# THE COMPARATIVE STUDY OF SHEAR WALL AND STEEL BRACING IN RCC FRAMED STRUCTURE

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***Abstract:*** Observation of damage after earthquakes has shown that torsional vibration in frame of structures induced by lateral seismic ground motion may cause serious distress in a structure, sometimes it's may collapse. Therefore, when designing a building for lateral loads such as those generated by earthquakes or wind, a design engineer may have several alternatives. Lateral loads may be transfer to the foundation via shear wall, braced frames or rigid frames methods. The design system should be strong enough to resist the seismic forces.

In this study, the seismic performance of reinforced concrete structures with concrete shear wall and with different types of steel bracing is studied. The effect of concrete shear wall and various types of steel bracings on lateral capacity of the structure has been examined, for this purpose reinforced concrete structures have been analysed. The performance of the structure is evaluated using base shear and storey displacement. STAAD-PRO V8i software is used for analysis. The efforts are made to compare result of concrete shear wall and steel bracing with STAAD-PRO V8i results. This dissertation also includes concluded the best location of concrete shear wall and best type of steel bracing member based on the above study in this work the most effective position and economical of shear wall and steel bracing system has been suggested.

The result shows that for new structures of reinforced concrete building shear wall system is most economical and simple for construction and cost of construction of shear wall is minimum as compared to bracing system. Also if shear wall is used in structure displacement of structure is minimum as compare to regular frame and steel bracing frame. But base shear increases as compare to regular frame and steel bracing frame. For existing structures or for retrofitting bracing system appear to be simple and effective. The bracing system improves not only the lateral stiffness and strength capacity but also the displacement capacity of the structure.

From present study it is observed that concrete shear wall is most effective as compared to steel bracing. Shear wall at mid bay is effective because it has minimum displacement as compared to the other position. X bracing system is have most effective as compared to the other bracing system, it has minimum base shear and minimum displacement.

**Index Terms -** Regular frame, shear wall frame, Steel bracing frame, Response spectrum method (CQC), Staad Pro V8i.

## I. Introduction

Vibration induced in the earth crust due to internal or external causes that virtually shake up a part of the crust and all the structures and living and non - living existing on it is called as earthquake". Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to toss peoples around and destroy whole cities. In its most general scenes, the word earthquake is used to describe any seismic event whether natural caused by humans that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults but also by other events such as volcanic activity landslides, mine blast and nuclear tests. The pleasurable operation of a large number of reinforced concrete structures, fact structures subjected to severe earthquakes in different areas of the earth has put examples on view of that it is possible to design such structures to successfully put up with earth shock of major in intensity. The behavior of reinforced concrete structures subjected to actual earthquake is observed by analytical studies and laboratory experiment, a number of investigators over the last three decades on the earthquake resistant design

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## II. PROBLEM STATEMENT

The investigations aims as introducing bracing in place of shear walls and its effectiveness compared with shear wall. The study of concrete shear wall and steel bracing in RCC framed structure.

## III. Linear dynamic analysis ( Response Spectrum Method )

This method is also known as the classical modal analysis. In this method the load vectors are calculated corresponding to predefined number of modes. These load vectors are applied at the design centre of mass to calculate the respective modal responses. These modal responses are then combined according to SRSS or CQC rule to get the total response. From the fundamentals of dynamics it is quite clear that modal response of the structure subjected to particular ground motion, is estimated by the combination of the results of static analysis of the structures subjected to corresponding modal load vector and dynamic analysis of the corresponding single degree of freedom system subjected to same ground motion. Static response of MDOF system is then multiplied with the spectral ordinate obtained from dynamic analysis of SDOF system to get that modal response. Same procedure is carried out for other modes and the results are obtained through SRSS or CQC rule.

In response spectrum analysis the spectral values are read from the design spectrum which are directly multiplied with the modal load vector and the static analysis is performed to determine the corresponding modal peak responses.

