# DYNAMIC ANALYSIS OF RCC BUILDING WITH FLOATING COLUMN

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**Abstract:** In urban India floating column structure may be a typical feature within the modern multi-storey construction. Floating column buildings are created either for architectural purpose or when more free space is required within rock bottom floor. Such features are more undesirable in seismically active area. In this project analysis of G+5, G+11 and G+13 storey RCC structure with floating column and without floating is carried out. The analysis is completed by using STAAD Pro V8i software by using Response spectroscopy. This paper shows the results variation in displacement of structure, base shear, Seismic weight calculation of building from manual calculation and STAAD pro V8i. For building with floating column and building without floating column, finding the change between the response parameters of earthquake and describe what happens when variation could also be high or low. The study is administered to seek out whether the floating column structures are safe or unsafe when inbuilt seismically prone areas, and also determine commercial aspects of floating column building either it's economical or uneconomical.

**Keyword: with and without floating column building, Response Spectrum Analysis, Staad Pro, ETAB**

## I .INTRODUCTION

A typical Column may be a vertical support which support to horizontal structural members by means of their weights, moments, shear force, axial load etc., to stay the structure in safe condition and transfer these loads to the bottom. But now a day some columns are designed in such a fashion that it doesn't reach to the bottom, due to various architectural aspects. In those cases, the columns transfer above loads as some extent load on a beam. This type of column is defining as Floating column. This Point load increases too much bending moment on beam so that area of steel required will be more in such cases. While earthquake happens, the building with floating columns destroys more as compared to the building without any floating columns because of discontinuity of structure & load transfer path.

### Floating Column:

The Columns whose lower end does not reach to the ground and transfers the above loading on a beam as a point load, such type of column are called as Floating Columns. Floating columns comes in use to provide more open space for assembly hall of parking purpose. The floating column building does not have any problem under only vertical loading condition but it increases vulnerability in lateral loading (earthquake loading) condition, due to vertical Discontinuity. During the earthquake the lateral forces developed in upper storeys have to be transmitted by the projected cantilever beams due to this the overturning forces are created over the column of the ground floor

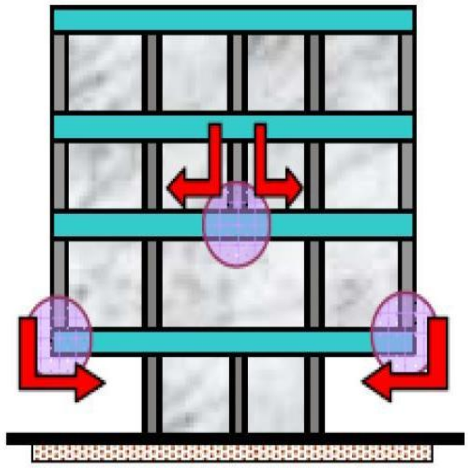


Fig no.1 Hanging or floating column in building

## II. OBJECTIVE OF THE WORK

In this project, the following aspects are attempted to study.

1) Modeling of the multi-storey building with and without floating Column using STAAD PRO.

2) The building with floating column are tend to fail at seismic excitations, hence the recommendations for the earthquake resistant design of the considered buildings are modeled and analyzed.

## III. MODEL DESCRIPTION

The structure must be modeled and analyzed so that the values of the response parameters of earthquake are calculated with sufficient accuracy for design purpose. The acceptance criteria of result of response parameter may vary on whether static or dynamic non-linear analysis is used. G+5, G+11 and G+13 RCC frame structures are modeled by using Staad Pro V8i software. The Building Frames are special moment- resisting frame (SMRF). All details of size, properties are tabulated above.

The space frame building is modeled in STAAD-Pro. The beams and columns are modeled as beam elements and the slab is modeled as a plate element.

Beam Size: 230 X 500 mm

Column Size: 230 X 600 mm

Slab Thickness: 150 mm

Storey Height: 3m

Grade of concrete: M25

### 3.3.1 Model Details G+5

The space frame building is modeled in STAAD-Pro. The beams and columns are modeled as beam elements and the slab is modeled as a plate element.

