

EISMIC EVALUATION OF DIFFERENT TECHNIQUES IN HIGH RISE STRUCTURES USING ETABS SOFTWARE

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ABSTRACT

Over the millennia earthquakes have had devastating implications on human life. In the recent time increased construction activities owing to various emerging technologies have accelerated the pace of growth of anthropogenic activity paving way for inclusive growth for all. But these constructions are always vulnerable to the risk of seismic activity as can be seen due to large number of recent disastrous earthquakes world over. So it becomes imperative for us to analyze the behavior of tall structures when subjected to severe ground motion popularly referred to as tremors and also earthquakes.

In this project we provide friction dampers, shear wall, V-bracings and X-bracings for a regular and symmetrical structure of plan area 18mX18m and perform seismic analysis for all of them in zone V. Seismic dampers are used to dampen buildings oscillations during an earthquake. One of the seismic dampers is friction damper which has moving parts that slip during an earthquake. Ultra durable V and X bracings are used primarily to increase a building capacity to withstand seismic activity. A shear wall is a vertical portion of a resistant seismic force system designed to withstand lateral forces in the plane, usually wind and seismic loads.

To check and analyze seismic impact ETABS software is used. The ETABS software is primarily used as a construction instrument for gravity and seismic analysis of High Rise buildings. It is an engineering software product that addresses the study and construction of a multi storey building. For analyzing the five structures response spectrum method is followed and results are extracted. The storey responses like storey displacements, storey drifts and storey shears are evaluated from the analysis. From the results a comparative study is carried out to know the most efficient technique for a tall structure (G+25) when subjected to seismic loads. From the conclusions it is clear that all the techniques have their benefits but they should be used depending upon the soil conditions and seismic zone conditions.

Keywords: Seismic analysis, ETABS, plain structure, dampers, shear wall, V-bracings, X-bracings, response spectrum, storey displacements, storey drifts and storey shears

I.INTRODUCTION

1.1 General Introduction

The world's urban population is growing at very faster rate. Currently, about half of the world's population is living in urban areas. In the coming decades, urban dwellers will make up roughly 60 to 70 percent of the world's population. Though the urban population is growing at an alarming rate, the land available for construction is limited. Increasing population coupled with urbanization has made the construction of multi-storey buildings a necessity to house the millions. Housing the millions is possible only by constructing multi-storey buildings. As The height of building increases, the behavior of the structure becomes more complex, these are more sensitive to wind and earthquake loads and hence, we need to be very careful to design them. Reinforced concrete is the best suited for multi-storey buildings. It has occupied a special place in the modern construction due to its several advantages. Owing to its flexibility in form and superiority in performance, it has replaced the earlier materials like stone, timber and steel. It has helped the engineers and architects to build pleasing structures. However, its role in several straight-line structural forms like, multi-storey building and bridges etc. is enormous. The unsymmetrical buildings require great attention in the analysis and design under the action of seismic excitation.

An earthquake is a natural way for the Earth to relieve itself of stress. Earth's upper mantle is under pressure as plates move against each other (lithosphere). The lithosphere cracks or moves under the weight of this stress. Plates on the Earth's surface move and exert pressure on one other. The crust will crack if the force is great enough. Earthquakes occur when seismic waves flow through the Earth as a result of tension being released during an earthquake.

A small area Faulting is a term used to describe the process of a rock breaking apart and releasing its energy. Seismic waves, which move at speeds of up to 14 kilometers per second, are generated as a result of these vibrations. The fastest waves might travel 13,000 kilometers to the opposite side of the Earth in about 20 minutes if they went right through its center. After the waves have passed through, the rock returns to its former shape. Epicenter: The spot-on Earth's surface where an earthquake originated is known as a quake's epicenter. Because rocks are no longer rigid at high pressures and temperatures, they can't hold tension because they act plastically. This is why earthquakes don't occur deeper than this. Smaller earthquakes are more common, and most of them cause little or minimal damage. An adjustment period of many months may be necessary if a big earthquake is followed by a series of lesser aftershocks and modest faulting. Nowadays, a plethora of methods are employed to mitigate the effects of earthquakes. Here are a few of them:

1.2 Dampers

1.2.1 Tuned Mass Dampers:

Tuned mass dampers have been widely employed in mechanical engineering systems for vibration control. Tuned Mass Dampers theory has been used in recent years to minimise vibrations in tall buildings and other civil engineering projects. Dynamic absorbers and tuned mass dampers are the structural vibration management applications of tuned absorbers and tuned dampers. In such devices, the inertial, resilient, and dissipative elements are: mass, spring, and dashpot (or material damping) for linear applications, and their rotating equivalents for rotational applications. These devices range in size from a few ounces (grams) to many tonnes, depending on the use.. Other configurations such as pendulum absorbers/dampers, and sloshing liquid absorbers/dampers have also been realized for vibration mitigation applications.

Tuned Mass Dampers is attached to a structure in order to reduce the dynamic response of the structure. Usually 5% of critical damping can be assumed for buildings, and an increase of the damping ratio causes a reduction of the stress or acceleration.

A tuned mass damper is a device that is mounted to a structure and consists of a mass, a spring, and a damper to lower the amplitude of undesired motion. In the event of an earthquake, tuned mass control systems can be used to regulate the displacements, accelerations, and internal stress variables of a structure. The position of the Tuned Mass Dampers on the structure is critical. For huge contemporary constructions, there are several sorts of control mechanisms.

Tuned mass damper systems are widely used for the reduction of vibration caused by wind and traffic like pedestrians or railway trains. Typical structures like slender bridges, stacks, high and slender buildings possess low levels of damping and may therefore undergo unacceptable vibration. Tuned Mass Dampers cause control effects which are similar to the increase of damping. Depending on the mass ratio, the tuning frequency and the damping capability the amplitude reduction can be very significant and achieve values of about 10 to 20% of the figures without Tuned Mass Dampers. The mass, stiffness and damping ratio has chosen according different criteria.

1.2.2 Friction dampers:

Friction is another good energy dissipation mechanism that has been employed in car brakes for many years to disperse kinetic energy of motion. To prevent introducing high frequency excitation, it is critical to limit stick-slip phenomena in the creation of friction dampers. Furthermore, appropriate materials must be used to ensure a constant coefficient of friction across the device's specified life. The Pall device is one of the friction-based damper components that may be fitted in a structure with an X-braced frame, as

shown in the image

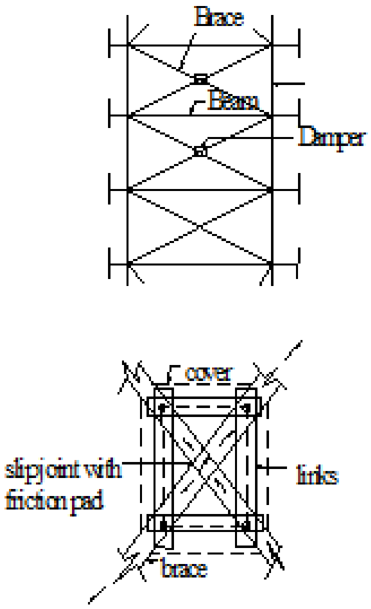


Figure 1: Friction Damper

1.2.3 Visco-elastic dampers:

The metallic and frictional devices described are primarily intended for seismic application. But, visco-elastic dampers find application in both wind and seismic application. Their application in civil engineering structures began in 1969 when approximately 10,000 visco-elastic dampers were installed in each of the twin towers of the World Trade Center in New York to reduce wind-induced vibrations. Further studies on the dynamic response of visco-elastic dampers have been carried out, and the results show that they can also be effectively used in reducing structural response due to large range of intensity levels of earthquake. Visco-elastic materials used in civil engineering structure are typical copolymers or glassy substances. A typical visco-elastic damper, developed by the 3M Company Inc., is shown in Fig. It consists of visco-elastic layers bonded with steel plates.

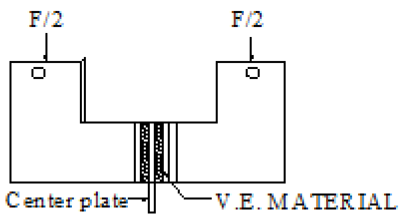


Figure 2: Visco-elastic damper

1.2.4 Tuned liquid damper:

A properly designed partially filled water tank can be utilized as a vibration absorber to reduce the dynamic motion of a structure and is referred to as a tuned liquid damper (TLD). Tuned liquid damper (TLD) and tuned liquid column damper (TLCD) impart indirect damping to the system and thus improve structural performance (Kareem 1994). A TLD absorbs structural energy by means of viscous actions of the fluid and wave breaking.

Tuned liquid column dampers (TLCDs) are a special type of tuned liquid damper (TLD) that rely on the motion of the liquid column in a U-shaped tube to counter act the action of external forces acting on the structure. The inherent damping is introduced in the oscillating liquid column through an orifice.

The performance of a single-degree-of-freedom structure with a TLD subjected to sinusoidal excitations was investigated by Sun(1991), along with its application to the suppression of wind induced vibration by Wakahara et al. (1989). Welt and Modi (1989) were one of the first to suggest the usage of a TLD in buildings to reduce overall response during strong wind or earthquakes.

1.2.5 SimplePassiveDampers:

Simple passive dampers, including viscous, friction, and visco-elastic systems, rely on a damper mounted between a vibrating structure and a stationary object to dissipate vibration energy as heat. As the two systems move relative to each other, the simple passive damper is stretched and compressed, reducing the vibrations of the structure by increasing its effecting damping. At the Terrace, there was no non-moving element nearby to attach a damper to, so these systems were rejected.

1.2.6 Metallic yield dampers:

One of the effective mechanisms available for the dissipation of energy, input to a structure from an earthquake is through inelastic deformation of metals. The idea of using metallic energy dissipaters within a structure to absorb a large portion of the seismic energy began with the conceptual and experimental work of Kelly et al. (1972) and Skinner et al. (1975). Several of the devices considered include torsional beams, flexural beams, and V-strip energy dissipaters. Many of these devices use mild steel plates with triangular or hourglass shapes so that yielding is spread almost uniformly throughout the material. A typical X-shaped plate damper or added damping and stiffness (ADAS) device is shown in Figure 3.

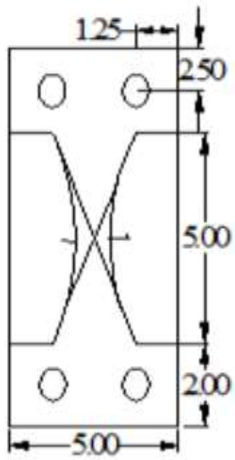


Figure 3: X-shaped ADAS device

1.2.7 Classification of Control Methods:

1.2.7.1 Active Control:

An active control system is one that uses an external power source to power the control actuators, which apply forces to the structure in a predetermined manner. These forces have the ability to both add and drain energy from the structure. The signals provided to the control actuators in an active feedback control system are a function of the system reaction as measured by physical sensors (optical, mechanical, electrical, chemical, and so on).

Advantages and limitations: The performance of active control is quite pronounced in some cases. Due to its capability to respond in real-time, active control eliminates most of the tuning drawbacks inherent in passive devices. However, active control has not been exuberantly embraced by the civil engineering community as a result of some significant limitations.

Most significant advantage of active control method is diminishes by their heavy reliance on external power supplies. The power consumption and cost is comparatively large for output of certain magnitude forces necessary to control large civil structures by the actuator. Additionally, there may be situation at which the control forces are needed coincides with the 5 time when the power cut is the most likely, such as during an earthquake or large wind storm. This raises question on reliability concerns.

Beyond the issue of energy supply, engineers also hesitate to embrace non-traditional technologies for structures. It is difficult for professional engineers to know where to position sensors and how to construct feedback mechanisms, and a badly built active system can lead to harmful energy inputs and system instability.

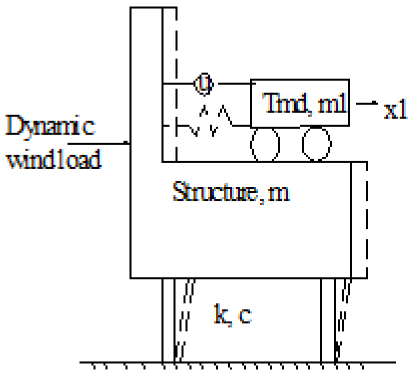


Figure 4: Active control system

1.3 Shear wall:

Shear walls are vertical components of the system that resists horizontal forces. Shear walls are used to protect structures from the effects of lateral loads. Shear walls are straight external walls that often create a box that provides all of the building's lateral support. When shear walls are correctly planned and built, they will have the strength and stiffness necessary to resist horizontal forces.

In building construction, a robust vertical diaphragm capable of transmitting lateral pressures parallel to the planes of external walls, floors, and roofs to the underlying foundation. A reinforced concrete wall or a vertical truss are two examples. In addition to the weight of the building and occupants, lateral pressures induced by wind, earthquakes, and uneven settlement loads create severe twisting (torsion) forces. These forces have the ability to actually rip (shear) a structure apart. By joining or enclosing a stiff wall within a frame, you can retain the form of the frame and prevent rotation at the joints. Shear walls are critical in high-rise structures that are susceptible to lateral wind and seismic stresses.

Shear walls have become an integral element of mid- and high-rise residential structures over the last two decades. As part of an earthquake-resistant building design, these walls are incorporated into the structure's blueprints to minimize lateral displacements during an earthquake. As a result, shear-wall frame structures are formed.

Typically, shear wall structures have a regular layout and elevation. However, in certain structures, the lower levels are used for commercial purposes, and the buildings' plan measurements on those floors are bigger. In certain circumstances, there are setbacks at higher storey levels. Shear wall structures are frequently utilized for residential reasons and may accommodate between 100 and 500 people per structure.