**Complete Quadratic Combination (CQC)**

For Three –dimensional structural systems exhibiting closely spaced modes, the peak response quantities shall be combined as per Complete Quadratic combination (CQC) method

$$\lambda = \sqrt{\sum_{i=1}^{r}\sum_{j=1}^{r}\lambda_i \rho_{ji} \lambda_j}$$

Where

r = number of modes being considered,

$_{i}$ = response quantity in mode i (including sign)

$_{j}$ = response quantity in mode j (including sign)

$_{ij}$= cross model coefficient.

$$\rho_{ji} = \frac{8\xi^2(1+\beta_{ij})\beta^{1.5}}{(1-\beta_{ij}{}^2)^2 + 4\xi^2\beta_{ij}(1+\beta_{ij})^2}$$

Where,

$\xi$ = model damping ratio (in fraction),

$_{ij}$ = Frequency ratio $_{j}$/ $_{i}$

$_{i}$ = Circular frequency in i$^{th}$mode and

$_{j}$ = Circular frequency in j$^{th}$mode

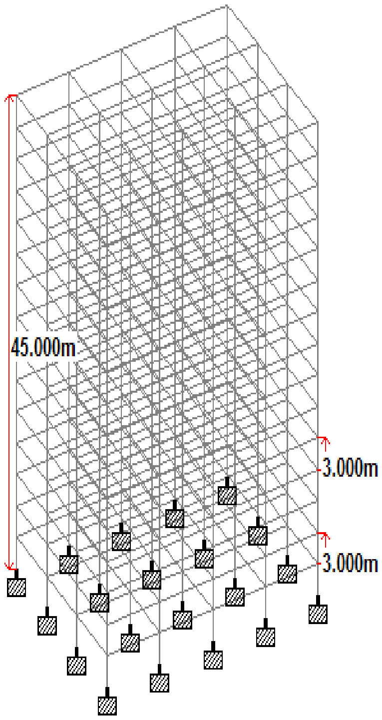
Here the terms $_{i}$ and $_{j}$ representthe response of different modes of a certain story level.

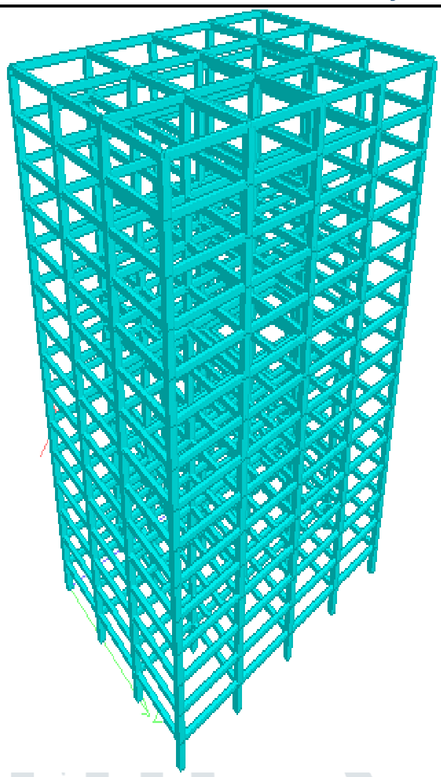
Using the matrix notation the story shears are worked out

V1, V2, V3, --------$V_n$.respectively.

A 15- storey reinforced concrete building with shear wall, without shear wall and with different types of steel bracing in zone V has been considered for the illustration .The main significance in this chapter is on loading of frame like self-weight of structure (beam and column), slab load, brick load and live load is assign. Also seismic load in direction of X and load combination as per IS 1893 (Part I):2002 is assign. All models are analyzing using complete quadratic combination method (CQC) and calculating the base shear, frequency, period and displacement for different story for all structure models.

Analyze a 15- storied RC building as shown in fig.4.1The live load on all the floors is 2KN/m2 and soil below the building is hard. The site lies in zone V. All the beams are of size 400 x 500 mm and slabs are 150 mm thick. The sizes of columns are 600 x 600 mm in the entire story and the wall around is 120 mm thick. Building is analysis on STAAD-PRO using response spectrum method [3]. Using this software frequency, time period, mode participation factor, base shear, displacement is calculated.