Beam Size: 230 X 500 mm

Column Size: 230 X 600 mm

Slab Thickness: 150 mm

Storey Height: 3m

Grade of concrete: M25

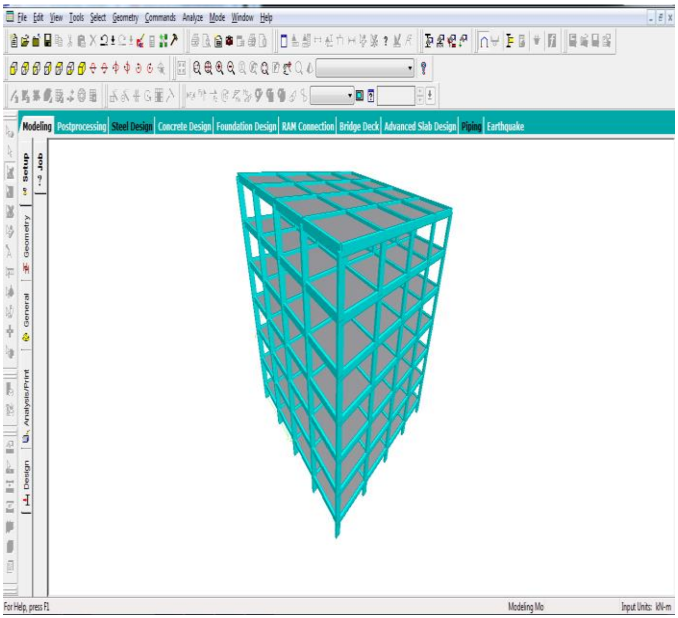


**Fig.3.1** G+5 Building model without any floating column.

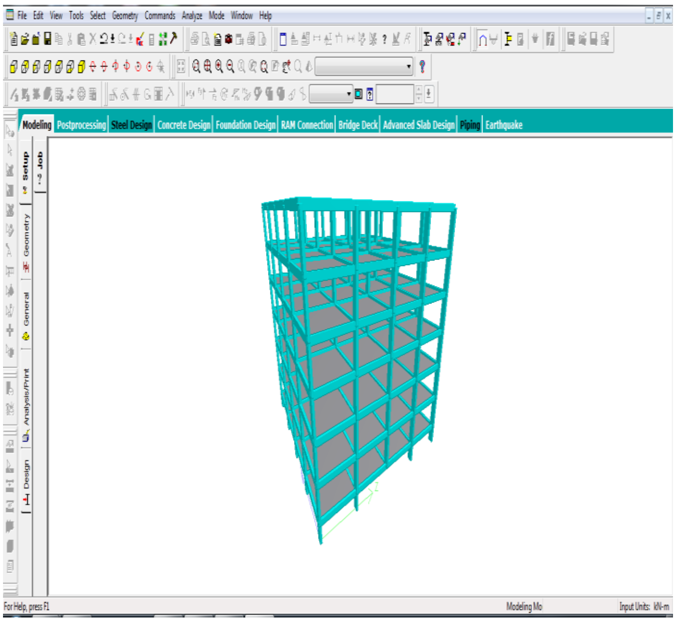


**Fig.3.2** G+5 Building model with floating column

### 3.3.4 Model Details G+11

The space frame building is modeled in STAAD-Pro. The beams and columns are modeled as beam elements and the slab is modeled as a plate element.

Beam Size: 230 X 500 mm

Column Size: 230 X 600 mm

Slab Thickness: 150 mm

Storey Height: 3m

Grade of concrete: M25

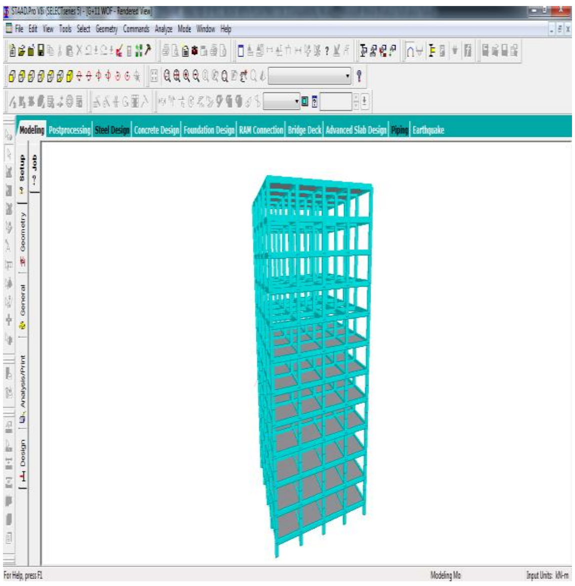


**Fig.3.7** G+11 Building model without any floating column.

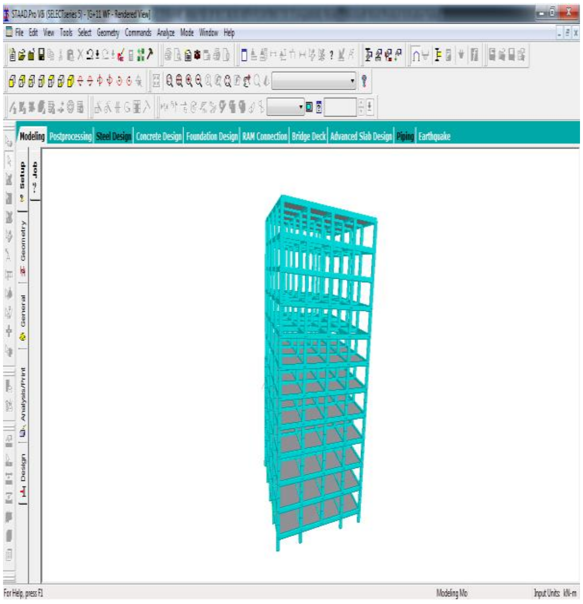


**Fig.3.8** G+11 Building model with floating column

### 3.3.5 Model Details G+13

The space frame building is modeled in STAAD-Pro. The beams and columns are modeled as beam elements and the slab is modeled as a plate element.

