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Research Paper

COMPARATIVE ANALYSIS OF EARTH QUAKE RESISTANT BUILDING BY USING BRACINGS AND SHEAR WALL BY USING ETABS SOFTWARE

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Abstract *Earthquake resistant structures are 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. Now a day's steel bracings technique and shear wall systems are generally using for designing of earth quake resistant structure due to simple construction methods, easy to install and they are reduces the deflection and shear in past studies the earth quack resistant structure is designed by using steel bracings or shear wall systems in present study a comparison made between these two systems along with general building in high seismic zone.*

In the present study a G+10 story is modeled by using ETABS software and analyzed in Response spectrum analysis and the comparison is made between the general building, steel building and shear wall buildings to design the earth quake resistant structures design. The results like story drift, story shear, story moment, building torsion, time period, and frequency values are compared.

Key words: *Earthquake, Response spectrum analysis, story drift, story shear, story moment, building torsion, time period, model frequency.*

1. INTRODUCTION

Earthquakes are considered one in all nature's most high-quality risks to life within the international and function decimated incalculable urban regions and cities on for all intents and purposes every landmass. They are one in every of guy's maximum dreaded regular marvels due to real seismic tremors delivering tremendously instantaneous pulverization of systems and great structures. Furthermore, the damage due to Earthquakes is on the complete connected with synthetic structures. As in the times of avalanches, seismic tremors likewise cause passing with the aid of the harm they instigate in structures, for instance, structures, dams, spans and top notch works of guy. Sadly massive numbers of Earthquakes supply nearly no or no note before taking region and that is one reason why Earthquake constructing is complex.

Nowadays the townhouse constructing is number one paintings of the social enhance of the province. Everyday new strategies are being produced for the development of living preparations financially, unexpectedly and pleasant the situations of the collection experts and creators do the crease work, arranging and format, and so forth, of the tendencies. Prepared representatives are honest for doing the example works of running with appreciate to the manner of architects and fashioners. The organized laborer should secure his interest and could likewise be successful to conform with the guideline of the architect and may likewise pull inside the coveted example of the building, website designs and layout designs and several others, with recognize to the requirements.

Earthquake resistant structures

Earthquake-resistant systems are structures designed to protect buildings from earthquakes. While no structure may be absolutely proof against harm from earthquakes, the goal of earthquake-resistant production is to erect systems that fare better throughout seismic interest than their conventional counterparts. According to building codes, earthquake-resistant systems are meant to resist the most important earthquake of a sure possibility that is possibly to occur at their region. This approach the lack of existence should be minimized by way of preventing crumble of the buildings for rare earthquakes even as the lacks of the functionality have to be confined for greater common ones.

To combat earthquake destruction, the best approach available to historic architects became to construct their landmark systems to remaining, regularly by using 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 overall performance for the seismic threat at the web site of hobby. These range from accurately sizing the shape to be strong and ductile sufficient to continue to exist the shaking with an acceptable harm, to equipping it with base isolation or using structural vibration manage technologies to limit any forces and deformations. While the former is the technique generally applied in most earthquake-resistant structures, crucial facilities, landmarks and cultural background buildings use the greater advanced (and high priced) strategies of isolation or manipulate to survive sturdy shaking with minimum damage. Examples of such applications are the Cathedral of Our Lady of the Angels and the Acropolis Museum.

Bracing system

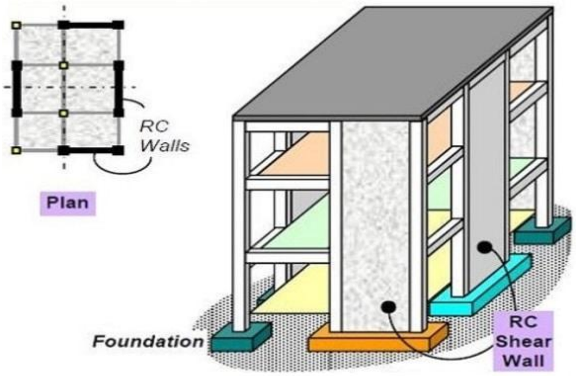
A braced frame is a structural machine normally utilized in systems concern to lateral masses which includes wind and seismic stress. The members in a braced body are typically made from structural metal, that can work correctly each in tension and compression.

