SEISMIC RESPONSE OF HIGHRISE STRUCTURES WITH FLOATING COLUMNS SUBJECTED TO NEAR AND FAR FIELD GROUND MOTIONS

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Abstract - *The floating column is a vertical part which lays on a bar however doesn't transmit the heap directly to the establishment. The gliding segment goes about as a point stack on the shaft and this pillar transmits the heap to the segments beneath it. The segment can begin off on the first or second or some other transitional floor while lying on a bar. In any case, the section lays on the shaft. Origination of drifting segment basically grasps of exasperating stream of exchange of seismic tremor compel. Hence in the present work seismic behavior of floating columns subjected to near field ground motions and far field ground motions in high rise buildings are considered in order to compare the response of the structures with floating columns and with no floating columns under near field ground motions as well as far field ground motions. This concept is employed for G+16 storey regular and irregular buildings which are subjected to near field and far field ground motions. To know the response of the buildings time history analysis is carried out using Kobe ground motion data by ETABS software. The response of buildings with no and with floating columns subjected to near and far field ground motions in terms of storey displacement, Storey shears, Storey stiffness, Storey drifts, Bending moments, Shear forces, Base shear and storey shear and the same is plotted. In the conclusion the comparison of these plots is used to know the difference in response of structures considered.*

Key Words: **floating column, near field, far field, regular building, irregular building etc**

1. INTRODUCTION

An earthquake otherwise temblor or tremor is the shaking of the surface of the Earth, due to sudden arrival of vitality in the Earth's lithosphere that makes seismic waves. Seismic tremors can run in measure from those that are weak to the point that they cannot be felt to those sufficiently savage to hurl individuals around and obliterate entire urban areas. The seismicity or seismic movement of a territory alludes to the recurrence, sort and size of quakes experienced over some stretch of time. A seismic tremor's purpose of introductory crack is called its concentration or hypo-center. The epicenter is the point at ground level straightforwardly over the hypo-center.

1.1 Some important definations

Normal fault: Normal faults happen mostly in areas where the crust is being extended such as at a convergent boundary

Reverse fault: Reverse faults ensue in areas where the crust is being shortened such as at a convergent boundary.

Strike slip: Reverse faults ensue in areas where the crust is being shortened such as at a convergent boundary. Strike – slip faults are abrupt structures where the two sides of the fault slip parallelly pass each other, transform boundaries are a definite kind of strike – slip fault.

Near filed ground motions: The ground motions which are in the range of 10 Km to 15 Km from the fault line are called near – field ground motion.

Far field ground motions: The ground motions which are more than 20 Km distant from the fault line are called far – field ground motions.

These earthquakes ensure superior accelerations and constrained frequency content in greater frequencies then far – field ones. Correspondingly their records have pulses in beginning of record with great period and great domain.

1.2 Floating columns

The drifting segment or floating column is a vertical part which lays on a bar however doesn't transmit the heap directly to the establishment. The gliding segment goes about as a point stack on the shaft and this pillar transmits the heap to the segments beneath it. The segment can begin off on the first or second or some other transitional floor while lying on a bar. In any case, the section lies on the shaft.

This is broadly utilized in multi storied structures for both business and private reason. This changes the arrangement of the best floors to our benefit. The exchange pillar which bolsters the drifting section exchanges the heaps up to establishment. This must be outlined with greater support or as profound pillar.

2. SCOPE OF THE STUDY

The objective of the work is to compare the response of regular building and irregular building with floating columns and without floating columns under near – field ground motions and far – field ground motions. Analysis of the buildings is done by using ETABS software and time history analysis is carried out using Kobe earthquake data.

The detailed objectives are as follows:

1. Modeling of G +16 storey structure and time history analysis of regular building with floating columns, regular building with no floating column, irregular building with no floating columns and irregular building with floating column, under near – field ground motions and far – field ground motions.
2. To observe the response of the regular building with floating columns, regular building with no floating columns, irregular building with no floating columns and irregular building with no floating columns under near – field ground motions and far – field ground motions.
3. To determine the parameters such as storey displacement, storey drift and storey shear and storey stiffness thereby assessing the performance of the structures with and without floating columns under near – field ground motions and far – field ground motions.
4. To compare the response of regular building with floating columns, regular building without floating columns, irregular building with no floating columns and irregular building with floating columns, under near – field ground motions and far – field ground motions.

