# COMPARATIVE STUDY ON THE EARTHQUAKE RESISTANCE STRUCTURE DESIGN BY STEEL BRACING AND SHEAR WALL

**Mohammed Rehan Aziz[1], Divya Vani B[2]**

[1] Pg Student, M.Tech In structural Engineering, Department Of Civil Engineering, Vidya Jyothi Institute of Technology (Autonomous) Aziz Nagar Gate, C.B Post, Chilkur Road – 500075.

[2] Divya Vani.B, Assistant Professor, Department Of Civil Engineering, Vidya Jyothi Institute of Technology (Autonomous) Aziz Nagar Gate, C.B Post, Chilkur Road – 500075.

**Abstract:** Earthquake-resistant structures are structures designed to protect buildings from earthquakes. While no structure can be entirely immune to damage from earthquakes, the goal of earthquake-resistant construction is to erect structures that fare better during seismic activity than their conventional counterparts. According to building codes, earthquake-resistant structures are intended to withstand the largest earthquake of a certain probability that is likely to occur at their location. This means the loss of life should be minimized by preventing collapse of the buildings for rare earthquakes while the loss of the functionality should be limited for more frequent ones. To combat earthquake destruction, the only method available to ancient architects was to build their landmark structures to last, often by making them excessively stiff and strong. Currently, there are several design philosophies in earthquake engineering, making use of experimental results, computer simulations and observations from past earthquakes to offer the required performance for the seismic threat at the site of interest. These range from appropriately sizing the structure to be strong and ductile enough to survive the shaking with an acceptable damage, to equipping it with base isolation or using structural vibration control technologies to minimize any forces and deformations.

In this present study a G+15 stories building is modeled by using ETABS V 9.7.4 software for checking displacement, shear force, bending moment, building torsion for both steel bracings building and shear wall building.

**Keywords:** G+15, base isolation, earthquake restraining structure, ETABS 9.7.4, etc

# I.INTRODUCTION

Earthquakes are one of nature's most prominent risks to life on this planet and have decimated incalculable urban areas and towns on for all intents and purposes each landmass. They are one of man's most dreaded regular marvels because of real seismic tremors delivering relatively immediate pulverization of structures and different structures. Furthermore, the harm caused by Earthquakes is on the whole connected with synthetic structures. As in the instances of avalanches, seismic tremors likewise cause passing by the harm they instigate in structures, for example, structures, dams, spans and different works of man. Sadly huge numbers of Earthquakes give almost no or no notice before happening and this is one reason why Earthquake building is complex.

The principal compose, the strategy for basic disengagement is exceptionally proficient, yet costly and hard to complete . The rule behind disconnection is to change the characteristic time of the structure, generously decouple a structure from the beginning info and subsequently lessen the subsequent inactivity constrain the structure must stand up to. This is finished by the inclusion of vitality retaining material between the substructures and superstructures, which will lessen the measure of seismic powers transmitted. In conventional structures, subjected to arbitrary or potentially flighty burdens, plastic pivots are given. These plastic pivots, which endure inelastic disfigurement are by and large accumulated at the pillar segment joints and are accordingly connected with harm to the essential auxiliary components.

**Energy Dissipation System (Dampers)**

Mechanical framework which scatter seismic tremor vitality into specific gadgets which misshapes or yield amid Earthquake. They upgrade vitality dissemination in a structure to which they are introduced with the goal that the structure needs to oppose lesser measure of Earthquake powers. They are not used to help the structure. At the point when seismic vitality is transmitted through them, dampers assimilate some portion of it and hence clammy the movement of the building. Conduct of Building with and without dampers when ground seismic waves reach up and begin to infiltrate a base of a building and the base of the building begins moving. Because of inactivity the building keep on remaining in the past position.