Beam Size: 230 X 500 mm

Column Size: 230 X 600 mm

Slab Thickness: 150 mm

Storey Height: 3m

Grade of concrete: M25

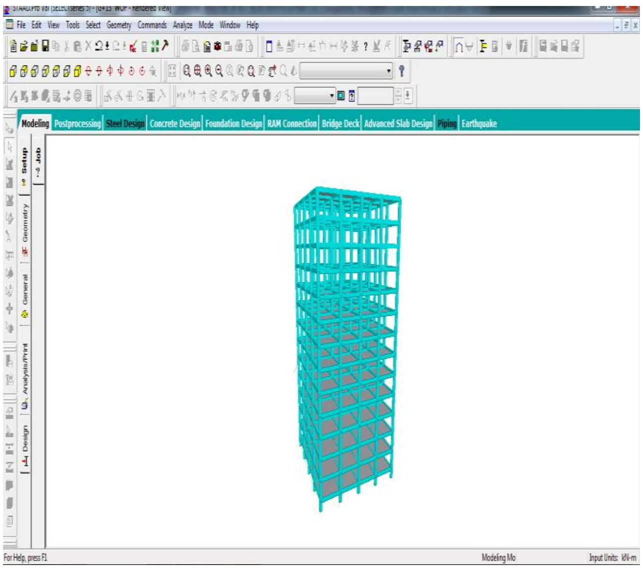


**Fig.3.9** G+13 Building model without any floating column.

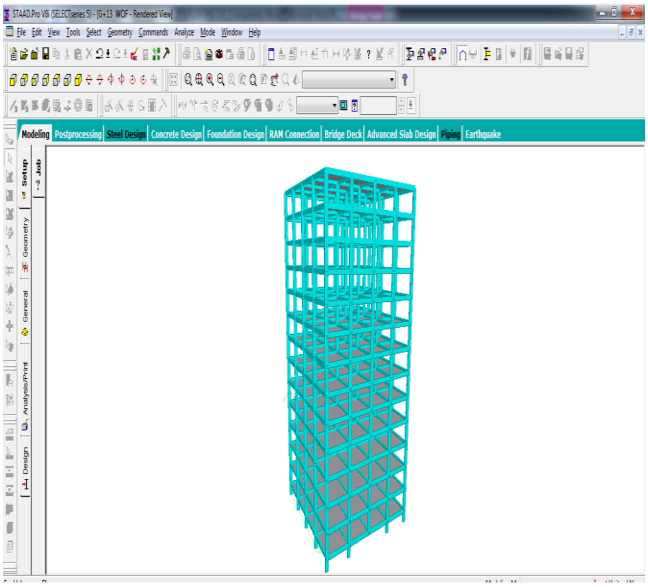


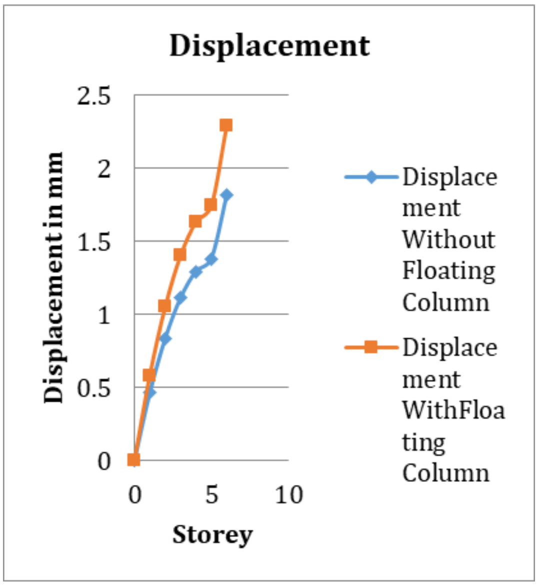
**Fig.3.10** G+13 Building model with floating column

## IV. Result and discussion

### 4.1 RESULTS OF MODEL G+5

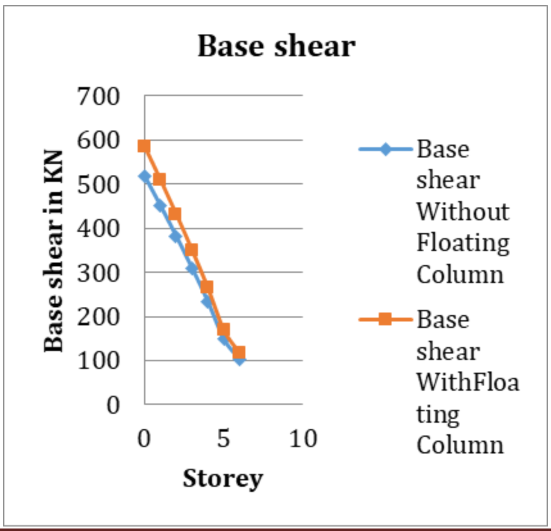
### 4.1.4 Displacement

| Storey no. | Displacement | |
|---|---|---|
| | Without Floating Column | With Floating Column |
| 0 | 0 | 0 |
| 1 | 0.464 | 0.585 |
| 2 | 0.836 | 1.054 |
| 3 | 1.114 | 1.405 |
| 4 | 1.296 | 1.636 |
| 5 | 1.383 | 1.747 |
| 6 | 1.817 | 2.295 |