3. METHODOLOGY AND ANALYSIS

1. Kobe earthquake data is collected from strong motion data centre.
2. Two regular G+16 storey building without floating columns are modeled and time history analysis is carried out under near field and far field ground motions.
3. Two regular G+16 storey building with floating columns are modeled and time history analysis is carried out for near field and far field ground motions.
4. Two irregular G+16 storey building with no floating columns are modeled and time history analysis is carried out for near field and far field ground motions.
5. Two irregular G+16 storey building with floating columns are modeled and time history analysis is carried out for near field and far field ground motions.
6. Graphs of storey drift, storey shear and storey displacement and storey stiffness will be plotted.
7. Comparing the structures from the graphs plotted thereby concluding the response of the structures with and with no floating columns under near and far field ground motions.

Modeling of G + 16 storey building is considered for the analysis. 2 plans of structures are considered, one is regular building and another is irregular building (shape irregularity). Modeling of the buildings is done using ETABS software.

The description of the model is shown in the table 1. In regular buildings the column sizes kept constant throughout and in the structures with floating columns the sections of the columns were designed for stable conditions. These column sizes were variable and shown in Table 1.

M1: Regular building with no floating column under near filed ground motions

M2: Regular building with no floating column under far filed ground motions

M3: Regular building with floating column under near filed ground motions

M4: Regular building with floating column under far filed ground motions

M5: Irregular building with no floating column under near filed ground motions

M6: Irregular building with no floating column under far filed ground motions

M7: Irregular building with floating column under near filed ground motions

M8: Irregular building with floating column under far filed ground motions

Table -1: Description of Models

Parameters	M_1 and M_2	M_3 and M_4	M_5 and M_6	M_7 and M_8
Grid spacing (m)	6	6	6	6
Beam size (mm)	450 x 600	900 x 600	B1 - 300 x 450 B2 - 450 x 600	450 x 600
Column size (mm)	450 x 450	C_1 300 x 300 C_2 750 x 750	450 x 450	C_1 – 300 x 300 C_2 – 750 x 750
Slab thickness (mm)	200	200	200	200
Concrete (N/mm^2)	M_{40}	M_{40}	M_{40}	M_{40}

Steel (N/mm²)	Fe 500	Fe 500	Fe 500	Fe 500
Wall load (KN/m²)	2	2	2	2
Live load (KN/m²)	3	3	3	3
Floor finish (KN/m²)	1.5	1.5	1.5	1.5
Zone	iii Moderate	iii Moderate	iii Moderate	iii Moderate
Importance factor (I)	1.5	1.5	1.5	1.5
Reduction factor (R)	5	5	5	5
Type of soil	ii - Medium soil	ii - Medium soil	ii - Medium soil	ii - Medium soil

