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Comparitive Study Of Different Bracing Systems Placing At Various Locations Of Steel Structure

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Abstract- Following the ongoing trends of earthquake everywhere throughout the world, it is seen that there is exceptionally high hazard for earthquake, along these lines making a need of seismic safe structure. The tall structures are inclined to the seismic and wind loads and improvement in terms of stiffness and lateral displacements is to be done. Bracing is perhaps the best technique to oppose these sort of loads. Bracings are extremely proficient in resisting the seismic waves. An endeavor is done to observe reduction in reactions of a structure with lateral stacking by using various bracings in the system. In this examination a G+20 building structure of plan region 10.5m X 9m is broke down under seismic load in zone IV by putting different bracing systems at various areas. The investigation is done in ETABS by utilizing response spectrum technique. The bracings considered are reversed V, V and X bracings. Bracing system generally improves the all round stiffness of the structural assembly and henceforth it controls both the movements of structure that is lateral as well torsional.

Keywords: storey-drifts, shears, displacements, overturning moments, ETABS

I. Introduction

Earthquake, the natural hazard which causes buildings to collapse that leads to loss of lives. The important problem for buildings is the lateral instability in the high risk areas. Bracing system effectively decreases the displacements occurring laterally. Bracing system is used from many years to resist loads like seismic and wind. These are made of steel material that performs in compression as well tension. This system works effectively by adding minimal load to structure where lateral stiffness is the main problem. Diagonal bracings helps in being resistant to horizontal shear developed in the structure. Concentric one helps in reducing lateral drifts. Due to decrease of bracings, shear forces and bending moments increases the compression axially in columns. Eccentric one’s helps in improving energy dissipation capacity to structure. In this connection, lateral stiffness rely on flexural stiffness of beams. The placing of these bracings is sometimes difficult task as they may obstruct the openings and interfere the facade design.

II. METHODOLOGY

A. *Response spectrum technique:*

Generally**,** seismic analysis of structures just cannot be done based on the highest values of acceleration of ground. This is because the response depends on frequency of ground movement and its dynamical properties**.** To get over this issue generally this method is used for structural seismic analysis. This method is basically a plot of steady or high state response of accelerator series of changing natural frequencies that are made into motion because of the shake or the vibrations. Steady state of result is obtained if input is in steady periodic state. It is also utilized in calculating responses of linear systems of multiple oscillation modes, even though they are accurate only for low level damping. This method is useful tool in analysing building performances that can be taken to consideration as the simple oscillators. If we know the building natural frequency, then the peak response can be evaluated by response spectrum values of ground for frequencies appropriately. The important limitation for this method is that it is used only for linear systems only.

B. *Errors in evaluating response spectrum:*

The straight line approximations errors, truncation errors, errors because of rounding off the time record values, discretization errors are most occurring ones in this method. In computing spectra, linear segments in between the digitalizing points are placed in the place of original seismic records causing errors. Numerical techniques are basically having the truncation errors. For instance the third order evaluation in Runge kutta method is having this error which is commensurate to $(\Delta ti)^4$. For record purposes of quakes, integration technique used that required round off time record values that led to rounding off the time record error. Rounding-off of 0.005 sec, gives the normal error upto less than two percent. In numerical computation methods, response is obtained in form of sets of discrete sets. Maximum error occurs if response is the midway of two discrete sets.

III. MODELLING

Building details:
Structure – OMRF
Type of building-Regular and symmetrical
Height of structure modelled=60 m.
Storeys=G+20
Storey height =3.0 m
Support type – fixed
Seismic zone – v
Material properties:
Grade of steel=Fe415
Desity of reinforced concrete=25 kn/m^3
M30 Young’s modulus,Ec=27386127.87 kn/m^2
Steel young’s modulus,Es=2 x 10^8kN/m^2
Types of loads and intensities:
Floor finish=1.5 kN/m2
Live load on floors=3 kN/m2

wall load on beams=3.9 kN/m2
Parapet wall loads=1 kN/ m2
Seismic Properties:
Zones IV 0.36
Importance factor (I)=1
Response reduction factor (R)=5%
Soil type II
Damping ratio=0.05

