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"STRENGTHENING OF REINFORCED CONCRETE AND STEEL STRUCTURE BY USING STEEL BRACING SYSTEMS"

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Abstract - *Due to earthquake major lossrs can occurred it may gives damages to structure and in worst case it may collapse. For avoiding this damage of structure steel braces provided to high rise building to provide strength and also for resist lateral load imposed by earthquake and wind. There are 'n' numbers of possibilities to arrange steel bracings such as X, V, Inverted V. A building is situated at seismic zone V. The building models are analyzing as per IS 1893:2002 using software ETABS. The main parameters consider is to compare the seismic analysis of buildings for lateral displacement, storey drift, base shear etc.*

***Key Words*: Seismic Lateral Displacement, Storey Drift, Storey shear etc .**

1.INTRODUCTION

High rise structures are very sensitive against lateral loads produce due to wind, earthquake. For resist this lateral load various reteroffiting methods are used. There are various steel bracing systems used to resist the lateral forces. The purpose of strengthening methods is to ensure that the displacement demand of a building is to be kept below its displacement capacity. This can be achieved by reducing displacement of the structure and it can improve the displacement capacity of the structure. For strengthening of RCC and Steel building against seismic forces steel bracing system applied on structure for avoiding displacement of building. Mostly steel bracings used are X, V, inverted V etc. The aim of project is by using this bracing for varying height of building analysis can be obtained for seismic zone V. In this project main thing is comparing building with and without bracing displacement ,drift and storey shear results at zone V.

1.1 OBJECTIVE OF THIS PAPER

The objective of this paper is to evaluate the response of braced and unbraced structure subjected to seismic loads and to identify the suitable bracing system for resisting the seismic load efficiently.

2. MODELLING & ANALYSIS OF BUILDING

The analysis of RCC & Steel G+14 floors is carried out using ETABS software for frame situated in zone V.The RCC & Steel G+14 structure is analysed without bracings and with different types of bracings system. Storey shears, story drifts and storey Displacement is compared for all type of structural systems i.e.braced and unbraced structural system.

3. Problem Statement for Reinforced Concrete Structure:-

For G+14 RC FRAME

- No. of stories= G+14
- Type of building use= Residential
- Young's modulus, E =21.7x10^6 kN/m^2
- Grade of concrete =M25
- Density of RCC =25 ken/m^3
- Beam Size =0.6x0.6m
- Column Size= 0.55x1.35m
- Dead Load Intensity= 4.6 ken/m^2
- Live Load Intensity= 3.0 ken/m^2
- Seismic Zone, Z =V
- Importance Factor, I = 1
- Response Reduction Factor, RF= 5