The beams and columns that shape the body deliver vertical masses, and the bracing gadget incorporates the lateral masses. The positioning of braces, however, may be complicated as they are able to intrude with the layout of the facade and the location of openings. Buildings adopting high-tech or submit-modernist patterns have replied to this through expressing bracing as an inner or outside design characteristic.

Cross Bracings

Shear wall system

Shear wall, in building development, an inflexible vertical stomach equipped for moving horizontal forces from outside walls, floors, and rooftops to the ground establishment toward a path corresponding to their planes. Models are the reinforced-substantial wall or vertical bracket. Parallel forces brought about by wind, quake, and lopsided settlement loads, notwithstanding the heaviness of structure and tenants, make amazing bending (tensional) forces. These forces can in a real sense tear (shear) a building separated. Supporting a casing by appending or putting an unbending wall inside it keeps up with the state of the casing and forestalls pivot at the joints. Shear walls are particularly significant in elevated structures subject to sidelong wind and seismic forces.



Shear Wall Building

Objectives of the study

The following are the main objectives of the project

1. To study the seismic behavior of building by using IS 1893:2016.
2. To design the earth quake resistant structure by using steel bracings and shear wall in zone V.
3. To study the multi story building of G+10 by using Response spectrum analysis
4. To compare the results of story drift, shear force, bending moment, building torsion, time period and frequency of buildings for earth quake resistant buildings.
5. To study the multi story buildings in ETABS software.

2. LITERATURE REVIEW

Shahzad Jamil Sardar and Umesh. N. Karadi., et al[2] (2013)

This project presents a study of a 25-story structure in Zone V with some exploration that is studied by altering the location of the shear wall to determine characteristics such storey drift, storey shear, and displacement using the standard programme ETABS. It was concluded from this study that seismic analysis of reinforced concrete frame structures is done by static and dynamic analysis to identify and compare the base shear. The greatest base shear was observed in model-5 in the longitudinal and transverse direction as compared to the other models.

Najma Nainan., et al (2012)

Static and dynamic loads are applied to structures all around the planet. Static loads remain the same throughout time whereas dynamic loads change over time. Most civil engineering structures are built on the premise that all applied loads are static, and this is generally true. Even if dynamic loads are uncommon, it is not taken into account in the analysis because doing so makes the solution more complicated and time consuming. This tendency to ignore dynamic forces can lead to catastrophe, especially during an earthquake. According to the findings of this investigation, an analytical research was conducted on the dynamic response of seismo-resistant building frames. Building frames have a dynamic reaction, and we can calculate the storey displacements for various shear wall heights.

Mr.K.LovaRaju, Dr.K.V.G.D.Balaji., et al[4] (2015)

This study examines the non-linear frame analysis for different shear wall locations in a building frame. Identifying an appropriate shear wall placement in a multi-story building is the goal of this research. When it comes to structural systems, model one has a bare frame, while the other three have a dual type system. Buildings in seismic zones II, III, IV, and V are subjected to an earthquake load under Code Provision IS1893-2002. ETABS software was used to do the analysis. When compared to a frame without a shear wall, the base shear rose by 9.82 percent with the use of a shear wall at position 3. In comparison to the frame without a shear wall, the shear wall in position 3 offers improved lateral displacement performance and decreases lateral displacement by 26.7%. Existing or new structures benefit from having a shear wall placed in a good location.

3. METHODOLOGY USED

Response spectrum method

The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2016 (part1). Here type of soil, seismic zone factor should be entered from IS 1893-2016 (part1). The standard response spectra for type of soil considered is applied to building for the analysis in ETABS software. Following diagram shows the standard response spectrum for medium soil type and that can be given in the form of time period versus spectral acceleration coefficient (Sa/g).