Structural models in Etabs are shown below:

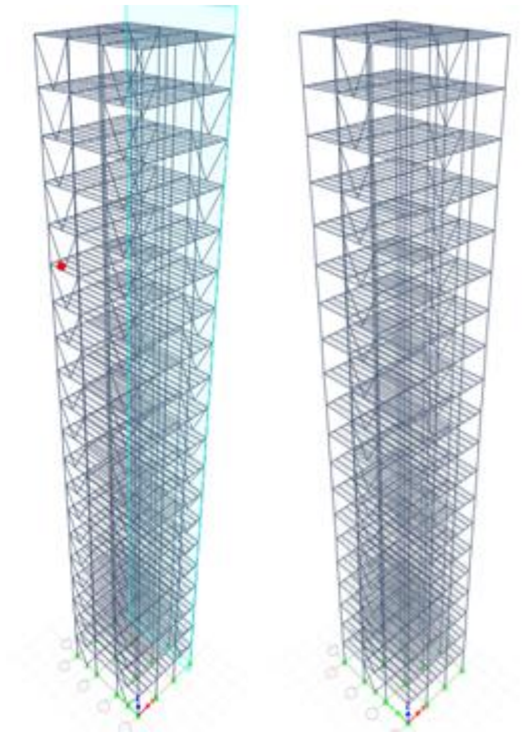

Figure.1: 3D elevation view of V-bracings at outer and outer bays

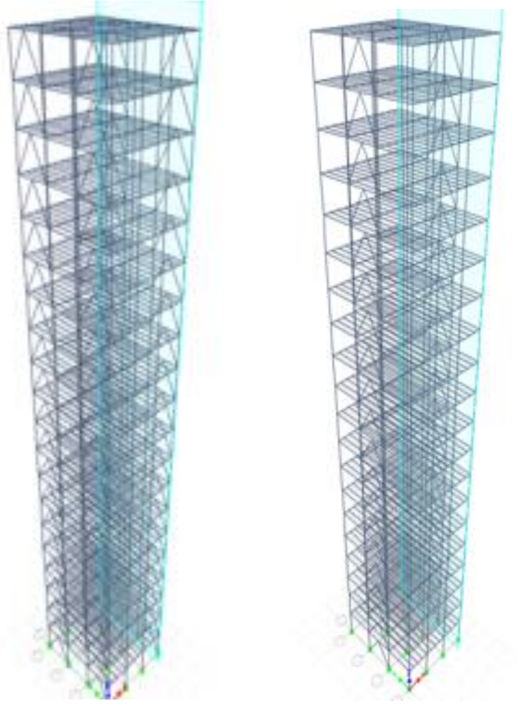

Figure.2: 3D elevation view of inverted V-bracings at outer and inner bays

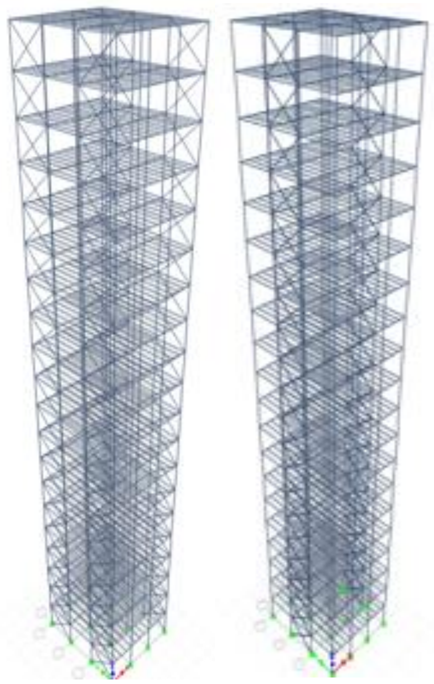

Figure.3: 3D elevation view of X-bracings at outer and outer bays

IV. RESULTS AND DISCUSSIONS

In this part, the examination consequences of G+20 building with different bracing systems are presented using Response-spectrum method.

