Comparision of Seismic Response of a Soft Storey Building with Gap Inclined Bracing and Conventional Brace System

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Abstract- *over the past few decades, we can see that soft-storey mechanisms are generally undesirable for the seismic response of building structures. Due to this building non-structural element and structural element are damaged. Generally Brace and Shear wall are used to prevent lateral force acting on building. A new bracing system are developed which is called gapped inclined bracing. It is used to reduce the soft storey effect so they providing at ground storey. This gapped inclined bracing resist the lateral force acting on soft storey building and reduce the damage of the structure. This Brace provide good performance in soft storey building. Gapped incline bracing compair with X-brace, V-Brace and invert V-Brace check for seismic parameter such as displacement, storey drift, base shear, p-Δ effect.*

Compare Gapped incline bracing with x-brace, v-brace, and invert v-brace at different length, angle and location. Make model of RCC building with G+4, G+9, G+14 and G+ 19 for different brace system. And analysis is done with response spectrum method in Etab 2013 software.

Keywords- Soft Storey, Retrofit, RC Building, Gapped-Inclined Brace, Response Spectrum Analysis, Displacement, Storey Drift, Base Shear.

I. INTRODUCTION

Most of all building is damage due to earthquake. Structures are subjected to two type of load which is acting on structure. One is static and other is dynamic. Static load are not varying with time but dynamic load are varying with time. All structure are designed as a static load. Dynamic load are occurred when wind load, earthquake load acting on structure. Buildings are poor performance due to this load and damaged due to this.

When designing building as a lateral force resisting system. We protect the building and reduce the damage of the structure. Most of the buildings are damaged due to soft storey at ground floor. This brace provide at soft storey Building to reduce the effect of soft storey. Also provide in single to multistory building. Some time brace is provide in retrofit building near the Interior or exterior column of the structure and provide stiffness and strength to it.

In last past few years many research has been done on soft storey building and they try to reduce soft storey effect and give them seismic strength.

Image of Gap Inclined Brace at soft storey connected with column both side is given below fig.1.1

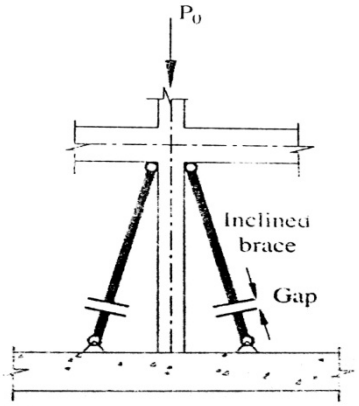

Figure 1. GAP INCLINED BRACE

II. LITERATURE SURVEY

- The detailed review of literature related to seismic behavior is carried out in this chapter. All the main researches are discussed with appropriate description. Their adaptability's are also discussed.
- The researcher research on soft storey building during earthquake and result are all buildings damaged.
- To prevent this soft storey effect they provide bracing at soft storey.
- Generally X-brace, V-brace and inverted V-brace used in multi storey building. They found a new bracing called Gap Inclined Brace for soft storey building.

- Also seismic analysis while providing this brace at soft storey using software with response spectrum method
- Researcher says that Gap Inclined Brace give seismic strength of structure and reduce the soft storey effect.

III. OBJECTIVES OF THE STUDY

- Seismic analysis when Gap Inclined Brace provide at soft storey using Etabs 2013 software with different height of building like G+4, G+9, G+14, G+19.
- Analysis the seismic result when this bracing provide at different location and different angle of the soft storey building.
- Also, Comparison between Gapped inclined brace, X-brace, invert V-brace and V-brace at soft storey building.
- Study of seismic response of building in terms of lateral displacement, storey drift, P-Δ effect, base shear while Gap Inclined Brace provide at soft storey.