3.1 ETABS models

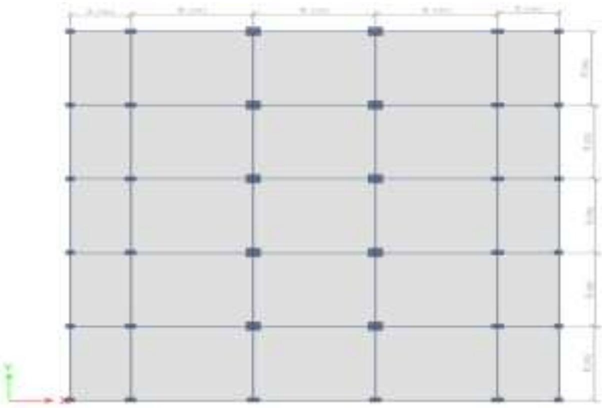

Fig -2: Plan view of regular building

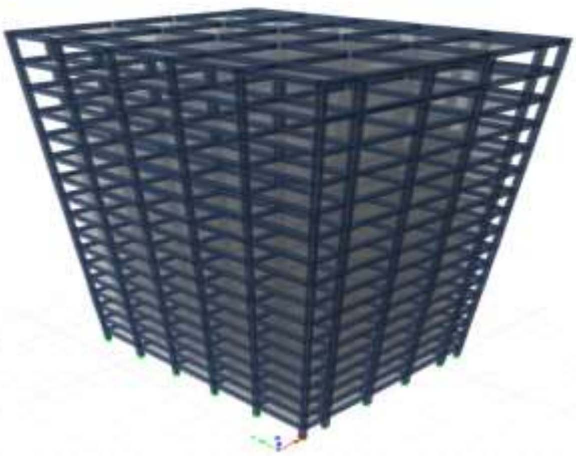

Fig -3: 3D view of regular building

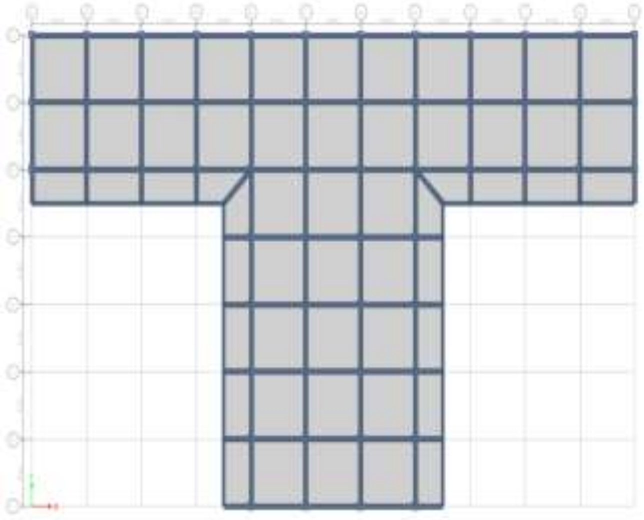

Fig -4: Plan view of irregular building

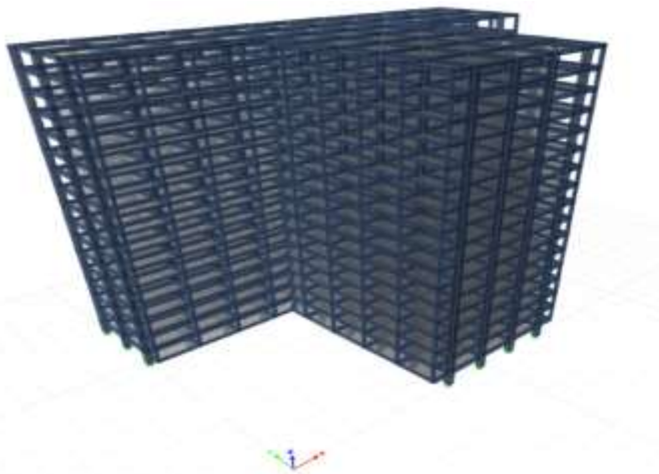

Fig -5: 3D view of irregular building

3.2 Time history analysis

Kobe earthquake ground motion data is considered which was occurred in 16/01/1995 with the magnitude of 6.9, latitude – 34.5948, longitude – 135.0121, depth – 17.9 Km and hypo central distance of 31.1 Km.

4. RESULTS AND DISCUSIONS

The outcomes got from the nonlinear time history examination of models by ETABS programming are talked about. The models with floating columns subjected to close field and far field ground movements are contrasted and the models without gliding subjected to close field and far field ground movements all together know the reaction of the structures. For the comparison following parameters have been considered:

1. Storey displacements
2. Storey shears
3. Storey stiffness

4.1 Storey displacements

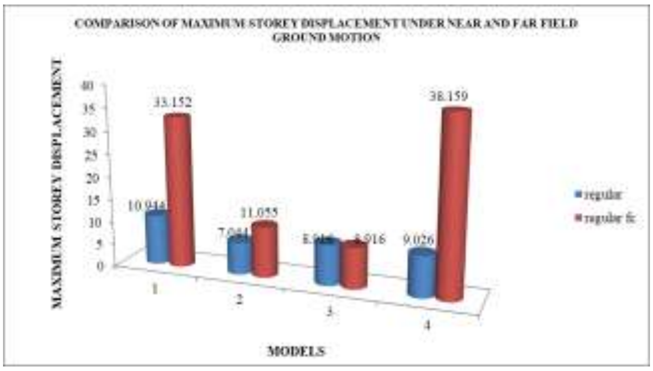

Fig 6: Comparison of max storey displacements under near and far field ground motions

