A Study On Seismic Analysis of Multistorey Building With Floating Column Using Staad.ProV8i

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Abstract: *Structural engineering is a part of civil engineering dealing with the analysis and design of structures that support or resist loads. This project deals with the study of architectural drawing and the framing drawing of the building having floating columns and non-floating columns. In recent trend most of the residential as well as commercial buildings lowers floors contains large parking space, showrooms, etc. While the upper floors are occupied with conference rooms, banquet halls etc. All these amenities require huge uninterrupted space; thus, the concept of floating column was adopted. The load distribution of the floating columns and the various effects due to it is also being studied. The importance and effects due to the line of action of force are also studied. In this we are dealing with the comparative study of seismic analysis of multistoried building with and without floating columns. 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 being done. This will help us to find the various analytical properties of the structure and we may also have a very systematic and economical design of the structure. The floating column is a vertical member which at its lower level rests on the beam which is a horizontal member. These beams carry this additional load to neighbor columns or the columns below it which ultimately increase the load on remaining columns. There are many buildings in which floating columns are practiced, especially above the ground floor, so as to provide more open space for parking and other needs.*

***Keywords:* Floating Column, Multistorey Buildings, STAAD PRO V8i, seismic.**

1. Introduction

In recent times, multi-storey buildings in urban cities are required to have column free space due to shortage of space, population and also for aesthetic and functional requirements. For this, buildings are provided with floating columns at one or more storey. These floating columns are highly disadvantageous in a building built in seismically active areas. The earthquake forces that are developed at different floor levels in a building need to be carried down along the height to the ground by the shortest path. Deviation or discontinuity in this load transfer path result in poor performance of the building. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. Many buildings with an open ground storey intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake.

Column: The column is a vertical member which transfers its self-weight and load of corresponding beams to the foundation under it.

Floating Column: The floating column is a vertical member which rests 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.

2. Collection of Data

Keerthi gowda B. S. (May 2014)[1] suggested that earthquakes in different parts of the world demonstrated the hazardous consequences and vulnerability of inadequate structures. The buildings with floating column have a typical feature in the modern multistory construction in urban India. The floating column means a vertical element which at its lower level rests on a beam. The seismic inertia forces generated at its floor levels in a building need to be brought down along the height to the ground and any deviation or discontinuity in this load transfer path results in poor performance. Thus features such as floating columns were highly undesirable in the building built in seismically active area. Present study examines the adverse effect of the floating columns in building. Models of the frame have been developed for multi-storey RC buildings with and without floating columns to carry out a comparative study of structural parameters such as natural period, base shear, and horizontal displacement under seismic excitation. Results obtained depicts that the alternative measure of providing lateral bracing to decrease the lateral deformation, should be taken. The RC building with floating column after providing lateral bracing was analyzed. A comparative study of the results obtained was carried out for all above three models. The building with floating columns after providing bracings showed improved seismic performance.

Nikhil Bandwal (May 2014)[2] suggested that many buildings were planned and constructed with architectural complexities. The complexities included various types of irregularities like floating columns at various levels and locations. Buildings were critically analyzed for the effect of earthquake. Earthquake load as specified in IS 1893 (part 1): 2002 were considered in the analysis of building. A G+6 storied building with different architectural complexities such as External Floating Columns, Internal floating columns and combination of Internal and External Floating columns had been analyzed for various earthquake zones. In overall study of seismic analysis, critical load combinations were found out. For these critical load combinations, Case wise variation in various parameters like displacements, moments and Forces on columns and Beams at Various floor level were compared and significant co-relationship between these values had been established with Graphs. That Building was Design and analyze with the help of STAAD-Pro Software

According to Sabari S. (October 2014)[3] stated that buildings with Floating Column was a typical feature in the modern multi-storey construction in urban India. Such features were highly undesirable in building built in seismically active areas. This study has highlighted 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, were proposed to reduce the irregularity introduced by the Floating Columns. FEM analysis carried for 2D multi storey frames with and without floating column to study the responses of the structure under different earthquake excitation having different frequency content keeping the PGA and time duration factor constant. The time history of roof displacement, inter storey drift, base shear, column axial force were computed for both the frames with and without Floating Column.

According to Ms. Priyanka D. Motghare (2016)[4] this paper pertains of analytical studies carried out to evaluate the performance of RCC frame under different position of floating columns. Building with a 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 had 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 were higher for all the floating column cases. The final maximum bending moments values were also influenced by the presence of floating column.