IV. GEOMETRICAL DATA OF THE BUILDING

For G+9 storey 23m x 23m grid line are consider for Seismic analysis of building and details of column and beam are given below table 4.1

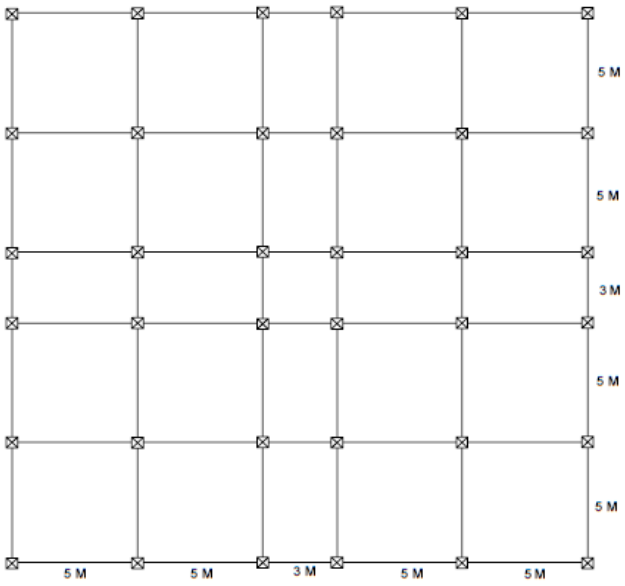

Figure 2. GEOMETRICAL PLAN FOR STOREY

Table 1. Geometrical Details

Sr No.	Content	**Description**
1	Plan Dimension	23 m X 23 m
2	Storey height	3.5 m
3	Beam And column size	300 x 500 mm 400 X 400 mm

The frames were assumed to be firmly fixed at the bottom. The building was analysis with three different types of bracing X-Brace, V-Brace, invert V-Brace. Using Etabs software seismic analysis for the G+9 storey building with Response Spectrum method and also check different seismic parameters. The height of soft storey is 3.5m and above all storey was 3m. The grade of concrete used for beam and column was M25. The grade of steel used was Fe415.

Loading – Various types of load considered are discussed in succeeding section.

Dead Load – The dead load on all floors was considered as 1 KN/m².

Live Load – The live load had been taken as 3 KN/m².

Seismic Load – As per IS 1893-2002, the dynamic analysis was performed using Response Spectrum Method. In Response Spectrum Method design parameters are given below.

Z, zone factor = 0.16
I, importance factor = 1
R, response reduction factor = 5
Soil Type = II
Damping ratio = 0.05

V. ANALYSIS OF RESULT

The building frames have been analyzed using response spectrum method in Etabs 2013. Various parameters like Displacement, Base shear, Storey shear has been compared for various bracing.

Response Spectrum Analysis - In this method due to seismic analysis different number of modes are caused for then they give single response of the structure. It plot the curve of acceleration at different time period and give maximum response value of structure.

Modal responses are combined by modal combination method to get the maximum response for one

direction of the earthquake. Generally we consider Complete Quadratic Combination method because it give good result.

Plan and elevation view while Gap Inclined Brace provide at soft storey are given below fig. 5.1 and fig.5.2

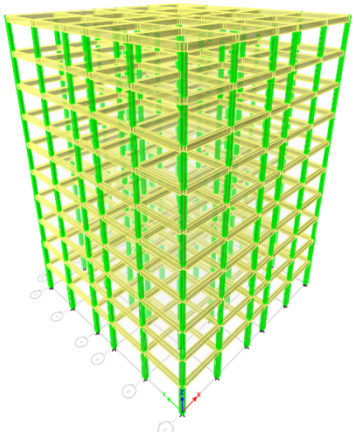

Figure 3. ELEVATION VIEW OF BUILDING

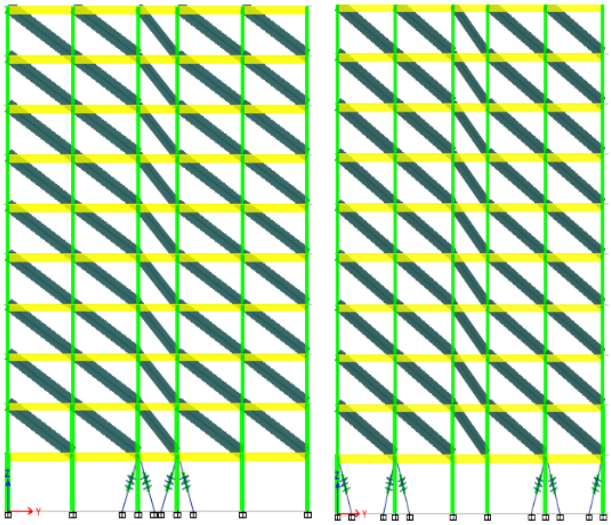

Figure 4. GIB AT INNER AND OUTER SIDE

A. Storey Displacement

Storey displacement is depends on the lateral stiffness of the structure. And when stiffness of the structure is increases then displacement is decrease and vice-versa. Storey displacement limits as per IS 1893-2002 is 0.122m.