This approach permits the multiple modes of response of a building to be taken in to account (in the frequency domain). This is required in many building codes for all except very simple or very complex structures. The response of a structure can be defined as a combination of many special shapes (modes) that in a vibrating string correspond to the "harmonic" computer analysis can be used to determine these modes for a structure. For each mode, a response is read from the design spectrum, based on the modal frequency and the modal mass, and they are then combined to provide an estimate of the total response of the structure. In this we have to calculate the magnitude of forces in all directions i.e. X, Y & Z and then see the effects on the building.

4. PROBLEM STATEMENT AND MODELS IN ETABS

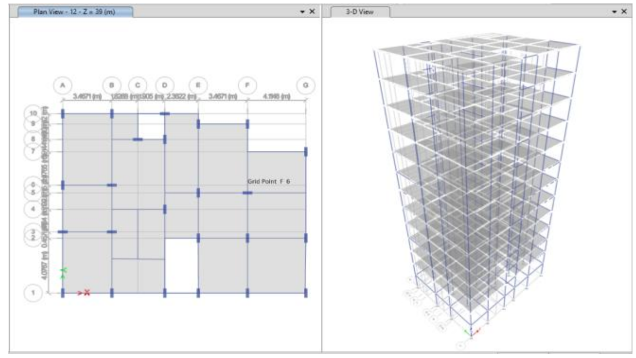
Statement of the project

In the present study, analysis of G+ 10 stories building in Zone V seismic zones is carried out in ETABS.

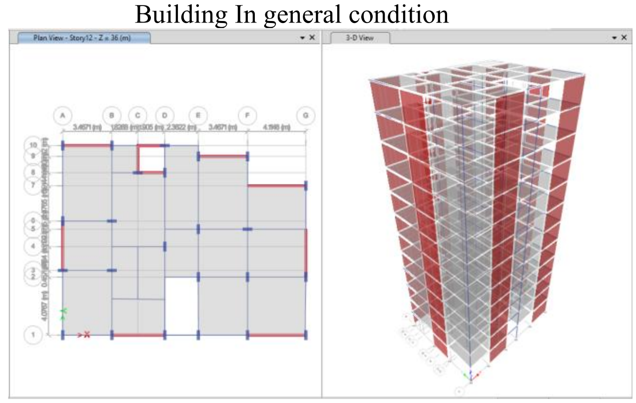
Basic parameters considered for the analysis are

1. Utility of Buildings : Residential Building
2. No of Storey : 11 Stories (G+10 Building)
3. Grade of concrete : M40
4. Grade of Reinforcing steel : HYSD Fe500
5. Type of construction : RCC framed structure
6. Dimensions of beam : 230mmX460mm
7. Dimensions of column : 230mmX690mm
8. Thickness of slab : 150mm
9. Thickness of Shear wall : 150mm
10. Height of bottom story : 4m
11. Height of Remaining story : 3m
12. Building height :34m
13. Live load : 5 KN/m^2
14. Dead load : 2 KN/m^2
15. Density of concrete : 25 KN/m^3
16. Loads considered in Buildings : Dead load, Live load, Floor load Earthquake ,Wind load
17. Seismic Zones : Zone V
18. Site type : II
19. Importance factor : 1.5
20. Response reduction factor : 5
21. Damping Ratio : 5%
22. Structure class : B
23. Basic wind speed : 44m/s
24. Method of Analysis :RESPONSE SPECTRUM
25. Wind design code :IS875-1987 (Part 3)
26. RCC design code : IS 456:2000
27. Steel design code : IS 800: 2007
28. Earth quake design code : IS 1893:2002 (Part 1).