A. Storey displacement

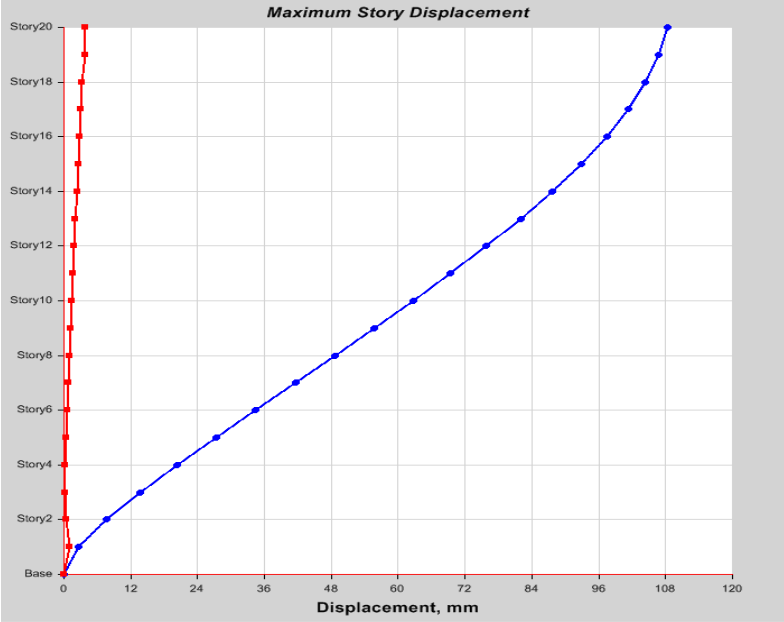

Figure.4: maximum displacement values of a building with V bracing at outer and centre bays

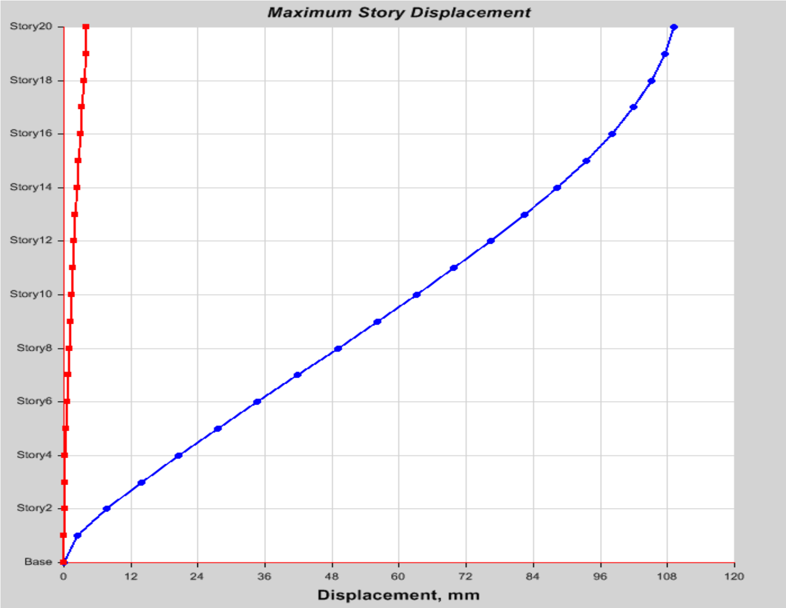

Figure.5: maximum displacement values of a building with inverted V bracing at outer and centre bays

Figure.6: maximum displacement values of a building with X-bracing at outer and centre bays

Displacement of storey is the absolute relocation of storey with forces acting laterally. In comparision of fig4,5,6, it is observed that maximum storey displacement in X-direction is higher when X bracings provided at outer bays than inverted V, V with value of 108.8 mm at storey level 20.

