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# Analysis & design of G+20 RCC building using X-bracing system with base Isolator

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*Abstract: Most of the reinforced concrete buildings failed due to earthquake strikes in that region. So, it is important to choose an effective lateral load resisting system. In the RCC frame, greater importance is given to making the structure safe against lateral load. To resist lateral load acting on the building different types of steel and RCC bracing systems are provided. Bracing systems have a significant effect on the performance of the structure. The use of RCC bracing has a potential advantage over other bracing like steel bracing is economical, easy to erect, occupies less space, and has the flexibility to design for meeting the required strength, stiffness, and stability. A present study aimed to evaluate the different types of bracing systems such as X, V, Inverted V, and Diagonal bracing for G+20 story reinforced concrete buildings, and provide a Base isolation system to prevent & minimize damage to building an earthquake. This technology can be used for both new structure design & seismic retrofit. On this basis prepare a model by using ETABS software. The results of the various bracing system such as X, V, Inverted V, and Diagonal bracing were compared with the bare frame, and V and Inverted V were compared with different methods on E-TAB software. The results showed that X and Inverted V braced frames are more efficient and safer at the time of the earthquake. Using X-bracing proved to be a safe method for building against collapse. Story shear is reduced after the LRB & X-bracing are provided as a base isolation system. Base shear is also reduced after providing LRB & X-bracing which makes the structure stable during earthquakes. Point displacements are increased in every story after providing LRB & X-bracing. Finally, it is concluded that after LRB & X-bracing is provided as a base isolation system it increases the structural stability against earthquakes and reduces reinforcement.*

***Keywords*** **– Bracings, Base Isolation, Etabs, Design.**

## I. INTRODUCTION

II. India at present is a fast-developing country that requires demands in an increase in infrastructure facilities along with the growth of population. Due to the increased population, the demand for land for housing is increasing day by day. To fulfill the need for land for housing and other commercial offices, vertical development that is multi-story buildings are the only option. These buildings are highly susceptible to additional lateral loads due to earthquakes and wind. In broad, as the elevation of building increases, its reaction to lateral loads increases. Reinforced concrete buildings are vulnerable to excessive deformation, which necessitates the introduction of special measures to decrease this deformation. Steel braced frame is one of the lateral loads opposing frameworks in multi-stored structures. The steel bracing system enhances the resisting of the structure against horizontal forces by expanding its stiffness and stability. Bracings hold the structure stable by exchanging the horizontal loads, for example, earthquake or wind burdens down to the ground and oppose side long loads, in that way keep the influence of the structure. Steel bracing members in RC buildings in conservative, simple to set up, involve less space, and give obliged quality and inflexibility. Human has been fighting various natural disasters like cyclones, earthquakes, floods, volcanic eruptions, etc., which causes enormous losses to life and property. To fight against these disasters, technologies like developing a warning system for disaster, adopting prevention measures, etc., have improved. It comes suddenly for seconds and causes low, medium, and huge loss of life and property depending on the magnitude of the earthquake. It can be controlled but cannot be completely avoided. So, preventing earthquakes and reducing strategies is a global concern today. The rivalry headed for new heights is impossible without challenges. When the height of the building increases, the toughness of the structure becomes more significant.

**Objectives: -**

1) To study G+20 RCC building with different types of bracing by the base isolator.
2) To identify the suitable bracing system to resist the lateral loads effectively.
3) To prepare the model of the RCC building in E-TAB software.
4) To analyze the RCC structure with a different type of bracing system.
5) To design the structure and compare it with the base shear, Drift, and displacement.

## III. LITERATURE REVIEW AND SUMMARY

From this literature review, we studied the detailed concept of the bracing system and its different subtypes. Papers give an idea about the methodology and design consideration for modeling and analyzing structures in ETABS and parameters which need to consider to compare the results of the analysis.

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## IV. METHODOLOGY

**Bracing: -**

A braced frame in a structural system that is designed primarily to resist wind and earthquake forces. The bracing is made of crossed diagonals when it is designed to resist only tension. Based on the direction of the wind, one diagonal takes all the tension while the other diagonal is assumed to remain inactive. One of the most common arrangements is cross bracing. There are other types of bracing systems like V and inverted V type bracing.