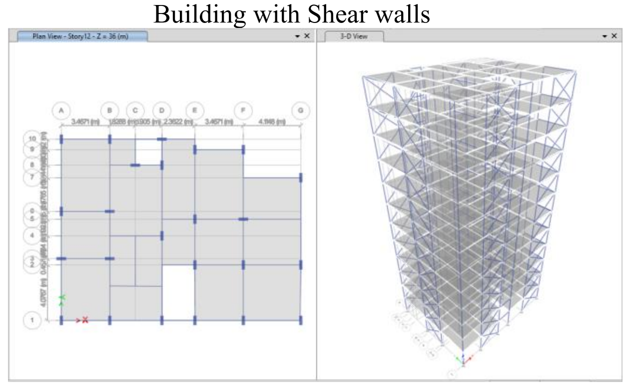
Models used in ETABS



Building In general condition



Building with Shear walls

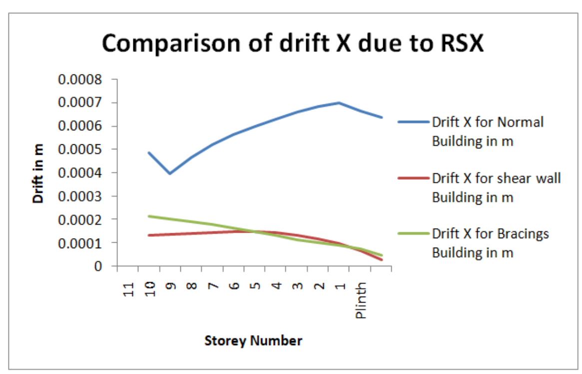


Building with steel bracings

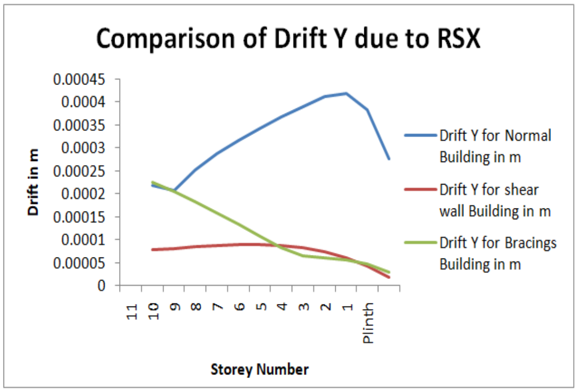
5. RESULTS AND ANALYSIS

RSX Results

Storey drift

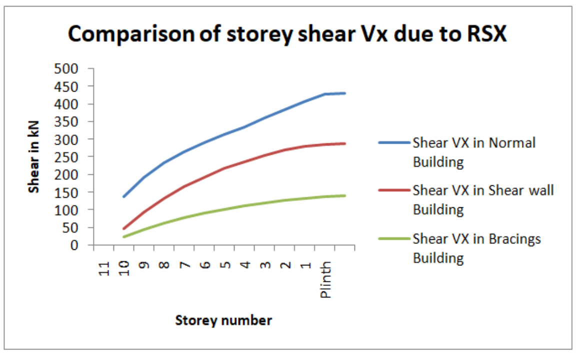


Comparison of drift X due to RSX load case

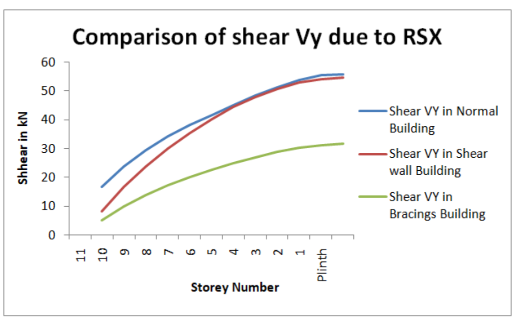


Comparison of drift Y due to RSX load case

Storey Shear

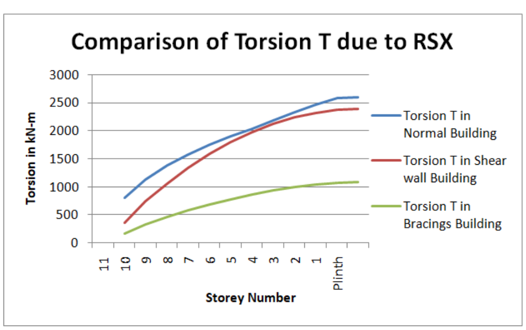


Comparison of Shear in X Direction due to RSX



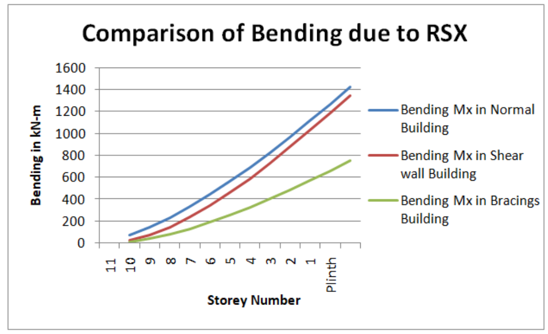
Comparison of Shear in Y Direction due to RSX