#### 4.1.5 Base shear

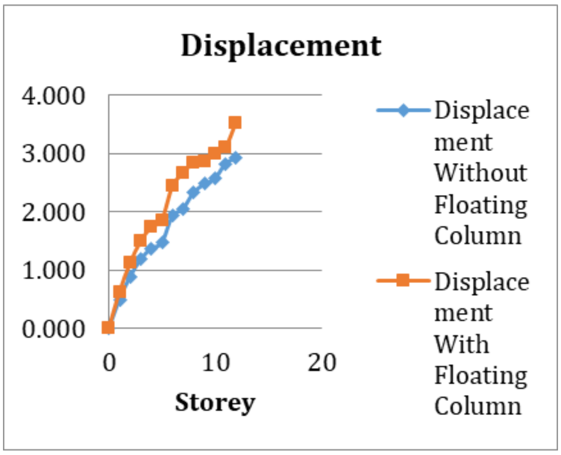
| Storey no. | Base shear | |
|---|---|---|
| | Without Floating Column | With Floating Column |
| 0 | 518.33 | 585.71 |
| 1 | 451.43 | 510.12 |
| 2 | 382.16 | 431.84 |
| 3 | 310.05 | 350.36 |
| 4 | 233.77 | 264.16 |
| 5 | 149.65 | 169.10 |
| 6 | 103.45 | 116.90 |




### 4.4 RESULTS OF MODEL G+11

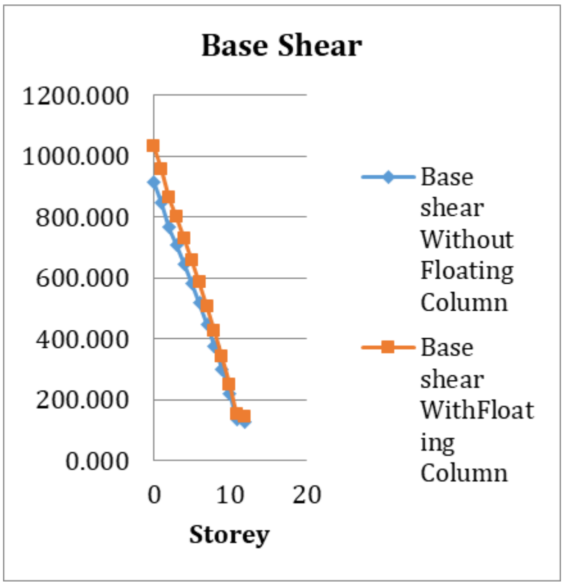
#### 4.4.4 Displacement

| Storey no. | Displacement | |
|---|---|---|
| | Without Floating Column | With Floating Column |
| 0 | 0.000 | 0.000 |
| 1 | 0.494 | 0.623 |
| 2 | 0.890 | 1.122 |
| 3 | 1.186 | 1.495 |
| 4 | 1.379 | 1.741 |
| 5 | 1.472 | 1.859 |
| 6 | 1.934 | 2.443 |
| 7 | 2.059 | 2.671 |
| 8 | 2.338 | 2.848 |
| 9 | 2.483 | 2.873 |
| 10 | 2.574 | 3.007 |
| 11 | 2.832 | 3.104 |
| 12 | 2.941 | 3.531 |



#### 4.4.5 Base shear

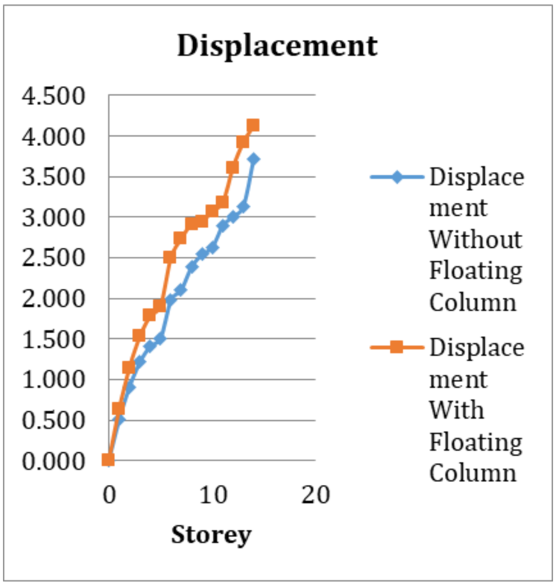
| Storey no. | Base shear | |
|---|---|---|
| | Without Floating Column | With Floating Column |
| 0 | 915.728 | 1034.773 |
| 1 | 847.658 | 957.853 |
| 2 | 766.790 | 866.473 |
| 3 | 708.410 | 800.503 |
| 4 | 647.230 | 731.370 |
| 5 | 583.510 | 659.366 |
| 6 | 517.350 | 584.606 |
| 7 | 448.680 | 507.008 |
| 8 | 377.040 | 426.055 |
| 9 | 301.500 | 340.695 |
| 10 | 221.720 | 250.544 |
| 11 | 135.990 | 153.669 |
| 12 | 127.340 | 143.894 |