B. Storey drifts

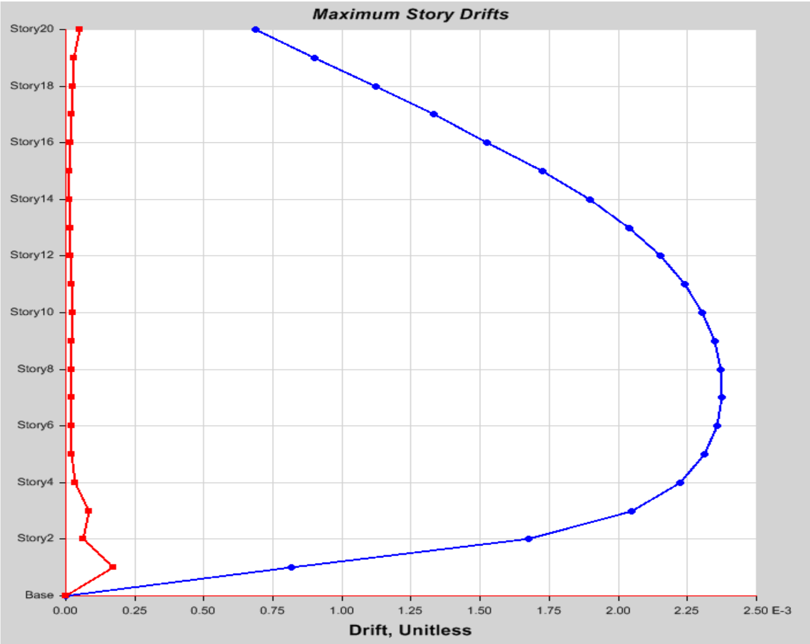

Figure.7: maximum values of drifts of the building with V-bracings at outer and centre bays

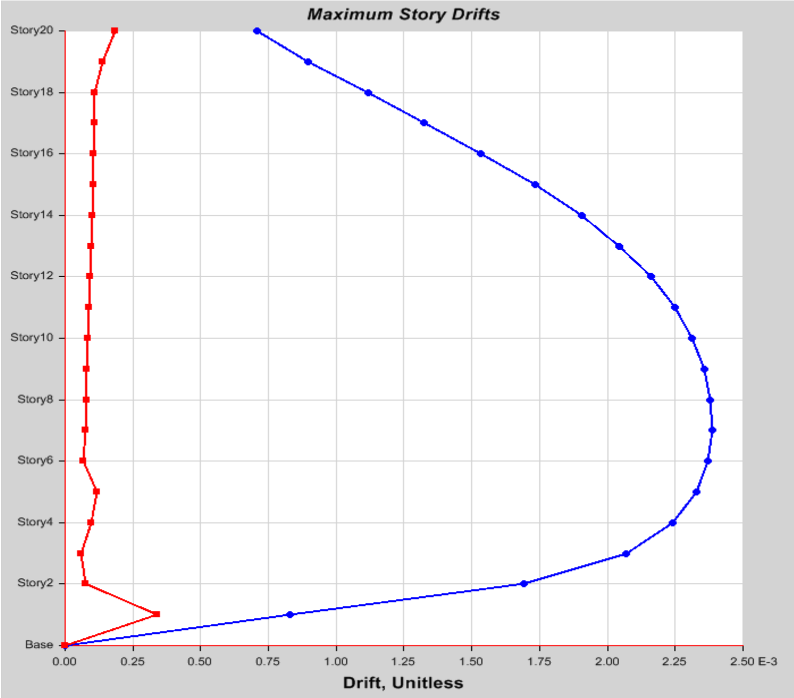

Figure.8: maximum values of drifts of the building with inverted V-bracings at outer and centre bays