## SHEAR WALL

Shear wallin building development, an inflexible vertical stomach fit for exchanging sidelong powers from outside dividers, floors and rooftops to the ground establishment toward a path parallel to their planes. Cases are the strengthened solid divider or vertical support. Sidelong powers caused by wind, Earthquake and uneven settlement loads, notwithstanding the heaviness of structure and inhabitants, make intense curving (torsional) powers. These powers can actually shred (shear) a building separated. Fortifying an edge by connecting or putting an unbending divider inside it keeps up the state of the casing and avoids revolution at the joints. Shear walls are particularly imperative in tall structures subject to sidelong breeze and seismic powers

## BRACINGS

Propped outlines build up their protection from parallel powers by the supporting activity of inclining individuals. The props actuate powers in the related shafts and segments so all cooperate like a bracket with all individuals subjected to stresses that are fundamentally hub.

## OBJECTIVES OF THE STUDY

The following are the main objectives of the project

1. To study the seismic behaviour of building by using IS 1893:2002
2. To design the earthquake resistant structure by using steel dampers.
3. To compare the results of story drift, shear force, bending moment, building torsion of buildings for earthquake resistant buildings.
4. To study the multi story buildings in ETABS V9.7.4 in Response spectrum analysis.

# II.LITERATURE REVIEW

**AbhijeetBaikerikar, KanchanKanagali** From the antiquated time we know Earthquake is a debacle causing occasion. Ongoing days structures are winding up increasingly thin and more defenseless to influence and subsequently unsafe in the seismic tremor. Scientists and specialists have worked out in the past to make the structures as Earthquake safe. After numerous down to earth thinks about it has demonstrated that utilization of sidelong load opposing frameworks in the building setup has massively enhanced the execution of the structure in Earthquake. In display explore we have utilized square framework of 20m toward every path of 5m sound toward every path, programming utilized is ETABS 9.7.0, the work has been completed for the distinctive cases utilizing shear divider and bracings for the diverse statures, most extreme tallness considered for the present investigation is 75m. The displaying is done to look at the impact of various cases alongside various statures on seismic parameters like base shear, horizontal relocations and sidelong floats. The investigation has been done for the Zone V and a wide range of soils as indicated in IS 1893-2002.

As the building tallness expands Lateral relocations and float increments. Contrasted with every other Case 1 (Bare Frame) produces bigger parallel relocations and floats. Sidelong removals and float is altogether lower in the wake of embeddings shear divider and bracings in the exposed edge. One of the imperative conclusions that can be produced using the above examination is that as the dirt changes from hard to delicate there is gigantic increment in base shear, horizontal relocations and parallel floats. Outrageous care ought to be taken in delicate soil. Day and age increments as the stature of the building increments since mass of the general building increments as day and age is straightforwardly corresponding to the mass. From the investigation plainly Case 2 (Shear Wall in Middle) is performing preferred and more productive over every single other case. Base Shear is diminished as the day and age increments. Day and age is essentially brought down subsequent to setting shear walls and bracings.

**AnujChandiwala** From the past records of seismic tremor, there is increment in the request of Earthquake opposing building which can be satisfied by giving the shear divider frameworks in the structures. For accomplishing economy in strengthened solid building structures, plan of basic area is deliberately done to get sensible solid sizes and ideal steel utilization in individuals. In the present paper the specialist, had endeavored to get minute happen at a specific segment including the seismic load, by taking distinctive horizontal load opposing basic frameworks, diverse number of floors, with different places of shear divider for tremor zone III in India has been found.

Among various area of shear divider (F-shear divider at end of "L" segment) gives best outcome. Fundamental reason is "END PORTION OF FLANGE ALWAYS OSCILLATE MORE

DURING EARTHQUAKE". Here shear divider straight forwardly deter this end swaying, subsequently diminish general bowing snapshot of building.

