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EFFECT OF EARTHQUAKE ON BUILDING WITH AND WITHOUT BRACING RESTING ON SLOPE

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Abstract: *Irregularities are formed in structures when structures are resting on slopes and prone to maximum damage during earthquake. Hence, usually such irregular structures are avoided. Such failures due to irregularity in structures during earthquake can be avoided by using seismic force resting members in irregular structures as it is unavoidable to erect structures over slopes. In this paper, a multistoreyed structure of symmetrical plan with 10 storeys has considered. To improve the performance of structure on slope of 10^0 V bracing is used along the outer periphery of structure. This structure of 10 storeys is analyzed in STAAD v8i by Response Spectrum Method. Result of the study is concluding the comparison of 10 storey building on slope with and without V bracing considering earthquake parameters as Storey drift, Base Shear and Fundamental Time Period.*

Keywords: *Irregularity, bracings, response spectrum method.*

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INTRODUCTION

Structures on slope are obligatory for continuous growth of country and also as requirement of increasing population. But slope forms irregularities in structures and such irregular structures are known as Step back structure having short column effect. These step back structures attract more inertia forces and fails during earthquake as a result of short column effect. To avoid such failures lateral force resisting member, bracings can be used. In this study V bracing is used to conclude about the results of step back structures with bracing and without bracing. Behavior of step back building with V bracing improves the performance by decreasing storey drift parameter is pivotal purpose of this study.

1. Methodology:

For this study methodology were decided to identify proper results and it is as follows:

1. Literature Study.
2. Symmetrical Plan and building parameters along with dimensions has been decided.
3. Both models are modeled and analyzed on sloping ground with Slope 10^0.
4. Response Spectrum method has been used for analysis in STAAD v8i.
5. Results are presented in terms of storey drift, base shear and fundamental time period.

2. Modeling and Analysis:

Two models of 10 Storey building, Step back structures without V bracing and with V bracing are modeled and analyzed in structural software STAAD v8i. To study seismic performance of these two models response spectrum method is used.

Table 1: Model Details

Group	Model No.	Structure	Slope	Storey
I	Model 1	Step back building without bracing	10^0	10 Storey
	Model 2	Step back building with V bracing		

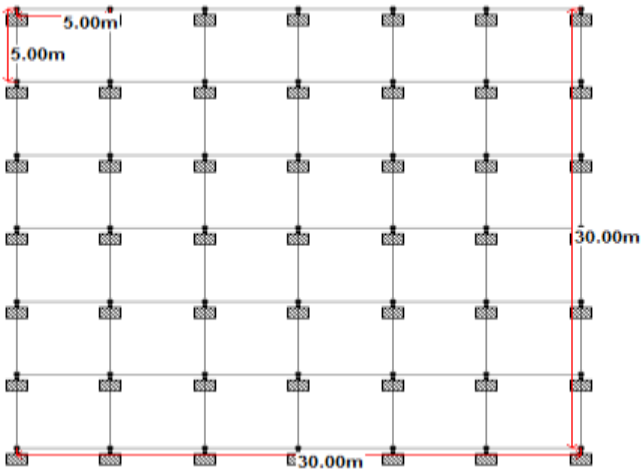
30 X 30 m size of plan on slope of 10^0 is decided. Size of column = 700 X 700 mm,
Size of beam = 230 X 700 mm and
Slab Thickness = 150 mm has considered for modeling.
Following paameters are consider for response spectrum analysis:

Storey Height: 3 m
Depth of Foundation: 1.75 m

Wall Thickness:

a) External :	230 mm
b) Partition:	115 mm
Grade of Concrete:	M 25
Slab thickness:	0.15 m
Superimposed Load:	4 KN/m^2
Zone factor:	0.24
Importance Factor:	1.5
Response Reduction Factor (SMRF):	5
Damping Ratio:	0.05

Figure 1: Plan of Building



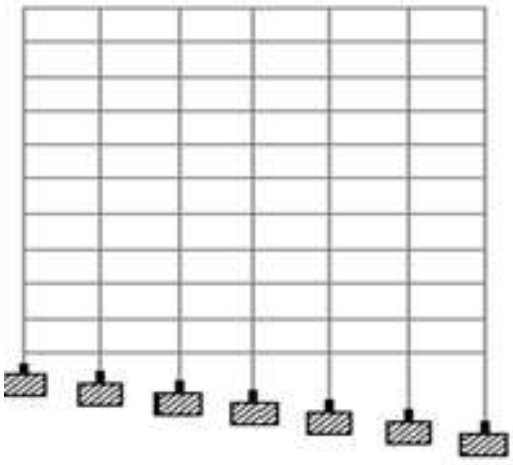


Figure 2: Model for Step back building without bracing

3. Results and Discussions:

Previously shown models of Step back building without bracing and Step back building with V bracing are analyzed for decided building parameter and response spectrum parameter in STAAD v8i by response spectrum method. Analysis results represented in terms of Storey drift, Base shear and Fundamental Time Period shown in table below with graphical representation:

1. Storey Drift:

Table 2: Storey Drift

Storey Height	Storey Drift of Step back building without bracing	Storey Drift of Step back building with V bracing
0	0.00451	0.00422
3	0.00959	0.00694
6	0.01103	0.00755
9	0.01053	0.00706
12	0.00955	0.00627
15	0.0085	0.00544
18	0.00749	0.00468
21	0.00644	0.00409
24	0.00529	0.00368
27	0.0039	0.0027
30	0.00249	0.00072

Graphical Representation:

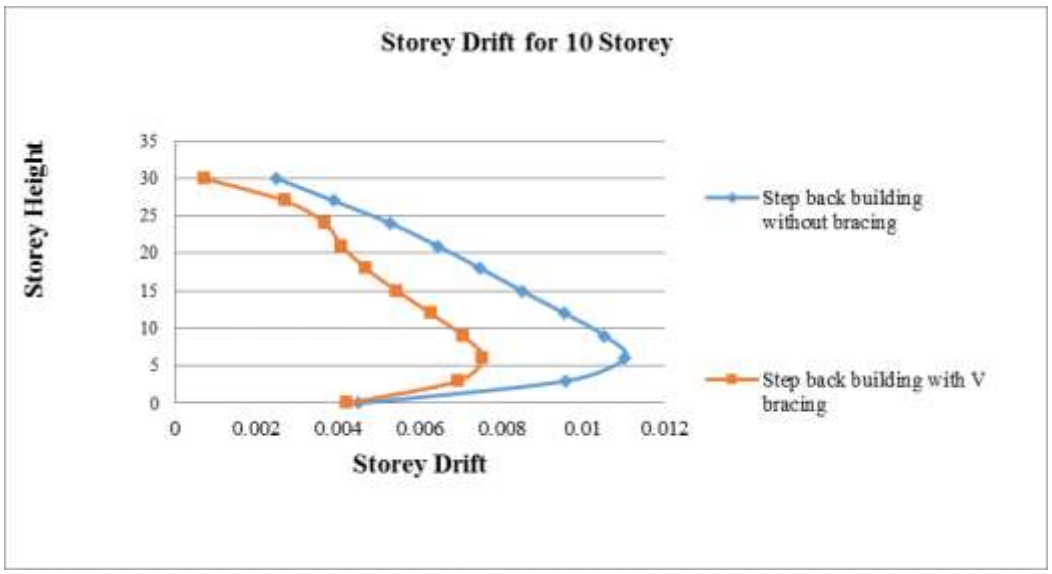


Figure No. 3: Storey Drift for 10 Storey

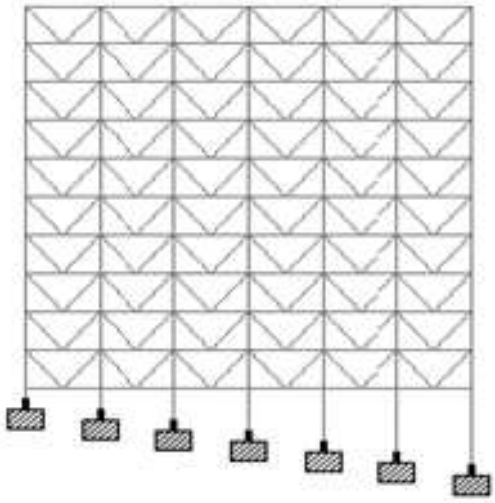


Figure 3: Model for Step back building with V bracing

1. Base Shear:

Table 4: Base Shear for 10 Storey

10 Storey	Step Back Building without bracing	Step Back Building with V braicng
	9935.11 KN	9976.71 KN

Graphical Representation:

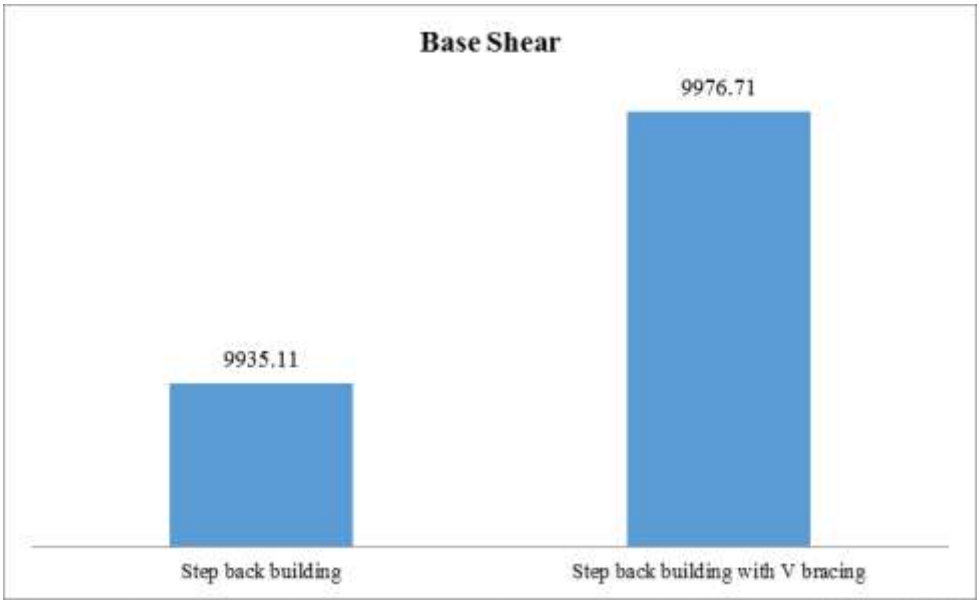


Figure No. 4: Base Shear for 10 Storey

2. Fundamental Time Period:

Table 5: Fundamental Time Period

10 Storey	Step Back Building without bracing	Step Back Building with V braicng
	1.50525 Sec	1.32929 Sec

Graphical Representation:

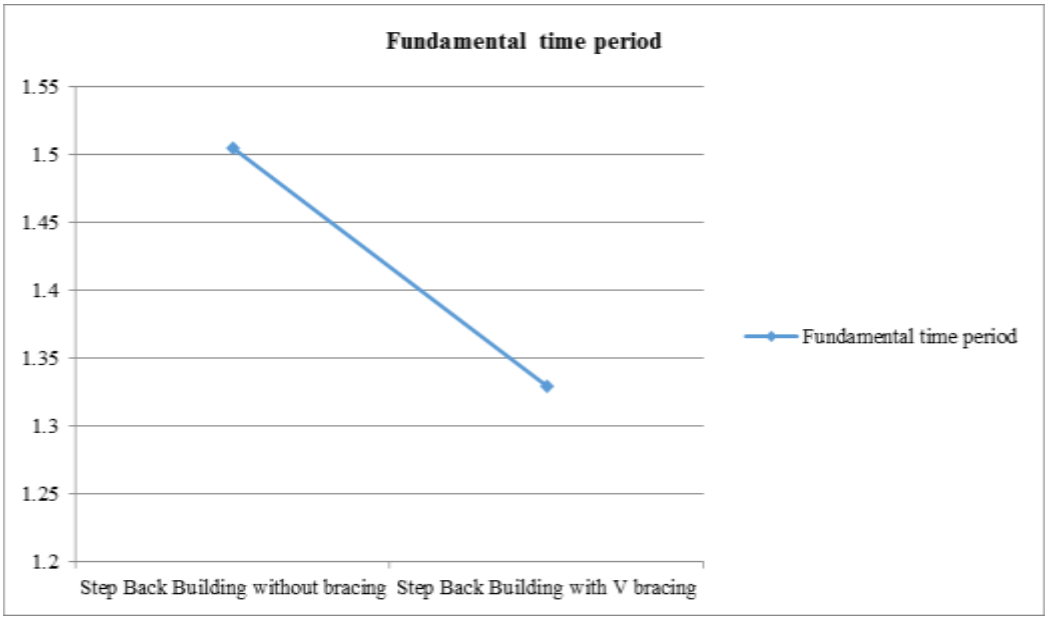


Figure No. 5: Fundamental Time Period for 10 Storey

Above results shows that storey drift is decreased when step back building is provided with bracing along with decrease in fundamental time period but base shear increased as weight of building is increased due to additional bracings on outer periphery of building. Storey drift is decreased by 31% compare to building without bracing and 12% decrease in fundamental time period.

CONCLUSION:

From above obtained result from analysis of building on slope with and without bracing following points are concluded:

1. Reduction in storey drift of step back building when provided with V bracing.
2. Due to additional bracings weight of building increases hence, base shear increases.
3. Fundamental time period of model provided with V bracing is comparatively less than without bracing.
4. Step building with V bracing can be suggested from above obtained results.

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