Comparison of Torsion T due to RSX

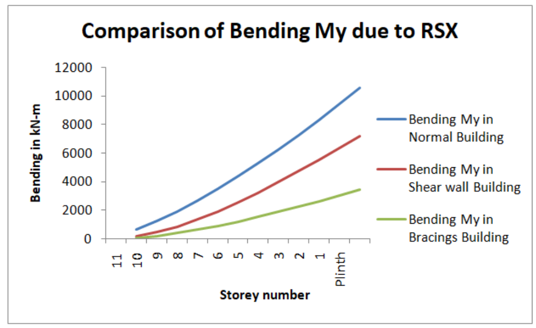


Comparison of Torsion due to RSX

Comparison of Bending

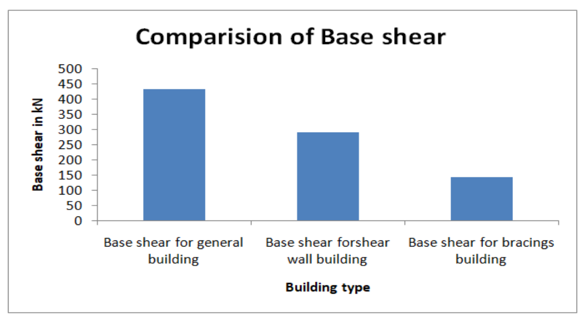


Comparison of Bending in X Direction due to RSX



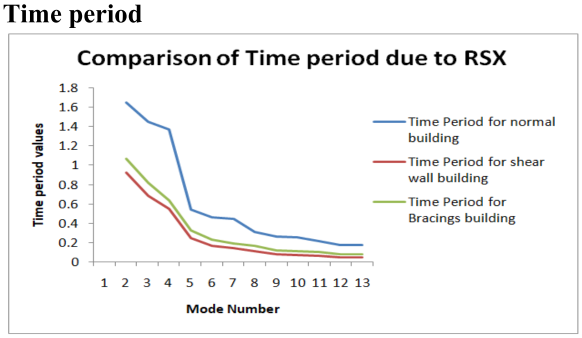
Comparison of Bending in Y Direction due to RSX