1. Diagonal bracing
2. V-bracing
3. Inverted V-bracing
4. X-bracing

**Base Isolation: -**

The base isolation system is a method of seismic protection where the structure (superstructure) is separated from the base (foundation or substructure). By separating the structure from its base, the amount of energy that is transferred to the superstructure during an earthquake is reduced significantly. There are two types of base isolation-

Elastomeric bearing isolation: - Elastomeric bearing is the most widely used base isolator. This isolation system consists of a layer either made of natural or synthetic rubber sandwiched between the mild steel plates.

Sliding isolation bearing: - Base isolation systems are Elastomeric Bearing, Sliding Isolation systems, and Combined Systems. The elastomeric bearing has a problem of tearing rubber under severe earthquakes. A sliding isolation system consists of deflecting the earthquake energy by incorporating a flexible device between the foundation and superstructure.**ETABS: -**

ETABS is the ultimate integrated software package for the structural analysis and design of buildings. From the start of design conception through the production of schematic drawings, ETABS integrates every aspect of the engineering design process. ETABS offers advanced finite element analysis and designing tools for structural engineers. CAD drawings can be converted directly into ETABS models. ETABS provides advanced tools for structural engineers for designing buildings, whether they are working on one-story industrial structures or the tallest commercial high-rises.

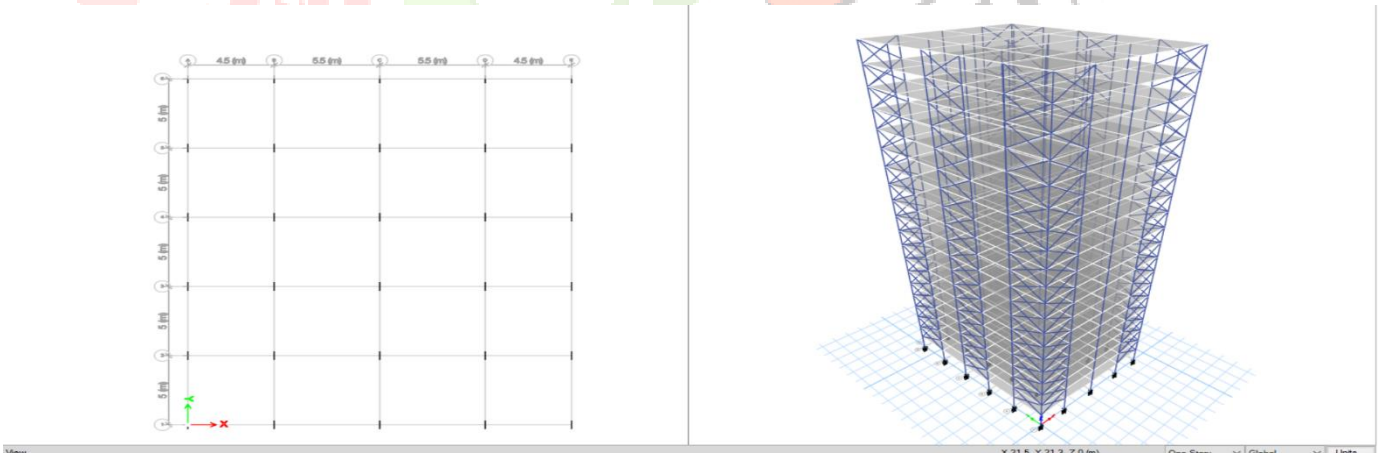


**Photo no.1 Model of building in Etabs.**

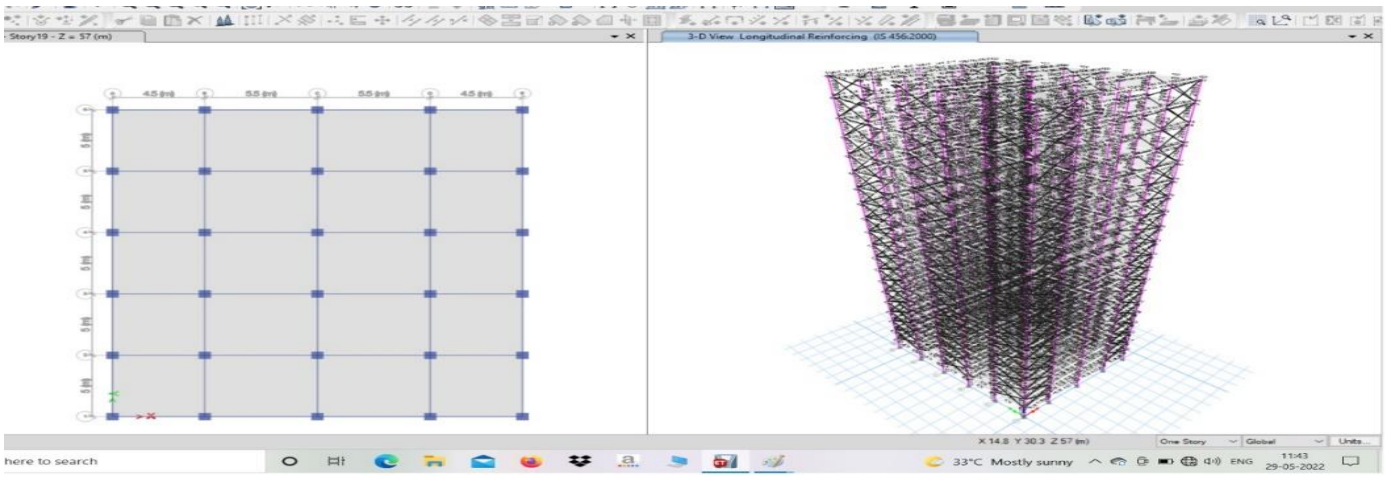


**Photo no.2 Model design with base isolator in Etabs**

**Base Isolation calculation: - (According to UBC 1997)**

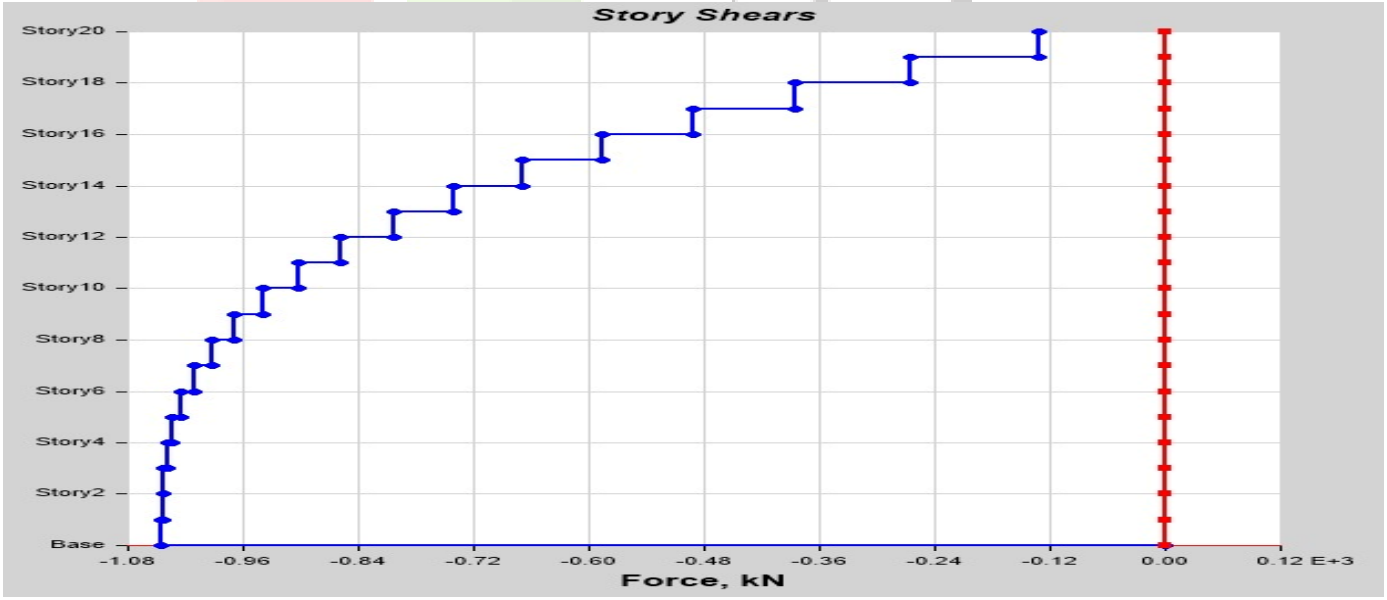
Seismic zone factor (Z) = Zone 3
Soil Profile Type = Sc