**LOAD CALCULATION**

Load calculation for frame of building

**Dead Load:–**

**Joint load**

Weight of beams: –

25 x 7.5 x 0.40 x 0.50 = 37.5 KN

Weight of columns: –

25 x 3 x 0.60 x 0.60 = 27 KN

Weight of brickwork: –

20 x 7.5 x 0.12 x 3 = 54 KN

**Member load**

Weight of beams: –

25 x 0.40 x 0.50 = 5 KN/m

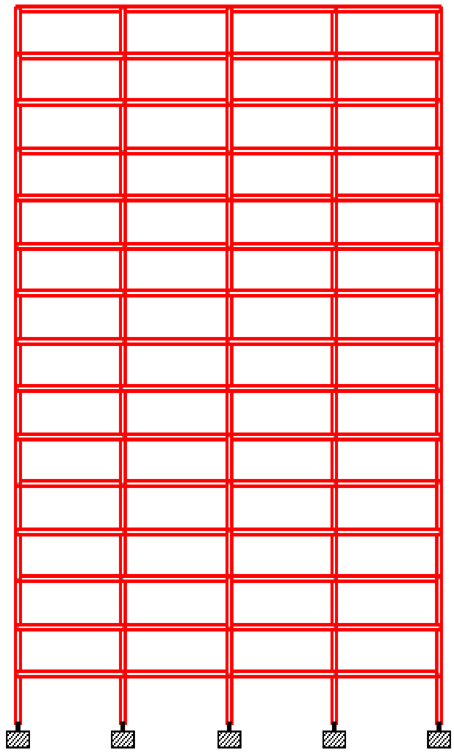
Weight of brickwork: –

20 x 0.12 x 3 = 7.2 KN/m

Weight of slabs: –

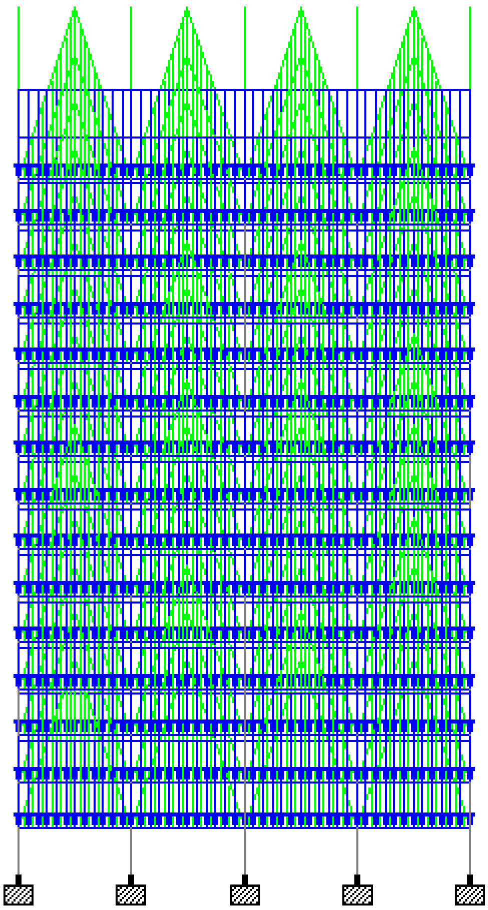
25 x 0.15= 3.75 KN/$m^2$

Live/ imposed load– 2 KN/$m^2$



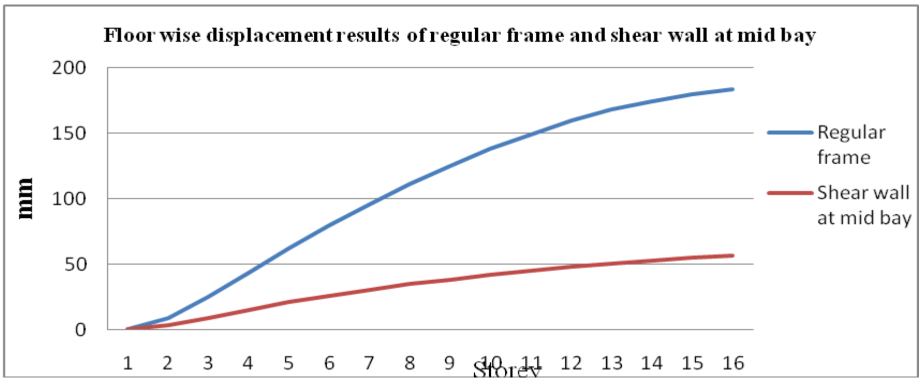
Member load of beams and columns

Slab load

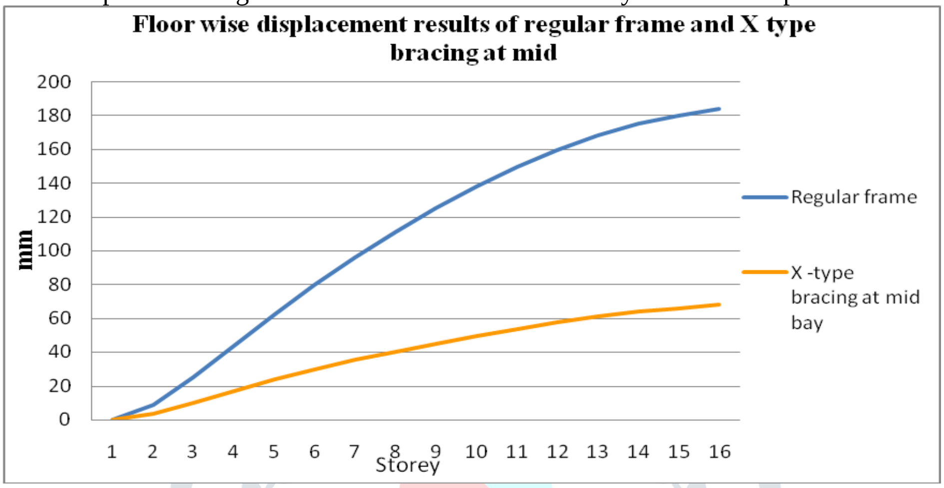