### 4.5 RESULTS OF MODEL G+13

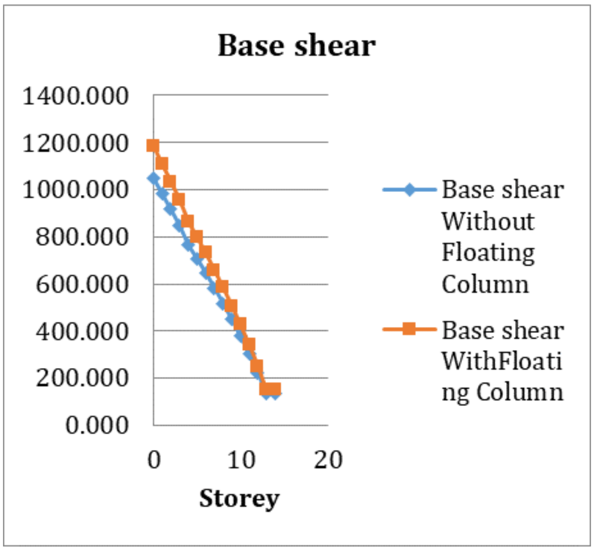
#### 4.5.4 Displacement

| Storey no. | Displacement | |
|---|---|---|
| | Without Floating Column | With Floating Column |
| 0 | 0.000 | 0.000 |
| 1 | 0.505 | 0.637 |
| 2 | 0.910 | 1.148 |
| 3 | 1.213 | 1.530 |
| 4 | 1.411 | 1.781 |
| 5 | 1.506 | 1.902 |
| 6 | 1.978 | 2.499 |
| 7 | 2.106 | 2.732 |
| 8 | 2.392 | 2.913 |
| 9 | 2.540 | 2.939 |
| 10 | 2.633 | 3.076 |
| 11 | 2.897 | 3.175 |
| 12 | 3.009 | 3.612 |
| 13 | 3.134 | 3.921 |
| 14 | 3.721 | 4.124 |

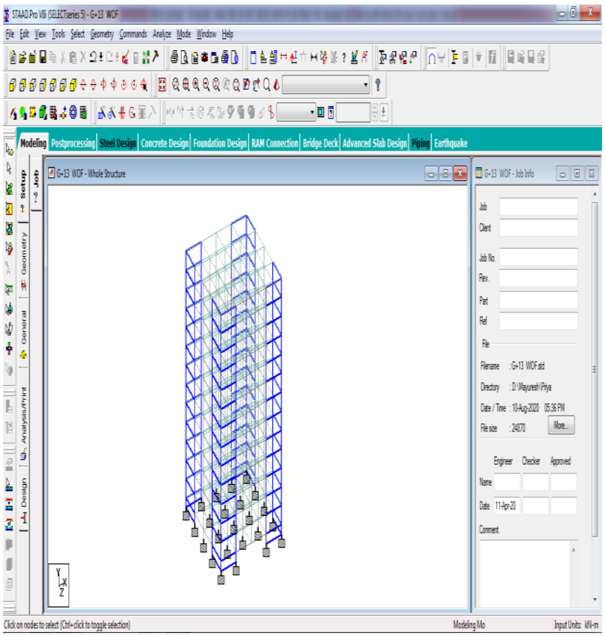


### 4.5.5 Base shear

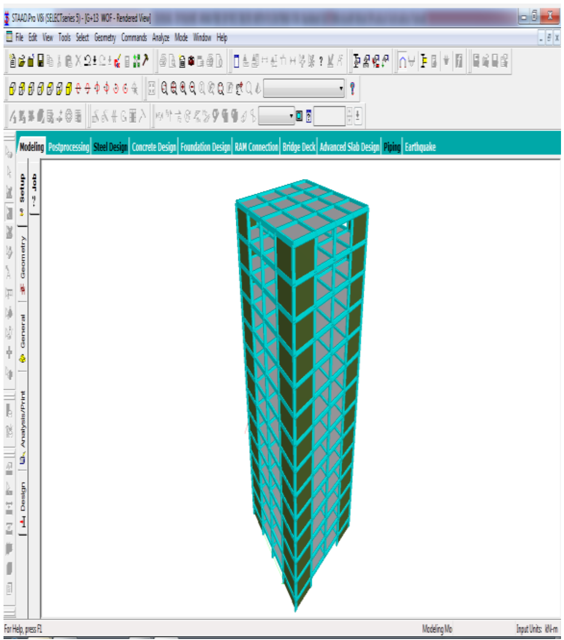
| Storey no. | Base shear | |
|---|---|---|
| | Without Floating Column | With Floating Column |
| 0 | 1050.193 | 1186.718 |
| 1 | 982.418 | 1110.132 |
| 2 | 915.728 | 1034.773 |
| 3 | 847.658 | 957.853 |
| 4 | 766.790 | 866.473 |
| 5 | 708.410 | 800.503 |
| 6 | 647.230 | 731.370 |
| 7 | 583.510 | 659.366 |
| 8 | 517.350 | 584.606 |
| 9 | 448.680 | 507.008 |
| 10 | 377.040 | 426.055 |
| 11 | 301.500 | 340.695 |
| 12 | 221.720 | 250.544 |
| 13 | 135.990 | 153.669 |
| 14 | 132.320 | 149.522 |