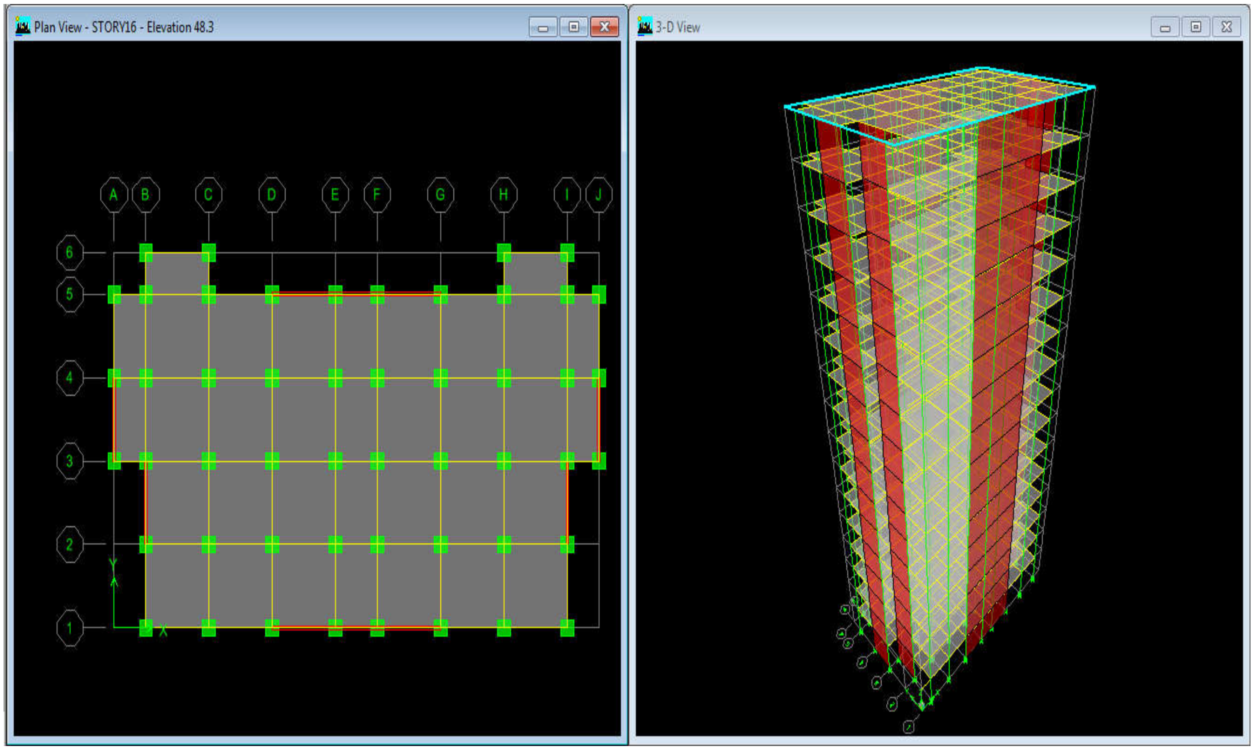
## III.METHODOLOGY

In the present study, analysis of G+20 multi-story building in most severs zone for wind and earthquake forces is carried out.3D model is prepared for G+20 multi-story building is in ETABS. Building has a typical size of

Basic parameters considered for the analysis are

1. Utility of building : Residential building
2. Number of stories : G+15
3. Shape of building : Rectangular
4. Type of walls : Brick wall
5. Geometric details
    a. Ground floor : 3.3m
    b. Floor to floor height : 3m
6. Material details
    a. Concrete Grade : M30 (COLUMNS AND BEAMS)
    b. All Steel Grades : HYSD reinforcement of Grade Fe415
    c. Bearing Capacity of Soil : 200 kN/$m^2$
7. Type Of Construction : R.C.C FRAMED structure
8. Column : 0.7m X 0.35m
9. Beams : 0.58m X 0.23m
10. Slab : 0.120m
11. Special considerations
    - Shear wall : Thickness 150mm