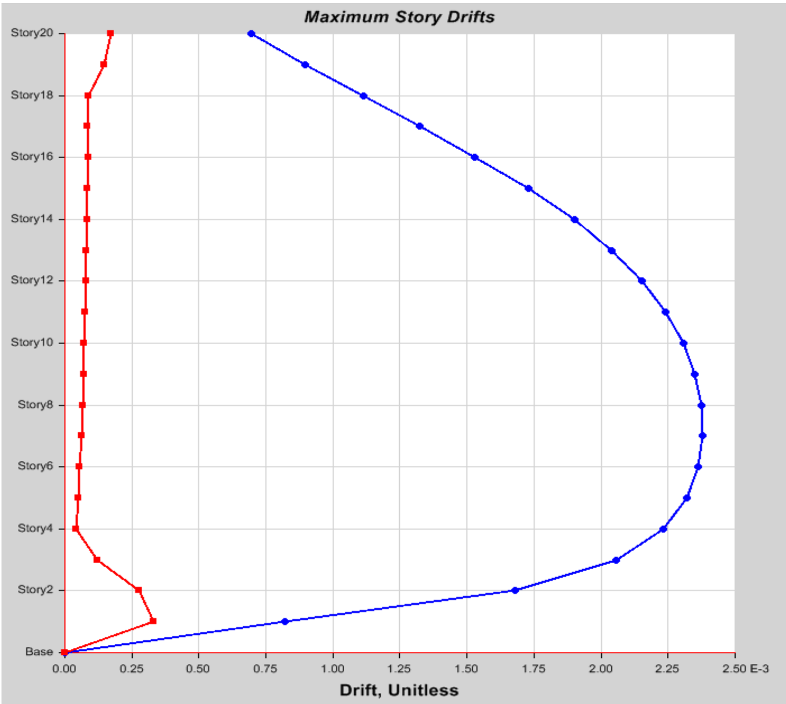

Figure.9: maximum values of drifts of the building with X-bracings at outer and centre bays

Storey drift is nothing but the variance of dislocations of successive storey divided to height of each storey. Comparing fig 7,8,9, storey drifts are almost similar for x, v, inverted-v with a value of 0.002474 at inverted V- bracings placed at centre bay

