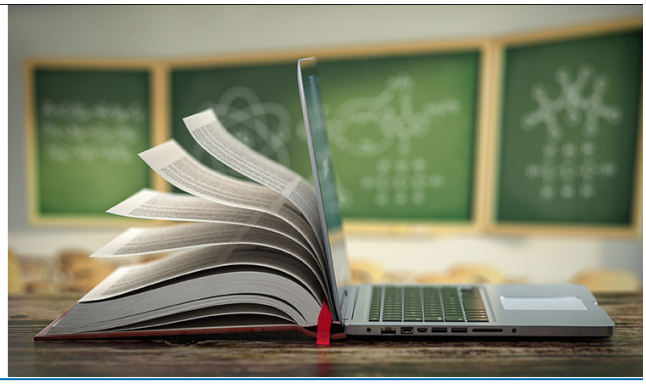
Comparative Study on Non-Linear Time History Analysis of a Building With and Without Base Isolation using ETABS



Comparative study on non-linear time history analysis of a building with and without base isolation using etabs

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Abstract. Base isolation is a device which is used to discrete the building from its foundation. Therefore, all through seismic activity, the building does not change due to the earthquake. Even if the earth moves violently, buildings tend to move like rigid bodies instead of collapsing In the current study, reinforced concrete framed structures of G + 8 and G + 16 (with and without base isolation) are considered with a 3 m high floor in the seismic zone V. The base isolator for both structures is designed to determine the stiffness and physical magnitudes of the lead rubber bearing core (LRB) specified at the base of the frame. The buildings were analyzed using nonlinear time history technique in ETABS. The effect of Base isolator is studied and building reactions like storey displacements, storey shear, storey drifts, and overturning moments can be seen in graphs. A general examination of G+8 and G+16 buildings with and without base isolator is watched.

Keywords-Base isolation,LRB, Nonlinear time history technique, Storey drift, Storey shear

1. Introduction

Earth tremors are unexpected phenomena when the building is in earthquake areas. A civil engineer has to stand up to save lives and at least damage buildings during an earthquake. The latest development in earthquake protection projects is basic insulation, which cannot reduce ground movement, but helps to minimize the effects of earthquake movement.

The basic isolation system is the most widely used seismic protection system. Reduces the effects of ground motion, thereby eliminating the effects of earthquakes on structures. Basic insulation has

become popular in buildings and bridges over the last few decades. Foundation isolation has become a customary idea in the plan of building structures and bridges in many high-hazard territories. Many are now under construction. At the point when soil isolation happens all through the formation of seismic structures because of earthquakes, the ground moves sideways and harms the structure. The answer for this issue is to isolate the structure starting from the earliest stage presenting an adaptable protection framework between the establishment and the structure. This uses the adaptability of the framework to ingest tremor vibrations. In this manner the seismic energy moved to the structure is better decreased and the structure stays stable for a generally lengthy time span. Base protection expands the characteristic time of the structure and consequently lessens dislodging of the structure during seismic occasions. Elastic and lead direction are main considerations in presenting underlying adaptability. This increases the natural period of the structure and the displacement of the base beyond predetermined limits. However, base isolators do not always compensate for strong earthquakes, as it can cause more displacement at the bottom of the structure.