1.4 Bracing Systems:

The resistance to horizontal forces is provided by two bracing systems:

1.4.1 Vertical bracing

Bracing between column lines (in vertical planes) provides load paths for the transference of horizontal forces to ground level. Framed buildings require at least three planes of vertical bracing to brace both directions in plan and to resist torsion about a vertical axis.

1.4.2 Horizontal bracing

The bracing at each floor (in horizontal planes) provides load paths for the transference of horizontal forces to the planes of vertical bracing. Horizontal bracing is needed at each floor level, however, the floor system itself may provide sufficient resistance. Roofs may require bracing.

1.5 Need of the Study:

An earthquake is a tremor of the earth's surface usually triggered by the release of underground stress along fault lines. The earthquake imposes several types of dynamic loads. The greatest dynamic load is the inertia load caused by the response of the concrete mass to ground accelerations. The behaviour of the structure depends on the way the structure absorbs the energy transmitted to it by an earthquake and the maximum amount of motion or energy the structure can sustain. The need for exploring various control devices which help in controlling the seismic response of buildings has come due to the damage and collapse of numerous concrete structures during recent earthquakes.

1.6 Objectives of the Study:

The Primary objectives of the present study are as follows:

- To analyze framed structures using ETABS to ascertain the seismic load carrying capacity.
- To study the seismic response of the reinforced cement concrete framed G+25 buildings with dampers, shear wall, V-bracings and X-bracings in Zone V with the help of ETABS using Response spectrum analysis.
- To evaluate the response of the building frames under seismic loads in zone V like storey displacements, storey drifts and storey shears in the structures.
- The comparative study of five types of frames is done to find out that which types of Technique is most suitable for earthquake resistant structure.

II. REVIEW OF LITERATURE

Bharat Patel (2017), They examined the base shear and lateral displacement for G+10 structures like Moment Resisting Frame (MRF), R.C.C building with V bracing (VBF) and R.C.C building with X bracing (XBF). The structures were analyzed using ETABS for Seismic Zone II. It was found that the base shear was highest in XBF and lowest in MRF. However the displacement was found for every storey for each structure, and was found that Displacement was highest in MRF and this was reduced considerably in XBF and VBF. These results concluded that XBF is the best structure in terms of safety as it has more stiffness and 61.6% reduced lateral displacement.

D E Nassani (2017), He studied the seismic behavior of steel structures without bracing system and with a various bracing systems. They also provide the comparative assessment of steel frames with different bracing systems under seismic load. The study include diagonal bracing, X bracing, Chevron bracing and V bracing composition. In their research, they analyze a total of 30 high rise 2-D steel building frames in terms of capacity curves, base shear and plasticization using pushover analysis. They use time history analysis to evaluate drift ratio, global damage index, storey displacement and roof displacement time history. The research describes the improvement in seismic resistance, effective reduction in drift and the results of time history analysis and pushover analysis were similar.

III. METHODOLOGY

3.1 General Introduction:

There is a significant demand for tall buildings worldwide as a result of increased urbanisation and population growth, and earthquakes have the potential to do the most damage to such tall structures. Due to the random and unexpected character of earthquake forces, engineering tools for studying buildings subjected to their action must be refined. Earthquake loads must be thoroughly studied in order to accurately predict the true behaviour of structures with the idea that damage is inevitable but should be managed. Earthquakes produce varying degrees of shaking in different areas, and the damage to structures in these sites varies as well. Thus, it is required to create a structure that is earthquake-resistant at a specified amount of shaking, rather than the magnitude of an earthquake. Even when earthquakes of comparable size occur as a consequence of their changing strength, the resulting damage is diverse in various places. As a result, it is vital to investigate and comprehend the seismic behavior of multistoreyRC framed structures under varying seismic intensities in terms of various reactions such as lateral displacements and base shear.

To determine the seismic responses it is necessary to carry out seismic analysis of the structure using different available methods. Based on the type of external action and behavior of structure, the analysis can be further classified as:

(1) Linear Static Analysis
(2) Nonlinear Static Analysis
(3) Linear Dynamic Analysis
(4) Nonlinear Dynamic Analysis

3.2 Linear Dynamic Analysis:

Linear dynamic analysis can be performed in two ways, either by the response spectrum method or by the linear time-history method.

RESPONSE SPECTRUM ANALYSIS:

Modal method: This method, also called mode superposition method, is also called mode method or mode superposition method. To use this method, you need to have a structure that has a lot of different modes that have a big effect on how it works. There are certain types of damping that are good enough to use in many buildings, so this method is based on that fact. The response in each natural mode of vibration is calculated separately and can be combined to get the total response. With each mode, there is a unique way it responds. It deforms in a specific way, at a specific frequency, and with its own modal damping. In order to figure out the time history of each modal response, you can look at an SDOF oscillator with properties that are representative of that mode and how much it is excited by the earthquake motion. Because earthquake response is mostly caused by vibrations in the first few modes, only the first few modes should be looked at. A complete modal analysis shows how a structure responds to a certain ground acceleration history. It shows how forces, displacements, and deformations change when the ground moves in a certain way. It's not always necessary to know the full history of how the structure responded to the earthquake in order to design it. The maximum response values over the course of the earthquake usually do. It's easy to figure out the maximum response in each vibration mode because the response of an SDOF oscillator can model it. Putting together the modal maxima to get an idea of the maximum of total response is possible, but it's not possible to get the exact value. In its most general form, the modal method for linear response analysis can be used with any three-dimensional structure. When designing buildings, it can be easier to keep it simple by only using it for things that move sideways in a plane. It's done for each of two orthogonal lateral directions separately, and the results of both analyses and the effects of torsional motions of the structures are combined to get the total.

Most of the time, this method can be used to look at the dynamic response of structures that aren't straight or have areas of discontinuity or irregularity in their linear range of behaviour. In particular, it can be used to look at how forces and deformations change in multi-storey buildings when the ground shakes a little. This causes the structure to move a little but mostly in the same direction.

IV.MODELLING AND ANALYSIS

4.1 General:

In this chapter building details of the modeled structure are presented. The G+25 building structure with dampers, shear wall, X-bracings, V-bracings and without all these are analysed using Response spectrum approach in ETABS 2018. Models of structures are presented below in this chapter.

4.2 Building Data:

4.1 Details of Building Data

1	**Building Details of the Structure:**	
i)	No. of Storeys	G+25
ii)	Structure Frame System	S.M.R.F
iii)	Structure Type	Symmetrical and Regular
iv)	Plan Area	18mx18m
v)	Storey Height- Bottom Storey Typical Storey	3.3m 3m
vi)	Height of the Building	75.3m
vii)	Seismic Zone	V
viii)	Thickness- Outer Wall Inner Wall	230mm 115mm
2	**Material Properties**	
i)	Grade of Concrete	M40
ii)	Grade of Steel	Fe415
iii)	Density of Concrete	25kN/m^3
iv)	Young' Modulus (E_c)	31622776.6kN/m^2
v)	Young' Modulus (E_s)	2x10^{8}kN/m^2
3	**Loads Considered**	
i)	Floor Finish	1kN/m^2
ii)	Live Load	3kN/m^2
iii)	Parapet Wall Load	1kN/m^2
4	**Seismic Properties**	
i)	Zone Factor	0.36
ii)	Soil Type	Medium Soil
iii)	Response Reduction Factor	5
iv)	Importance Factor	1

In the present study the same building properties and loads are applied on G+25 buildings with dampers, shear wall, V-bracings, X-bracings and plain building and analysed in ETABS 2018 software by response spectrum method. From the analysis storey displacements, storey drifts and storey shears are evaluated. All the results of 5 models are compared to achieve the aim of the study.

4.3 Models in ETABS:

Dampers are attached at the bottom of the storey1 of the building which is shown in Figure 4.3. Shear walls are placed at corners of each side as shown in figure 4.4. V-bracings and X-bracings are placed at center bay of the building as shown in figures 4.5 and 4.6 respectively.