For G+14 RC Structure:-

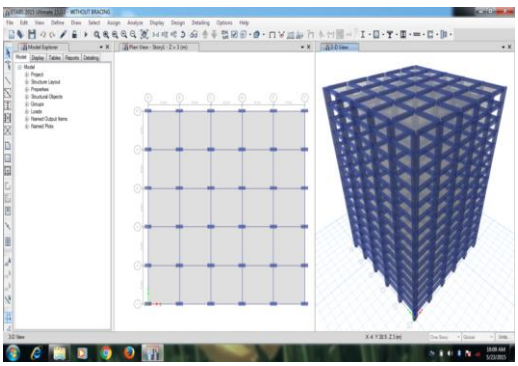

Figure 1.Without Bracing

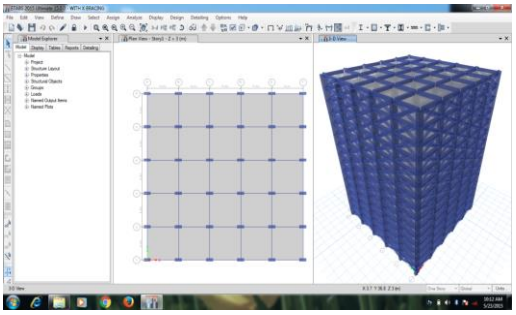

Figure 2.With X Bracing

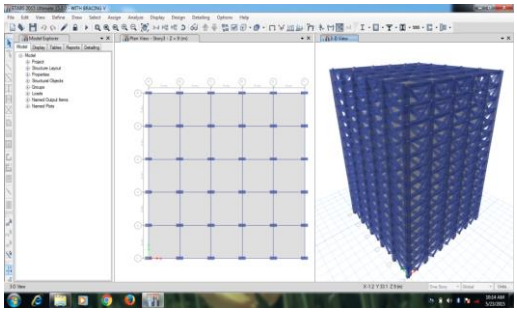

Figure3.With V Bracing

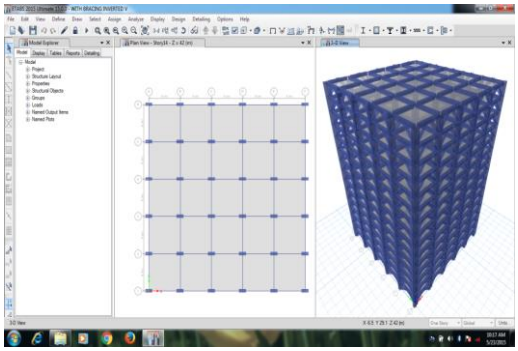

Figure 4.With Inverted V Bracing

4. Problem Statement for Steel Structure:-

For G+14 STEEL FRAME :-

- No. of stories= G+14
- Type of building use= Residential
- Beam Size =ISMB300
- Column Size= ISMB250
- Dead Load Intensity= 4.6 kN/m2
- Live Load Intensity= 3.0 kN/m2
- Seismic Zone, Z =V
- Importance Factor, I = 1
- Response Reduction Factor, RF= 5

For G+14 STEEL Structure :-

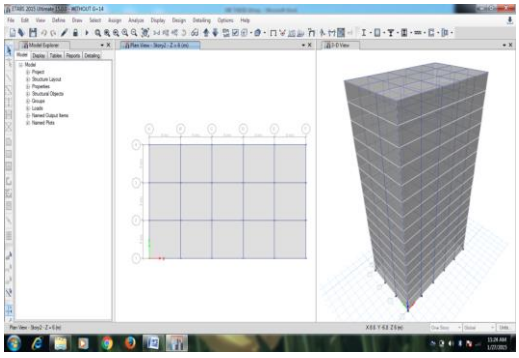

Figure 3.Without Bracing

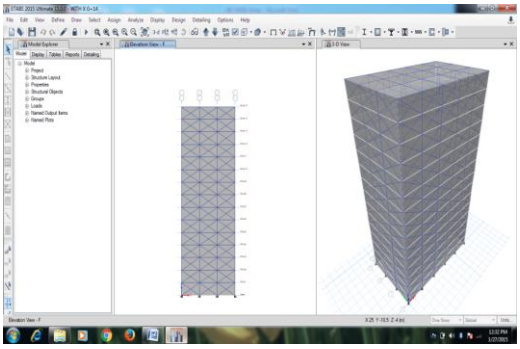

Figure 4.With X Bracing

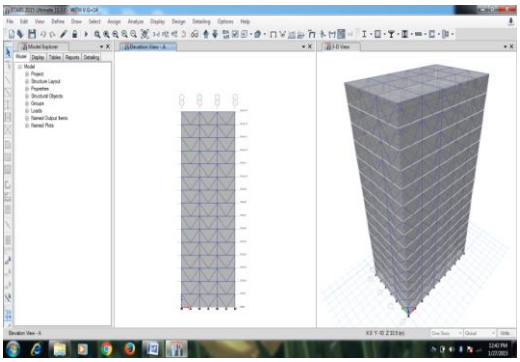

Figure3.With V Bracing

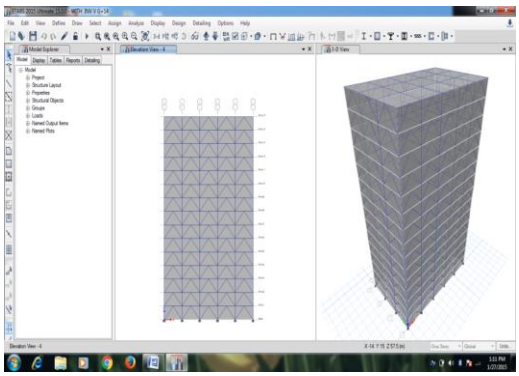

Figure 4.With Inverted V Bracing

5.RESULT:-

5.1 FOR RCC G+14 BUILDING :-

1.Storey shear:

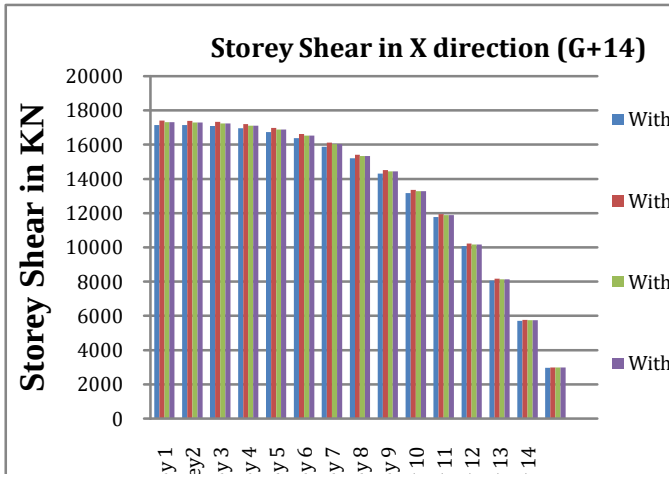

Fig.1.1 Storey Shear in X direction (G+14)

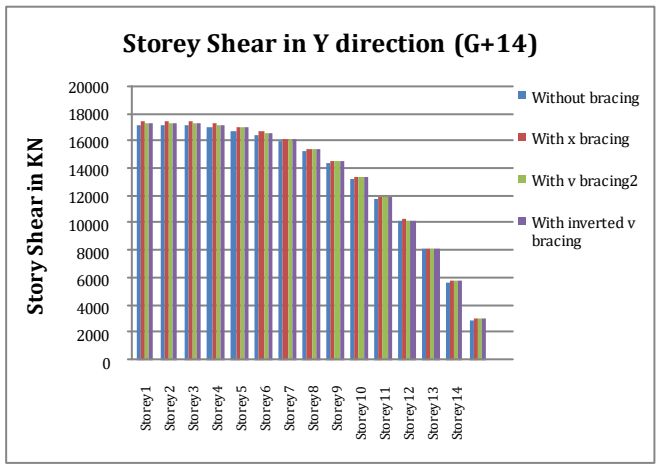

Fig.1.2 Storey Shear in Y direction (G+14)

The graphical representation of storey shear obtained for building without & with different bracing system shown in figure 1.1, 1.2 For structure with X bracing system have maximum storey shear.

Table 1. Comparison of manual results with software results of storey shear for different bracing

Type of bracing	Manual calculation (KN)	ETABS (KN)	% Difference
Without bracing	16592.08	17154.768	3.39%
With X bracing	16992.08	17406.137	4.09%
With v bracing	16992.08	17313.747	4.30%
With inverted v bracing	16992.08	17313.747	4.30%

2.Storey Displacement:

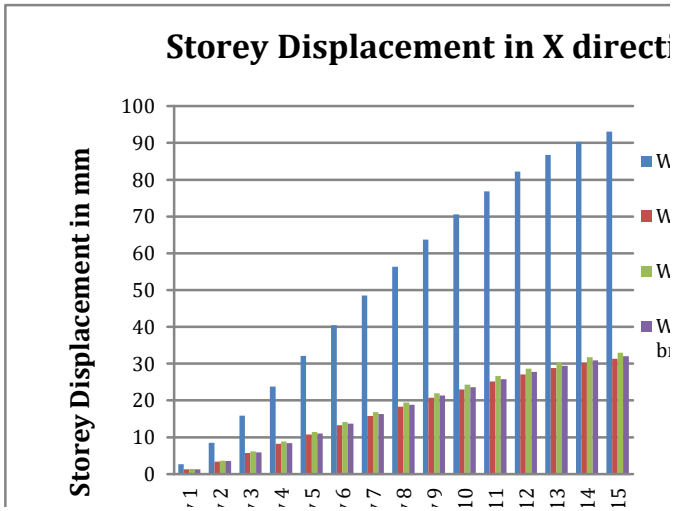

Fig.1.3 Storey Displacement in X direction (G+14)