Soft storey buildings compare storey displacement value. when X-Brace, V-Brace, invert V-Brace, GIB and without brace provide at soft storey.

Values for displacement when GIB provide at inner and outer side of the soft storey are given in table 5.1

Table 2. Displacement At Inner And Outer Side

Bracing at Inner and Outer Side		
	Inner Side	Outer Side
Without Brace	4.5	4.5
X-Brace	3.3	2
V-Brace	3.9	2.5
Invert V-Brace	4.1	2.4
GIB at 10˚	4.3	3.6
GIB at 20˚	3.5	1.9
GIB at 30˚	2.6	1.1

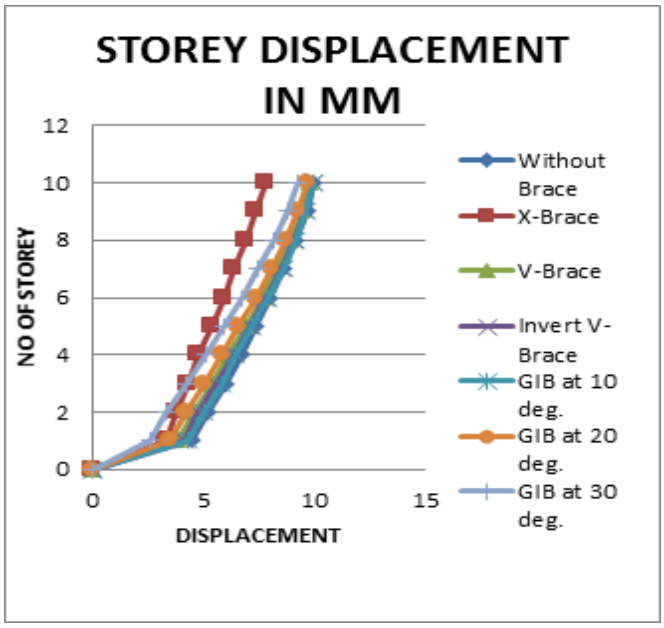

Figure 5. DISPLACEMENT AT INNER SIDE FOR G+9

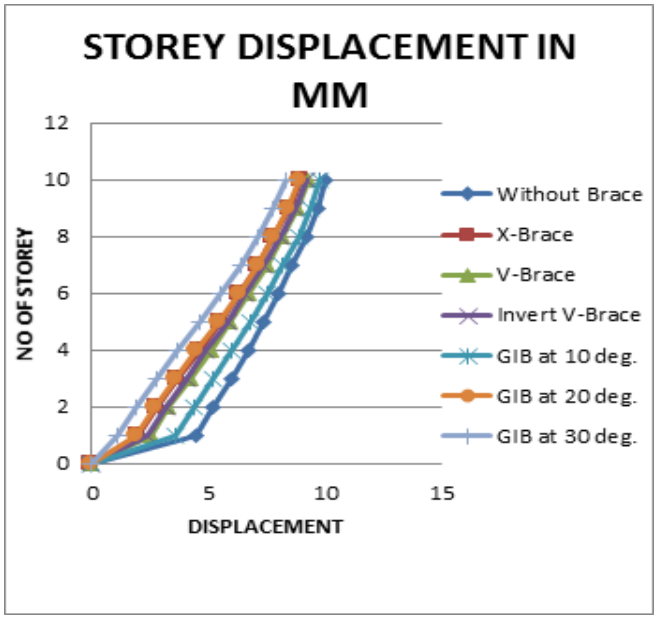

Figure 6. DISPLACEMENT AT OUTER SIDE FOR G+9

From the above result displacement are reduce in GIB brace compare than other brace system.

B. Storey Drift

Storey drifts change with height of the building. This is the soft storey so that storey drift is more at soft storey means ground floor and it reduse at upper storey because increase in stiffness at upper floor. Storey drift limit as per IS 1893(Part 1):2002 is 0.004 times the storey height. In our case study storey drift limit is 0.014m.