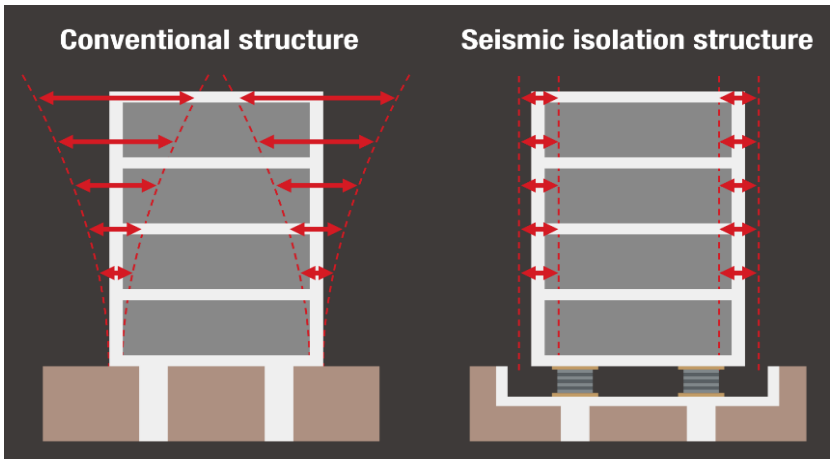

Figure 1. Performance of conventional building Vs seismic isolated building

2. Scope of the study

1. The scope of the present study is limited to analysis of reinforced concrete framed structures of G+8 and G+16 with and without base LRB base isolator using nonlinear time history technique in ETABS.
2. The seismic behavior of G+8 and G+16 buildings in region V with and without base isolators were studied.
3. The above buildings were compared by taking parameters like storey shears, floor displacements, storey drifts into consideration.

3. Methodology

Nonlinear time history technique

The only strategy to depict the genuine nature of a structure during tremor is through non-linear dynamic investigation or nonlinear time-history investigation.The strategy depends only on the direct numerical combination of differential equations of motion, taking into account the elasto-plastic deformation of a structural element. This is a significant strategy for structural seismic investigation, particularly when the assessed basic reaction is nonlinear. To conduct such an investigation, a agent seismic time history is needed for a structure being assessed. Time history examination is a bit by bit investigation of dynamic reaction of a structure to a predefined loading that may differ with time. Time history investigation is utilized to decide the seismic response of model to the dynamic loading

of a typical earthquake. Time-history investigation is a bit by bit examination of the dynamical reaction of a structure to a particular loading that may differ with time. The investigation might be linear or nonlinear.

For nonlinear direct-combination time history investigation, the entirety of the material and geometric nonlinearities might be taken into account. For general nonlinear model time history examination, just only the nonlinear conduct of the link or support components is incorporated. On the off chance that the modes utilized for these examinations were calculated utilizing the firmness from the finish of a nonlinear investigation, all different kinds of nonlinearities are secured in the state that existed toward the finish of that nonlinear investigation.

4. Modelling

A.BuildingS data

S.No.	Description	Model A,B(G+8)	Model C,D (G+16)
1	**Building Details of the Structure:**		
i)	No. of Storeys	G+8	G+16
ii)	Structure Frame System	S.M.R.F	S.M.R.F.
iii)	Structure Type	Symmetrical and Regular	Symmetrical and Regular
iv)	Plan Area	6mx6m	6mx6m
v)	Storey Height- Bottom Storey	3.3m	3.3m
	Typical Storey	3m	3m
vi)	Height of the Building	24.3m	48.3m
vii)	Seismic Zone	V	V
	Thickness- Outer Wall	230mm	230mm
vii)	Inner Wall	115mm	115mm
2	**Material Properties**		
i)	Grade of Concrete	M40	M40
ii)	Grade of Steel	Fe415	Fe415
iii)	Density of Concrete	25kN/m^3	25kN/m^3
iv)	Young' Modulus (E_c)	31622776.6kN/m^2	31622776.6kN/m^2

v)	Young' Modulus (E_s)	$2x10^8$ kN/m^2	$2x10^8$ kN/m^2
3	**Loads Considered**		
i)	Floor Finish	1kN/m^2	1kN/m^2
ii)	Live Load	3kN/m^2	3kN/m^2
iii)	Parapet Wall Load	1kN/m^2	1kN/m^2
4	**Seismic Properties**		
i)	Zone Factor	0.3	0.3
ii)	Soil Type	Hard Rock	Hard Rock
iii)	Response Reduction Factor	8.5	8.5
iv)	Importance Factor	1.5	1.5
v)	Time History Function	Elcentro	Elcentro
vi)	Damping Ratio	5%	5%