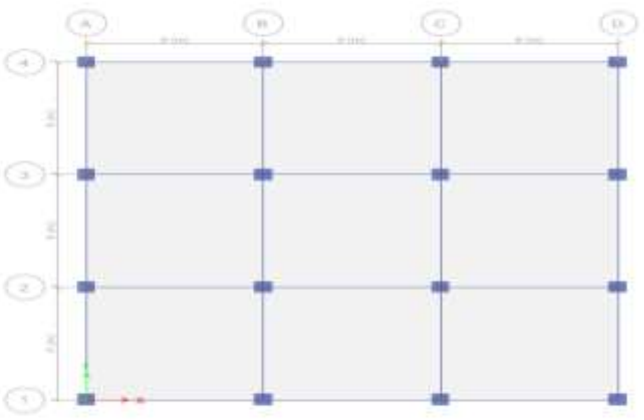


Figure 5:Plan of a G+25 Building

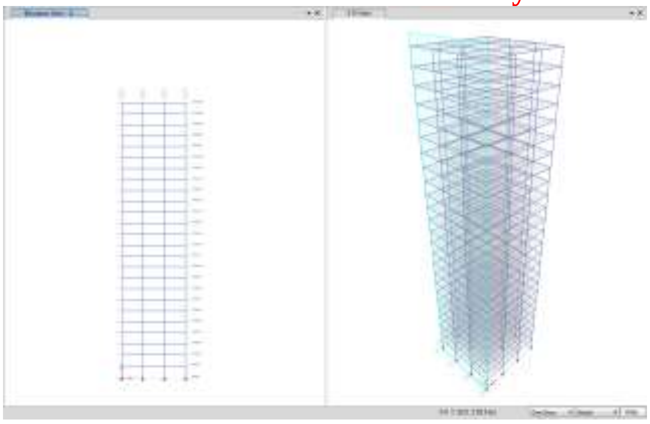


Figure 6: Elevation and 3D view of aG+25 Plain Building

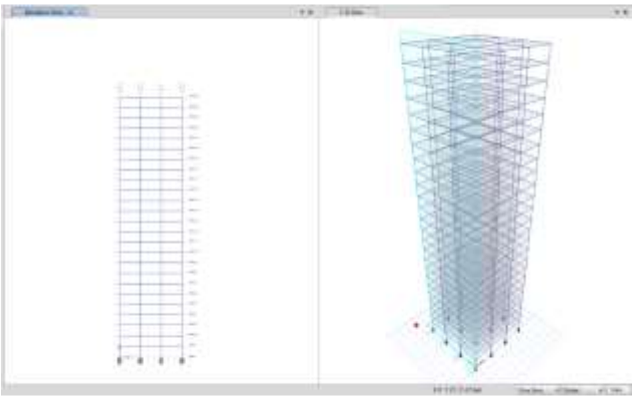


Figure 7: Elevation and 3D view of a G+25 Building with Dampers

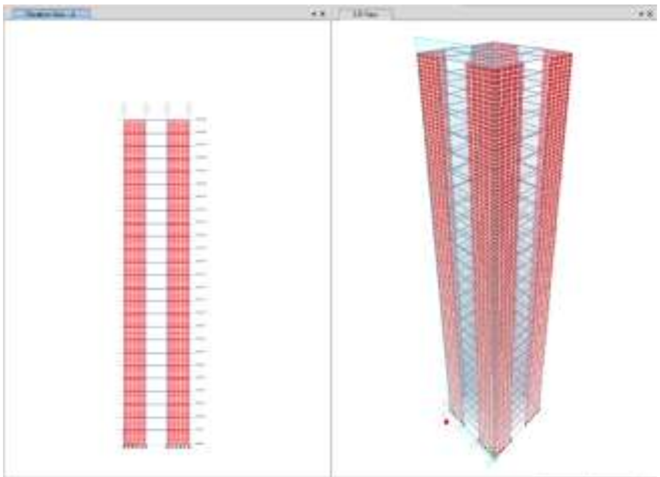


Figure 8: Elevation and 3D view of a G+25 Building with Shear Wall

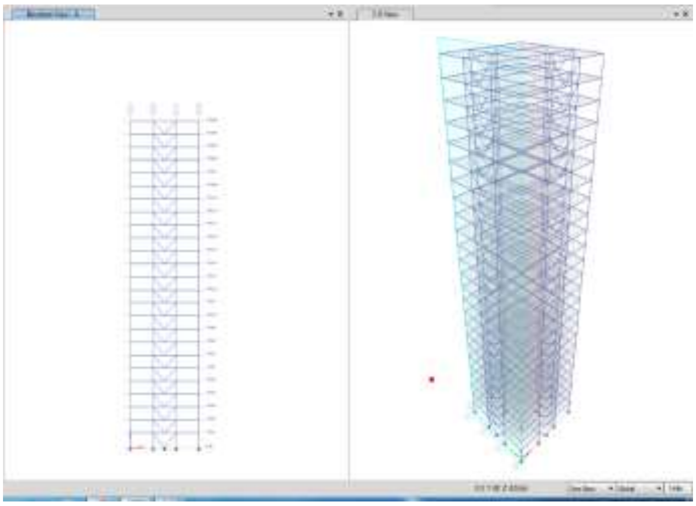


Figure 9: Elevation and 3D view of a G+25 Building with V-bracings

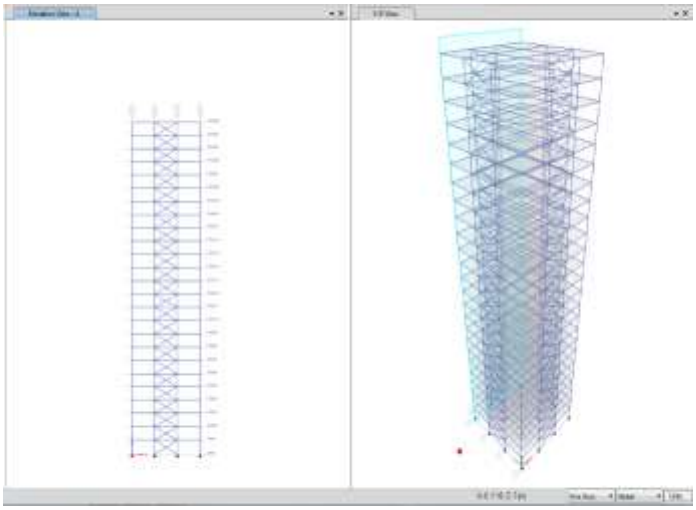


Figure 10: Elevation and 3D view of a G+25 Building with X-bracings

V. RESULTS AND DISCUSSIONS

5.1 Results of G+25 Plain Building:

5.1.1 Storey Displacements:

Table : Storey Displacements of G+25 Plain Building

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir (mm)	Y-Dir (mm)	X-Dir (mm)	Y-Dir (mm)
Storey25	75.3	Top	32.8	1.751E-04	1.751E-04	32.8
Storey24	72.3	Top	32.6	5.657E-05	5.657E-05	32.6
Storey23	69.3	Top	32.5	5.397E-06	5.398E-06	32.5
Storey22	66.3	Top	32.4	3.465E-06	3.466E-06	32.4
Storey21	63.3	Top	32.3	5.832E-06	5.832E-06	32.3
Storey20	60.3	Top	32.2	1.201E-05	1.201E-05	32.2
Storey19	57.3	Top	32	3.008E-05	3.008E-05	32
Storey18	54.3	Top	31.9	1.167E-04	1.167E-04	31.9
Storey17	51.3	Top	31.7	6.027E-05	6.027E-05	31.7
Storey16	48.3	Top	31.4	7.524E-04	7.524E-04	31.4
Storey15	45.3	Top	30.9	6.393E-04	6.393E-04	30.9
Storey14	42.3	Top	30	4.881E-04	4.881E-04	30
Storey13	39.3	Top	28.9	4.078E-04	4.078E-04	28.9
Storey12	36.3	Top	27.6	3.425E-04	3.425E-04	27.6
Storey11	33.3	Top	26.1	2.864E-04	2.864E-04	26.1
Storey10	30.3	Top	24.1	2.37E-04	2.37E-04	24.1
Storey9	27.3	Top	22.4	1.93E-04	1.93E-04	22.4
Storey8	24.3	Top	20.4	1.535E-04	1.535E-04	20.4
Storey7	21.3	Top	18.3	1.174E-04	1.174E-04	18.3
Storey6	18.3	Top	16.2	8.203E-05	8.203E-05	16.2
Storey5	15.3	Top	13.9	3.987E-05	3.987E-05	13.9
Storey4	12.3	Top	11.6	1.07E-05	1.07E-05	11.6
Storey3	9.3	Top	9.3	2.173E-04	2.173E-04	9.3
Storey2	6.3	Top	6.8	8.478E-04	8.478E-04	6.8
Storey1	3.3	Top	4	2.991E-03	2.991E-03	4
Base	0	Top	0	0	0	0

Figure 11: Storey Displacements of G+25 Plain Building for EQ X

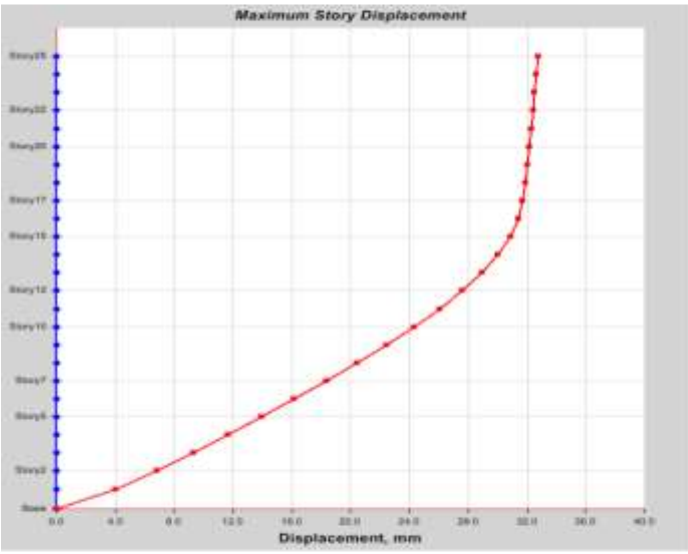


Figure 12: Storey Displacements of G+25 Plain Building for EQ Y

5.1.2StoreyShears:

Table: Storey Shears of G+25 Plain Building

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir (kN)	Y-Dir (kN)	X-Dir (kN)	Y-Dir (kN)
Storey25	75.3	Top	0	0	0	0
Storey24	72.3	Top	0	0	0	0
Storey23	69.3	Top	0	0	0	0
Storey22	66.3	Top	0	0	0	0
Storey21	63.3	Top	0	0	0	0
Storey20	60.3	Top	0	0	0	0
Storey19	57.3	Top	0	0	0	0
Storey18	54.3	Top	0	0	0	0
Storey17	51.3	Top	0	0	0	0
Storey16	48.3	Top	-68.8817	0	0	-68.8817
Storey15	45.3	Top	-129.4725	0	0	-129.4725
Storey14	42.3	Top	-182.3037	0	0	-182.3037
Storey13	39.3	Top	-227.9068	0	0	-227.9068
Storey12	36.3	Top	-266.8134	0	0	-266.8134
Storey11	33.3	Top	-299.5549	0	0	-299.5549
Storey10	30.3	Top	-326.6628	0	0	-326.6628
Storey9	27.3	Top	-348.6685	0	0	-348.6685
Storey8	24.3	Top	-366.1035	0	0	-366.1035
Storey7	21.3	Top	-379.4993	0	0	-379.4993
Storey6	18.3	Top	-389.3874	0	0	-389.3874
Storey5	15.3	Top	-396.2992	0	0	-396.2992
Storey4	12.3	Top	-400.7662	0	0	-400.7662
Storey3	9.3	Top	-403.32	0	0	-403.32
Storey2	6.3	Top	-404.4919	0	0	-404.4919
Storey1	3.3	Top	-404.8169	0	0	-404.8169
Base	0	Top	0	0	0	0

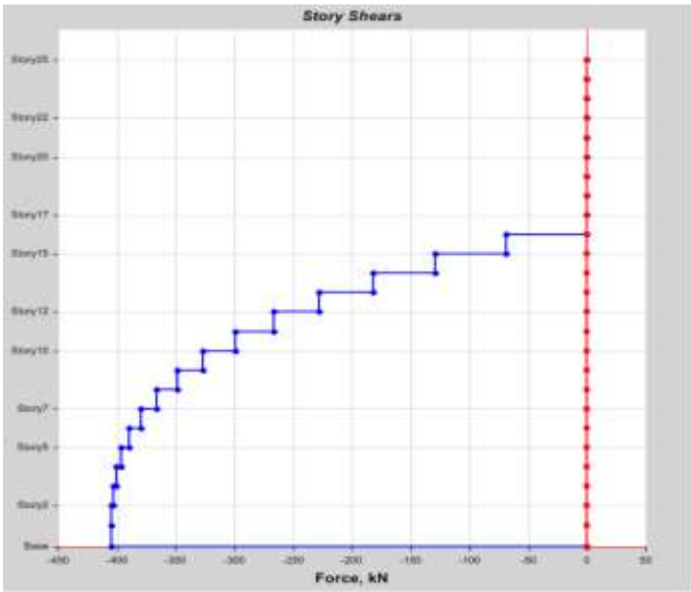


Figure 13: StoreyShears of G+25 Plain Building for EQ X

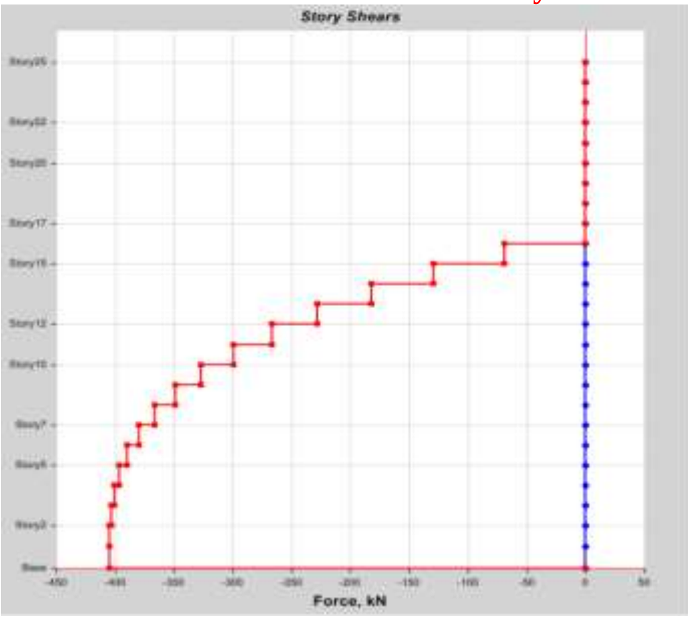


Figure 14: Storey Shears of G+25 Plain Building for EQ Y

5.1.3 Storey Drifts:

Table : Storey Drifts of G+25 Plain Building

5.1.2 Storey Drifts:
Table 5.2: Storey Drifts of G+25 Plain Building

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir	Y-Dir	X-Dir	Y-Dir
Storey25	75.3	Top	0.00004	7.723E-08	7.723E-08	0.00004
Storey24	72.3	Top	0.00004	2.065E-08	2.065E-08	0.00004
Storey23	69.3	Top	0.00004	0	0	0.00004
Storey22	66.3	Top	0.00004	0	0	0.00004
Storey21	63.3	Top	0.000041	0	0	0.000041
Storey20	60.3	Top	0.000043	6.025E-09	6.025E-09	0.000043
Storey19	57.3	Top	0.000048	2.888E-08	2.888E-08	0.000048
Storey18	54.3	Top	0.000062	1.882E-08	1.882E-08	0.000062
Storey17	51.3	Top	0.0001	2.709E-07	2.709E-07	0.0001
Storey16	48.3	Top	0.00018	3.77E-08	3.77E-08	0.00018
Storey15	45.3	Top	0.000274	5.043E-08	5.043E-08	0.000274
Storey14	42.3	Top	0.000365	2.677E-08	2.677E-08	0.000365
Storey13	39.3	Top	0.000447	2.175E-08	2.175E-08	0.000447
Storey12	36.3	Top	0.000518	1.871E-08	1.871E-08	0.000518
Storey11	33.3	Top	0.000579	1.646E-08	1.646E-08	0.000579
Storey10	30.3	Top	0.000628	1.467E-08	1.467E-08	0.000628
Storey9	27.3	Top	0.000668	1.316E-08	1.316E-08	0.000668
Storey8	24.3	Top	0.0007	1.204E-08	1.204E-08	0.0007
Storey7	21.3	Top	0.000724	1.18E-08	1.18E-08	0.000724
Storey6	18.3	Top	0.000743	1.432E-08	1.432E-08	0.000743
Storey5	15.3	Top	0.000759	1.342E-08	1.342E-08	0.000759
Storey4	12.3	Top	0.000781	7.205E-08	7.205E-08	0.000781
Storey3	9.3	Top	0.000825	2.102E-07	2.102E-07	0.000825
Storey2	6.3	Top	0.000934	0.000001	0.000001	0.000934
Storey1	3.3	Top	0.001224	0.000001	0.000001	0.001224
Base	0	Top	0	0	0	0