C. Storey shears

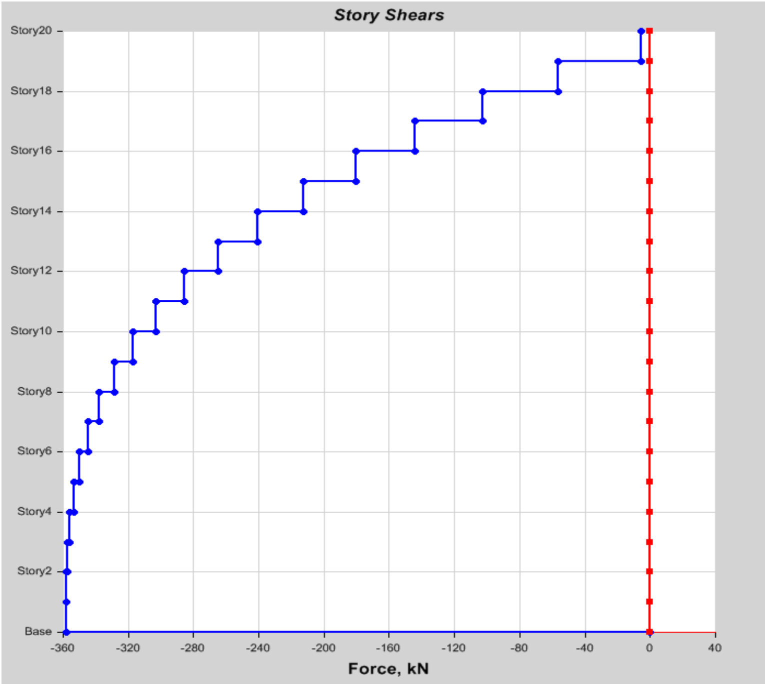

Figure.10: maximum shears of storey with V-bracing at outer and centre bays

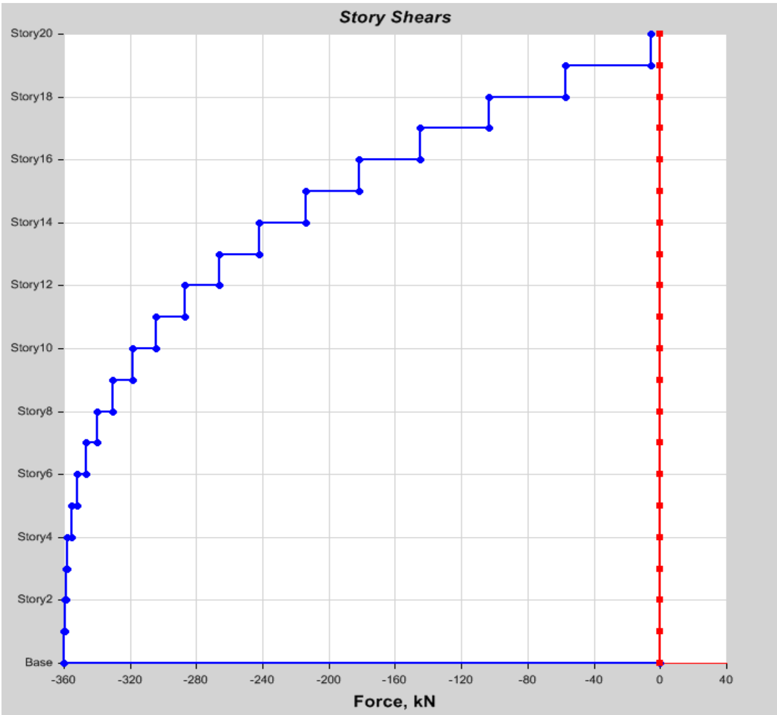

Figure.11: maximum shears of storey with inverted V-bracing at outer and centre bays

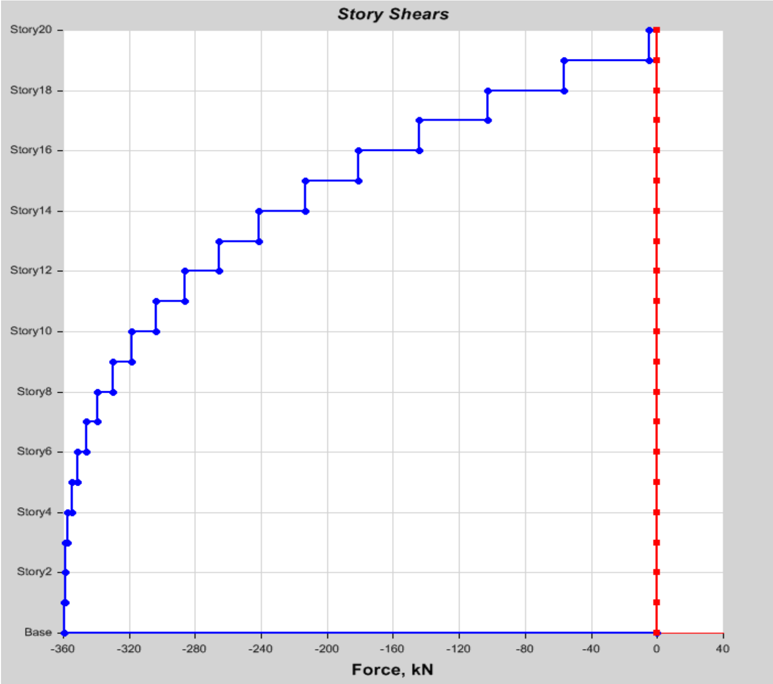

Figure.12: maximum shears of storey with X-bracing at outer and centre bays

Storey shears is the lateral forces following up on the storey because of burdens, for example seismic load, wind and so on. Maximum shear is almost similar to all bracings with value of 362.65 KN at X-bracing placed at the outer bay.