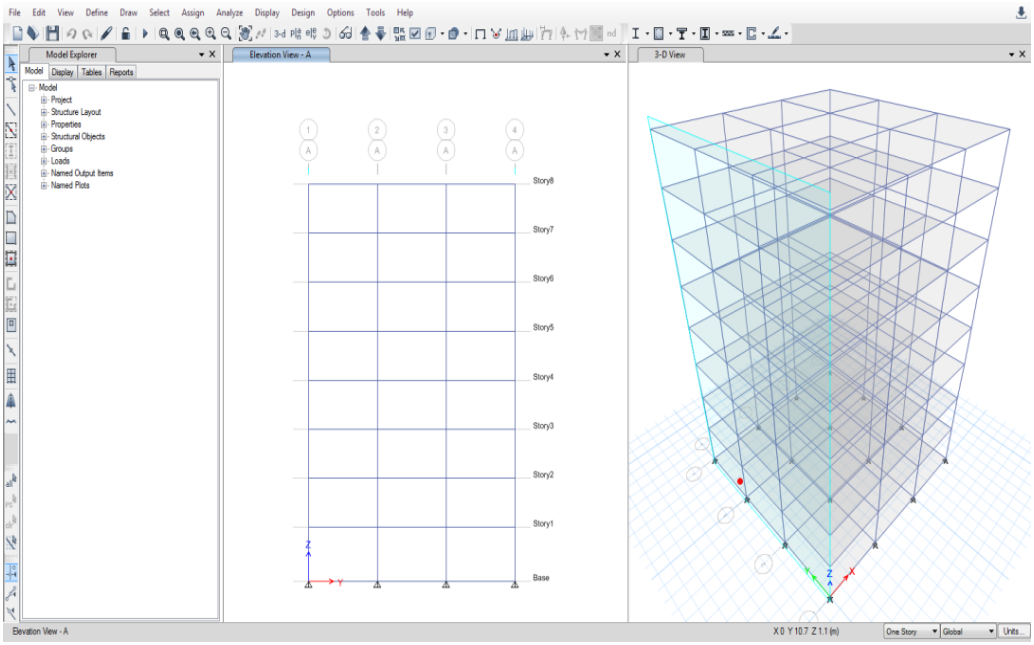

Figure 2. Model A: Elevation of G+8 building without LRB base isolator

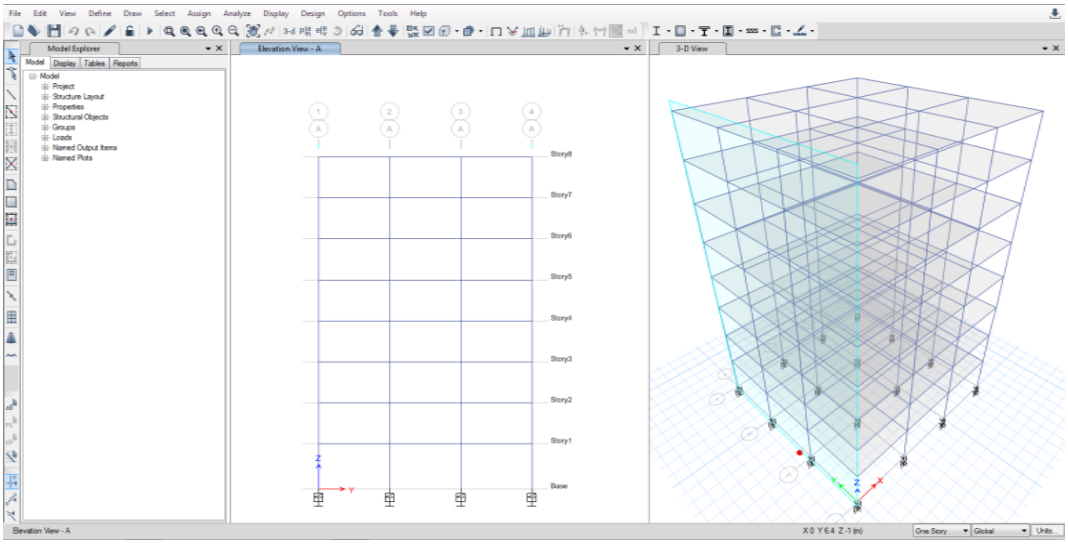

Figure 3.Model B: Elevation of G+8 building with LRB base isolator

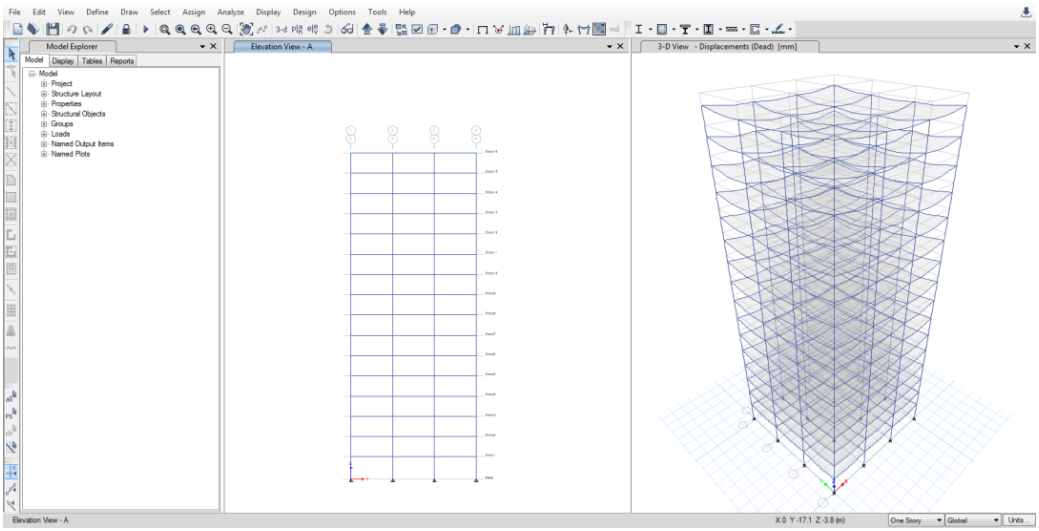

Figure 4.Model C: Elevation of G+16 without LRB Base Isolator

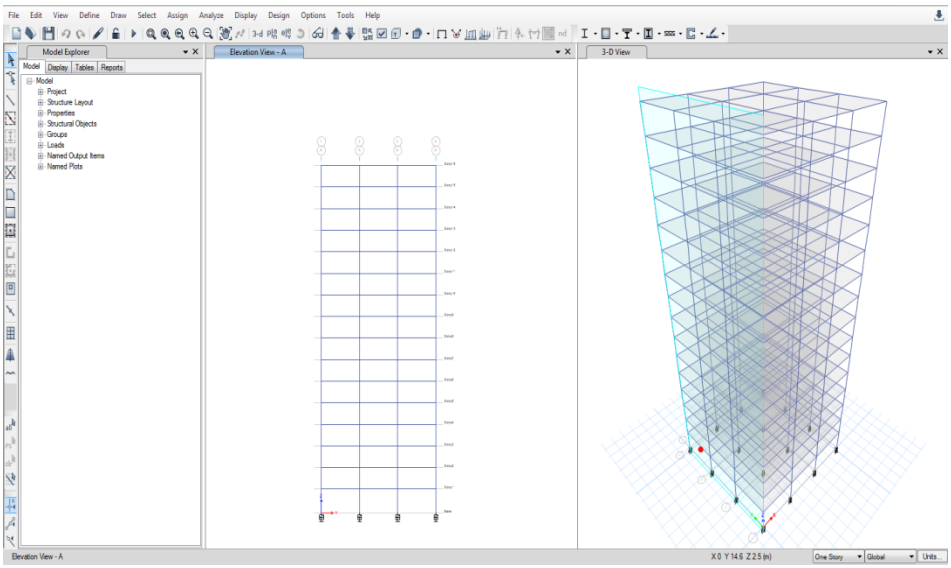