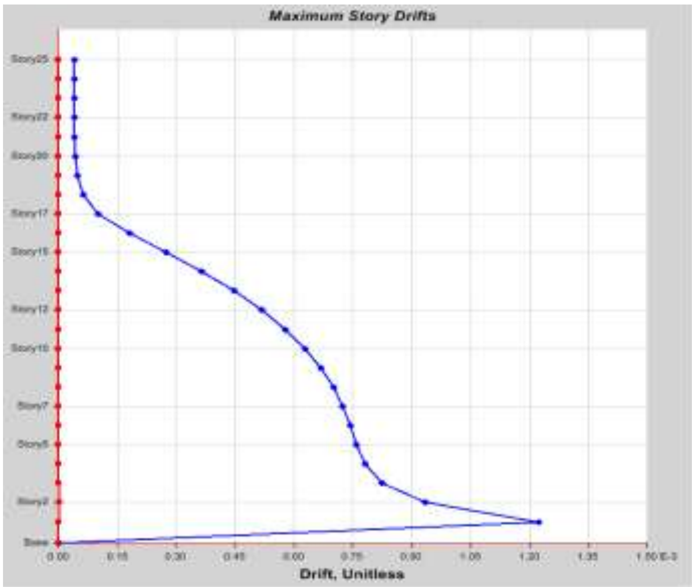


Figure 15: Storey Drifts of G+25 Plain Building for EQ X

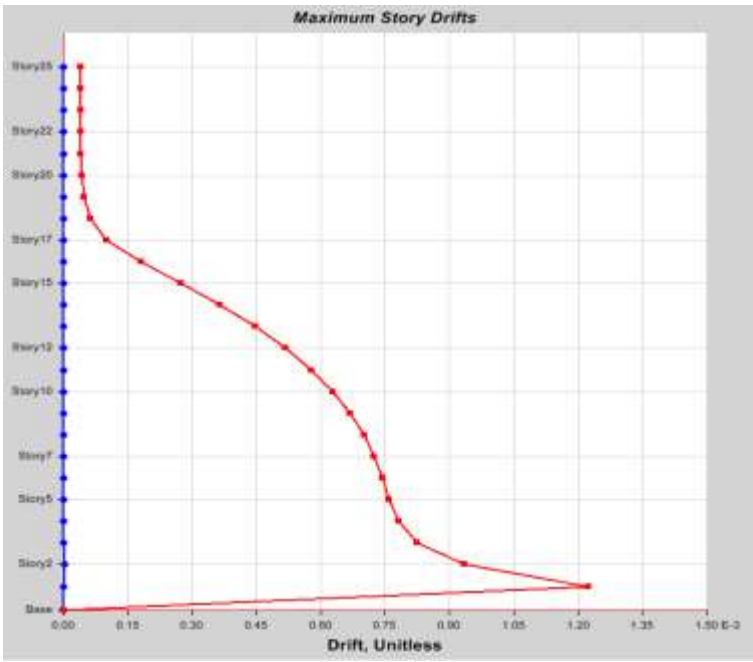


Figure 16: Storey Drifts of G+25 Plain Building for EQ Y

5.2 Results of G+25 Building with Dampers:

5.2.1 Storey Displacements:

Table: Storey Displacements of G+25 Building with Dampers

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir (mm)	Y-Dir (mm)	X-Dir (mm)	Y-Dir (mm)
Storey 25	75.3	Top	154	3.328 E-04	3.328 E-04	154
Storey 24	72.3	Top	153.5	1.081 E-04	1.081 E-04	153.5
Storey 23	69.3	Top	153.1	1.034 E-05	1.034 E-05	153.1
Storey 22	66.3	Top	152.7	5.311 E-06	5.312 E-06	152.7
Storey 21	63.3	Top	152.3	7.513 E-06	7.514 E-06	152.3
Storey 20	60.3	Top	151.9	1.399 E-05	1.399 E-05	151.9
Storey 19	57.3	Top	151.5	3.179 E-05	3.179 E-05	151.5
Storey 18	54.3	Top	151.1	1.163 E-04	1.163 E-04	151.1
Storey 17	51.3	Top	150.6	5.368 E-05	5.368 E-05	150.6
Storey 16	48.3	Top	150	7.259 E-04	7.259 E-04	150
Storey 15	45.3	Top	149.2	6.082 E-04	6.082 E-04	149.2
Storey 14	42.3	Top	148.1	4.635 E-04	4.635 E-04	148.1
Storey 13	39.3	Top	146.8	3.861 E-04	3.861 E-04	146.8
Storey 12	36.3	Top	145.2	3.23E -04	3.23E -04	145.2
Storey 11	33.3	Top	143.4	2.687 E-04	2.687 E-04	143.4
Storey 10	30.3	Top	141.5	2.208 E-04	2.208 E-04	141.5
Storey 9	27.3	Top	139.4	1.781 E-04	1.781 E-04	139.4
Storey 8	24.3	Top	137.1	1.397 E-04	1.397 E-04	137.1
Storey 7	21.3	Top	134.8	1.045 E-04	1.045 E-04	134.8
Storey 6	18.3	Top	132.4	7.02E -05	7.02E -05	132.4

Storey 5	15.3	Top	130	2.014E-05	2.014E-05	130
Storey 4	12.3	Top	127.5	2.664E-05	2.664E-05	127.5
Storey 3	9.3	Top	125	1.573E-04	1.573E-04	125
Storey 2	6.3	Top	122.3	2.638E-03	2.638E-03	122.3
Storey 1	3.3	Top	119.3	6.497E-03	6.497E-03	119.3
Base	0	Top	115.4	3.845E-02	3.845E-02	115.4

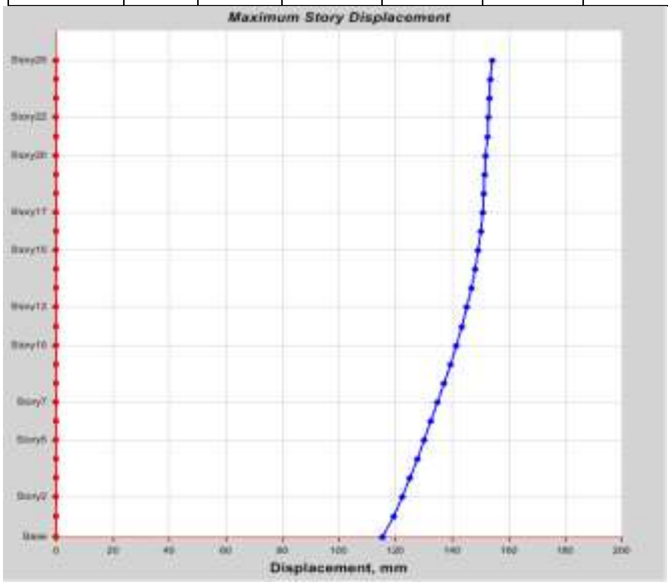


Figure 17: Storey Displacements of G+25 Building with Dampers for EQ X

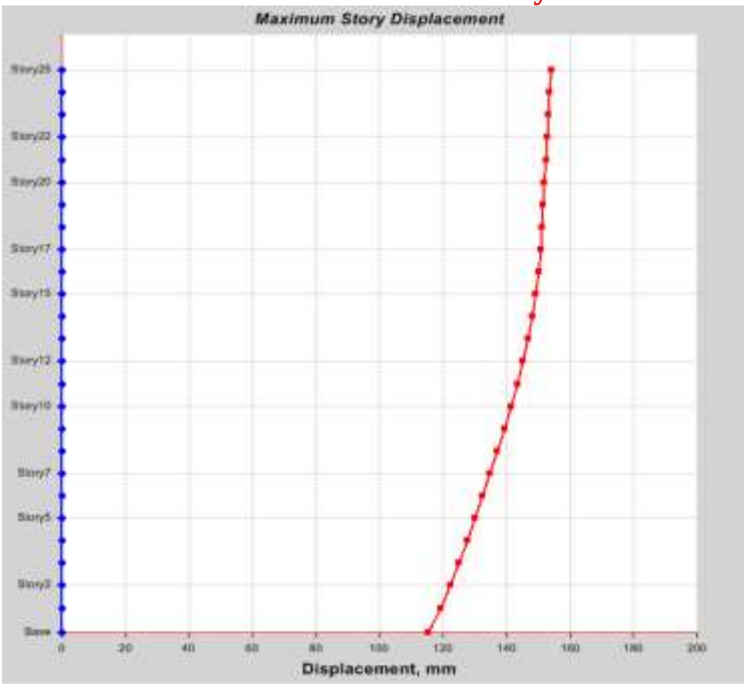


Figure 18: Storey Displacements of G+25 Building with Dampers for EQ Y

5.2.2 Storey Drifts:

Table : Storey Drifts of G+25 Building with Dampers

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir	Y-Dir	X-Dir	Y-Dir
Storey25	75.3	Top	0.000136	1.469E-07	1.469E-07	0.000136
Storey24	72.3	Top	0.000136	3.932E-08	3.932E-08	0.000136
Storey23	69.3	Top	0.000136	0	0	0.000136
Storey22	66.3	Top	0.000136	0	0	0.000136
Storey21	63.3	Top	0.000137	0	0	0.000137
Storey20	60.3	Top	0.000139	5.936E-09	5.936E-09	0.000139
Storey19	57.3	Top	0.000143	2.816E-08	2.816E-08	0.000143
Storey18	54.3	Top	0.000157	2.087E-08	2.087E-08	0.000157

Storey17	51.3	Top	0.000193	2.598E-07	2.598E-07	0.000193
Storey16	48.3	Top	0.00027	3.926E-08	3.926E-08	0.00027
Storey15	45.3	Top	0.000361	4.821E-08	4.821E-08	0.000361
Storey14	42.3	Top	0.000448	2.582E-08	2.582E-08	0.000448
Storey13	39.3	Top	0.000527	2.102E-08	2.102E-08	0.000527
Storey12	36.3	Top	0.000595	1.81E-08	1.81E-08	0.000595
Storey11	33.3	Top	0.000653	1.595E-08	1.595E-08	0.000653
Storey10	30.3	Top	0.000701	1.424E-08	1.424E-08	0.000701
Storey9	27.3	Top	0.00074	1.28E-08	1.28E-08	0.00074
Storey8	24.3	Top	0.00077	1.174E-08	1.174E-08	0.00077
Storey7	21.3	Top	0.000794	1.142E-08	1.142E-08	0.000794
Storey6	18.3	Top	0.000812	1.669E-08	1.669E-08	0.000812
Storey5	15.3	Top	0.000828	0	0	0.000828
Storey4	12.3	Top	0.000849	6.129E-08	6.129E-08	0.000849
Storey3	9.3	Top	0.000893	0.000001	0.000001	0.000893
Storey2	6.3	Top	0.001003	0.000003	0.000003	0.001003
Storey1	3.3	Top	0.001361	0.00001	0.00001	0.001361
Base	0	Top	0	0	0	0

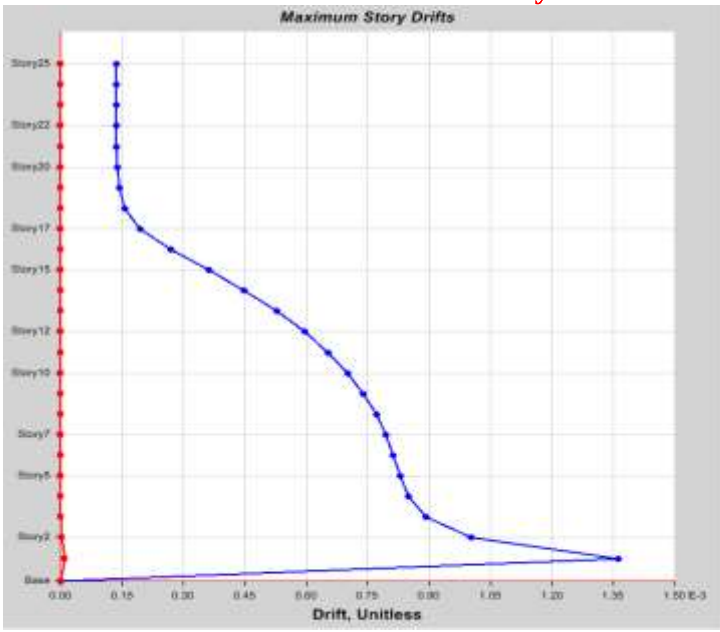


Figure 19: Storey Drifts of G+25 Building with Dampers for EQ X

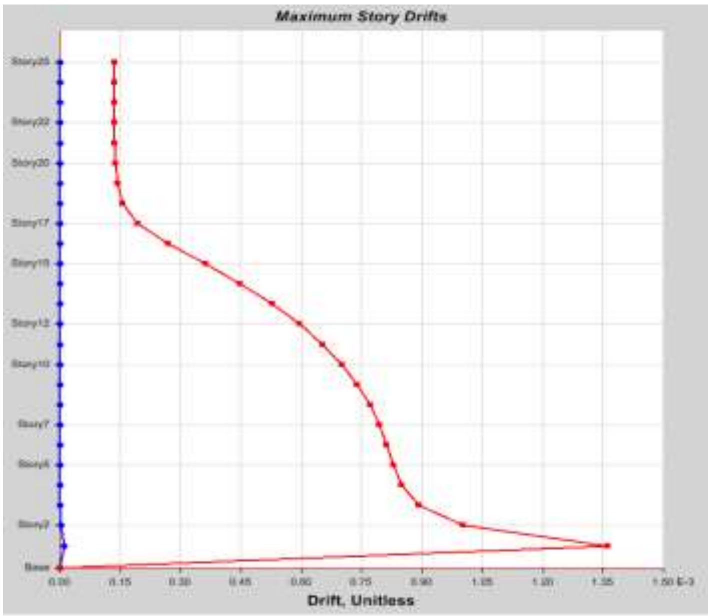


Figure 20: Storey Drifts of G+25 Building with Dampers for EQ Y

5.2.3 Storey Shears:

Table: Storey Shears of G+25 Building with Dampers

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir (kN)	Y-Dir (kN)	X-Dir (kN)	Y-Dir (kN)
Storey25	75.3	Top	0	0	0	0

Storey24	72.3	Top	0	0	0	0
Storey23	69.3	Top	0	0	0	0
Storey22	66.3	Top	0	0	0	0
Storey21	63.3	Top	0	0	0	0
Storey20	60.3	Top	0	0	0	0
Storey19	57.3	Top	0	0	0	0
Storey18	54.3	Top	0	0	0	0
Storey17	51.3	Top	0	0	0	0
Storey16	48.3	Top	-66.0834	0	0	-66.0834
Storey15	45.3	Top	-124.2126	0	0	-124.2126
Storey14	42.3	Top	-174.8976	0	0	-174.8976
Storey13	39.3	Top	-218.6481	0	0	-218.6481
Storey12	36.3	Top	-255.9741	0	0	-255.9741
Storey11	33.3	Top	-287.3854	0	0	-287.3854
Storey10	30.3	Top	-313.392	0	0	-313.392
Storey9	27.3	Top	-334.5037	0	0	-334.5037
Storey8	24.3	Top	-351.2304	0	0	-351.2304
Storey7	21.3	Top	-364.082	0	0	-364.082
Storey6	18.3	Top	-373.5684	0	0	-373.5684
Storey5	15.3	Top	-380.1994	0	0	-380.1994
Storey4	12.3	Top	-384.485	0	0	-384.485
Storey3	9.3	Top	-386.935	0	0	-386.935
Storey2	6.3	Top	-388.0593	0	0	-388.0593
Storey1	3.3	Top	-388.3711	0	0	-388.3711
Base	0	Top	0	0	0	0