Base shear due to RSX



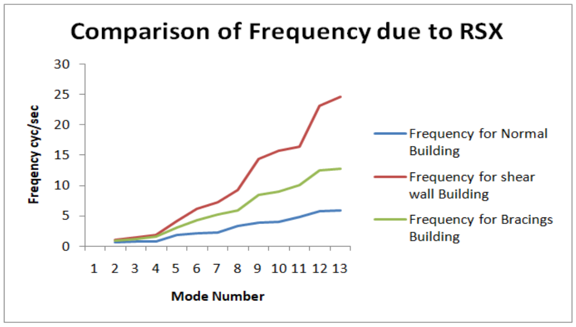
Comparison of Base shear due to RSX

Time period



Comparison of Time period due to RSX

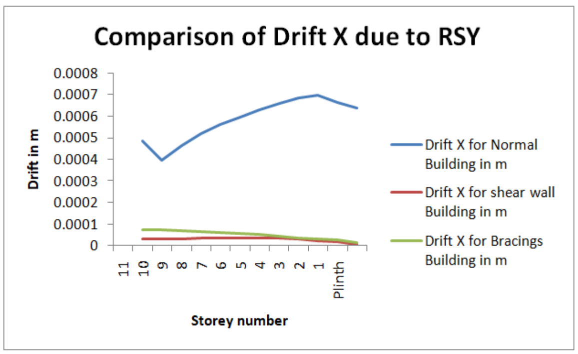
Frequency



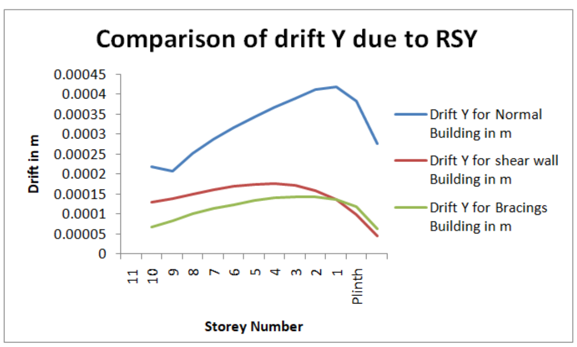
Comparison of Frequency due to RSX

RSY Results

Storey drift

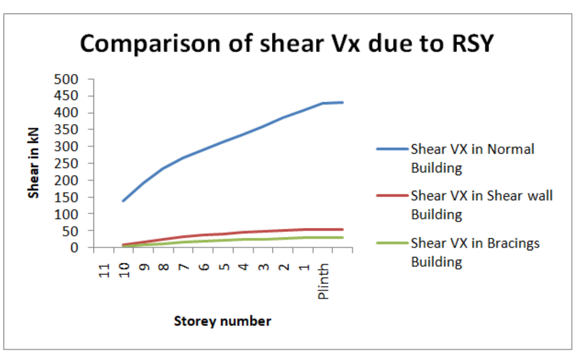


Comparison of drift X due to RSY load case

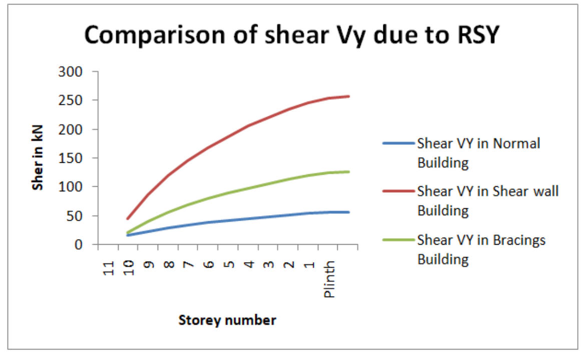


Comparison of drift Y due to RSY load case

Storey Shear

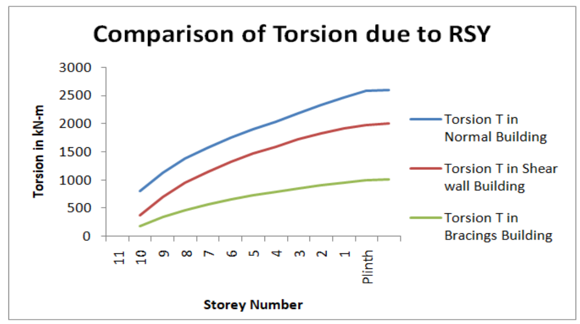


Comparison of Shear in X Direction due to RSY



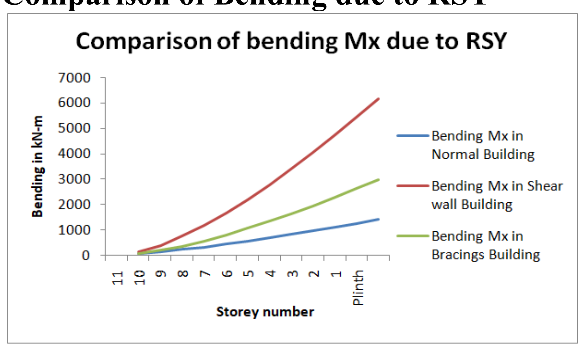
Comparison of Shear in Y Direction due to RSY