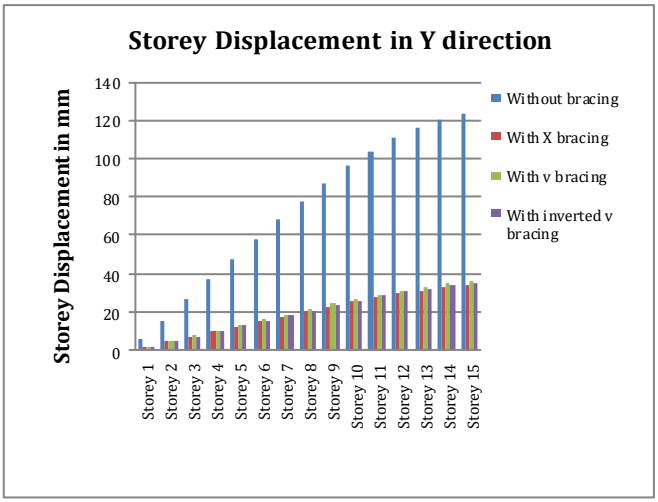

Fig.1.4 Storey Displacement in Y direction (G+14)

The graphical representation of storey displacement obtained for building with & without bracing shown in figure 1.3 and 1.4. The graph shows that the values of storey displacements are gradually increased with increasing the height of building in both X and Y direction.For structure with X bracing have minimum storey displacement and maximum for structure without bracing After appling bracings the displacement reduces upto 89.00% maximum.

3.Storey Drift :-

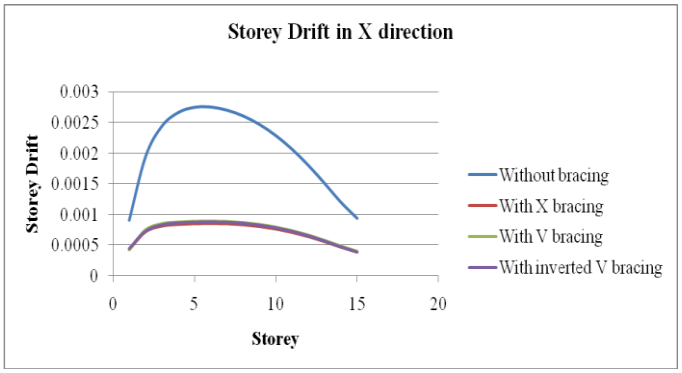

Fig.1.5 Storey Drift in X direction (G+14)

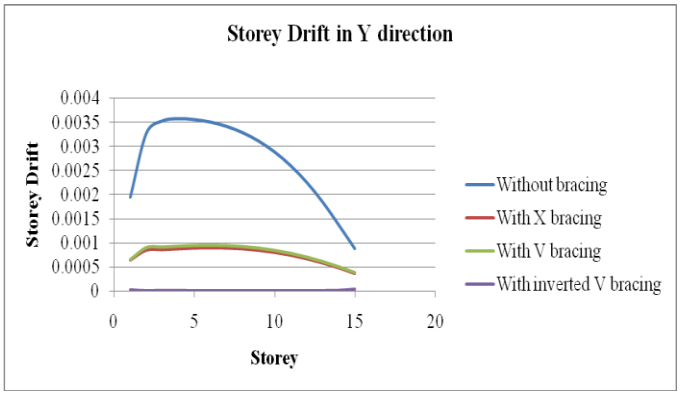

Fig.1.6 Storey Drift in Y direction (G+14)

As per IS 1893:2002 maximum storey drift should not be more than 0.004 times to storey height Of the structure. Here value of limiting storey drift is 0.012 where height of storey is 3m. From the graph it is observed that the values of the storey drift for all the stories are found to be within the limits.