Sharma R. K. (June 2016)[5] studied that in urban India floating column building was a typical feature in the modern multi-storey construction. Buildings with floating column were adopted either for architectural aspect or when more free space was required in the ground floor. Such features were highly undesirable in seismically active areas. In the project studies the analysis of G+5, G+7, G+9, G+11 and G+13 storey building with floating column and without floating was carried out. The analysis has been done by using Staad Pro V8i software by using Response spectrum analysis. The paper deals with the variation in results in displacement of structure, base shear, Seismic weight calculation of the building from manual calculation and STAAD.Pro V8i. For building with floating column and building without floating column, finding the variation between the response parameters of earthquake and describe what happens when variation may be high or low. The study was carried out to find whether the floating column structures were safe or unsafe when built in seismically prone areas, and has also found out commercial aspects of floating column building either it was economical or uneconomical.

According to Ms. Waykule S.B. (January 2017)[6] in recent times, multi-storey buildings in urban cities were required to have column free space due to shortage of space, population and also for aesthetic and functional requirements. For this, buildings were provided with floating columns at one or more storey. These floating columns were highly disadvantageous in a building built in seismically active areas. The earthquake forces that were developed at different floor levels in a building need to be carried down along the height to the ground by the shortest path. Deviation or discontinuity in that load transfer path results in poor performance of the building. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces were carried to the ground. Many buildings with an open ground storey intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake.

3. Methodology

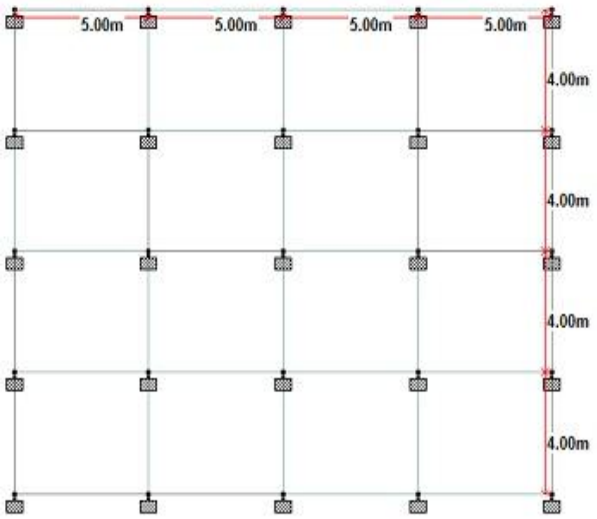
1. Studying literature related to seismic analysis of buildings with and without floating columns.
2. Making different models of multistorey building using STAAD.Pro.
3. Designing for the different model cases.
4. Analyse based on parameters such as base shear, storey drift, displacement, etc.
5. Suggesting the best suitable model cases from all the structures.

4. Objective and Scope

To analyse RCC frame building with floating columns and without floating columns using STAAD.Pro v8i.
To study behaviour of multistorey buildings with floating column under earthquake excitations.
To compare analysis between floating column and without floating column.

5. Modelling and Analysis

The building selected is in seismically active zone. The building is a G+7 storied RC framed building. The analysis is carried out by Response Spectrum Analysis method. All the loads i.e dead load, live load, seismic load and load combinations are considered using IS 1893:2002.
Plan of building is as follows:



A. Properties of Building

1) Site properties

a. Building details: G+7
b. Main wall thickness: 230 mm
c. Partition wall thickness: 230 mm
d. Floor height: 3m
e. Height of parapet: 0.8m
f. Thickness of Parapet: 230mm
g. Thickness of Internal plastering: 12mm
h. Thickness of External plastering: 15mm

2) Seismic properties

a. Seismic zone: IV
b. Zone factor: 0.24
c. Response reduction factor: 5.0
d. Importance factor: 1.0
e. Soil type: Medium

3) Material properties

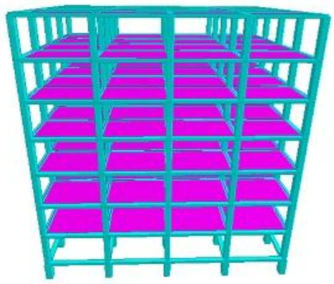
a. Grade of concrete: Fe25
b. Grade of steel: Fy415
c. Fy_{main} maximum: 20 mm
d. Fy_{sec} maximum: 20mm
e. Fy_{main} minimum: 8mm
f. Fy_{sec} minimum: 8mm

4) Member size

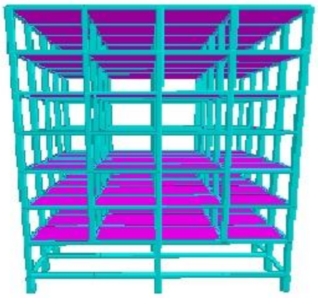
a. Column: 400mm x 500mm
b. Column in foundation: 500mm x 600mm
c. Beam: 250mm x 350mm
d. Slab thickness: 150mm