d. Storey overturning

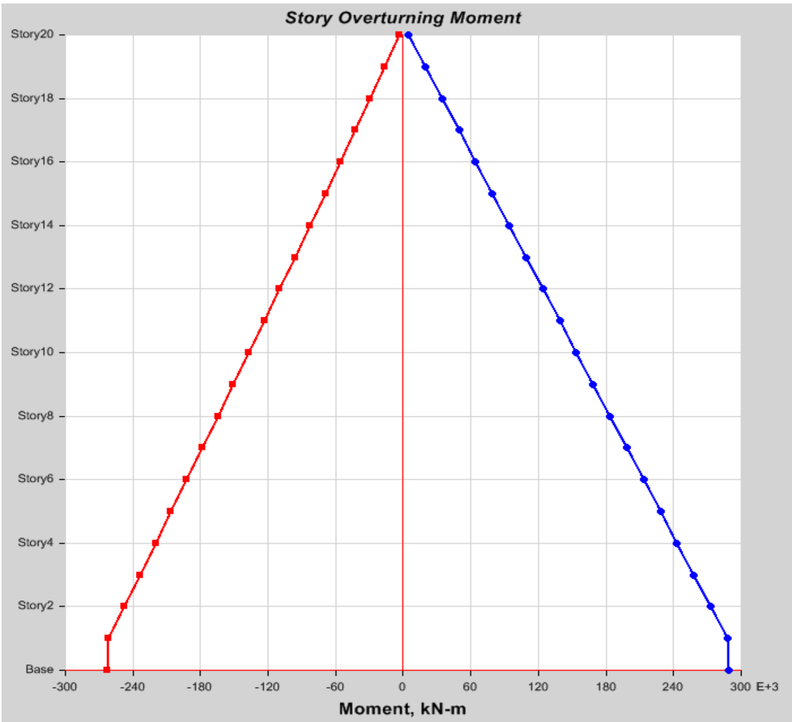

Figure.13: maximum overturning-moments of storey with V-bracing at outer and centre bays

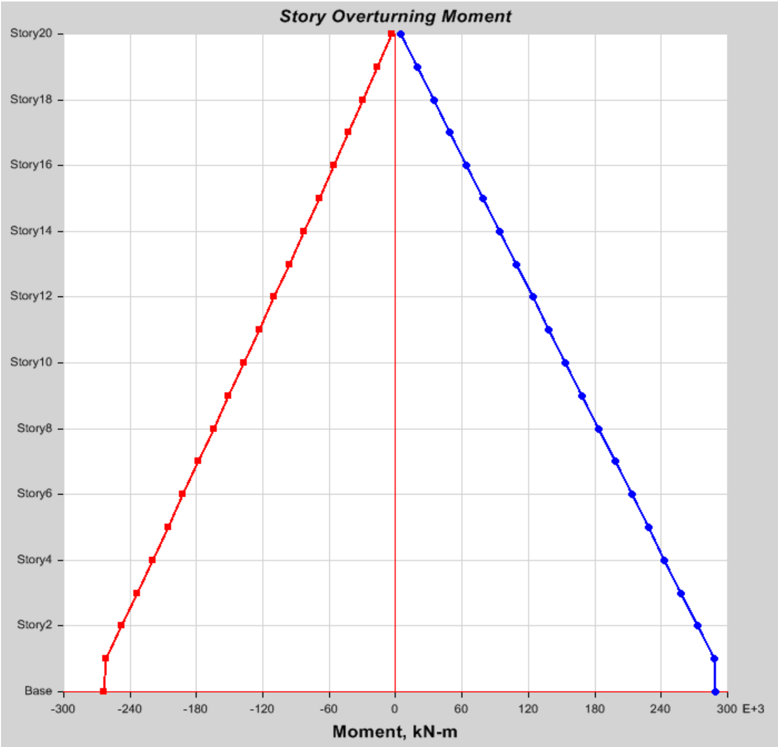

Figure.14: maximum overturning-moments of storey with inverted V-bracing at outer and centre bays