Brickwork load

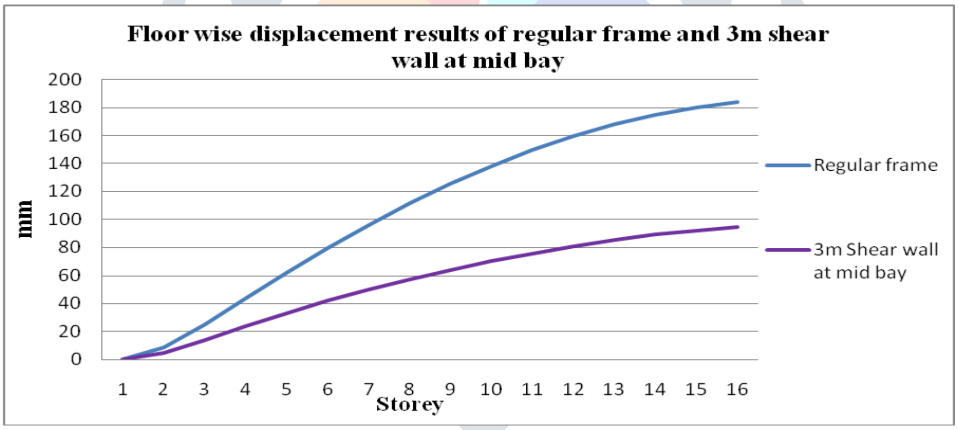
## IV. RESULTS AND DISCUSSION



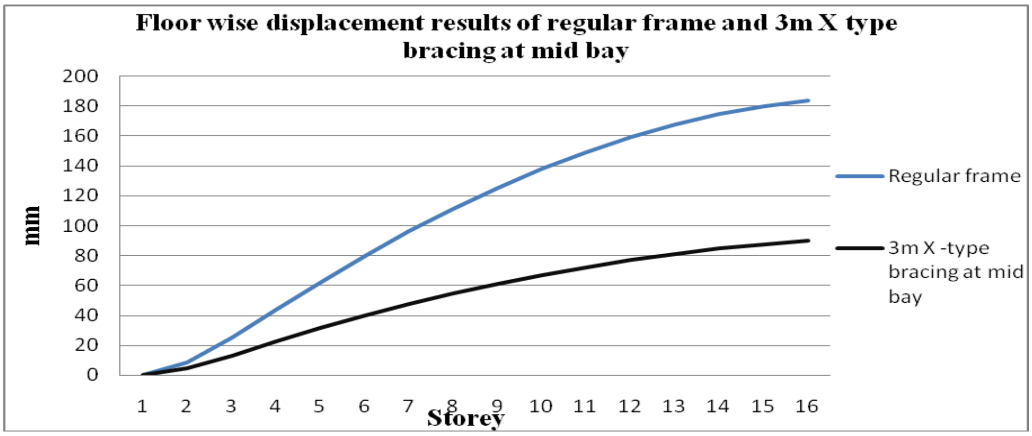

Comparison of regular frame and shear wall at mid bay floor wise displacement



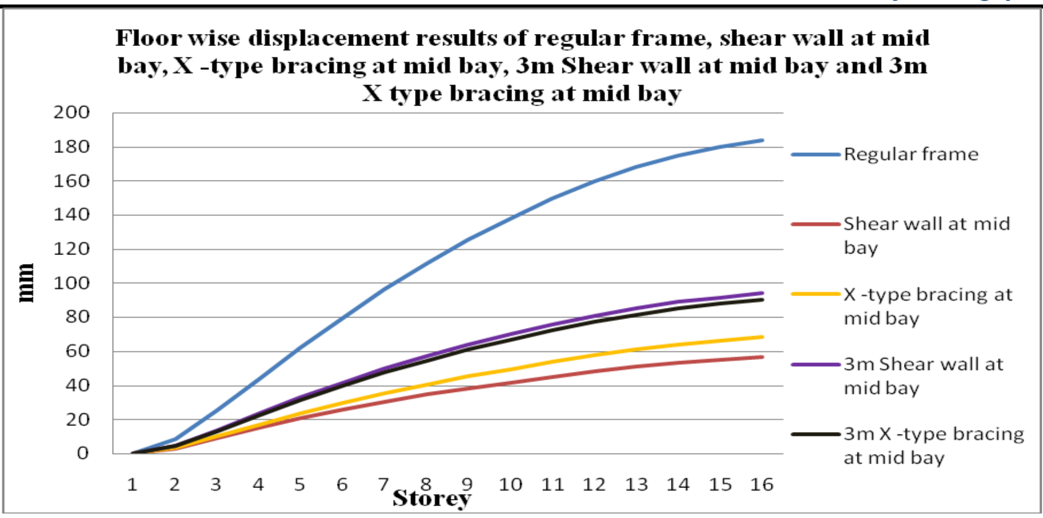

Comparison of regular frame and X type bracing at mid bay floor wise displacement