4.2 storey shear

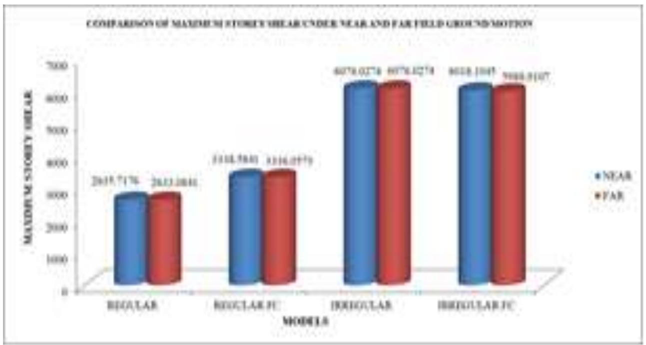

Fig 7: Comparison of max storey shear under near and far field ground motions

4.3 Storey stiffness

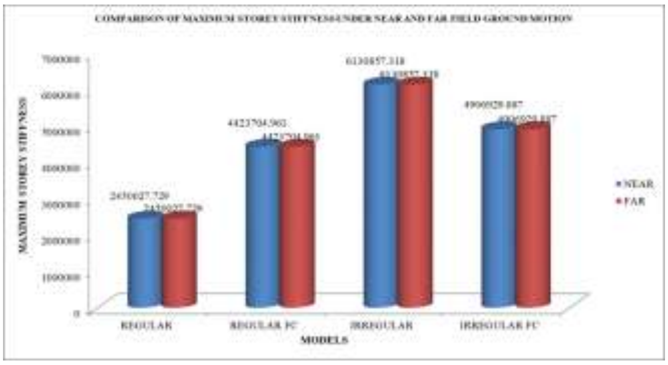

Fig 8: Comparison of max storey stiffness under near and far field ground motions

4. NON DIMENSIONAL GRAPHS

The non-dimensional graphs (storey versus storey shear / vertical reactions) of 16, 12, 8 and 4 storey regular buildings is plotted figure 9, 10, 12 and 13 respectively.

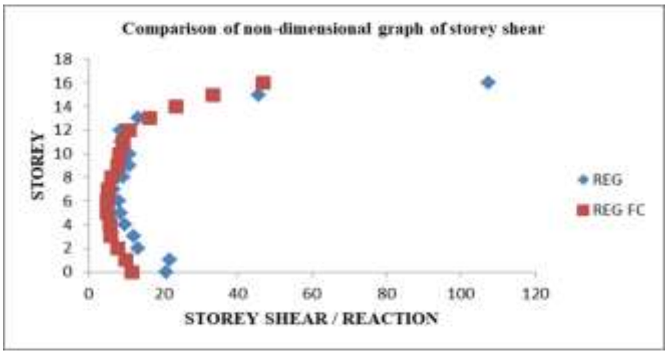

Fig 9: Comparison of non-dimensional graph of storey shear of 16 storey regular building

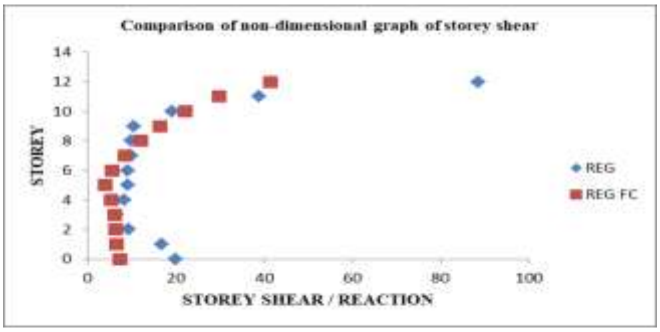

Fig 10: Comparison of non-dimensional graph of storey shear of 12 storey regular building

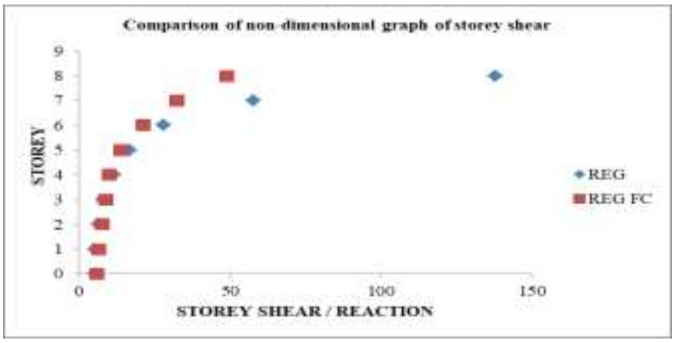

Fig 11: Comparison of non-dimensional graph of storey shear of 8 storey regular building