### 4.5 COMPARISON OF G+13 BUILDING HAVING FLOATING COLUMN WITH AND WITHOUT SHEAR WALL



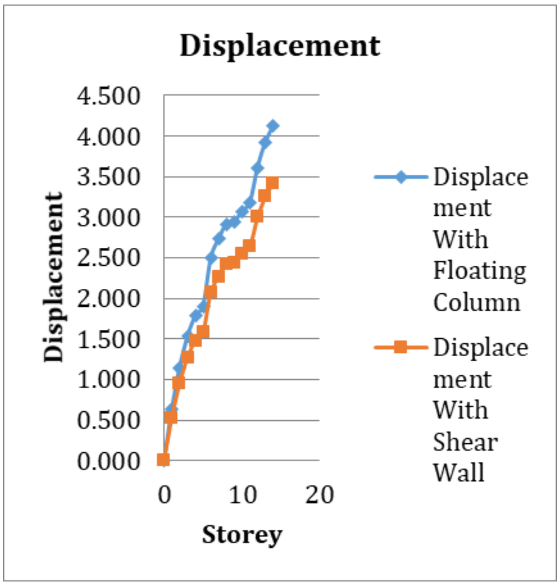
Modelling of G+13 with Shear Wall



### 4.5.4 Displacement

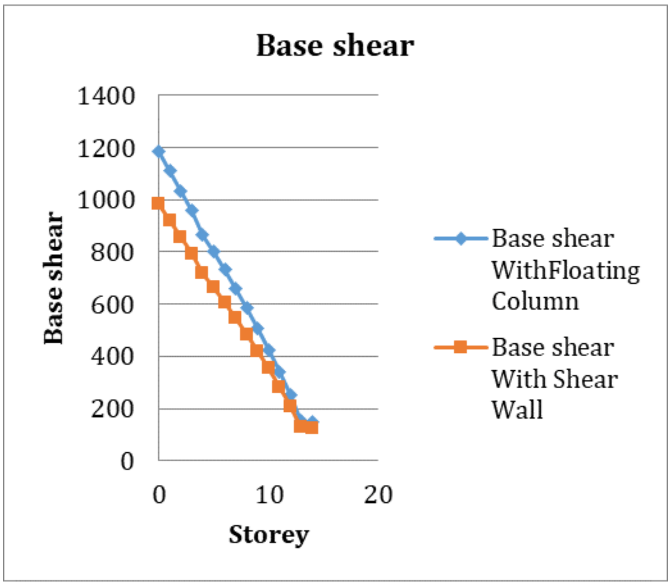
| Storey no. | Displacement | |
|---|---|---|
| | With Floating Column | With Shear Wall |
| 0 | 0.000 | 0.000 |
| 1 | 0.637 | 0.529 |
| 2 | 1.148 | 0.953 |
| 3 | 1.530 | 1.270 |

| | | |
|---|---|---|
| 4 | 1.781 | 1.478 |
| 5 | 1.902 | 1.579 |
| 6 | 2.499 | 2.074 |
| 7 | 2.732 | 2.268 |
| 8 | 2.913 | 2.418 |
| 9 | 2.939 | 2.440 |
| 10 | 3.076 | 2.553 |
| 11 | 3.175 | 2.636 |
| 12 | 3.612 | 2.998 |
| 13 | 3.921 | 3.254 |
| 14 | 4.124 | 3.423 |