Figure 5.Model D: Elevation of G+16 with LRB Base Isolator

5. Results and Discussions

A. *Storey shear*

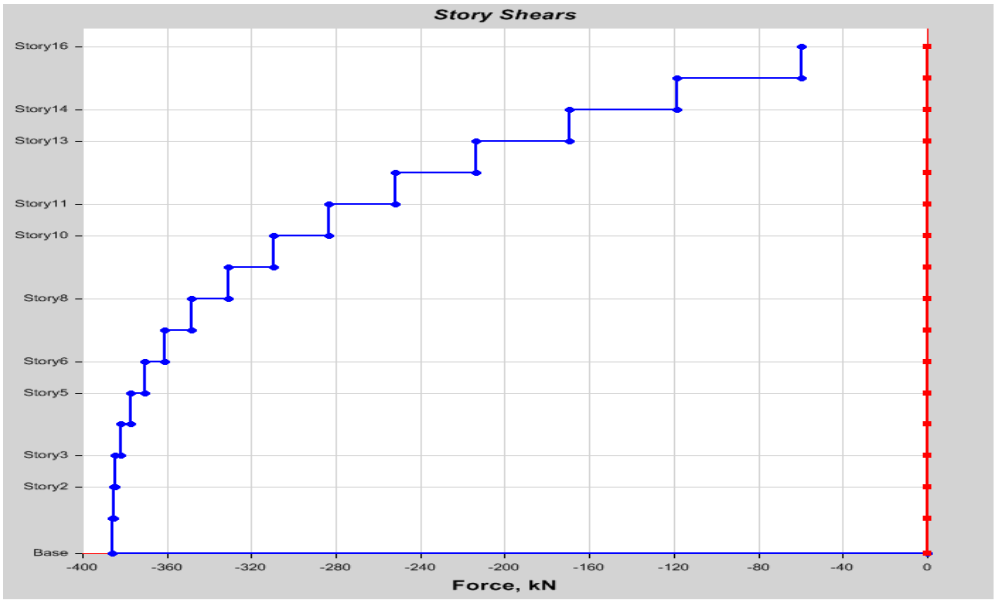

Figure 6. Storey Shears for G+16 model with L.R.B for E.Q. X direction

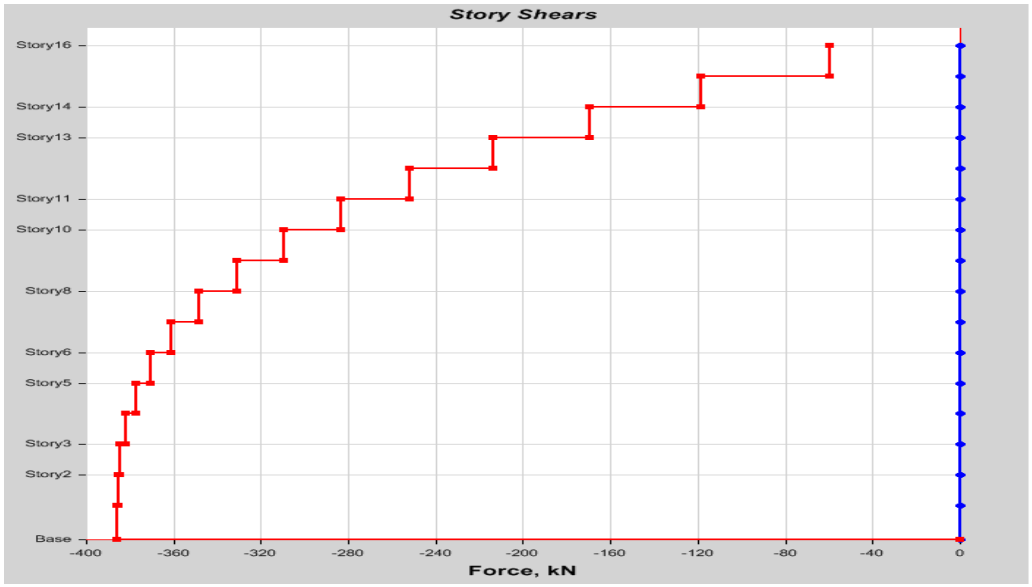

Figure 7. Storey Shears for G+16 model with L.R.B for E.Q. Y direction

Storey shears are diagrams showing how parallel (read: uniform) loads, wind or seismic, act on a plot. The lower you go, the more noticeable the shift is (see image below the shift plot below). The story float is again the next float chart on each floor. Storey shears with L.R.B for G+16 model is lesser than G+16 model without L.R.B. From the above Fig.6&7 it was observed that storey shear was same in both E.Q .X and Y direction.