Soft storey buildings compare storey drift value. when X-Brace, V-Brace, invert V-Brace, GIB and without brace provide at soft storey.

Values for storey drift when GIB provide at inner and outer side of the soft storey are given in table 5.2

Table 3. Storey Drift At Inner And Outer Side

Bracing at Inner and Outer Side		
	Inner Side	Outer Side
Without Brace	0.00147	0.00147
X-Brace	0.00117	0.000676
V-Brace	0.00126	0.000824
Invert V-Brace	0.00132	0.000801
GIB at 10˚	0.00138	0.00113
GIB at 20˚	0.00112	0.000650
GIB at 30˚	0.000877	0.000398

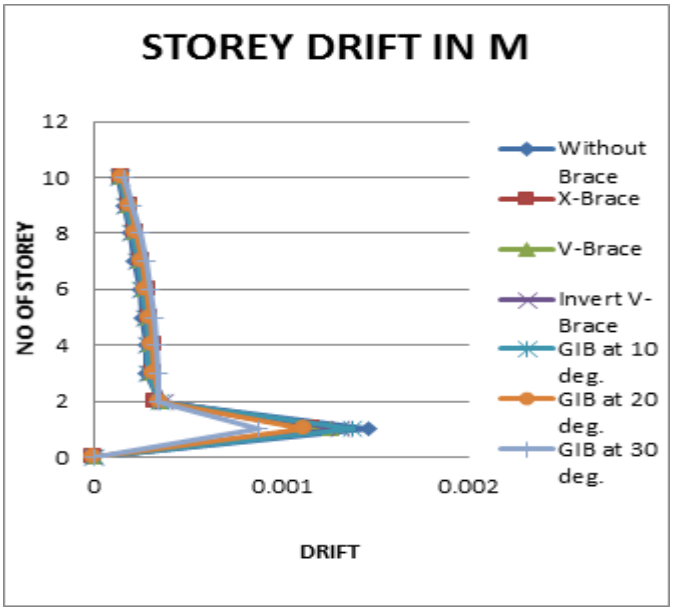

Figure 7. STOREY DRIFT AT INNER SIDE FOR G+9

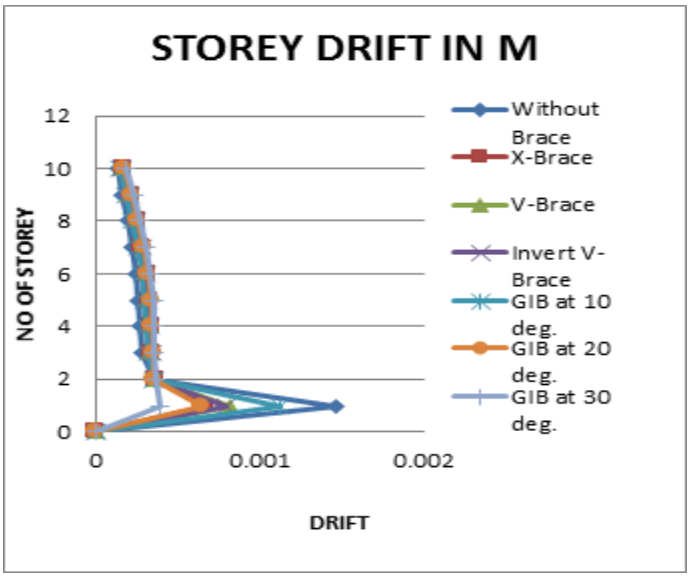

Figure 8. STOREY DRIFT AT OUTER SIDE FOR G+9

From the above result storey drift are reduce in GIB brace compare than other brace system. After that X-Brace, V-Brace give good result. Also when increase the angle of GIB then more reduce the drift values as shown in result.

C. Base Shear

The magnitude of the lateral force depends on the mass of the building lumped at each floor level.