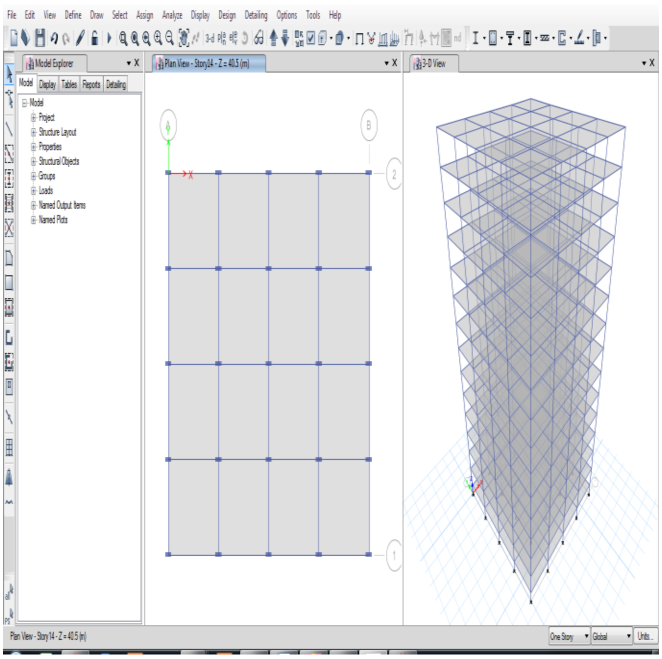



#### 4.5.5 Base shear

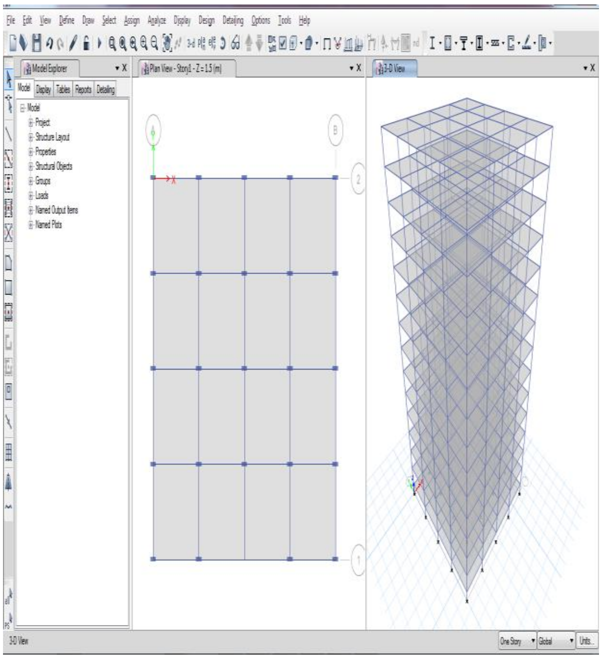
| Storey no. | Base shear | |
|---|---|---|
| | With Floating Column | With Shear Wall |
| 0 | 1186.718 | 984.976 |
| 1 | 1110.132 | 921.410 |
| 2 | 1034.773 | 858.862 |
| 3 | 957.853 | 795.018 |
| 4 | 866.473 | 719.173 |
| 5 | 800.503 | 664.417 |
| 6 | 731.37 | 607.037 |
| 7 | 659.366 | 547.274 |
| 8 | 584.606 | 485.223 |
| 9 | 507.008 | 420.817 |
| 10 | 426.055 | 353.626 |
| 11 | 340.695 | 282.777 |
| 12 | 250.544 | 207.952 |
| 13 | 153.669 | 127.545 |
| 14 | 149.522 | 124.103 |



