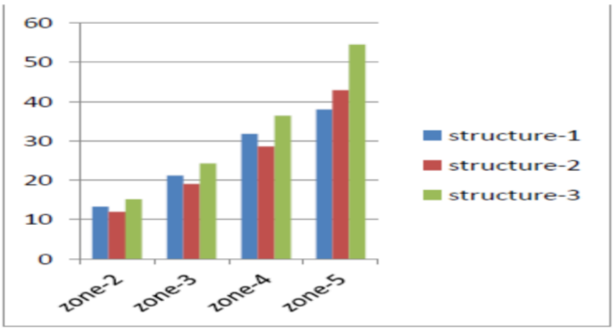
is 146.5kN and zone 5 is 172.19kN..From the structure-2 we can say that the support reaction at zone-2 is 86.6 kN , zone 3 is138.56 kN, zone 4 is207.85 kN and zone 5 is 311.77kN..From the structure-3 we can say that the support reaction at zone-2 is 64.05 kN , zone 3 is 102.49kN,zone 4 is 153.74kN and zone 5 is 230.6kN.We are comparing all 3 structures in graph 4.1



Graph 5.1

From the structure-1 we can say that the maximum bending moment at zone-2 is 30.36 kNm , zone 3 is 48.57kNm,zone 4 is 72.86kNm and zone 5 is 87.24kNm.From the structure-2 we can say that the maximum bending moment at zone-2 is 27.23 kNm , zone 3 is 43.58 kNm, zone 4 is 65.37 kNm and zone 5 is 98.05kNm.From the structure-3 we can say that the support reaction at zone-2 is 64.05 kNm , zone 3 is 102.49kNm,zone 4 is 153.74kNmand zone 5 is 230.6kNm.We are comparing all 3 structures in graph 5.1

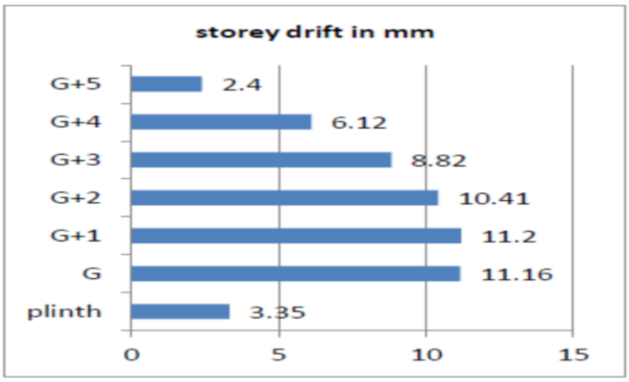


Graph 6.1

From the structure-1 we can say that the maximum shear force at zone-2 is 35.17 kNm , zone 3 is 56.28kN,zone 4 is 84.43kNm and zone 5 is 126.64kNm.From the structure-2 we can say that the maximum shear force at zone-2 is 11.92 kNm , zone 3 is 19.07 kNm, zone 4 is 28.6 kNm and zone 5 is 42.92kNm.From the structure-3 we can say that the support reaction at zone-2 is 15.13 kNm , zone 3 is 24.21kNm,zone 4 is 36.33kNmand zone 5 is 54.5kNm.We are comparing all 3 structures in graph 6.1

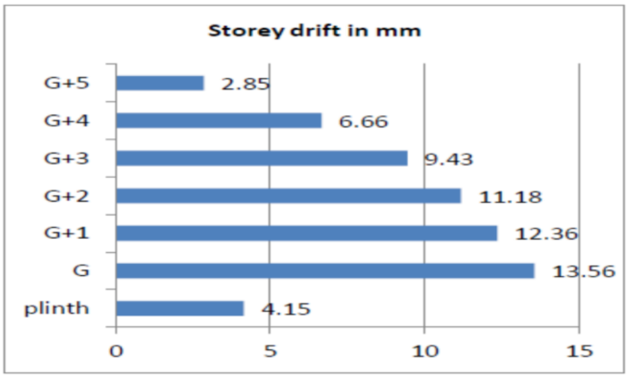
Variation of maximum storey drift at different floor levels

Height of the storey = 3m =3000mm; Maximum Storey Drift = 0.004x3000 =12mm



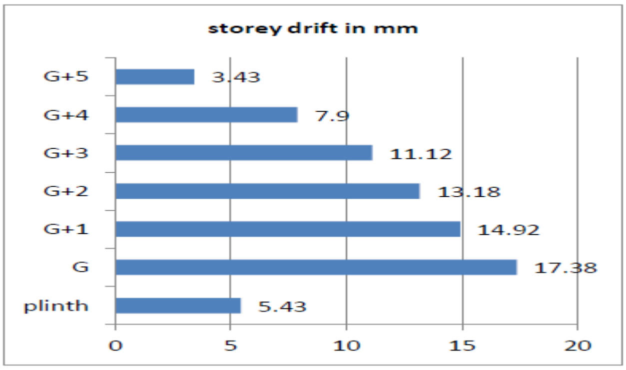
Graph 7.1

Variation of maximum storey drift in structure-1 from graph 7.1



Graph 7.2

Variation of maximum storey drift in structure-1 from graph 7.2



Graph 7.3

Variation of maximum storey drift in structure-1 from graph 7.3

CONCLUSIONS:

The following are the conclusions drawn from the present study of three G+5 structure models. The structures having length = 8x4 = 32m, width = 4x4 =16m and height = 20m, the material properties considered are M30 grade concrete and Fe415 reinforcing steel bars for structures with and without floating columns to determine the severity effect namely structure-1(no floating columns), structure-2(external floating columns) and structure-3(internal floating columns)

1. The maximum displacement due to wind loading is observed to be 32.58mm in structure-1, 37.29mm in, structure-2 and 36.12 in structure-3.
2. The maximum displacements when compared with structure-1 are found to be increased by 14.45% in structure-2 and 10.86% in structure-3
3. Maximum Support reactions are found to be increasing with the increase in seismic zone, maximum support reactions are observed in structure-2
4. When compared with structure-1 the Maximum support reactions are observed to be increased by 80.22% in structure-2 and 33.30% in structure-3 in seismic zone-5
5. Maximum Bending moment is found to be increasing with the increase in seismic zone, maximum Bending moment are observed in structure-3
6. When compared with structure-1 the Maximum Bending moment are observed to be increased by 12.39% in structure-2 and 45.16% in structure-3 in seismic zone-5
7. Maximum shear force is found to be increasing with the increase in seismic zone, maximum shear force are observed in structure-3
8. When compared with structure-1 the Maximum shear force are observed to be increased by 13.03% in structure-2 and 43.53% in structure-3 in seismic zone-5
9. Storey drift is in limits for structure-1 and exceeded the limit of 12mm in structure-2(at G, G+1 storey's) in structure-3(at G, G+1, G+2 storey's)

From the above results it can be concluded that the floating columns are not preferable in higher seismic zones.

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