B. *Storey drift*

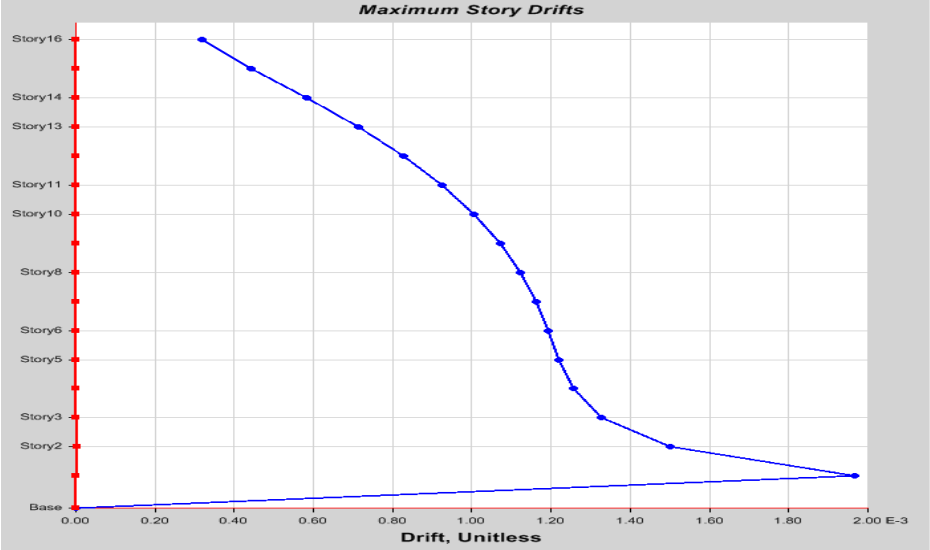

Figure 8. Storey Drifts for G+16 model without L.R.B for E.Q. X direction

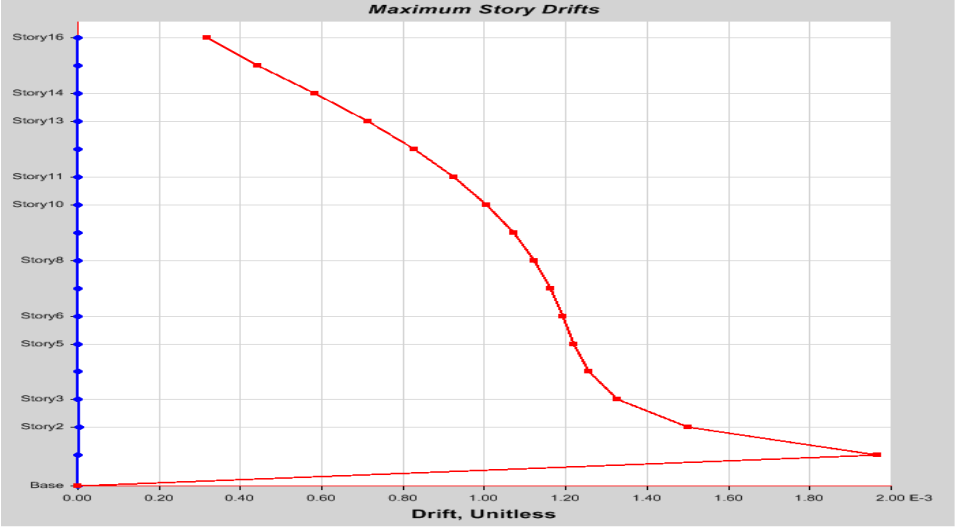

Figure 9. Storey Drifts for G+16 model without L.R.B for E.Q. Y direction

Story drift is the sidelong relocation of one level comparative with the level above or beneath. Story drift ratio is the story float isolated by the story tallness. Storey drifts without L.R.B for G+16 model is more than G+16 model with L.R.B. From the above Fig.8&9 it was observed that storey drifts were same in both E.Q .X and Y direction.

C. *Storey Displacements*

Storey displacement is all out dislodging of ith story regarding ground and there is greatest admissible cut-off recommended in IS codes for structures. Storey displacements with L.R.B for G+8 model is higher than G+8 model without L.R.B. From the above Fig.10& 11 it was observed that storey displacements were same in both E.Q .X and Y direction.