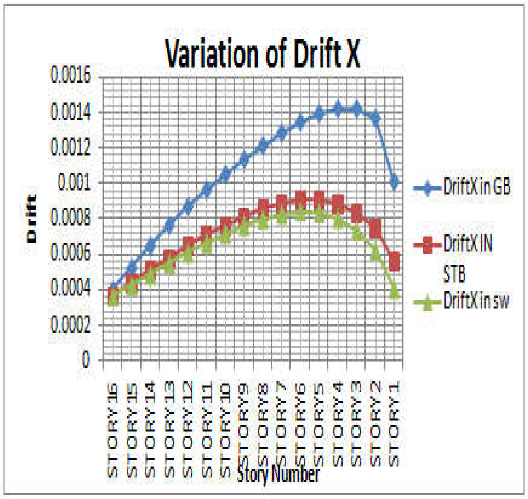
MODELLING IN ETABS




# IV.RESULTS AND ANALYSIS

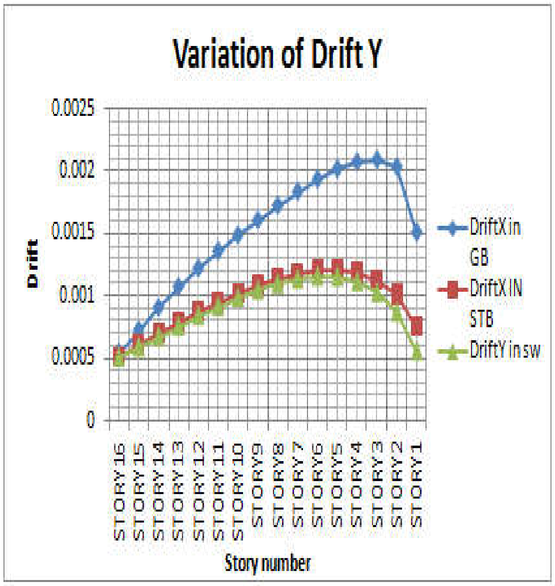
## DRIFT IN X DIRECTION

| Story | DriftX in GB (m) | Drift X in STB (m) | DriftX in SW (m) |
|---|---|---|---|
| STORY16 | 0.000402 | 0.00036 | 0.000365 |
| STORY15 | 0.000525 | 0.000434 | 0.000425 |
| STORY14 | 0.000649 | 0.000504 | 0.000486 |
| STORY13 | 0.000764 | 0.000574 | 0.000548 |
| STORY12 | 0.000869 | 0.00064 | 0.000609 |
| STORY11 | 0.000964 | 0.000702 | 0.000665 |
| STORY10 | 0.001051 | 0.000758 | 0.000717 |
| STORY9 | 0.001134 | 0.000808 | 0.000763 |
| STORY8 | 0.001212 | 0.00085 | 0.0008 |
| STORY7 | 0.001283 | 0.000883 | 0.000827 |
| STORY6 | 0.001345 | 0.000902 | 0.00084 |
| STORY5 | 0.001392 | 0.000904 | 0.000834 |
| STORY4 | 0.001419 | 0.000883 | 0.000802 |
| STORY3 | 0.001418 | 0.000831 | 0.000736 |
| STORY2 | 0.001365 | 0.000746 | 0.000624 |
| STORY1 | 0.00101 | 0.000555 | 0.000409 |