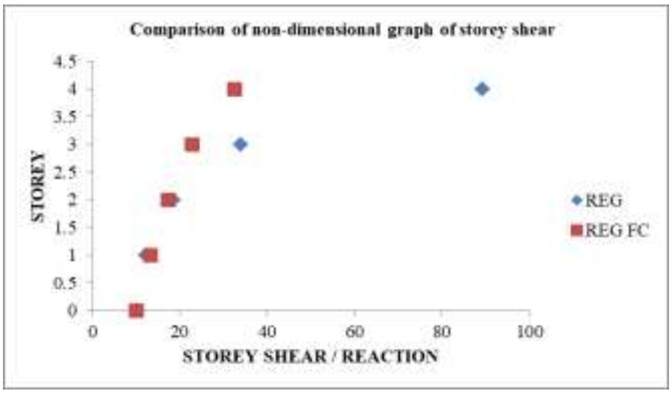

Fig 12: Comparison of non-dimensional graph of storey shear of 4 storey regular building

5. CONCLUSIONS

The structures with floating columns were considered for regular and irregular (shape) buildings. These models were analyzed and compared for the near and for field ground motions considering Kobe earthquake data. The major results were compared with respect to the base shear, storey displacement, storey stiffness etc., the following conclusions were drawn. The analyzed structure has G +16 floors model.

1. The structures with floating columns provided at the corners of the structure shows decrease in the storey displacement by 35% when compared with regular building of same height. In irregular building the storey displacement is increased by 1% than that of irregular building with no floating columns when they are subjected to near field ground motions.
2. The structures subjected to far field ground motions with floating columns in a regular building has 66% lesser storey displacement than that of regular building with floating column. Irregular building with floating columns has 23% more storey displacement than that of irregular building with no floating columns.
3. Under near field ground motions the storey shear has been increased about 21% when regular building is provided with floating columns and in irregular building with floating columns it is increased for about 21% than the irregular building with no floating columns.
4. Under far field ground motions, when floating columns are provided to a regular building the storey shear is 20% greater than that of regular building with no floating columns. But irregular building with floating columns has 1% less storey shear than that of irregular building with no floating columns.
5. The regular building subjected to near field ground motions shows the extreme storey stiffness of 45 % when it is provided with floating columns and irregular building with floating columns has 20% lesser storey stiffness than that of irregular building without floating columns.
6. Under far field ground motions the maximum storey stiffness of the regular building has been increased to 45 % when it is provided with floating columns and irregular building with floating columns has 20% lesser storey stiffness than that of irregular building without floating columns.
7. The regular buildings with no and with floating columns has an higher storey shear in regular building for the structures above G+8 storeys and the storey shear remains same below 8 floors. The structures with more than or less than 8 floors shows higher storey shear for the regular buildings in upper most floors.

6. REFERENCES

1. Sachin Mankal and Karuna S., (2017), "Comparative study on regular and irregular RC structures under far and near field ground motion with base isolation". IRJET, vol.04 (08), pp. 1550 – 1556

2. Nakul A. Patil and Riyaz Sameer Shah., (2016), "Comparative study of floating and non – floating columns with and without seismic behavior".

3. Bhamre Vaibhav Vijay and Dr. R S Talikoti., (2016), "Seismic analysis of floating column". IJIR, vol.02 (12), pp. 330 – 333

4. Bhavya B S and Jisha P., (2016), "Seismic evaluation of RC unsymmetrical building with floating columns and soft storey considering different configuration". IJIRSET, vol.05 (08), pp. 15465 – 15465

5. Mahdi Heydari and Mahdi Mousavi., (2015), "The comparison of seismic effects of near field and far field earthquake on relative displacement of seven storey concrete building with shear wall". Vol.10 (01), pp. 40 – 46

6. Hardik Bhensdadia and Siddharth Shah., (2015), "Pushover analysis of RC frame structure with floating column and soft storey in different earthquake zones". IJRET, vol.04 (04), pp. 114 – 121

7. Shiwli Roy and Gargi Danda de., (2015), "Behavioral studies of floating column on framed structure". IJRET, vol.09 (09), pp. 435 – 440

8. S K Shama Banu and G Shani Priyanka., (2015), "Study of behavior of seismic evaluation of multistoried building with floating column". IJCERT, vol.02 (12), pp. 983 – 988

9. Sreekanth Gandla Nanabala et.al., (2014), "Seismic analysis of a normal building and floating column building". IJERT, vol.03 (09), pp. 981 – 987

10. H R Tavakoli et.al., (2012), "Comparative evaluation of seismic parameters for near – fault and far – fault earthquakes".