5.2 FOR STEEL G+14 BUILDING :-

1. **Storey shear:**

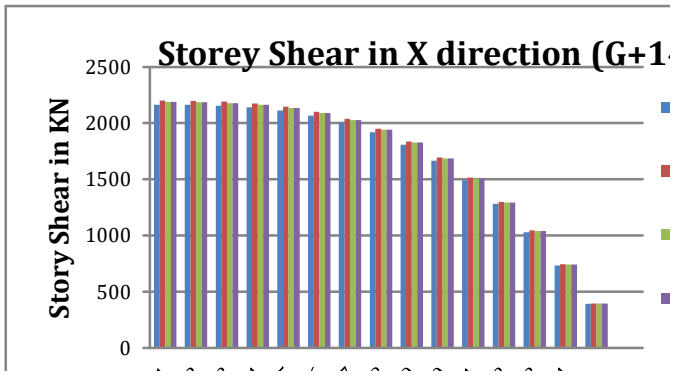

Fig.2.1 Storey Shear in X direction (G+14)

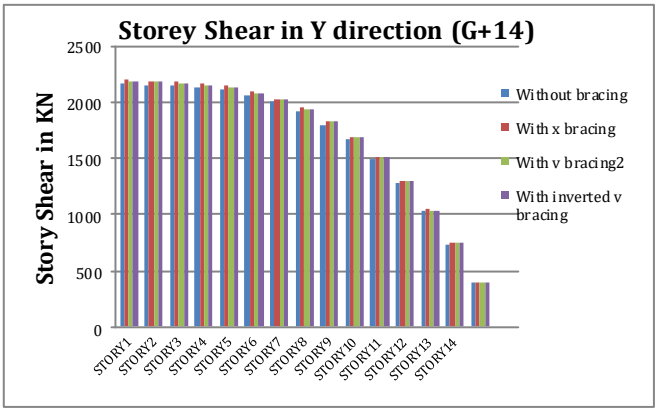

Fig.2.2 Storey Shear in Y direction (G+14)

The graphical representation of storey shear obtained for building without & with different bracing system shown in figure 2.1 ,2.2 For structure with X bracing system have maximum storey shear.

Table 2. Comparison of manual results with software results of storey shear for different bracing

Type of bracing	Manual calculation (KN)	ETABS (KN)	% Difference
Without bracing	2085.4	2163.7	3.75%
With X bracing	2108.36	2199.18	4.30%
With v bracing	2108.36	2187.46	3.75%
With invrted v bracing	2108.36	2187.46	3.75%

2.Storey Displacement:-

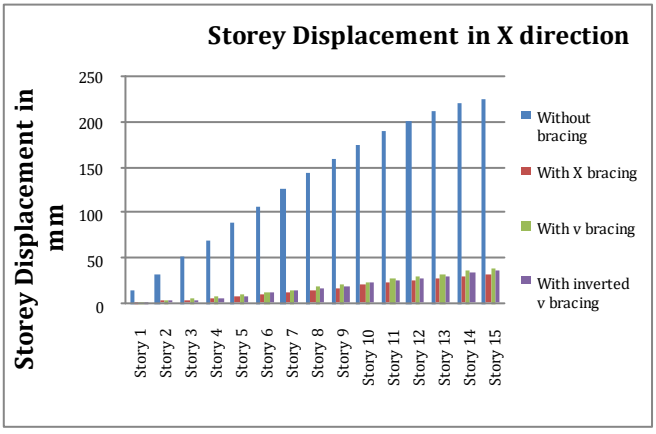

Fig.2.3 Storey Displacement in X direction (G+14)