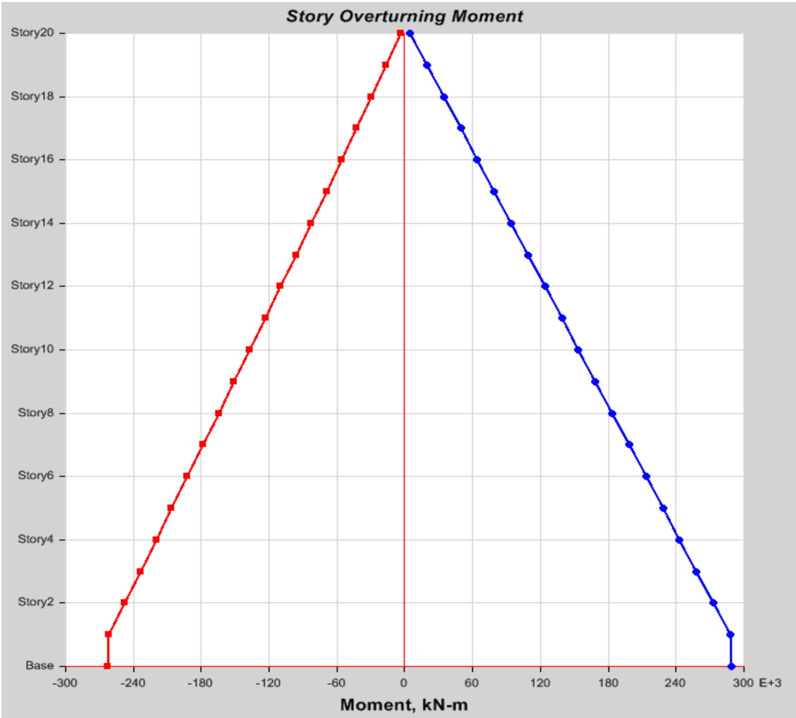

Figure.15: maximum overturning-moments of storey with X-bracing at outer and centre bays

Storey overturning moments is taken by multiplying the shears of storey by distance to the mass centre above the considered elevation. The overturning-moments of a building with inverted V, V, and X bracings are almost similar with value 301729.6234 Kn-m.

V. CONCLUSION

Conclusions of G+20 structure with different bracing systems are presented. Bracings are placed at centre and outer bays of the building. Storey displacement, storey drifts, storey shears, and overturning-moments are evaluated from the analysis of building with different bracings. The comparative results are presented below as follows

[1]. The maximum storey displacement in X-direction is higher when X bracings provided at outer bays for the building. Storey displacements of inverted V and V bracings at outer and center bays of the building are 10% lesser than building with X bracings at outer bays.

[2]. The maximum storey displacement in Y-direction is higher when X bracings provided at center bays for the building. Storey displacements of inverted V and V bracings at center bays of the building are 5% and 12% lesser than the building with X bracings at center bays respectively.

[3]. The storey drifts of the buildings in X-direction with inverted V, V and X bracings are almost similar. The maximum storey drift is 0.002474 occurred in inverted V bracings placed at center bays.

[4]. The drifts of storey in Y-axis are high with X-bracings placed at outer bays and the value is 0.000463. Storey drifts of buildings with inverted V and V bracings placed at center bays are 46% and 28% lesser than building with X-bracings placed at outer bays respectively.

[5]. The storey shears of the buildings in X-direction with inverted V, V and X bracings are almost similar. The maximum storey shear is 362.6566 KN occurred in X bracings placed at outer bays.

[6].The overturning moments of the buildings in X-direction with inverted V, V and X bracings are almost similar. The maximum overturning moment is 301729.6234 KN-m occurred in X bracings placed at outer bays.

[7].The overturning moments of the buildings in Y-direction with inverted V, V and X bracings are almost similar. The maximum overturning moment is 275265.9902 KN-m occurred in X bracings placed at outer bays.

[8].From this examination we can conclude that the building with inverted V bracings placed at outer bays is more efficient to seismic effect than other bracings placed at different locations

[9].The braced structural frames are more resistant to lateral loads as compared to structural frames without bracings.

[10].Bracing framework in any structure builds the general firmness of the framework and thus goes about as control system for both horizontal and torsional developments of the structure.

Conflict of Interest

There isn’t any admissile strife of interests in this report examination.

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