Table 4. Base Shear At Inner And Outer Side

Bracing at Inner and Outer Side		
	Inner Side	Outer Side
Without Brace	1940.38	1940.38
X-Brace	2286.48	2284.74
V-Brace	2070.27	2251.53
Invert V-Brace	2007.51	2262.37
GIB at 10˚	2058.64	2224.02
GIB at 20˚	2202.48	2362.90
GIB at 30˚	2295.82	2365.62

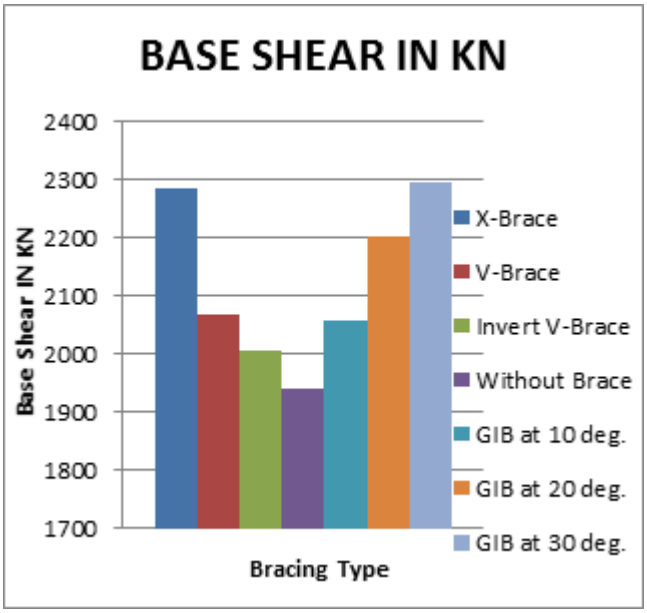

Figure 9. BASE SHEAR AT INNER SIDE FOR G+9

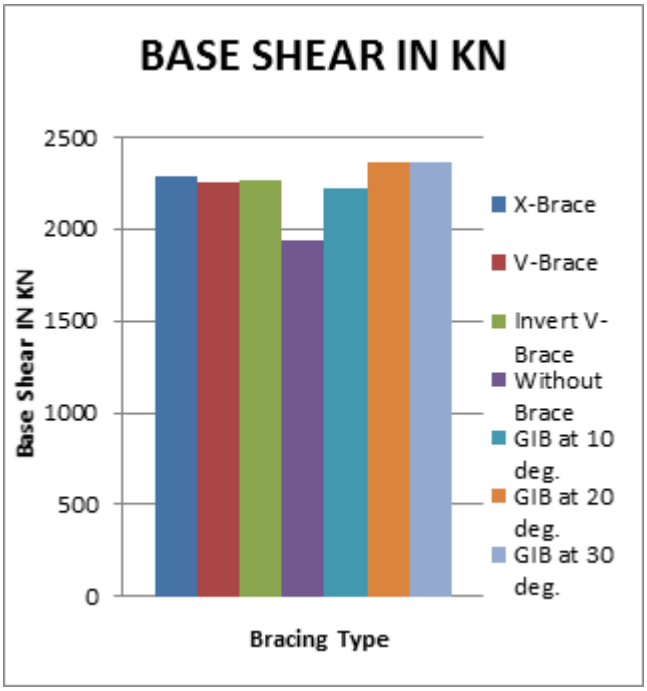

Figure 10. BASE SHEAR AT OUTER SIDE FOR G+9

From the above result of base shear say that GIB system are more base shear value compare with other after than X-Brace and V-Brace give good result.Conclusion from the whole seismic analysis result is given below.

VI. CONCLUSION

From this seismic analysis we conclude that due to seismic force structure are damage so reduce this lateral force in structure we use different types of bracing in building. This type of bracing provide in single-multi storey building to reduce displacement, storey drift and base shear value in building.

- Gap Inclined Bracing give effective seismic response compare with other brace system.
- Displacement and storey drift value for G+9 storey building are effective in GIB system compare with other brace system.
- Outer Side location for bracing is better. When provide bracing at outer side they give effective seismic response compare with inner side location.
- Displacement and storey drift values are more reduce by Gap Inclined Bracing compare with other brace system when increasing the size of angle.
- % Reduce in displacement for G+9 storey building when all type of bracing provide at outer side of soft storey in order of X-Bracing, V-Bracing, Invert V-Bracing and GIB at 10˚,20˚,30˚ angle are 55.55%, 44.4%, 46.6%, 20%, 57.77% and 75.55%.

Gap Inclined Bracing is the best alternative to ensures good seismic behavior in soft storey building compare with other brace system. Future study for different gap distance and non-linear time history analysis in etabs 2013 software. Also Parametric study of models by different symmetry of building and number of bays of building.

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