| | |
|---|---|
| Rotational Inertia | 114.98kN/m |
| For U1 Effective Stiffness | 3235.28kN/m |
| For U2 & U3 Effective Stiffness | 3232.96kN/m |
| For U2 &U3 Effective Damping | 0.05 |
| Yield Stiffness Ratio | 0.1 |
| Yield Strength | 2.187kN |

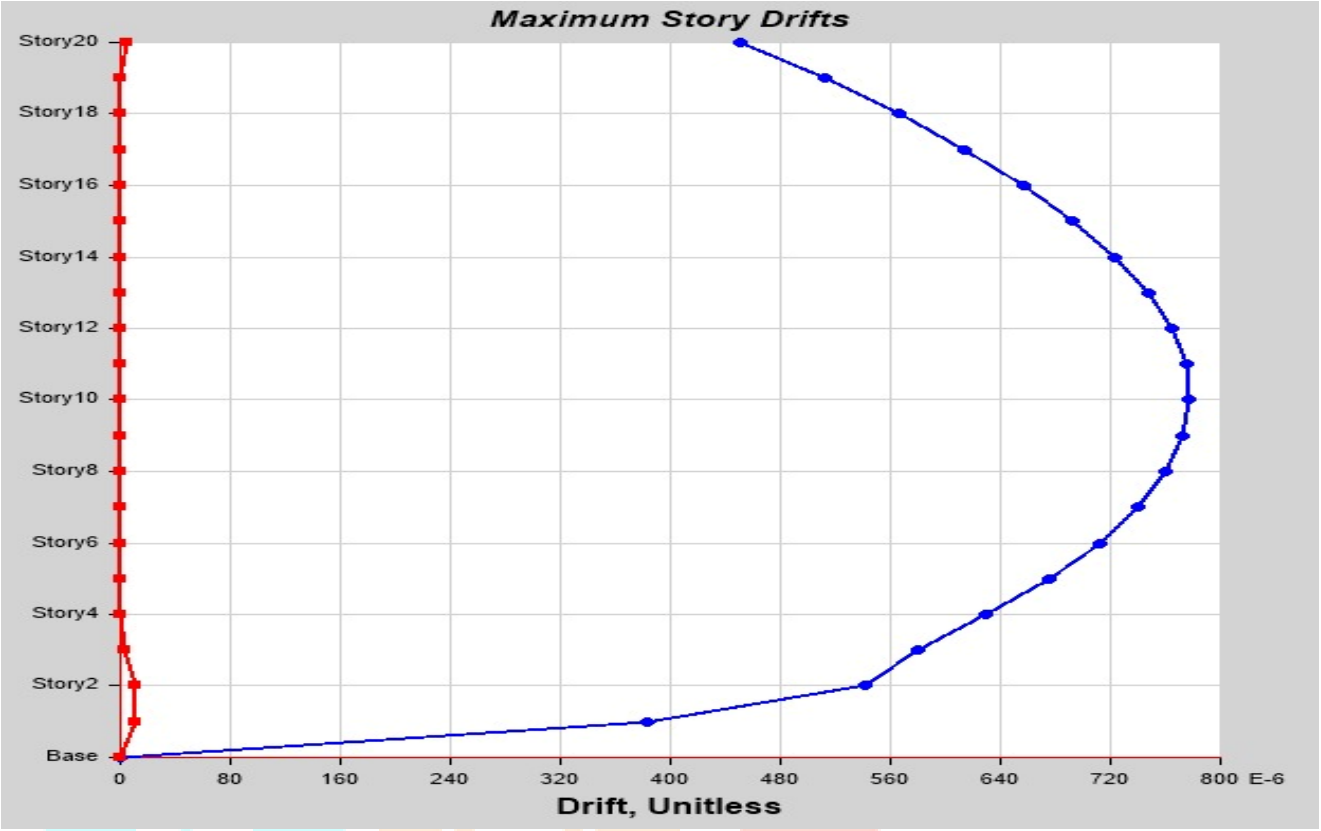
## IV. RESULT AND DISCUSSION

We design a G+20 RCC building and we design two models. The first model is seismic design (X-bracing with a simple foundation). The second model is the LRB