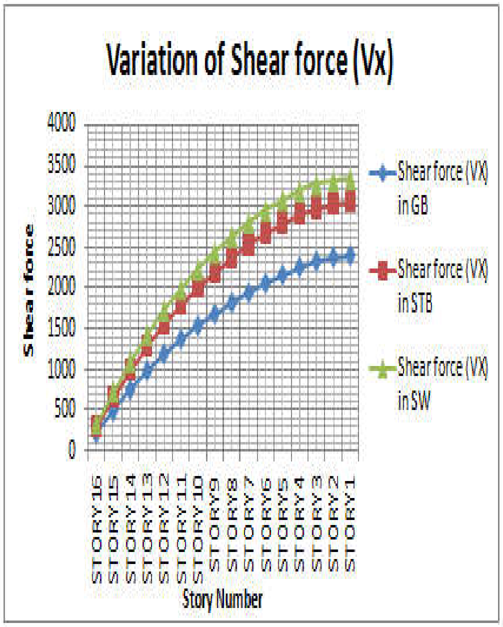
## DRIFT IN Y DIRECTION

| Story | Drift Y in GB (m) | Drift Y in STB (m) | Drift Y in SW (m) |
|---|---|---|---|
| STORY16 | 0.000538 | 0.000507 | 0.000508 |
| STORY15 | 0.000719 | 0.000606 | 0.000589 |
| STORY14 | 0.000901 | 0.000699 | 0.000672 |
| STORY13 | 0.001067 | 0.000788 | 0.000757 |
| STORY12 | 0.001216 | 0.000872 | 0.000838 |
| STORY11 | 0.001352 | 0.00095 | 0.000913 |
| STORY10 | 0.001479 | 0.00102 | 0.000981 |
| STORY9 | 0.0016 | 0.001082 | 0.001042 |
| STORY8 | 0.001717 | 0.001136 | 0.001093 |
| STORY7 | 0.001828 | 0.001178 | 0.001131 |
| STORY6 | 0.001928 | 0.001204 | 0.001152 |
| STORY5 | 0.00201 | 0.001207 | 0.001148 |
| STORY4 | 0.002066 | 0.001182 | 0.00111 |
| STORY3 | 0.002084 | 0.001116 | 0.001023 |
| STORY2 | 0.002027 | 0.001007 | 0.000869 |
| STORY1 | 0.001501 | 0.000755 | 0.000558 |



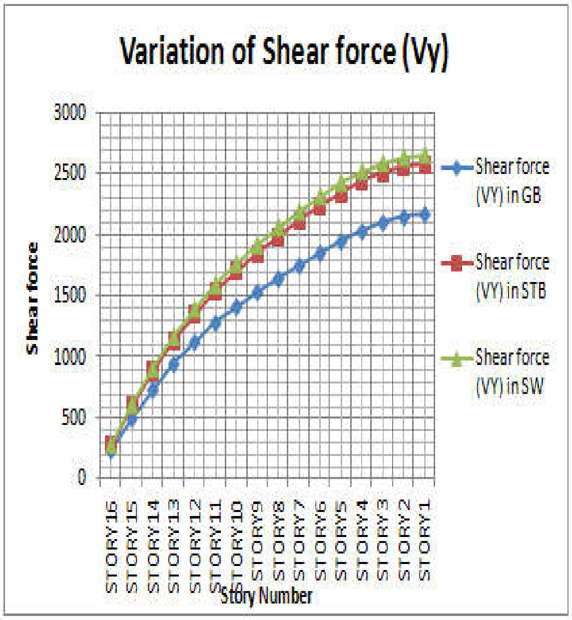

## SHEAR FORCE (Vx)

| Story | Shear force (VX) in GB (kN/m) | Shear force (VX) in STB (kN/m) | Shear force (VX) in SW (kN/m) |
|---|---|---|---|
| STORY16 | 233.95 | 305.5 | 337.32 |
| STORY15 | 507.92 | 662.49 | 734.84 |
| STORY14 | 761.94 | 991.34 | 1099.23 |
| STORY13 | 992.26 | 1289.88 | 1429.1 |
| STORY12 | 1197.52 | 1558.02 | 1725.03 |
| STORY11 | 1378.91 | 1797.67 | 1989.48 |
| STORY10 | 1539.67 | 2012.15 | 2226.12 |
| STORY9 | 1684.22 | 2205.31 | 2438.89 |
| STORY8 | 1816.85 | 2380.41 | 2630.87 |
| STORY7 | 1940.44 | 2539.22 | 2803.49 |
| STORY6 | 2055.58 | 2681.55 | 2956.21 |
| STORY5 | 2160.36 | 2805.4 | 3086.8 |
| STORY4 | 2250.94 | 2907.63 | 3192.24 |
| STORY3 | 2322.56 | 2985.07 | 3269.9 |
| STORY2 | 2370.91 | 3035.69 | 3318.84 |
| STORY1 | 2393.98 | 3059.95 | 3341.2 |