5) Model type

a. Type I: No float



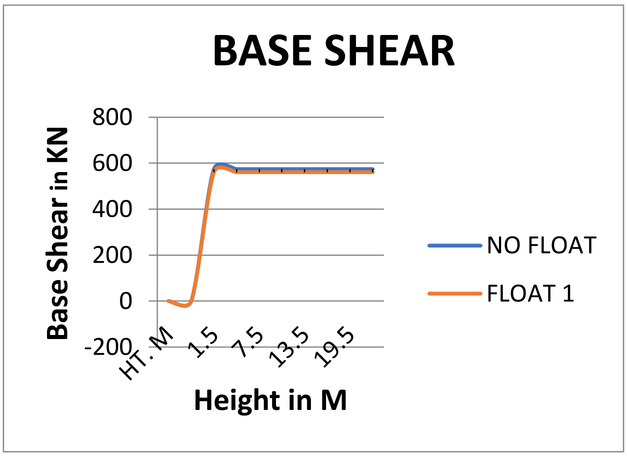
b. Type II: Float type 1



6. Results

6.1 Base Shear

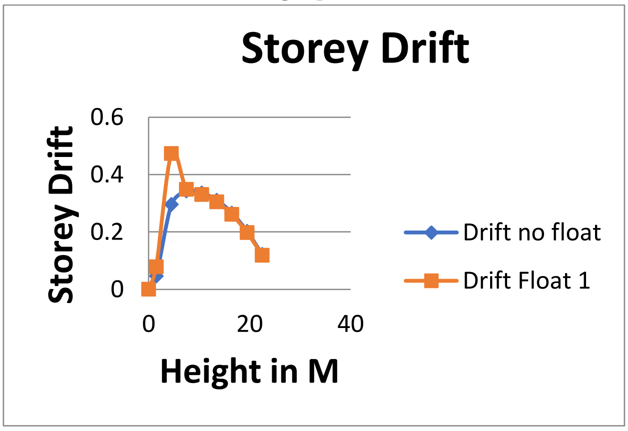
The following result was observed during comparison of base shear of non-floating column with floating column



The base shear of floating column had higher values, but the difference between the values was comparatively less.

6.2 Storey drift

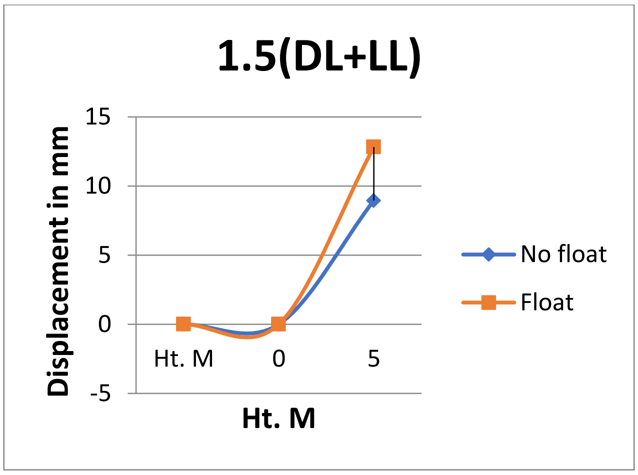
The lateral movement of stories w.r.t adjacent storey was observed as shown in graph.

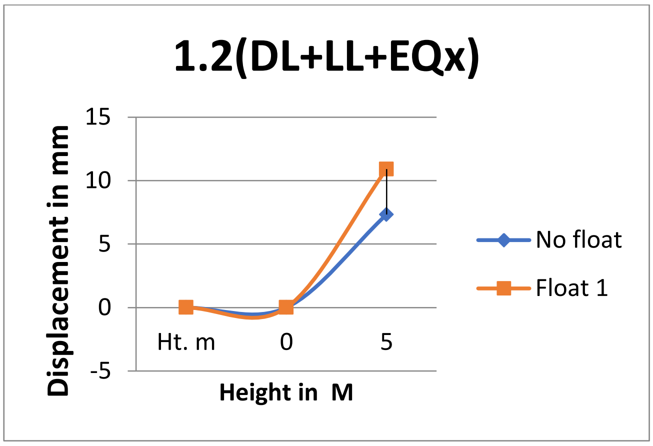


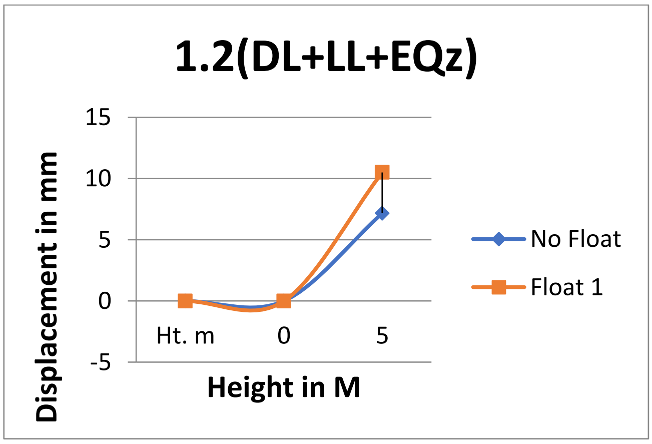
The storey where floating columns were provided showed more lateral displacement between adjacent stories than non-floating columns. The stories where floating columns were not provided showed same storey drift