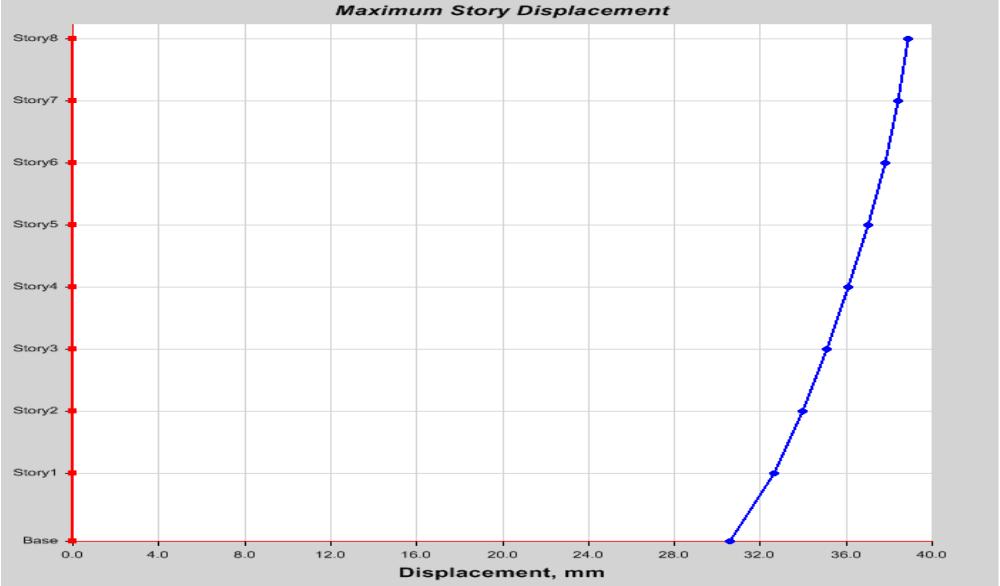

Figure 10. Storey Displacements for G+8 model with L.R.B for E.Q. X dir.

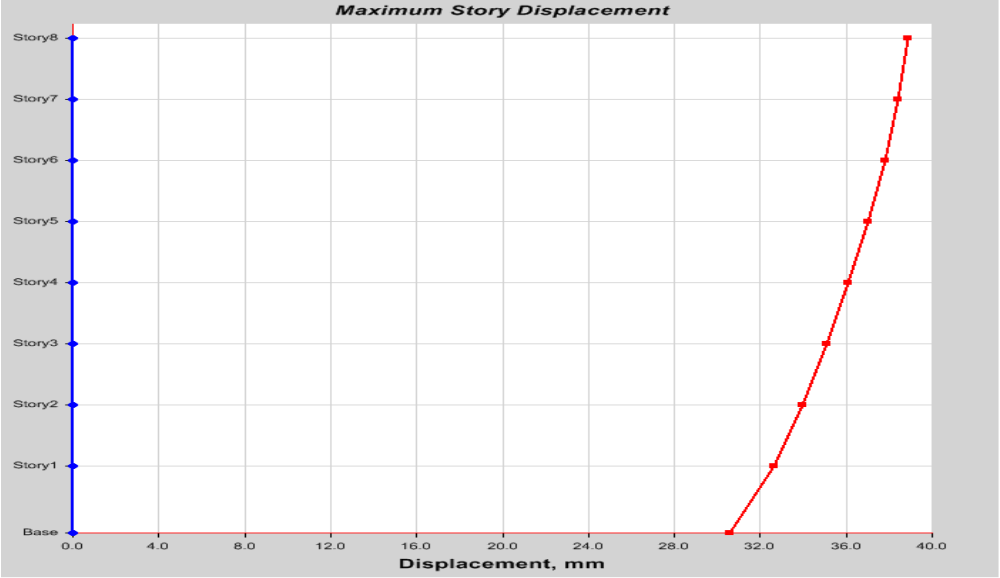

Figure 11. Storey Displacements for G+8 model with L.R.B for E.Q. Y dir.

D. *Overturning moments*

The Overturning Moment is taken as the measure of the minutes on the segment and any shear on the fragment expanded by the great ways from the base of the section to the base of the equilibrium. If there is lift on the part, by then the second associated with that center point load is furthermore considered in the Overturning Moment. Overturning Moments without L.R.B for G+8 model is higher than G+8 model with L.R.B. From the above Fig.12 & 13 it was observed that Overturning Moment was same in both E.Q .X and Y direction.