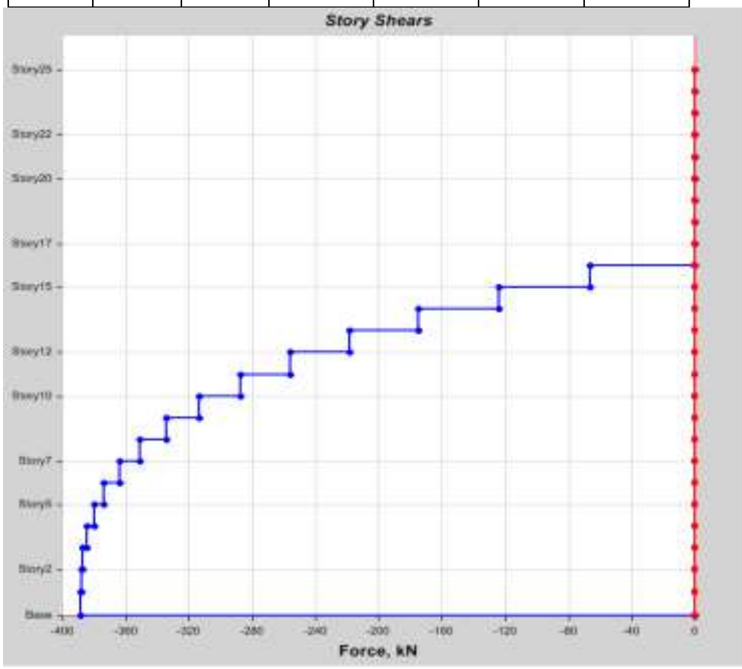


Figure 21: Storey Shears of G+25 Building with Dampers for EQ X

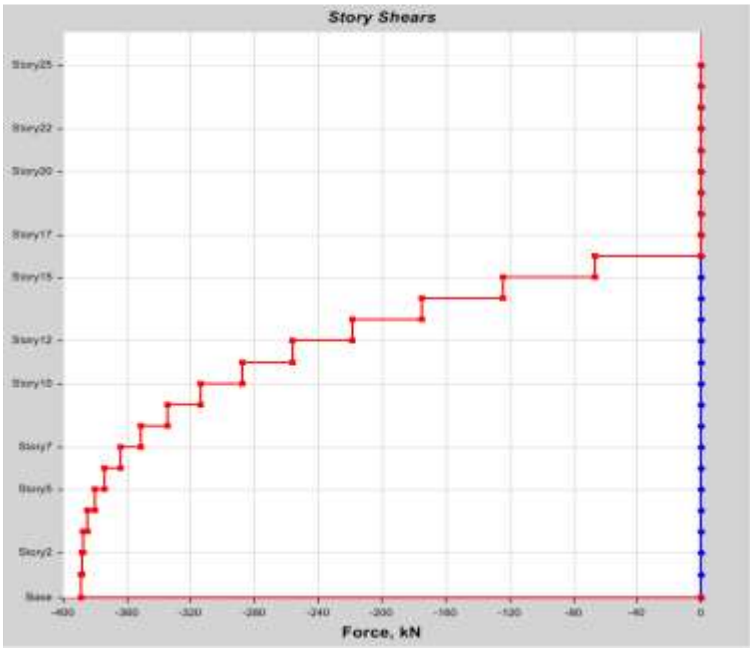


Figure 22: Storey Shears of G+25 Building with Dampers for EQ Y

5.3 Results of G+25 Building with Shear Wall:

5.3.1 Storey Displacements:

Table: Storey Displacements of G+25 Building with Shear Wall

Store y	Ele vati on (m)	Loca tion	For EQ X		For EQ Y	
			X-Dir (mm)	Y-Dir (mm)	X-Dir (mm)	Y-Dir (mm)
Store y25	75.3	Top	14.7	9.18E-03	9.18E-03	14.7
Store y24	72.3	Top	14.2	3.32E-03	3.32E-03	14.2
Store y23	69.3	Top	13.6	2.457 E-03	2.457 E-03	13.6
Store y22	66.3	Top	13.1	2.603 E-03	2.603 E-03	13.1
Store y21	63.3	Top	12.5	2.718 E-03	2.718 E-03	12.5
Store y20	60.3	Top	11.9	2.85E-03	2.85E-03	11.9
Store y19	57.3	Top	11.3	3.087 E-03	3.087 E-03	11.3
Store y18	54.3	Top	10.8	4.246 E-03	4.246 E-03	10.8
Store y17	51.3	Top	10.1	7.698 E-03	7.698 E-03	10.1
Store y16	48.3	Top	9.5	1.002 E-02	1.002 E-02	9.5
Store y15	45.3	Top	8.9	1.08E-02	1.08E-02	8.9
Store y14	42.3	Top	8.2	1.084 E-02	1.084 E-02	8.2
Store y13	39.3	Top	7.5	1.065 E-02	1.065 E-02	7.5
Store y12	36.3	Top	6.7	1.054 E-02	1.054 E-02	6.7
Store y11	33.3	Top	6	1.062 E-02	1.062 E-02	6
Store y10	30.3	Top	5.2	1.091 E-02	1.091 E-02	5.2
Store y9	27.3	Top	4.5	1.141 E-02	1.141 E-02	4.5
Store y8	24.3	Top	3.8	1.204 E-02	1.204 E-02	3.8
Store y7	21.3	Top	3.1	1.267 E-02	1.267 E-02	3.1
Store y6	18.3	Top	2.4	1.311 E-02	1.311 E-02	2.4
Store y5	15.3	Top	1.8	1.311 E-02	1.311 E-02	1.8
Store y4	12.3	Top	1.2	1.253 E-02	1.253 E-02	1.2
Store y3	9.3	Top	0.8	1.125 E-02	1.125 E-02	0.8
Store y2	6.3	Top	0.4	1.267 E-02	1.267 E-02	0.4
Store y1	3.3	Top	0.2	1.264 E-02	1.264 E-02	0.2
Base	0	Top	0	0	0	0

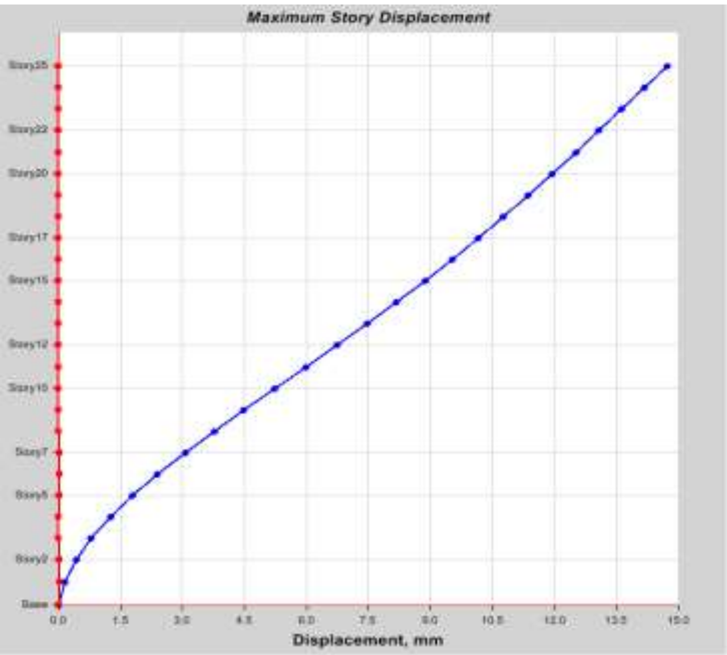


Figure 23: Storey Displacements of G+25 Building with Shear Wall for EQ X

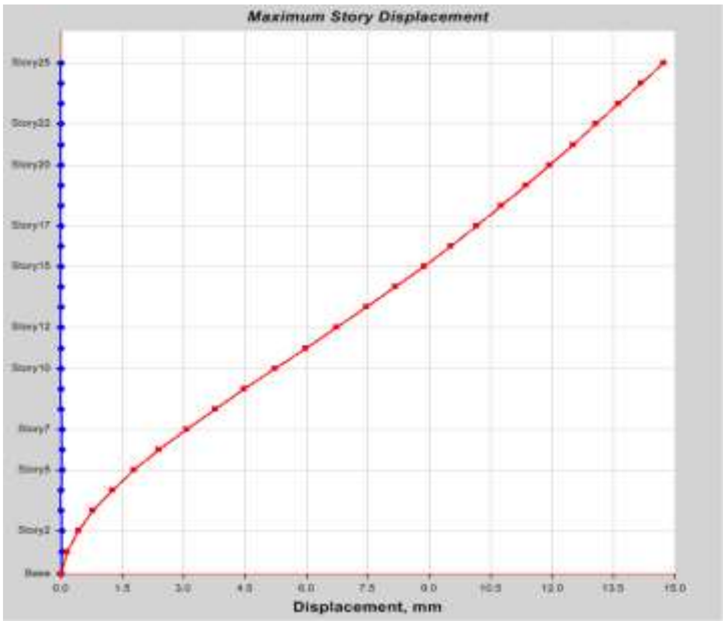


Figure 24: Storey Displacements of G+25 Building with Shear Wall for EQ Y

5.3.2 Storey Drifts:

Table Storey Drifts of G+25 Building with Shear Wall

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir	Y-Dir	X-Dir	Y-Dir
Storey25	75.3	Top	0.000183	0.000002	0.000002	0.000183
Storey24	72.3	Top	0.000184	0.000001	0.000001	0.000184
Storey23	69.3	Top	0.000186	2.512E-07	2.512E-07	0.000186
Storey22	66.3	Top	0.000188	9.623E-08	9.623E-08	0.000188
Storey21	63.3	Top	0.000191	9.136E-08	9.136E-08	0.000191
Storey20	60.3	Top	0.000195	2.04E-07	2.04E-07	0.000195
Storey19	57.3	Top	0.000199	4.543E-07	4.543E-07	0.000199
Storey18	54.3	Top	0.000204	0.000001	0.000001	0.000204
Storey17	51.3	Top	0.00021	0.000001	0.000001	0.00021
Storey16	48.3	Top	0.00022	0.000001	0.000001	0.00022
Storey15	45.3	Top	0.00023	2.027E-07	2.027E-07	0.00023
Storey14	42.3	Top	0.000238	1.794E-07	1.794E-07	0.000238
Storey13	39.3	Top	0.000245	2.908E-07	2.908E-07	0.000245
Storey12	36.3	Top	0.000249	3.334E-07	3.334E-07	0.000249
Storey11	33.3	Top	0.00025	3.387E-07	3.387E-07	0.00025
Storey10	30.3	Top	0.000248	3.289E-07	3.289E-07	0.000248
Storey9	27.3	Top	0.000242	3.207E-07	3.207E-07	0.000242
Storey8	24.3	Top	0.000233	3.29E-07	3.29E-07	0.000233
Storey7	21.3	Top	0.00022	3.692E-07	3.692E-07	0.00022
Store	18.3	Top	0.0002	4.572	4.572	0.0002

y6			02	E-07	E-07	02
Storey5	15.3	Top	0.000181	0.000001	0.000001	0.000181
Storey4	12.3	Top	0.000155	0.000001	0.000001	0.000155
Storey3	9.3	Top	0.000124	0.000001	0.000001	0.000124
Storey2	6.3	Top	0.000088	0.000001	0.000001	0.000088
Storey1	3.3	Top	0.000047	0.000003	0.000003	0.000047
Base	0	Top	0	0	0	0

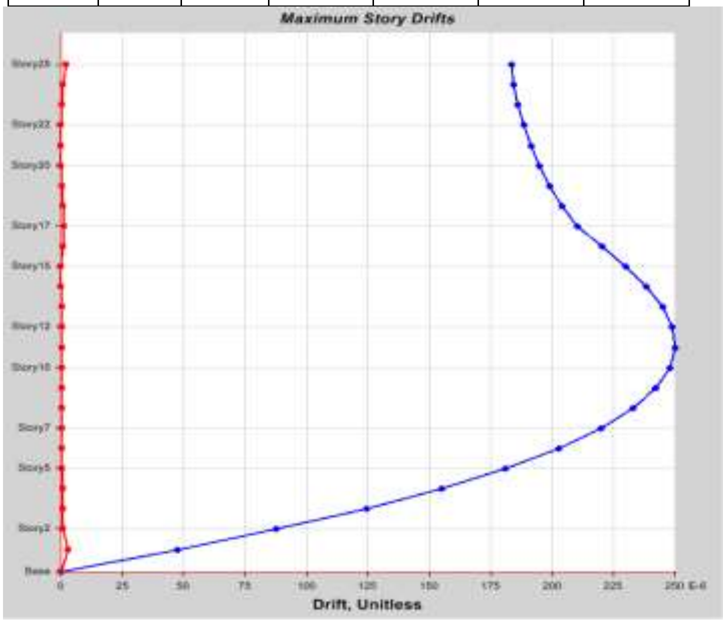


Figure 25: Storey Drifts of G+25 Building with Shear Wall for EQ X

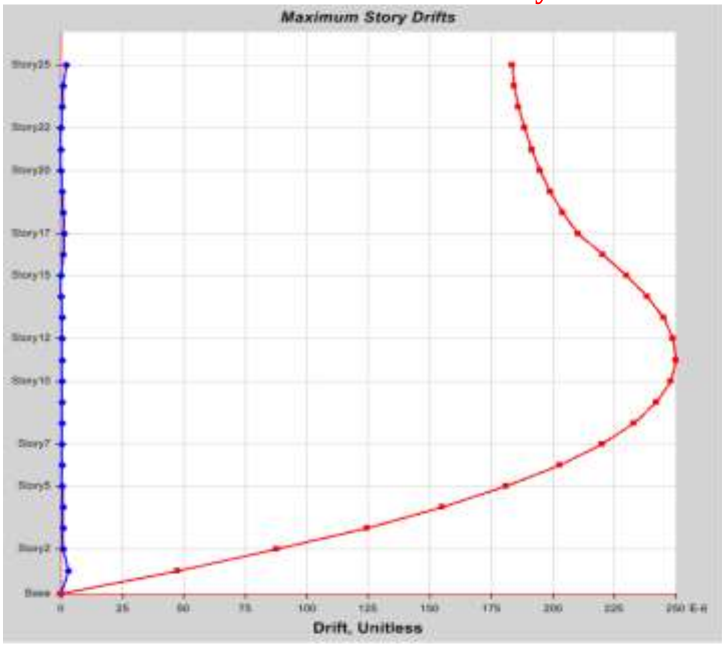


Figure 26: Storey Drifts of G+25 Building with Shear Wall for EQ Y

5.3.3 Storey Shears:

Table: Storey Shears of G+25 Building with Shear Wall

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir (kN)	Y-Dir (kN)	X-Dir (kN)	Y-Dir (kN)
Storey25	75.3	Top	0	0	0	0
Storey24	72.3	Top	0	0	0	0
Storey23	69.3	Top	0	0	0	0
Storey22	66.3	Top	0	0	0	0
Storey21	63.3	Top	0	0	0	0
Storey20	60.3	Top	0	0	0	0
Storey19	57.3	Top	0	0	0	0
Storey18	54.3	Top	0	0	0	0
Storey17	51.3	Top	0	0	0	0