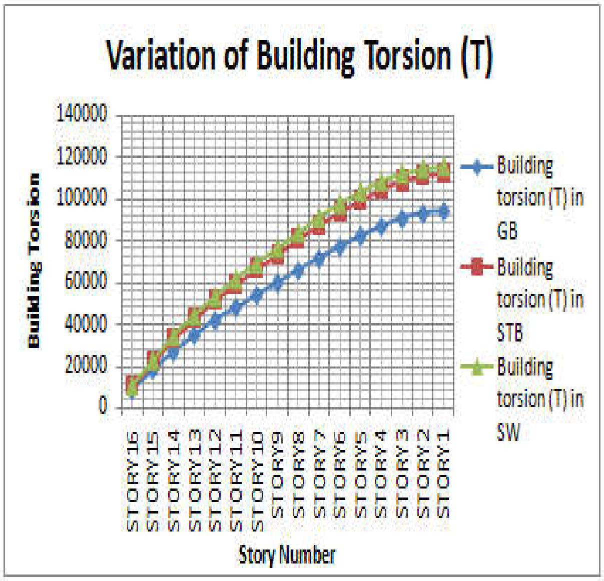
## SHEAR FORCE (Vy)

| Story | Shear force (Vy) in GB (kN/m) | Shear force (Vy) in STB (kN/m) | Shear force (Vy) in SW (kN/m) |
|---|---|---|---|
| STORY16 | 229.56 | 279.2 | 284.87 |
| STORY15 | 492.68 | 598.03 | 614.76 |
| STORY14 | 730.79 | 883.91 | 910.67 |
| STORY13 | 940.72 | 1135.35 | 1171.29 |
| STORY12 | 1122.16 | 1353.61 | 1397.9 |
| STORY11 | 1277.7 | 1542.5 | 1594.48 |
| STORY10 | 1412.31 | 1707.77 | 1766.96 |
| STORY9 | 1532.23 | 1855.76 | 1921.83 |
| STORY8 | 1643.37 | 1991.94 | 2064.49 |
| STORY7 | 1749.69 | 2119.48 | 2197.84 |
| STORY6 | 1852.13 | 2238.57 | 2321.52 |
| STORY5 | 1948.44 | 2346.56 | 2432.27 |
| STORY4 | 2033.86 | 2438.96 | 2525.14 |
| STORY3 | 2102.61 | 2510.89 | 2595.21 |
| STORY2 | 2149.39 | 2558.65 | 2639.43 |
| STORY1 | 2171.54 | 2581.42 | 2658.88 |