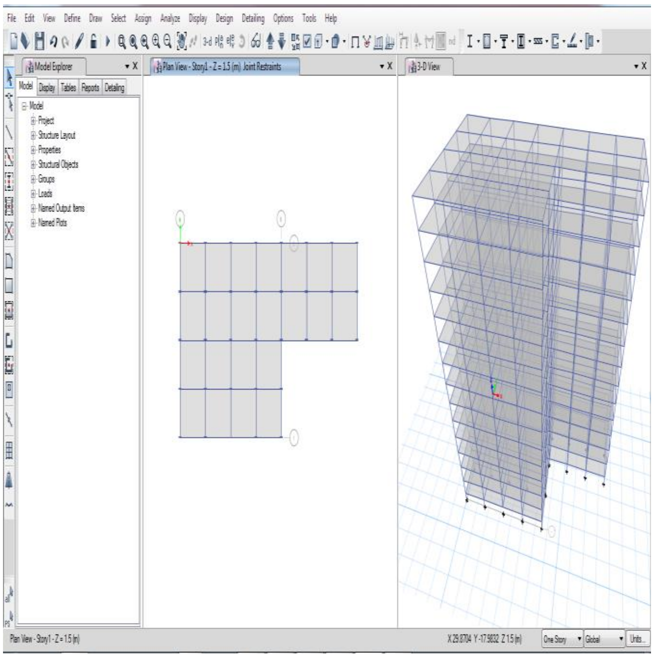

### 4.6 COMPARISON OF G+ 13 IN ETABS



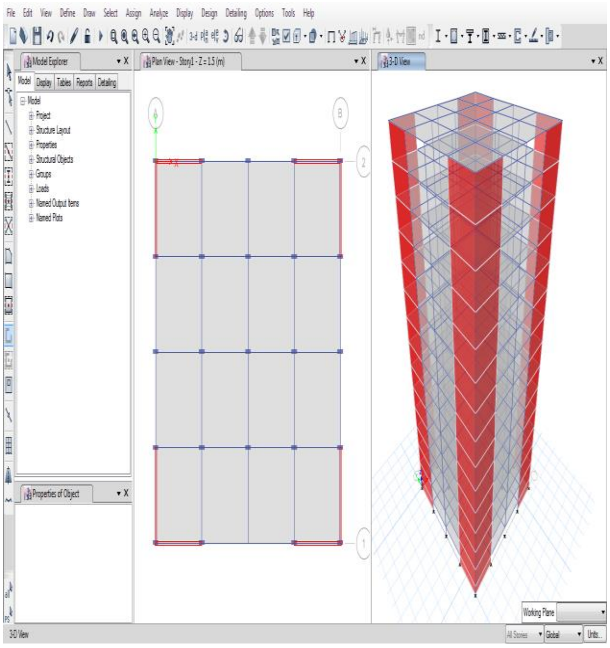
Model without Floating Column



Model with Floating Column



Unsymmetrical model with Floating Column

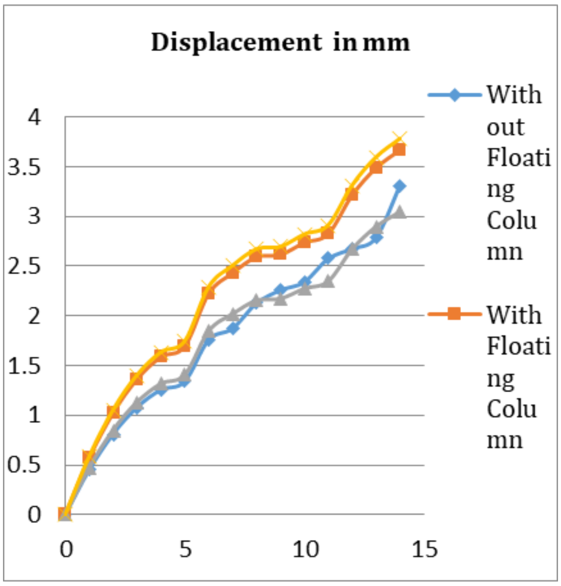


Model with Floating Column and Shear Wall

### 4.6.1 Displacement

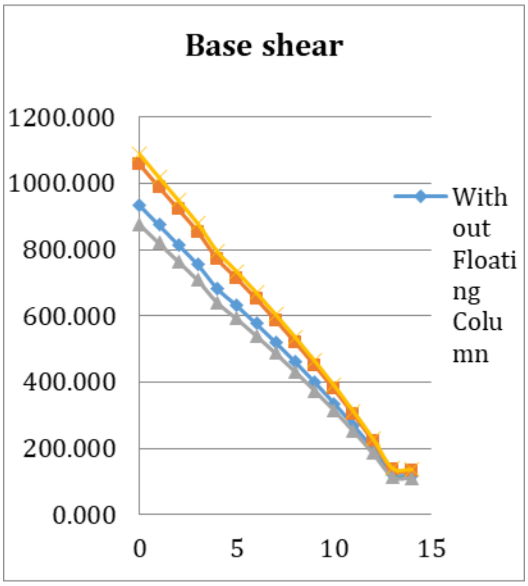
| DISPLACEMENT | | | | |
|---|---|---|---|---|
| Storey | Without Floating Column | With Floating Column | With Floating Column Shear Wall | Unsymmetrical with Floating Column |
| 0 | 0 | 0 | 0 | 0 |
| 1 | 0.449 | 0.567 | 0.471 | 0.584 |
| 2 | 0.810 | 1.022 | 0.848 | 1.052 |
| 3 | 1.080 | 1.362 | 1.130 | 1.403 |
| 4 | 1.256 | 1.585 | 1.315 | 1.633 |
| 5 | 1.340 | 1.693 | 1.405 | 1.744 |
| 6 | 1.760 | 2.224 | 1.846 | 2.291 |
| 7 | 1.874 | 2.431 | 2.019 | 2.504 |
| 8 | 2.129 | 2.593 | 2.152 | 2.670 |
| 9 | 2.261 | 2.616 | 2.172 | 2.694 |
| 10 | 2.343 | 2.738 | 2.272 | 2.820 |
| 11 | 2.578 | 2.826 | 2.346 | 2.911 |

| | | | | |
|---|---|---|---|---|
| 12 | 2.678 | 3.215 | 2.668 | 3.311 |
| 13 | 2.789 | 3.490 | 2.896 | 3.594 |
| 14 | 3.312 | 3.670 | 3.046 | 3.780 |




### 4.6.3 Base shear

| BASE SHEAR | | | | |
|---|---|---|---|---|
| **Storey** | **Without Floating Column** | **With Floating Column** | **With Floating Column Shear Wall** | **Unsymmetrical with Floating Column** |
| 0 | 934.672 | 1056.179 | 876.629 | 1087.864 |
| 1 | 874.352 | 988.017 | 820.055 | 1017.658 |
| 2 | 814.998 | 920.948 | 764.387 | 948.576 |
| 3 | 754.416 | 852.489 | 707.566 | 878.064 |
| 4 | 682.443 | 771.161 | 640.064 | 794.296 |
| 5 | 630.485 | 712.448 | 591.331 | 733.821 |
| 6 | 576.035 | 650.919 | 540.263 | 670.447 |
| 7 | 519.324 | 586.836 | 487.074 | 604.441 |
| 8 | 460.442 | 520.299 | 431.848 | 535.908 |
| 9 | 399.325 | 451.237 | 374.527 | 464.774 |
| 10 | 335.566 | 379.189 | 314.727 | 390.565 |
| 11 | 268.335 | 303.219 | 251.672 | 312.315 |
| 12 | 197.331 | 222.984 | 185.077 | 229.674 |
| 13 | 121.031 | 136.765 | 113.515 | 140.868 |
| 14 | 117.765 | 133.075 | 110.452 | 137.067 |




## CONCLUSIONS

1. From the response spectrum analysis it is noticed that the floating column building is having more displacements than a building without any floating column. So Floating column building is unsafe than a regular building.

2. After the analysis of building, it is seen that quantity of steel and concrete have to increase in floating column building to keep it safe in earthquake excitation. So floating column building becomes uneconomical as compare to regular building.

3. By the lateral stiffness calculation at each floor for the structure it is concluded that the building with floating column will make the soft storey effect very worse while the normal building without any floating column have less soft storey effect. So the floating column building is unsafe.

4. The Torsional effect in earthquake excitation is high in floating column building as compare to normal building, as a result overturning effect occurs in floating column building and structure becomes unsafe.

5. Generally, a building structure becomes expensive if it is designed to sustain any damage during an strong earthquake shaking.

6. In this study, it is observed that the normal column building is more efficient when compared with other models i.e. floating column buildings.

7. Hence the recommendations such as shear walls, infill walls, bracings are considered in the modeling and analysis and observed that they can also be designed as an earthquake resistant up to an extent, such that on introduction of floating columns in the RCC frames increases the time period of bare frames due to decrease in the stiffness.

8. On comparison of the results obtained for each model, it is observed that the building with normal column building have lesser displacements and story drifts when compared with the floating column models.

9. After Analyzing floating column with and without shear wall building it conclude that shear wall is effective to reduce deflection, story drift and other parameters , so use shear wall while designing of building with floating column.

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