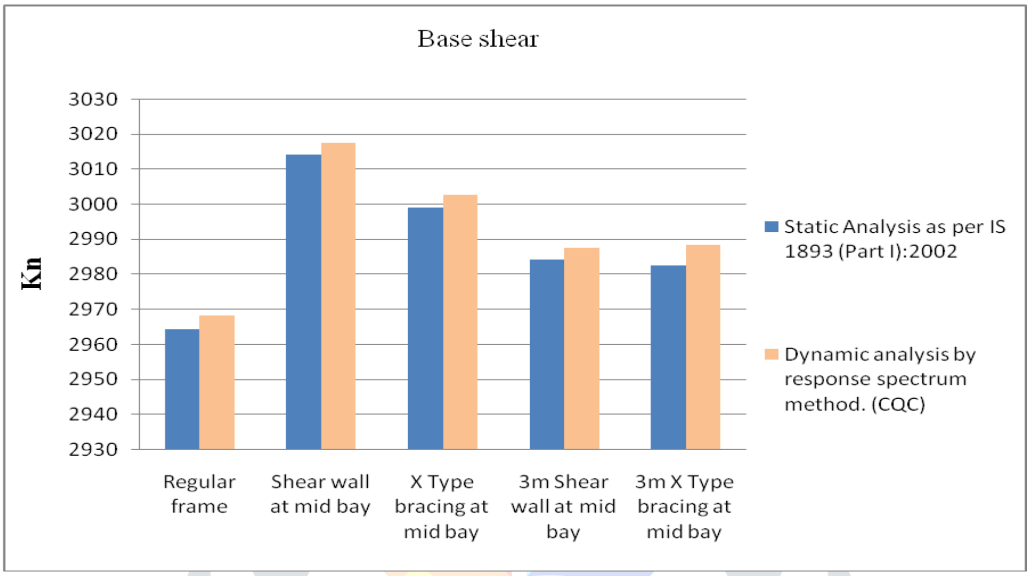


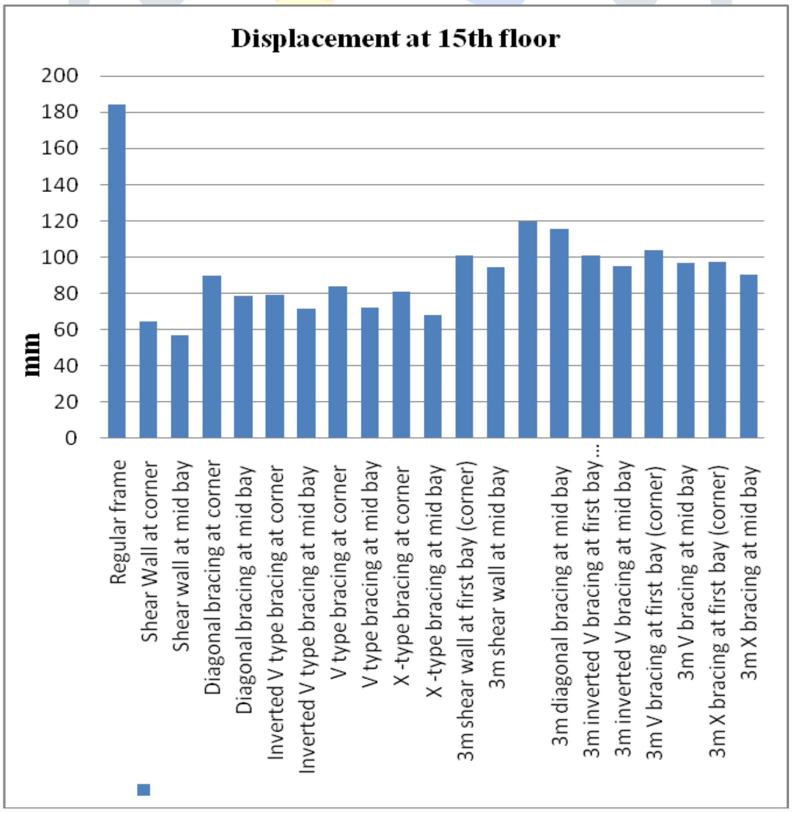

Comparison of regular frame and 3m shear wall at mid bay floor wise displacement



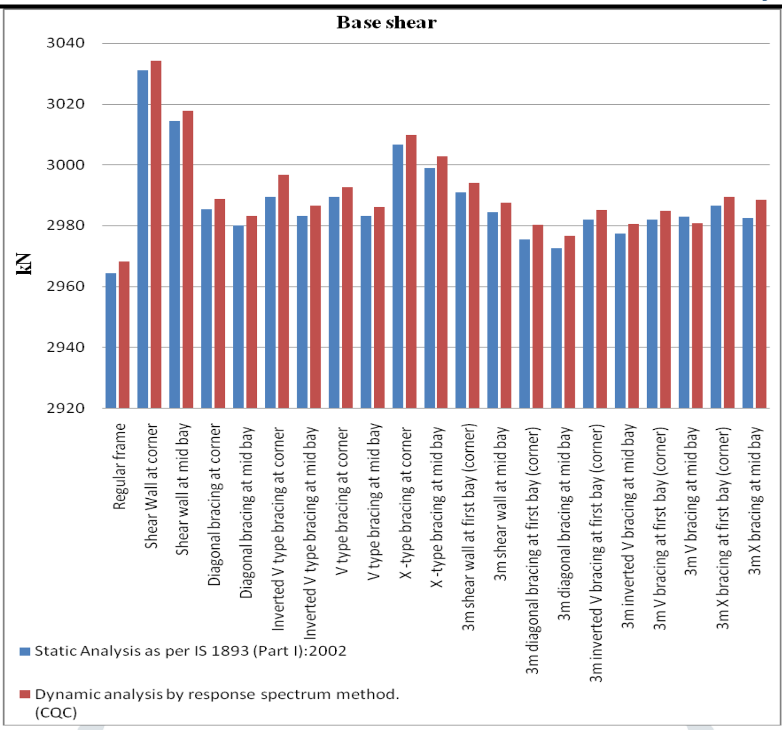

Comparison of regular frame and 3m X type bracing at mid bay floor wise displacement




combination of bar chart for displacement at 15th floor




combination of bar chart for baser shear

## V. Conclusion

1) When shear wall or steel bracing is provided on structures then lateral displacement of structure is reduced as comparing to regular frame structure.
2) Shear wall at mid bay gives the better results amongst all other types steel wall bracing and other position of shear wall.
3) Shear wall at mid bay reduces displacement whereas base shear and storey shear get increases.

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