Storey16	48.3	Top	-228.0701	0	0	-228.0701
Storey15	45.3	Top	-428.6884	0	0	-428.6884
Storey14	42.3	Top	-603.6147	0	0	-603.6147
Storey13	39.3	Top	-754.6085	0	0	-754.6085
Storey12	36.3	Top	-883.4297	0	0	-883.4297
Storey11	33.3	Top	-991.838	0	0	-991.838
Storey10	30.3	Top	-1081.5932	0	0	-1081.5932
Storey9	27.3	Top	-1154.4549	0	0	-1154.4549
Storey8	24.3	Top	-1212.183	0	0	-1212.183
Storey7	21.3	Top	-1256.537	0	0	-1256.537
Storey6	18.3	Top	-1289.2768	0	0	-1289.2768
Storey5	15.3	Top	-1312.1622	0	0	-1312.1622
Storey4	12.3	Top	-1326.9527	0	0	-1326.9527
Storey3	9.3	Top	-1335.4082	0	0	-1335.4082
Stor	6.3	Top	-	0	0	-
ey2			1339.2884			1339.2884
Storey1	3.3	Top	-1340.3769	0	0	-1340.3769
Base	0	Top	0	0	0	0

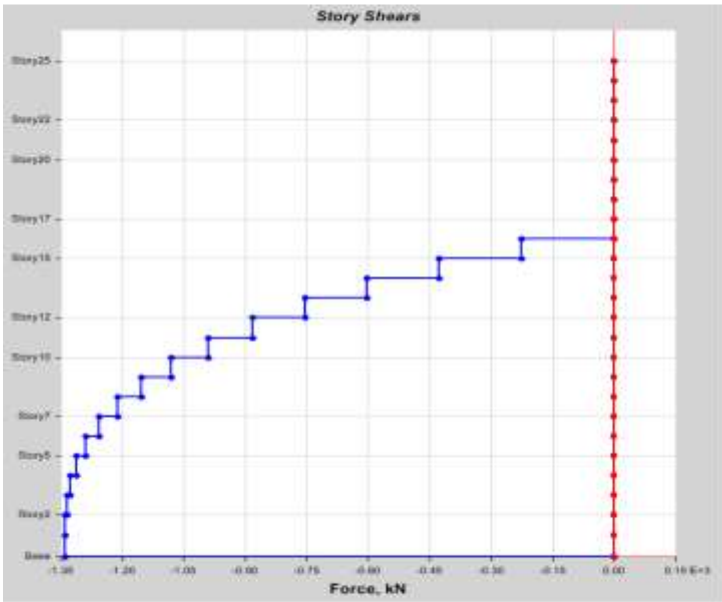


Figure 27: Storey Shears of G+25 Building with Shear Wall for EQ X

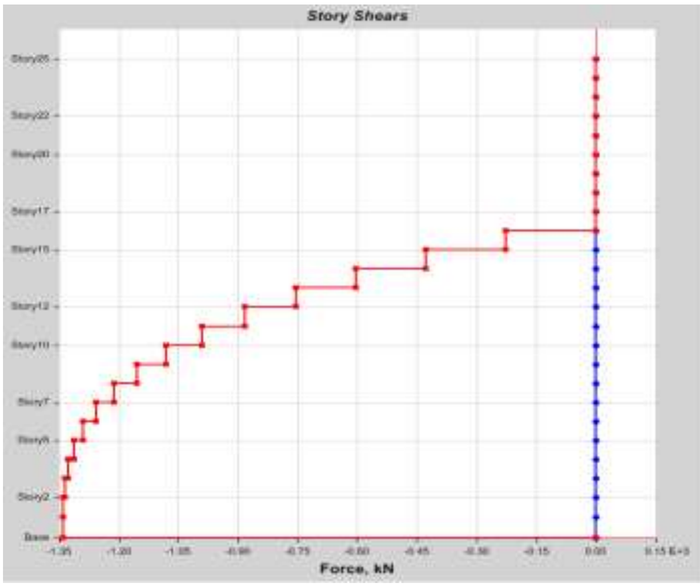


Figure 28: Storey Shears of G+25 Building with Shear Wall for EQ Y

5.4 Results of G+25 Building with V-Bracings:

5.4.1 Storey Displacements:

Table Storey Displacements of G+25 Building with V-Bracings

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir (mm)	Y-Dir (mm)	X-Dir (mm)	Y-Dir (mm)
Storey25	75.3	Top	21.4	8.996 E-04	8.996 E-04	21.4
Storey24	72.3	Top	21	4.91E-04	4.91E-04	21
Storey23	69.3	Top	20.6	6.958 E-04	6.958 E-04	20.6
Storey22	66.3	Top	20.2	6.227 E-04	6.227 E-04	20.2
Storey21	63.3	Top	19.8	6.753 E-04	6.753 E-04	19.8
Storey20	60.3	Top	19.4	7.279 E-04	7.279 E-04	19.4
Storey19	57.3	Top	18.9	7.873 E-04	7.873 E-04	18.9
Storey18	54.3	Top	18.4	9.079 E-04	9.079 E-04	18.4
Storey17	51.3	Top	17.9	9.938 E-04	9.938 E-04	17.9
Storey16	48.3	Top	17.3	2.373 E-03	2.373 E-03	17.3
Storey15	45.3	Top	16.6	2.853 E-03	2.853 E-03	16.6
Storey14	42.3	Top	15.7	2.947 E-03	2.947 E-03	15.7
Storey13	39.3	Top	14.8	3.058 E-03	3.058 E-03	14.8
Storey12	36.3	Top	13.8	3.143 E-03	3.143 E-03	13.8
Storey11	33.3	Top	12.6	3.206 E-03	3.206 E-03	12.6
Storey10	30.3	Top	11.4	3.255 E-03	3.255 E-03	11.4
Storey9	27.3	Top	10.2	3.297 E-03	3.297 E-03	10.2
Storey8	24.3	Top	8.9	3.518 E-03	3.518 E-03	8.9
Storey7	21.3	Top	7.6	3.849 E-03	3.849 E-03	7.6
Storey6	18.3	Top	6.3	4.147 E-03	4.147 E-03	6.3
Storey5	15.3	Top	5.1	4.42E-03	4.42E-03	5.1
Storey4	12.3	Top	3.9	4.681 E-03	4.681 E-03	3.9
Storey3	9.3	Top	2.8	4.968 E-03	4.968 E-03	2.8
Storey2	6.3	Top	1.8	5.11E-03	5.11E-03	1.8
Storey1	3.3	Top	0.9	8.006 E-03	8.006 E-03	0.9
Base	0	Top	0	0	0	0

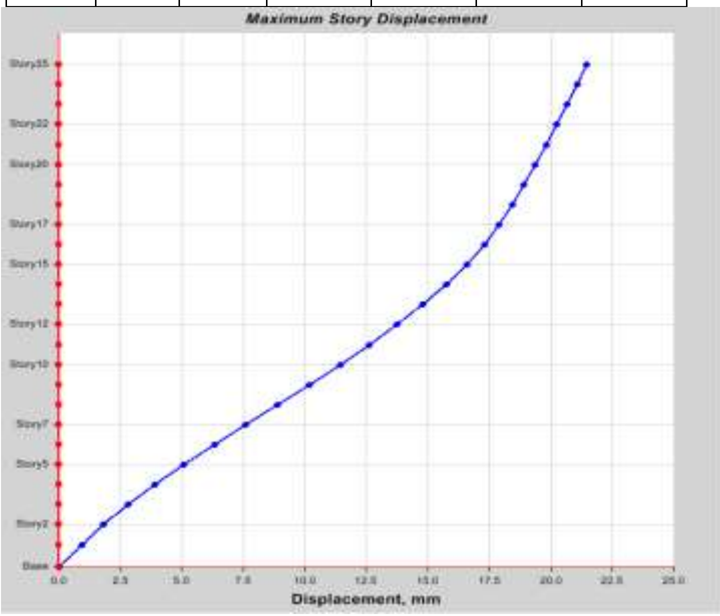


Figure 29: Storey Displacements of G+25 Building with V-Bracings for EQ X

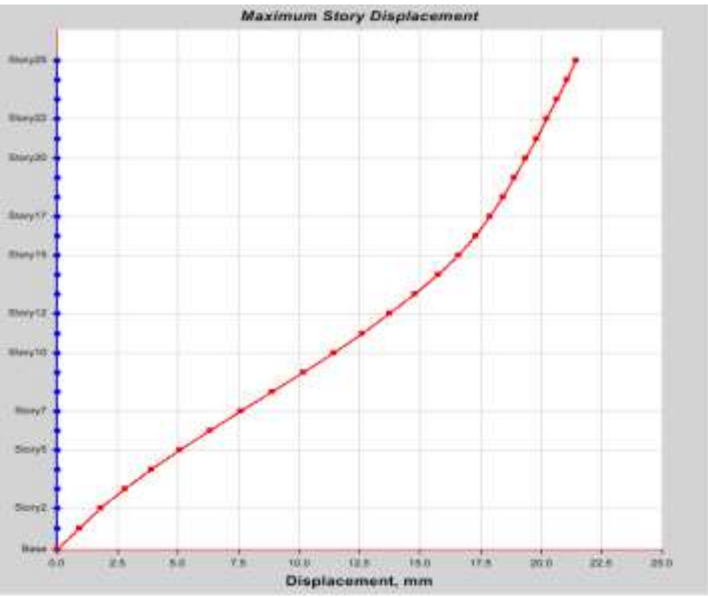


Figure 30: Storey Displacements of G+25 Building with V-Bracings for EQ Y

5.4.2 Storey Drifts:

Table :Storey Drifts of G+25 Building with V-Bracings

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir	Y-Dir	X-Dir	Y-Dir
Storey25	75.3	Top	0.000129	2.038E-07	2.038E-07	0.000129
Storey24	72.3	Top	0.000134	8.487E-08	8.487E-08	0.000134
Storey23	69.3	Top	0.000137	2.837E-08	2.837E-08	0.000137
Storey22	66.3	Top	0.000142	1.753E-08	1.753E-08	0.000142
Storey21	63.3	Top	0.000148	1.753E-08	1.753E-08	0.000148
Storey20	60.3	Top	0.000155	2.101E-08	2.101E-08	0.000155
Storey19	57.3	Top	0.000165	4.018E-08	4.018E-08	0.000165
Storey18	54.3	Top	0.000176	1.93E-07	1.93E-07	0.000176
Storey17	51.3	Top	0.000197	0.000001	0.000001	0.000197
Storey16	48.3	Top	0.000238	1.914E-07	1.914E-07	0.000238
Storey15	45.3	Top	0.00028	3.142E-07	3.142E-07	0.00028
Storey14	42.3	Top	0.000318	2.597E-07	2.597E-07	0.000318
Storey13	39.3	Top	0.000351	2.254E-07	2.254E-07	0.000351
Storey12	36.3	Top	0.00038	1.942E-07	1.942E-07	0.00038
Storey11	33.3	Top	0.000402	1.674E-07	1.674E-07	0.000402
Storey10	30.3	Top	0.000418	1.447E-07	1.447E-07	0.000418
Storey9	27.3	Top	0.000428	1.258E-07	1.258E-07	0.000428
Storey8	24.3	Top	0.000431	1.106E-07	1.106E-07	0.000431
Storey7	21.3	Top	0.000426	9.912E-08	9.912E-08	0.000426
Storey6	18.3	Top	0.000415	9.121E-08	9.121E-08	0.000415
Storey5	15.3	Top	0.000396	8.688E-08	8.688E-08	0.000396
Storey4	12.3	Top	0.000369	9.555E-08	9.555E-08	0.000369
Storey3	9.3	Top	0.000334	2.712E-07	2.712E-07	0.000334
Storey2	6.3	Top	0.000292	0.000001	0.000001	0.000292
Storey1	3.3	Top	0.000268	0.000002	0.000002	0.000268
Base	0	Top	0	0	0	0