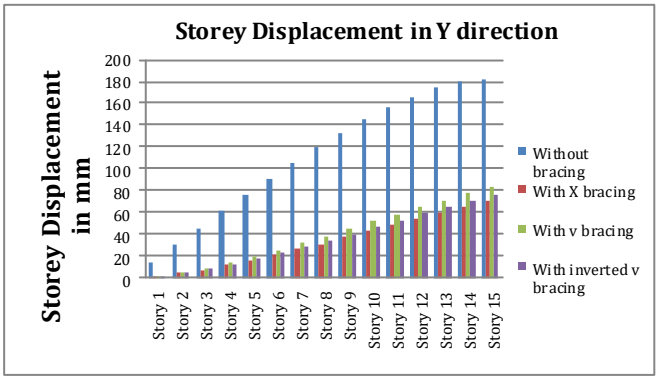

Fig.2.4 Storey Displacement in Y direction (G+14)

The graphical representation of storey displacement obtained for building with & without bracing shown in figure 2.3 and 2.4. The graph shows that the values of storey displacements are gradually increased with increasing the height of building in both X and Y direction.For structure with X bracing have minimum storey displacement and maximum for structure without bracing After appling bracings the displacement reduces upto 80% and above .

3.Storey Drift:-

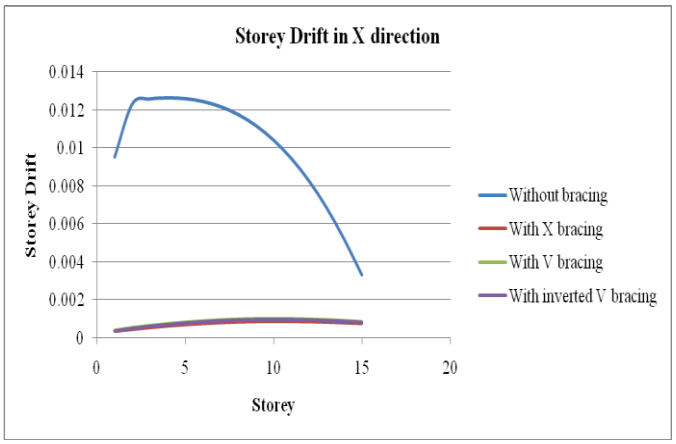

Fig.2.5 Storey Drift in X direction (G+14)

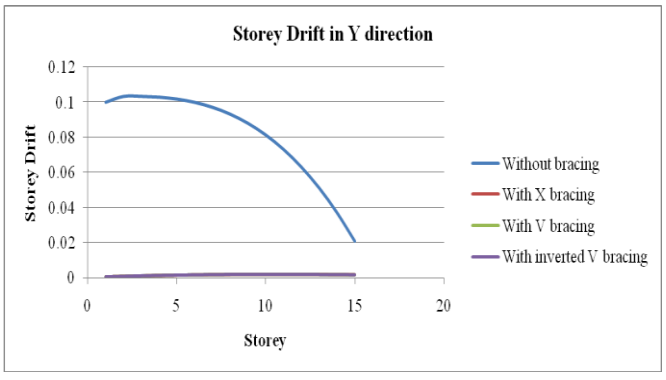

Fig2.6 Storey Drift in Y direction (G+14)

As per IS 1893:2002 maximum storey drift should not be more than 0.004 times to storey height of the structure. Value of limiting storey drift is 0.012 where height of storey is 3m. From the graph it is observed that the values of the storey drift for all the stories are found to be within the limits.

6. CONCLUSIONS

From analysis of 15 storied RC & Steel building with provision of Bracing for different types ,following conclusions are drawn.

1. The seismic responses in X and Y direction namely base shear for 15 storied RC structure with X bracing gives maximum result for base shear as compare to without bracing .
2. For structure with bracing X have minimum storey displacement. Storey displacement is uniformly increasing when structure unbraced and it is maximum at top floor of the structure.
3. For structure with bracing have minimum storey drift compared to structure without bracing respectively. Structure with inverted V Bracing gives minimum Storey drift as compare to other X,V.The values of storey drift for all the stories are found to be within the limits i.e. 0.004 times to storey height according to IS 1893:2002 (Part I)
4. Building with bracing leads to minimum displacement, maximum base shear and minimum storey drift compared to building without bracing.
5. Structure with X Bracing is suitable for G+14 RC and Steel frame the effect of earthquake load on the seismic performance.

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