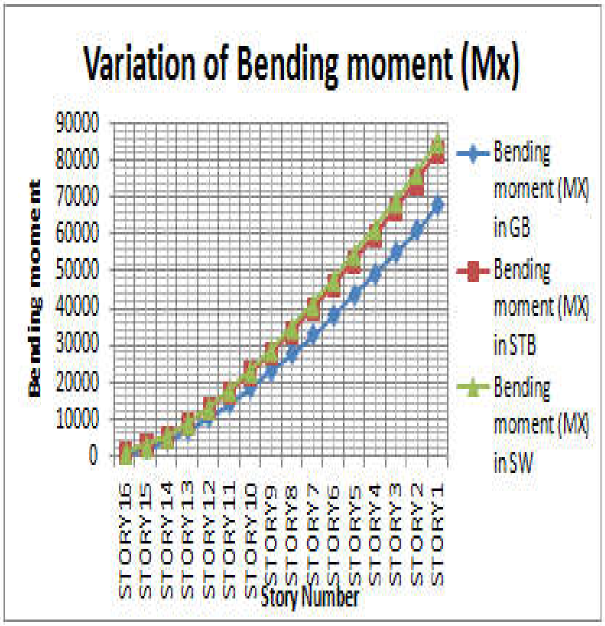

## BUILDING TORSION (T)

| Story | Building torsion (T) in GB (kN-m) | Building torsion (T) in STB (kN-m) | Building torsion (T) in SW (kN-m) |
|---|---|---|---|
| STORY16 | 8389.258 | 10370.77 | 10687.34 |
| STORY15 | 18041.61 | 22279.4 | 23128.04 |
| STORY14 | 26820.94 | 33032.14 | 34361.74 |
| STORY13 | 34657.7 | 42628.07 | 44398.25 |
| STORY12 | 41624.7 | 51202.27 | 53381.56 |
| STORY11 | 47935.42 | 59008.68 | 61576.18 |
| STORY10 | 53878.65 | 66344.6 | 69286.65 |
| STORY9 | 59705.47 | 73444.64 | 76745.37 |
| STORY8 | 65542.12 | 80408.02 | 84038.21 |
| STORY7 | 71367.49 | 87185.82 | 91094.17 |
| STORY6 | 77033.37 | 93608.16 | 97717.34 |
| STORY5 | 82302.24 | 99428.79 | 103637.8 |
| STORY4 | 86892.42 | 104376.3 | 108570.1 |
| STORY3 | 90525.26 | 108206.3 | 112274.7 |
| STORY2 | 92971.57 | 110750.5 | 114620.3 |
| STORY1 | 94129.25 | 111975.6 | 115667.6 |



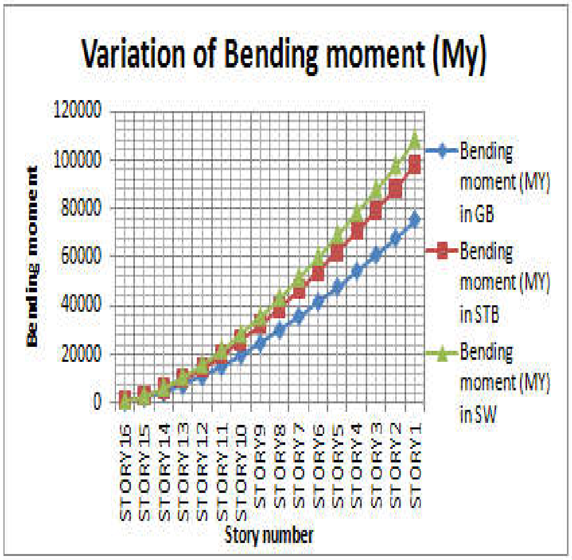
## BENDING MOMENT (MX)

| Story | Bending moment (MX) in GB (kN-m) | Bending moment (MX) in STB (kN-m) | Bending moment (MX) in SW (kN-m) |
|---|---|---|---|
| STORY16 | 688.665 | 837.597 | 854.607 |
| STORY15 | 2166.485 | 2631.314 | 2698.457 |
| STORY14 | 4357.533 | 5281.012 | 5428.242 |
| STORY13 | 7174.881 | 8680.275 | 8934.729 |
| STORY12 | 10528.09 | 12723.58 | 13109.61 |
| STORY11 | 14331.01 | 17313.43 | 17852.88 |
| STORY10 | 18508.69 | 22366.19 | 23078.9 |
| STORY9 | 23002.14 | 27815.54 | 28719.95 |
| STORY8 | 27770.09 | 33612.74 | 34726.3 |
| STORY7 | 32787.32 | 39723.76 | 41062.78 |
| STORY6 | 38039.89 | 46123.79 | 47702.66 |
| STORY5 | 43518.14 | 52790.5 | 54620.42 |
| STORY4 | 49209.37 | 59697.65 | 61785.17 |
| STORY3 | 55091.7 | 66810.79 | 69156.85 |
| STORY2 | 61130.83 | 74086.09 | 76686.31 |
| STORY1 | 67900.13 | 82215.75 | 85087.97 |