design (X-bracing with base isolator). Thus, after comparing both of these methods, we have arrived at the conclusion that X-bracing with a base isolator was found to be more effective than the X-bracing with a simple foundation.

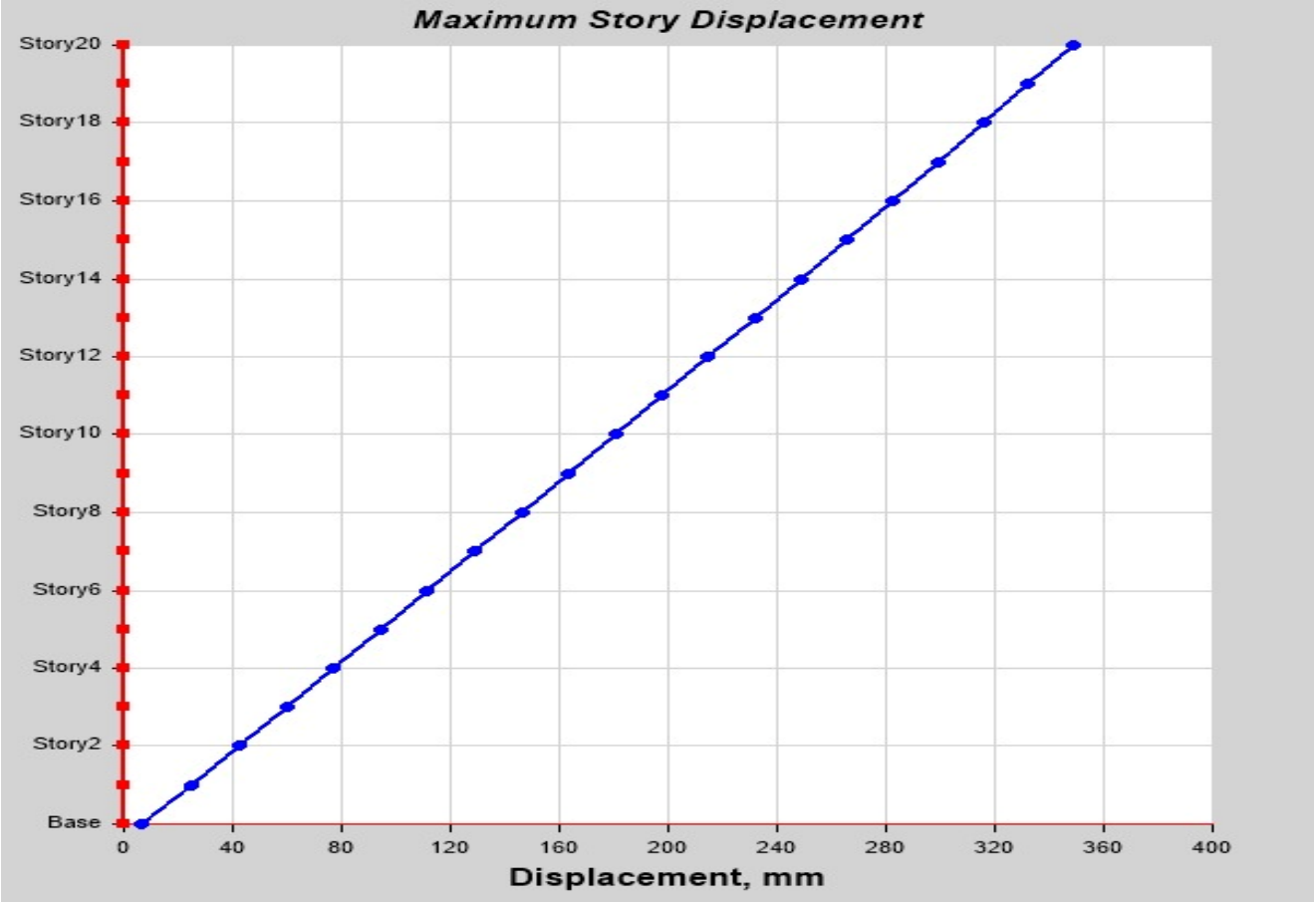
LRB & X- bracing model will be shown more displacement for flexible support but the variation in the maximum displacement of stories in the base-isolated model is very low compared with the fixed base model.