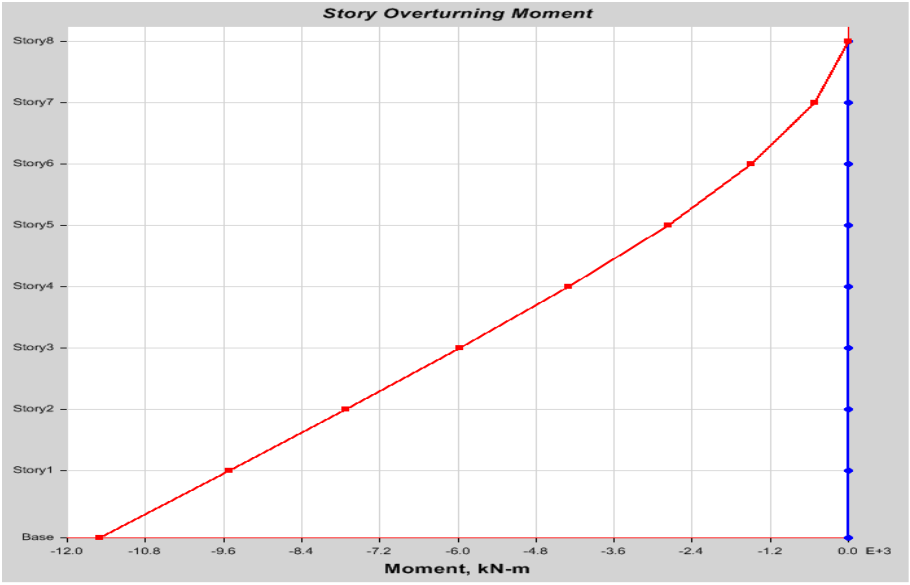

Figure 12. Overturning Moments for G+8 model without L.R.B for E.Q .X dir.

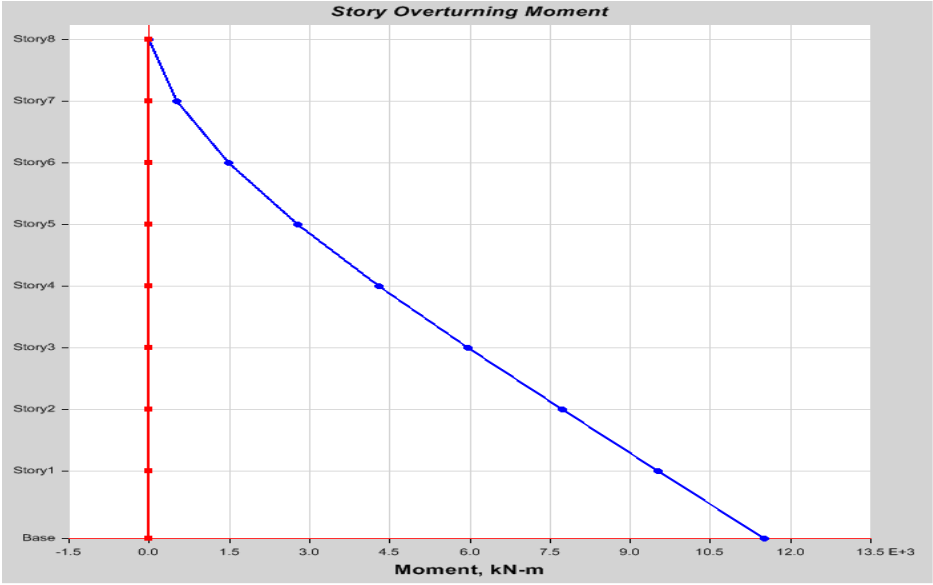

Figure 13. Overturning Moments for G+8 model without L.R.B for E.Q. Y dir.

6. Conclusions

The conclusions drawn from the analysis of G+8 and G+16 buildings with and without LRB are as follows

1. As the storeys increases storey displacements, drifts, overturning moments and base shears increases.
2. Storey displacements are increased in the wake ofgiving LRB which is important to make a structure flexible during earthquake.
3. Overturning moments of G+8 and G+16 buildings with LRB are 68% and 40% lesser than the G+8 and G+16 buildings without LRB respectively.
4. Storey displacements of G+8 and G+16 buildings with LRB are 49% and 66% higher than the G+8 and G+16 buildings without LRB respectively.

5. Storey drifts of G+8 and G+16 buildings with LRB are 25% and 30% lesser than the G+8 and G+16 buildings without LRB respectively.
6. Storey shears of G+8 and G+16 buildings with LRB are 69% and 40% lesser than the G+8 and G+16 buildings without LRB respectively.
7. The maximum base shears values of G+8 and G+16 buildings with LRB are 73% and 92.4% lesser than the G+8 and G+16 buildings without LRB respectively.
8. At long last,it is inferred that after LRB is given as base isolation system it increases the structures steadiness against earthquake and diminishes reinforcement subsequently make structure economical.

7. References

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