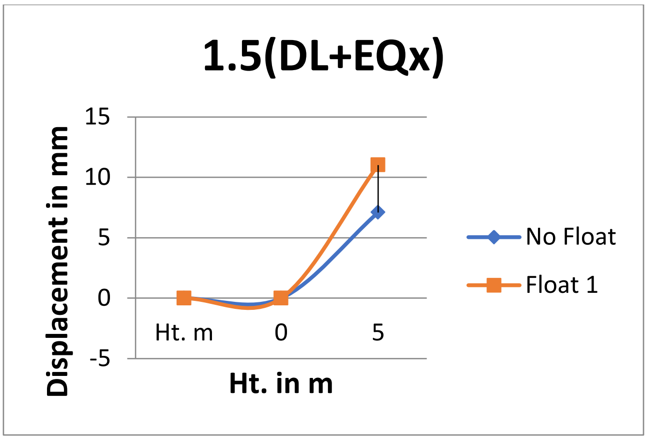
6.3 Displacement

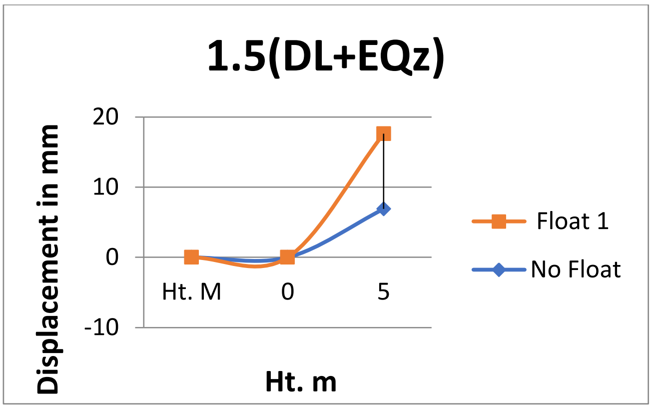
Maximum displacement of building with floating column and without floating column for different load combinations ws observed as in the graphs.

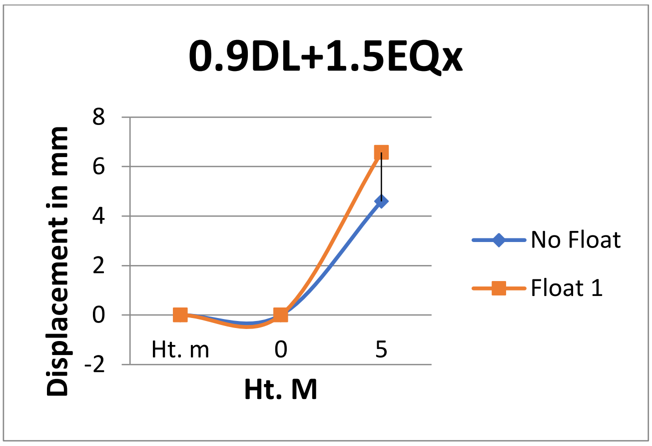


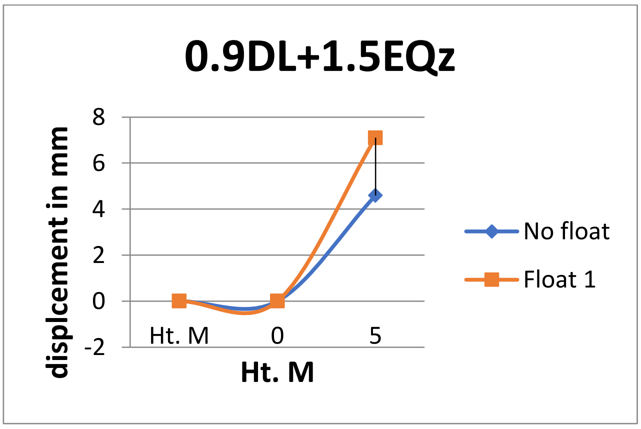












6. Conclusion

The following conclusions were observed during comparison and analysis of multistorey building using STAAD.Pro v8i

1) In seismic zones floating columns gives more base shear than non-floating columns.
2) The lateral displacement i.e storey drift of floating column building is eventually more but does not affect stability of structure.
3) There are more displacements of members in floating column buildings in seismic zones
4) The floating column buildings in seismic active zones there is no failure of structure.
5) The floating column structure gives good aesthetic view and also increases floor space ratio.

Hence, we have arrived to conclusion that floating column structures in seismic active zones does not cause more displacement and are safe for construction. Also these structures gives good aesthetic look than the non-floating columns and uninterrupted space for showrooms, theaters,etc.

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