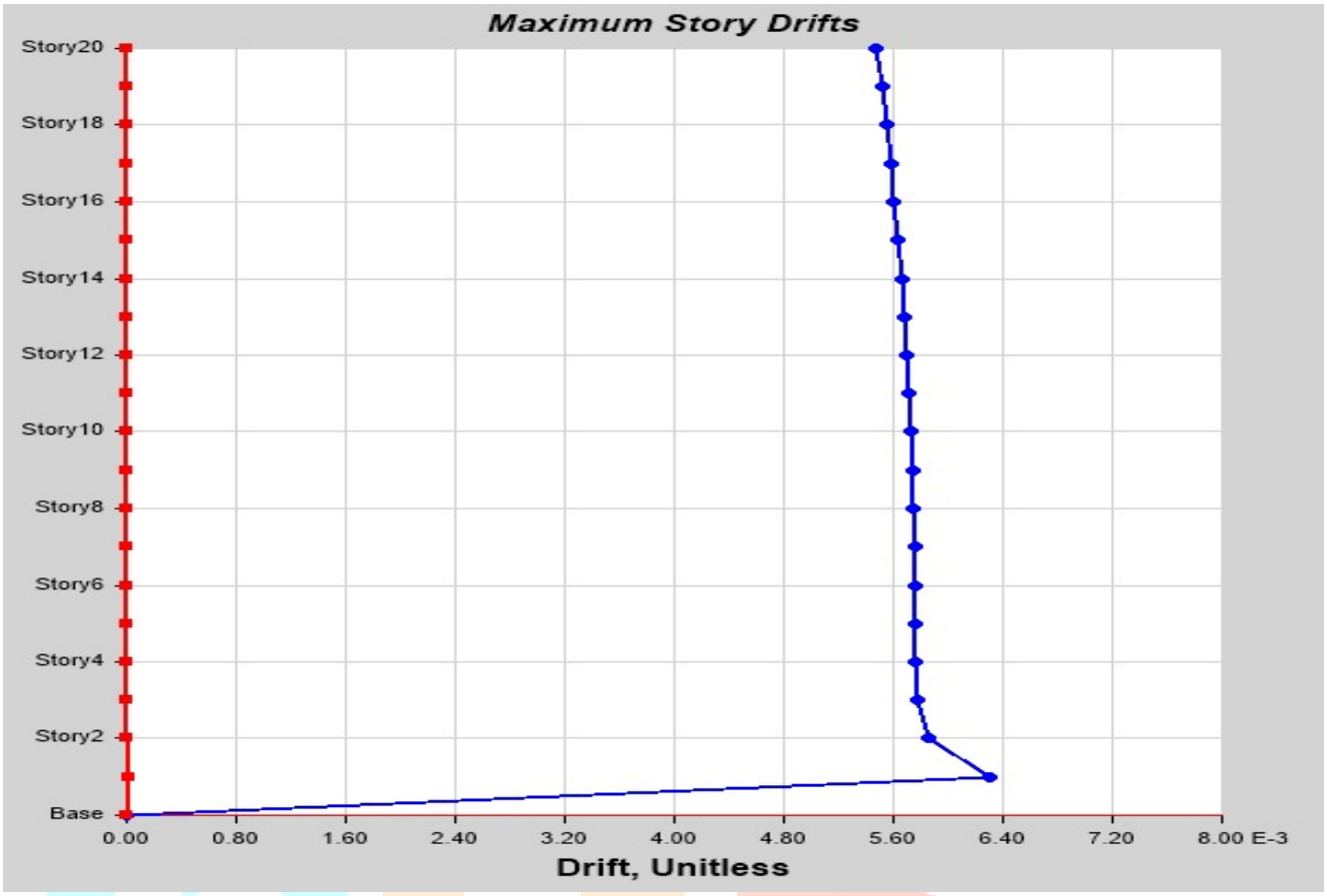

**GRAPH NO.1 Story shears (Seismic building)**



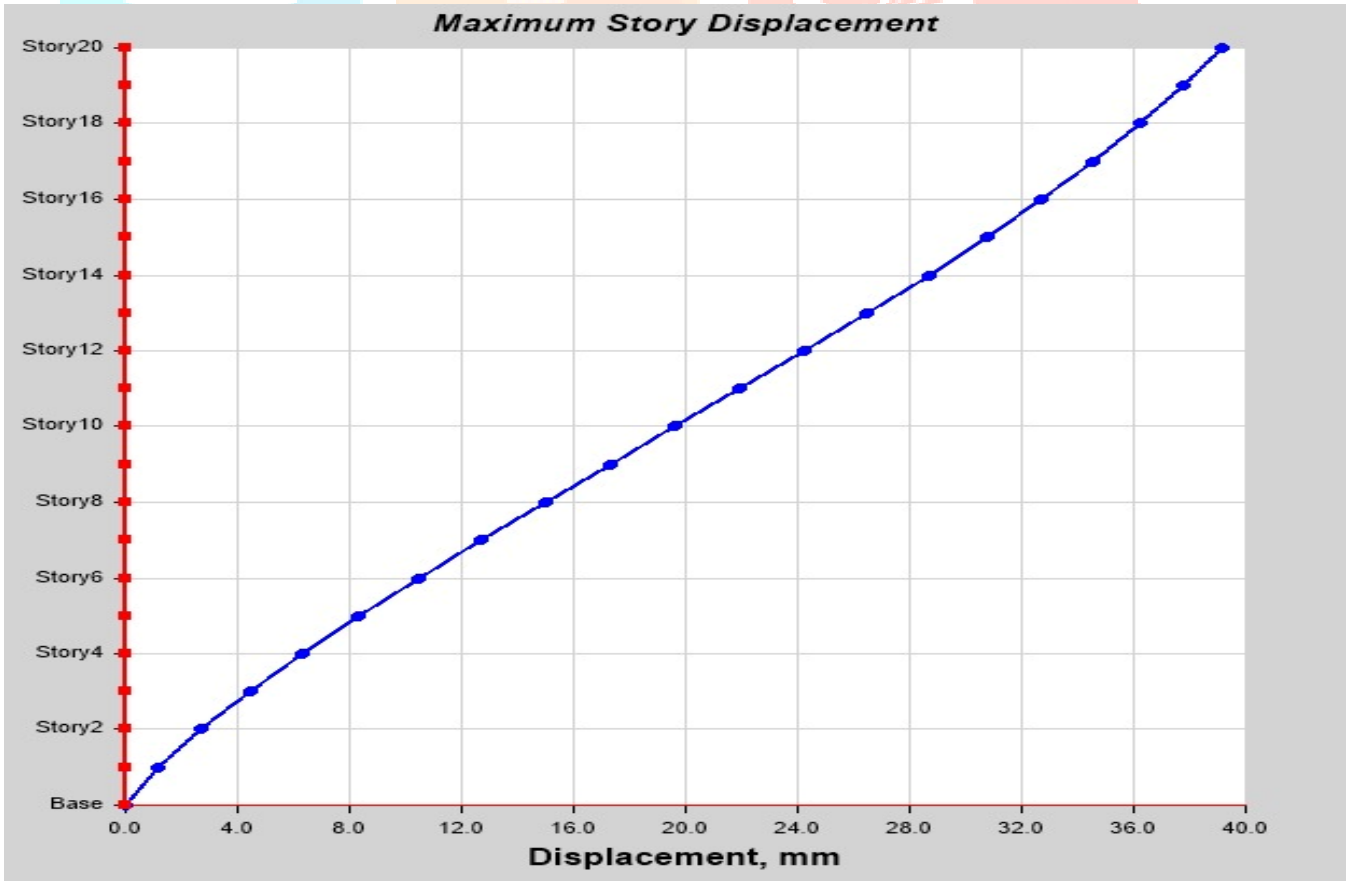

**GRAPH NO.2 Maximum Story Drifts (Seismic building)**



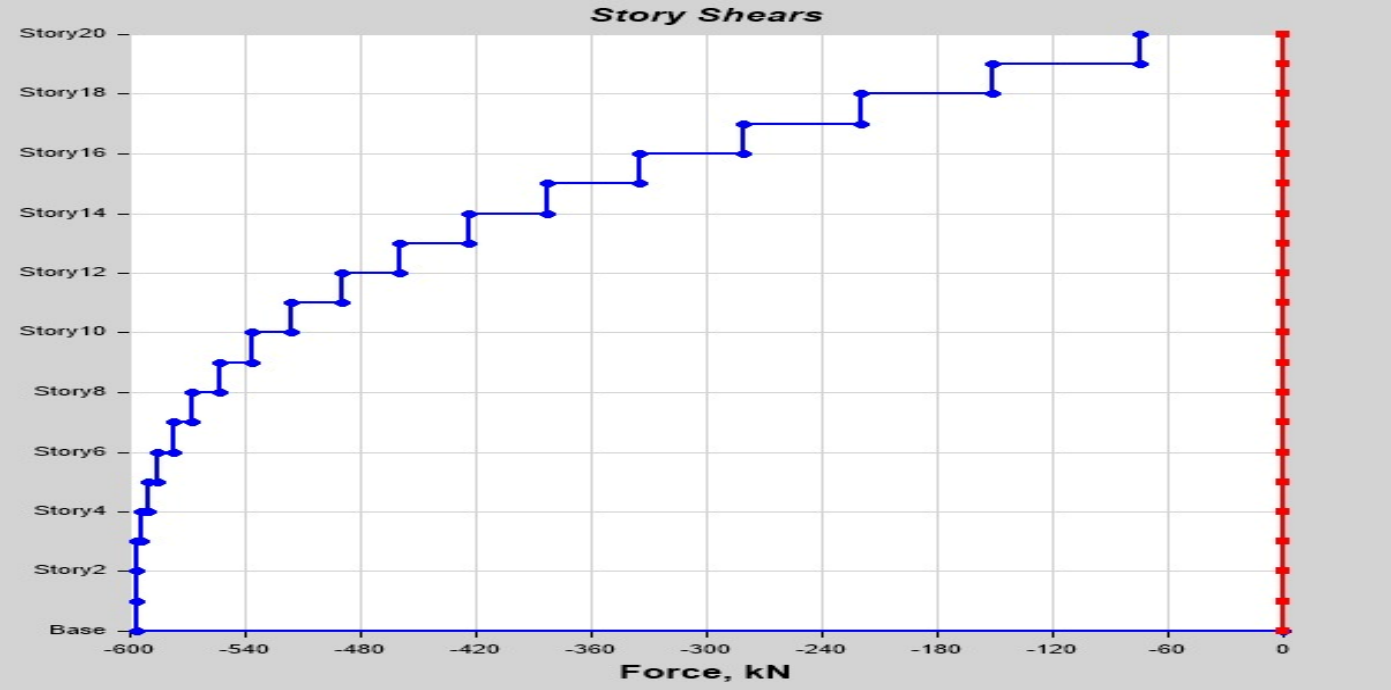

**GRAPH NO.3 Maximum Story Displacements (Seismic building)**




**GRAPH NO. 4 Maximum Story Drifts (LRB building)**




**GRAPH NO. 5 Maximum Story Displacements (LRB building)**




**GRAPH NO. 6 Story Shears (LRB building)**

## CONCLUSION

1. After using X-bracing proved to be a safe method for building against collapse.
2. Story shear is reduced after the LRB & X-bracing are provided as a base isolation system.
3. Base shear is also reduced after providing LRB & X-bracing which makes the structure stable during an earthquake.
4. Point displacements are increased in every story after providing LRB & X-bracing.
5. Finally, it is concluded that after LRB & X-bracing is provided as a base isolation system it increases the structural stability against earthquake and reduces reinforcement.

## [2] ACKNOWLEDGMENT

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