## BENDING MOMENT (My)

| Story | Bending moment (MY) in GB (kN-m) | Bending moment (MY) in STB (kN-m) | Bending moment (MY) in SW (kN-m) |
|---|---|---|---|
| STORY16 | 701.852 | 916.496 | 1011.95 |
| STORY15 | 2225.459 | 2903.657 | 3216.06 |
| STORY14 | 4510.285 | 5876.013 | 6511.648 |
| STORY13 | 7483.272 | 9740.133 | 10792.21 |
| STORY12 | 11065.25 | 14400.2 | 15950.74 |
| STORY11 | 15177.81 | 19763.63 | 21885.12 |
| STORY10 | 19749.38 | 25745.7 | 28502.29 |
| STORY9 | 24719.64 | 32272.25 | 35720.48 |
| STORY8 | 30041.31 | 39280.13 | 43468.95 |
| STORY7 | 35678.99 | 46715.23 | 51685.59 |
| STORY6 | 41605.51 | 54528.89 | 60312.94 |
| STORY5 | 47796.51 | 62673.49 | 69294.01 |
| STORY4 | 54224.69 | 71098.65 | 78568.95 |
| STORY3 | 60855.14 | 79748.98 | 88073.79 |
| STORY2 | 67642.96 | 88564.4 | 97742.05 |
| STORY1 | 75227.26 | 98378.22 | 108489.4 |



# V.CONCLUSIONS

The following are the conclusions are

1. The drifts or displacements of building with shear walls are less with comparison of Bracings and Dampers and general Building

2. Among the all the cases (i.e., general, bracing, shear wall and dampers) the general building shows the larger drifts and displacements.

3. From the study it is clear that building with shear walls is performing better and more efficient than all other cases.

4. The story shear for forces (V) and moment (M) is maximum for the building using shear walls among all the cases (i.e., general, bracing, shear wall and dampers).

5. The value of building twist (T) is also maximum for the shear wall case than other cases.

6. The story shear values are increases from story 11to story 1 (top story to bottom story) in all the cases.

7. The support reactions for the shear wall cases has less values than other cases in the study.

8. Compared to all the systems the shear wall systems are economical and the combination of shear wall and dampers will be used for more seismic intensity regions.

SCOPE FOR FURTHUR WORK

- The study can be extended for different plan size of the building.
- By locating systems at different positions andcomparing the results.
- Further study can be done by using different types of systems and for different heights.

## REFERENCES


1) Shaik Kamal Mohammed Azam, VinodHosur, "Seismic Performance Evaluation of Multistoried RC Framed Buildings with Shear Wall", International Journal of Scientific and Engineering Research, Volume 4, Issue 1, January 2013.
2) C.V.R Murthy, RupenGoswami, A.R.Vijaynarayanan, Vipul V. Mehta, "A few Concepts in Earthquake Behavior of Buildings", Gujrat State Disaster Management Authority, Government of Gujrat.
3) PankajAgarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures" (PHI Learning Private Limited, New Delhi, India).
4) Dr.VinodHosur, "Earthquake Resistant Design of Building Structures" (Wiley India Pvt. Ltd, New Delhi, India).
5) Bryan Stafford Smith, Alex Coull, "Tall Building Structures Analysis and Design" (John Wiley and Sons, Inc).
6) ASCE (1982). "Best in class Report on Finite Element Analysis of Reinforced Concrete", ASCE Special Publication, New York, N.Y., U.S.A. 3. Can Balkaya and Schnobrich W.C (1993) "Nonlinear 3D Behavior of

Shear-Wall Dominant RC Building Structures", Journal of Structural Engineering and Mechanics. Vol 1: No.1, pp 1-16.

7) P.P.Chandurkar, Dr.P.S.Pajgade, "Seismic investigation of RCC Building with and without shear divider". IJMER, Vol.3, Issue 3, May-june 2013, pp-1805-1810, 2013.