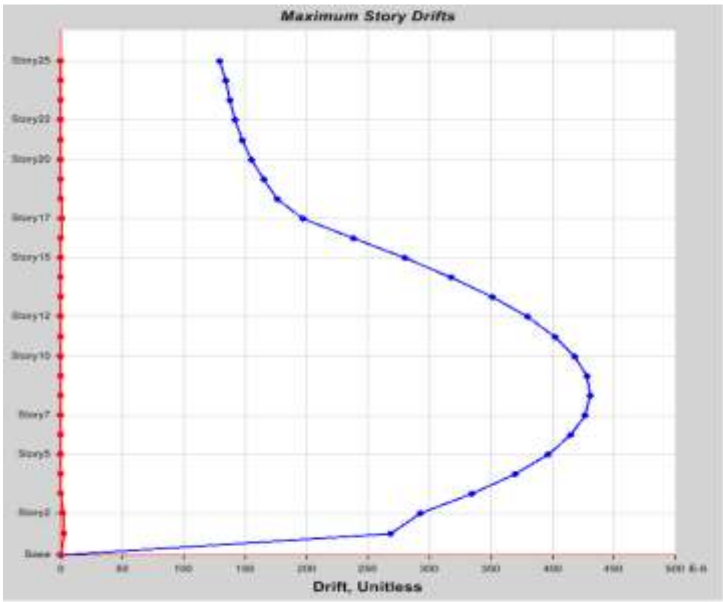


Figure .31: Storey Drifts of G+25 Building with V-Bracings for EQ X

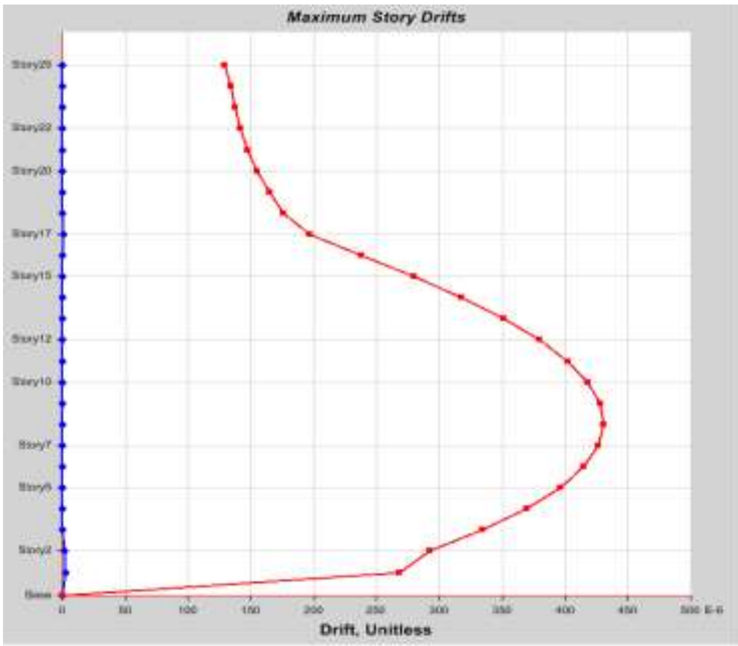


Figure 32: Storey Drifts of G+25 Building with V-Bracings for EQ Y

5.4.3 Storey Shears:

Table : Storey Shears of G+25 Building with V-Bracings

Store	Elev	Loca	For EQ X		For EQ Y	
y	ation (m)	tion	X-Dir (kN)	Y-Dir (kN)	X-Dir (kN)	Y-Dir (kN)
Storey25	75.3	Top	0	0	0	0
Storey24	72.3	Top	0	0	0	0
Storey23	69.3	Top	0	0	0	0
Storey22	66.3	Top	0	0	0	0
Storey21	63.3	Top	0	0	0	0
Storey20	60.3	Top	0	0	0	0
Storey19	57.3	Top	0	0	0	0
Storey18	54.3	Top	0	0	0	0
Storey17	51.3	Top	0	0	0	0
Storey16	48.3	Top	-108.0883	0	0	-108.0883
Storey15	45.3	Top	-203.1665	0	0	-203.1665
Storey14	42.3	Top	-286.0686	0	0	-286.0686
Storey13	39.3	Top	-357.6285	0	0	-357.6285
Storey12	36.3	Top	-418.6802	0	0	-418.6802
Storey11	33.3	Top	-470.0577	0	0	-470.0577
Store	30.3	Top	-512.59	0	0	-512.59

y10			5			5
Storey9	27.3	Top	-547.126	0	0	-547.126
Storey8	24.3	Top	-574.4848	0	0	-574.4848
Storey7	21.3	Top	-595.5054	0	0	-595.5054
Storey6	18.3	Top	-611.0216	0	0	-611.0216
Storey5	15.3	Top	-621.8676	0	0	-621.8676
Storey4	12.3	Top	-628.8772	0	0	-628.8772
Storey3	9.3	Top	-632.8845	0	0	-632.8845
Storey2	6.3	Top	-634.7234	0	0	-634.7234
Storey1	3.3	Top	-635.2336	0	0	-635.2336
Base	0	Top	0	0	0	0

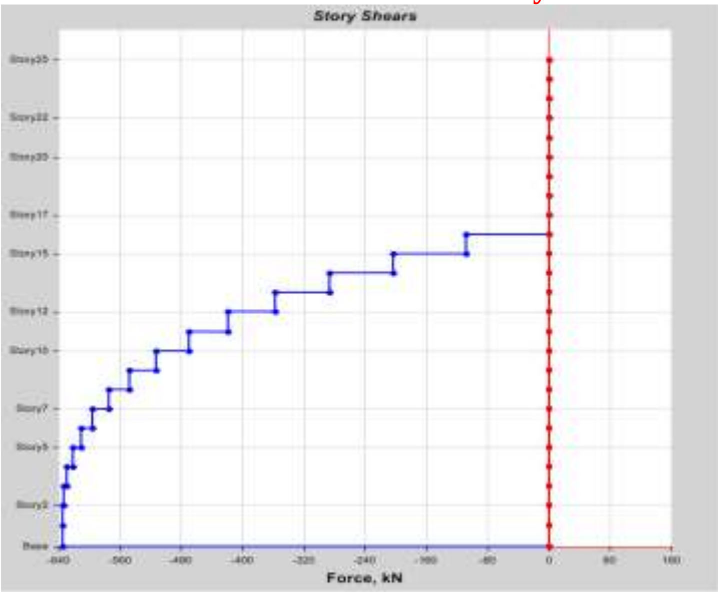


Figure 33: Storey Shears of G+25 Building with V-Bracings for EQ X

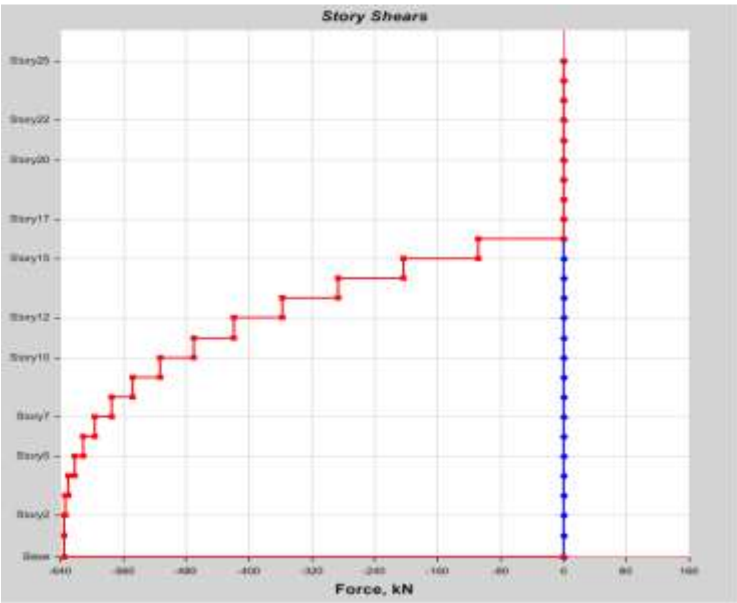


Figure 34: Storey Shears of G+25 Building with V-Bracings for EQ Y

5.5 Results of G+25 Building with X-Bracings:

5.5.1 Storey Displacements:

Table: Storey Displacements of G+25 Building with X-Bracings

Storey	Elevation (m	Location	For EQ X		For EQ Y	
			X-Dir (mm)	Y-Dir (mm)	X-Dir (mm)	Y-Dir (mm)

	)					
Storey 25	75.3	Top	20.9	7.985 E-04	7.985 E-04	20.9
Storey 24	72.3	Top	20.5	2.59E-04	2.59E-04	20.5
Storey 23	69.3	Top	20.1	1.373 E-04	1.373 E-04	20.1
Storey 22	66.3	Top	19.7	1.267 E-04	1.267 E-04	19.7
Storey 21	63.3	Top	19.3	1.779 E-04	1.779 E-04	19.3
Storey 20	60.3	Top	18.8	2.245 E-04	2.245 E-04	18.8
Storey 19	57.3	Top	18.3	2.691 E-04	2.691 E-04	18.3
Storey 18	54.3	Top	17.8	3.012 E-04	3.012 E-04	17.8
Storey 17	51.3	Top	17.3	6.714 E-04	6.714 E-04	17.3
Storey 16	48.3	Top	16.7	3.009 E-03	3.009 E-03	16.7
Storey 15	45.3	Top	15.9	3.098 E-03	3.098 E-03	15.9
Storey 14	42.3	Top	15.1	2.746 E-03	2.746 E-03	15.1
Storey 13	39.3	Top	14.1	2.505 E-03	2.505 E-03	14.1
Storey 12	36.3	Top	13.1	2.309 E-03	2.309 E-03	13.1
Storey 11	33.3	Top	11.9	2.151 E-03	2.151 E-03	11.9
Storey 10	30.3	Top	10.7	2.029 E-03	2.029 E-03	10.7
Storey 9	27.3	Top	9.5	1.949 E-03	1.949 E-03	9.5
Storey 8	24.3	Top	8.2	2.048 E-03	2.048 E-03	8.2
Storey 7	21.3	Top	7	2.162 E-03	2.162 E-03	7
Storey 6	18.3	Top	5.7	2.288 E-03	2.288 E-03	5.7
Storey 5	15.3	Top	4.5	2.424 E-03	2.424 E-03	4.5
Storey 4	12.3	Top	3.4	2.57E-03	2.57E-03	3.4
Storey 3	9.3	Top	2.4	2.66E-03	2.66E-03	2.4
Storey 2	6.3	Top	1.5	2.893 E-03	2.893 E-03	1.5
Storey 1	3.3	Top	0.7	4.565 E-03	4.565 E-03	0.7
Base	0	Top	0	0	0	0

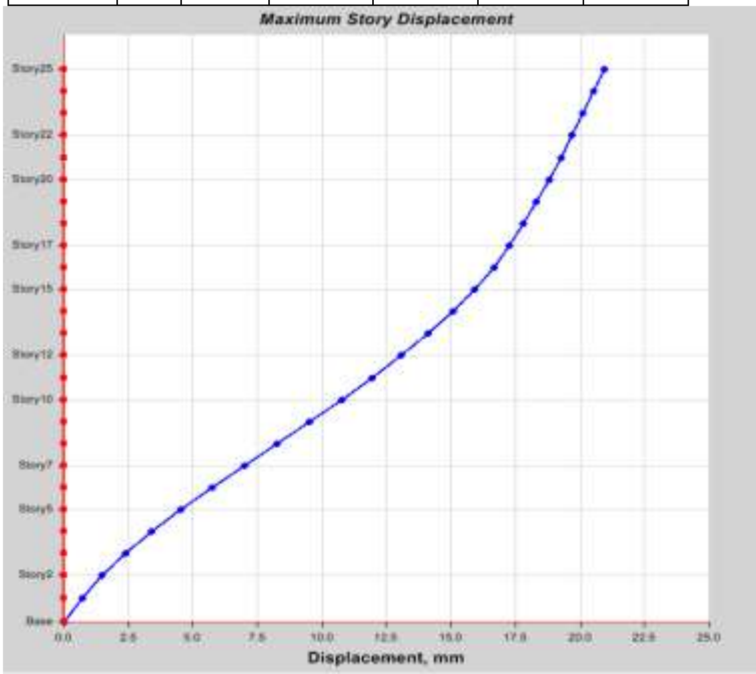


Figure 35: Storey Displacements of G+25 Building with X-Bracings for EQ X

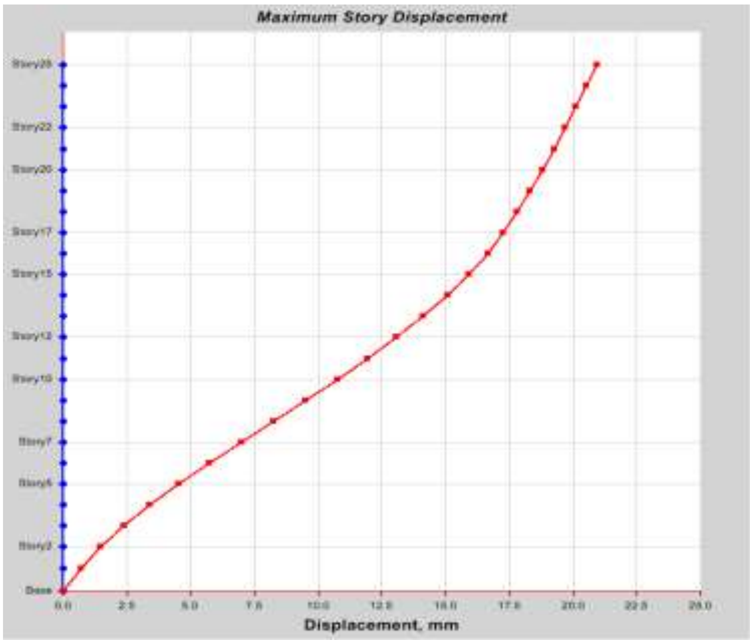


Figure 36: Storey Displacements of G+25 Building with X-Bracings for EQ Y

5.5.2 Storey Drifts:

Table Storey Drifts of G+25 Building with X-Bracings

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir	Y-Dir	X-Dir	Y-Dir
Storey25	75.3	Top	0.000132	2.643E-07	2.643E-07	0.000132
Storey24	72.3	Top	0.000138	1.199E-07	1.199E-07	0.000138
Storey23	69.3	Top	0.000141	2.517E-08	2.517E-08	0.000141
Storey22	66.3	Top	0.000146	1.707E-08	1.707E-08	0.000146
Storey21	63.3	Top	0.000152	1.551E-08	1.551E-08	0.000152
Storey20	60.3	Top	0.00016	1.487E-08	1.487E-08	0.00016
Storey19	57.3	Top	0.00017	1.598E-08	1.598E-08	0.00017
Storey18	54.3	Top	0.000183	1.971E-07	1.971E-07	0.000183
Storey17	51.3	Top	0.000203	0.000001	0.000001	0.000203
Storey16	48.3	Top	0.000242	7.405E-08	7.405E-08	0.000242
Storey15	45.3	Top	0.000282	1.174E-07	1.174E-07	0.000282
Storey14	42.3	Top	0.000319	8.043E-08	8.043E-08	0.000319
Storey13	39.3	Top	0.000351	6.528E-08	6.528E-08	0.000351
Storey12	36.3	Top	0.000378	5.267E-08	5.267E-08	0.000378
Storey11	33.3	Top	0.000399	4.047E-08	4.047E-08	0.000399
Storey10	30.3	Top	0.000413	2.911E-08	2.911E-08	0.000413
Storey9	27.3	Top	0.000421	3.293E-08	3.293E-08	0.000421
Storey8	24.3	Top	0.000421	3.805E-08	3.805E-08	0.000421
Storey7	21.3	Top	0.000414	4.211E-08	4.211E-08	0.000414
Storey6	18.3	Top	0.000399	4.509E-08	4.509E-08	0.000399
Storey5	15.3	Top	0.000376	4.885E-08	4.885E-08	0.000376
Storey4	12.3	Top	0.000344	2.981E-08	2.981E-08	0.000344
Storey3	9.3	Top	0.000304	1.21E-07	1.21E-07	0.000304
Storey2	6.3	Top	0.000254	0.000001	0.000001	0.000254
Storey1	3.3	Top	0.000215	0.000001	0.000001	0.000215
Base	0	Top	0	0	0	0