Comparison of Torsion T due to RSY

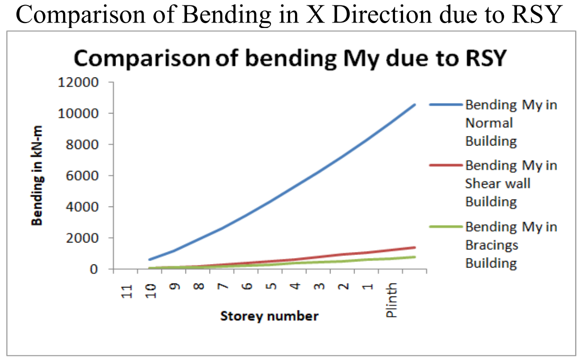


Comparison of Torsion due to RSY

Comparison of Bending due to RSY

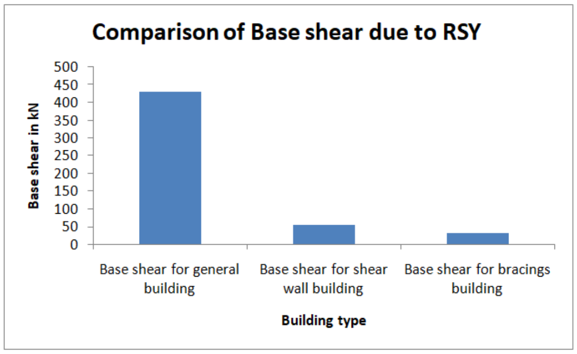


Comparison of Bending in X Direction due to RSY



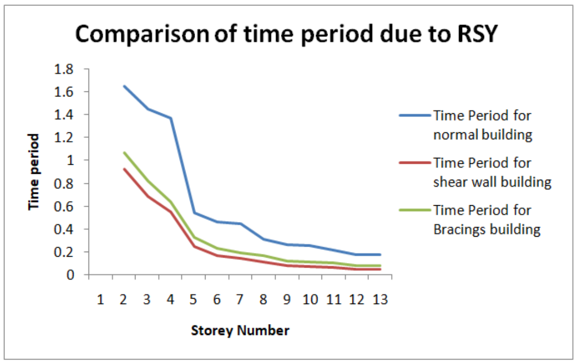
Comparison of Bending in Y Direction due to RSY

Base shear due to RSY



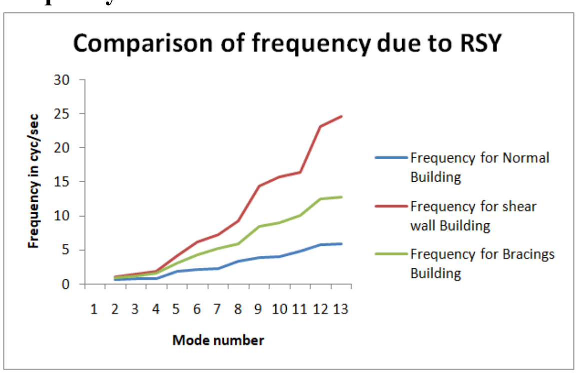
Comparison of Base shear due to RSY

Time period



Comparison of Time period due to RSY

Frequency



Comparison of Frequency due to RSY

6. CONCLUSIONS

From this study the following conclusions were made

1. Steel bracings and shear walls can be used as an alternative to the other strengthen or retrofitting techniques available as the total weight on the existing building will not change significantly.
2. The location of shear-wall and bracing members has significant effect on the seismic response of the shear-wall frame and braced frame respectively. The central locations of shear-wall and brace member are favorable as they are effective in reducing actions induced in frame with less horizontal deflection and drift.
3. Story drift in X and Y direction decreases from top story to bottom story the higher value of story drift in X direction was observed for General building than remaining cases buildings like with bracings and with shear wall building and higher value of story drift in Y direction was observed for general building than remaining cases building with bracings and steel building due to effect of extra load from the shear wall the drift values increasing to some extent for both RSX and RSY load case.
4. The maximum value of shear, moment and torsion were observed for general bracings building than remaining cases like shear wall and bracings structure for both RSX and RSY load case in Zone V condition and bracings will give more effective results than shear wall and general building.
5. The value of time period decreases from mode 1 to mode 12 the maximum value of time period was observed for the general building than remaining cases building with steel bracings and building with shear wall case.
6. The value of frequency increases from mode 1 to mode 12 the maximum value of stiffness was observed for the building with shear wall case than reaming.

Finally as per observation of results building model made with bracings is giving better results than general and shear wall building in Zone V seismic condition for G+10 model.

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