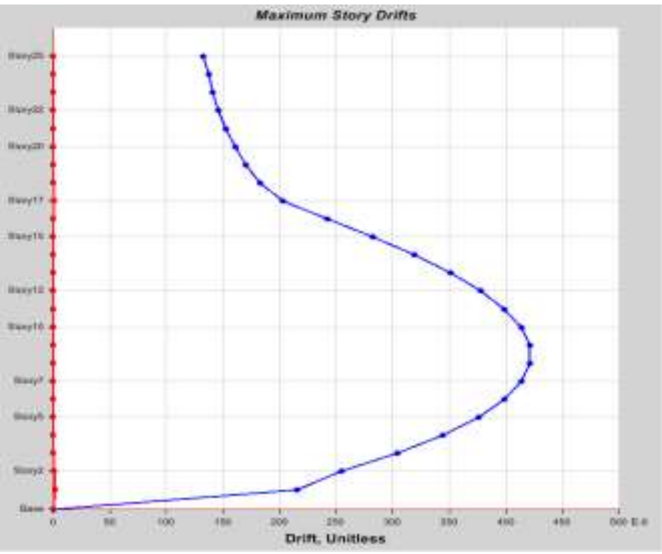


Figure 37: Storey Drifts of G+25 Building with X-Bracings for EQ X

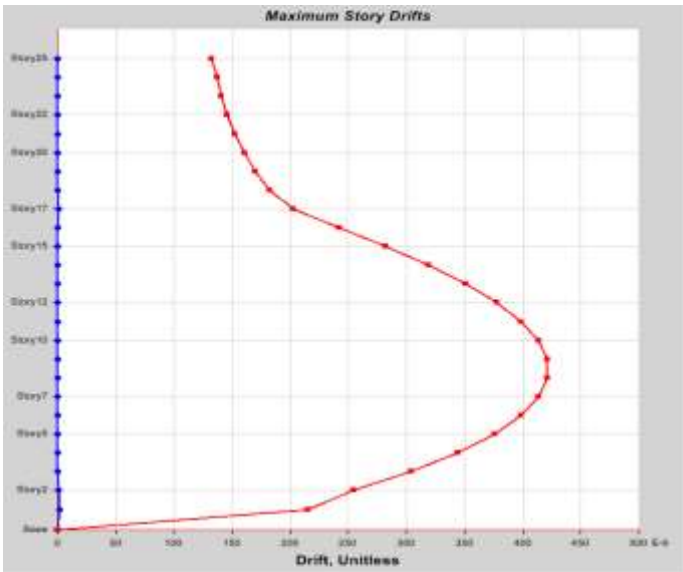


Figure 38: Storey Drifts of G+25 Building with X-Bracings for EQ Y

5.5.3 Storey Shears:

Table : Storey Shears of G+25 Building with X-Bracings

Storey	Elevation (m)	Location	For EQ X		For EQ Y	
			X-Dir (kN)	Y-Dir (kN)	X-Dir (kN)	Y-Dir (kN)
Storey 25	75.3	Top	0	0	0	0
Storey 24	72.3	Top	0	0	0	0
Storey 23	69.3	Top	0	0	0	0
Storey 22	66.3	Top	0	0	0	0
Storey 21	63.3	Top	0	0	0	0
Storey 20	60.3	Top	0	0	0	0
Storey 19	57.3	Top	0	0	0	0
Storey 18	54.3	Top	0	0	0	0
Storey 17	51.3	Top	0	0	0	0
Storey 16	48.3	Top	-111.1562	0	0	-111.1562
Storey 15	45.3	Top	-208.933	0	0	-208.933
Storey 14	42.3	Top	-294.188	0	0	-294.188
Storey 13	39.3	Top	-367.779	0	0	-367.779
Storey 12	36.3	Top	-430.5635	0	0	-430.5635
Storey 11	33.3	Top	-483.3993	0	0	-483.3993
Storey 10	30.3	Top	-527.1439	0	0	-527.1439
Storey 9	27.3	Top	-562.6551	0	0	-562.6551
Storey	24.	Top	-590.79	0	0	-590.79

8	3		04			04
Storey 7	21.3	Top	-612.4075	0	0	-612.4075
Storey 6	18.3	Top	-628.3642	0	0	-628.3642
Storey 5	15.3	Top	-639.518	0	0	-639.518
Storey 4	12.3	Top	-646.7266	0	0	-646.7266
Storey 3	9.3	Top	-650.8476	0	0	-650.8476
Storey 2	6.3	Top	-652.7387	0	0	-652.7387
Storey 1	3.3	Top	-653.2632	0	0	-653.2632
Base	0	Top	0	0	0	0

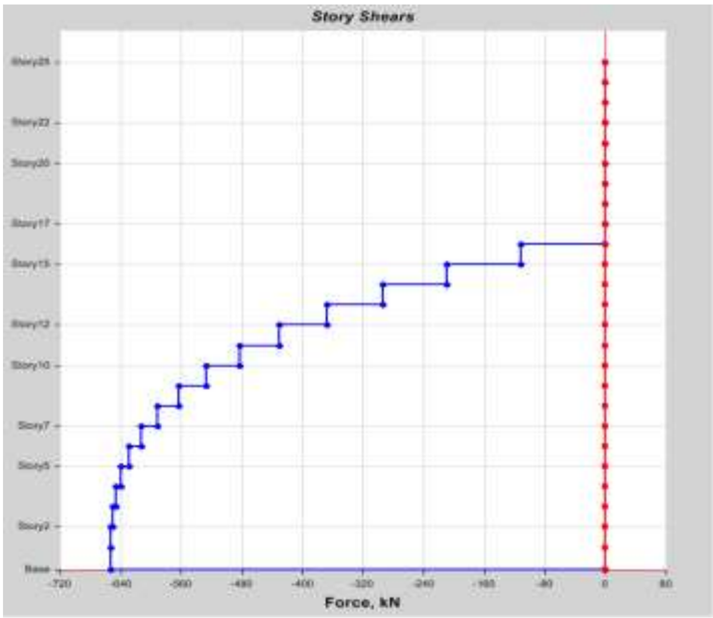


Figure 39: Storey Shears of G+25 Building with X-Bracings for EQ X

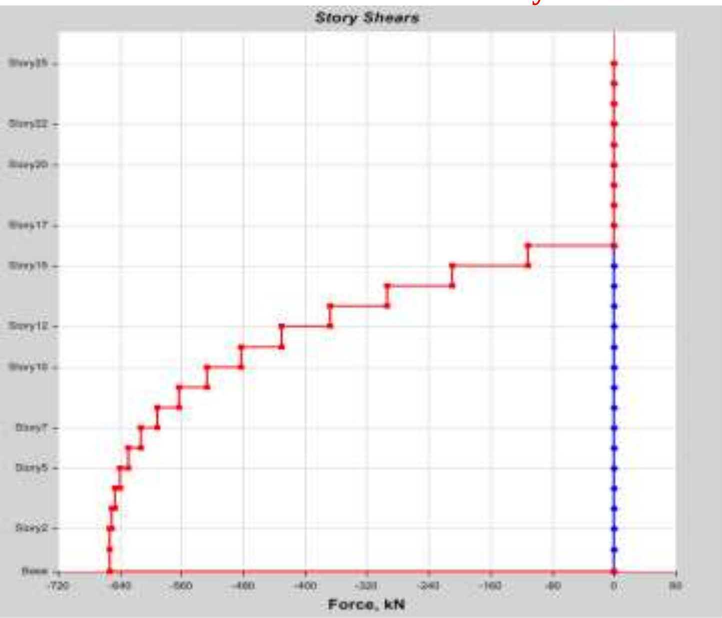
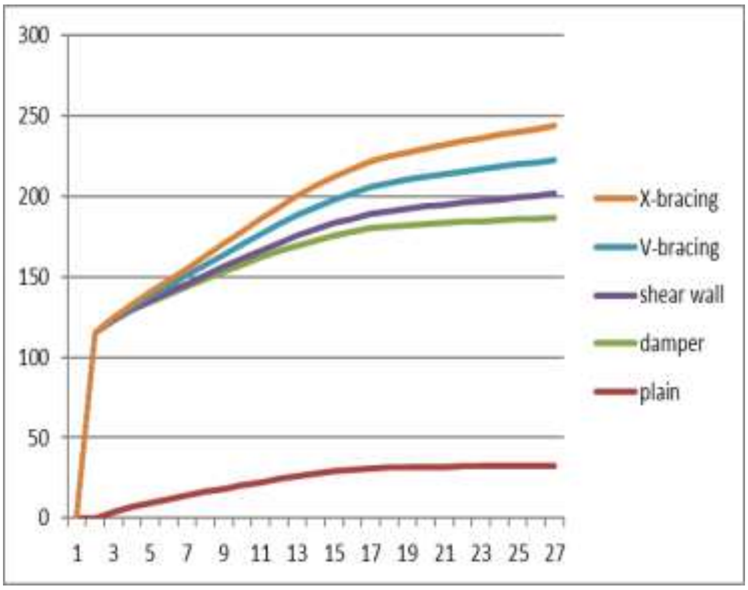
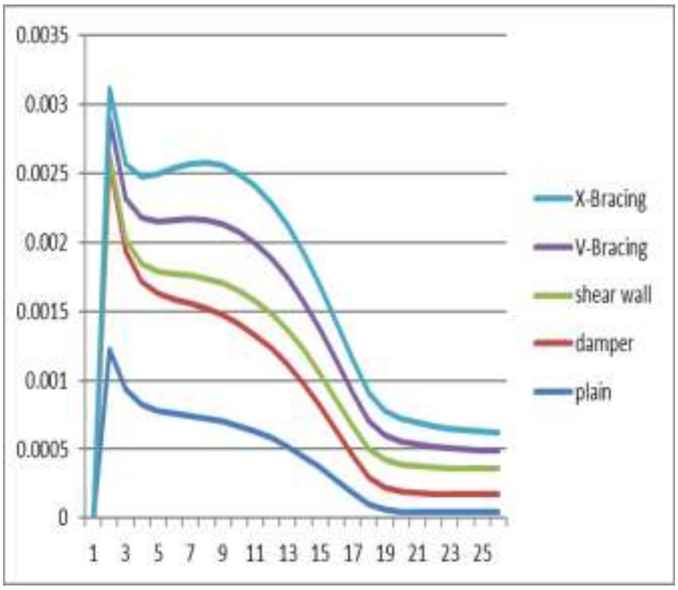


Figure 40: Storey Shears of G+25 Building with X-Bracings for EQ Y

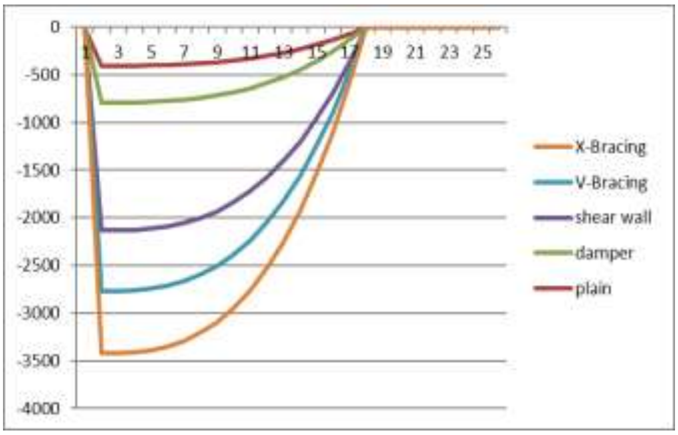
Graphical representation of results:



Storey displacements



Storey drift



Storey Shears

VI. CONCLUSIONS

Based on the analysis result of regular modal of G+25 building with dampers, shear walls , X-bracings , V-bracings are concluded as follows :

1. Storey Displacement is found to be maximum in plain structure with the value of 32.8mm. and is minimum for shear wall with the value of 14.7mm . Therefore the shear walls are suggested for a zone-V regular structures when compared to dampers , shear walls , X-bracings , V-bracings.
2. Storey Drift is found to be maximum in dampers with the value of 0.001361 and minimum is found in shear wall with the value of 0.00025 . Therefore the shear walls are suggested for a zone-V regular structures when compared to dampers , shear walls , X-bracings , V-bracings.
3. Storey Shear is maximum for shear wall with the value of 1380.3KN and minimum value in dampers with 388.4KN . Therefore the shear walls are suggested for a zone-V regular structures when compared to dampers , shear walls , X-bracings , V-bracings
4. Considering the parameters such as Storey Displacement, Storey Drift , Storey Shear we conclude that the shear walls are the most efficient to earthquake when compared with dampers , X-bracings , V-bracings

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