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EFFECT OF SLOPING GROUND ON STEP -BACK AND SETBACK OF RC FRAMED BUILDING

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Abstract: The buildings situated on hill slopes in earthquake prone areas are generally irregular, torsionally coupled & hence, susceptible to serve damage when affected by earthquake ground motion. Such buildings have mass & stiffness varying along the vertical & horizontal planes, resulting the center of mass & center of rigidity do not coincide on various floors, hence they demand torsional analysis, in addition to lateral forces under the action of earthquakes. These unsymmetrical buildings require great attention in the analysis & design. Analysis of hill buildings is somewhat different than the buildings on leveled ground, since the column of hill building rests at different levels on the slope. The shorter column attracts more forces & undergoes damage, when subjected to earthquakes.

Keywords: Seismic Effect, Setback Building, Sloping Ground, Time Period.

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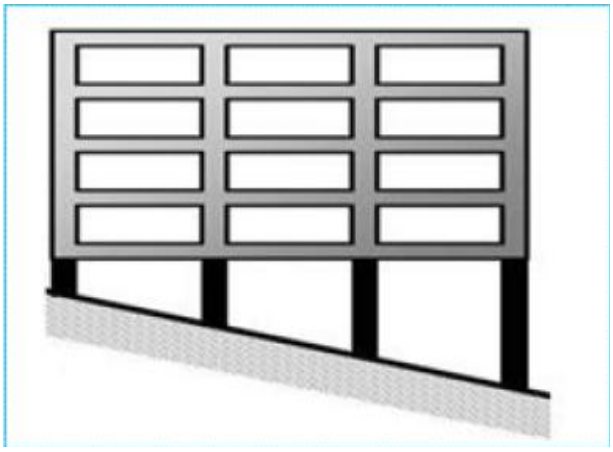
INTRODUCTION

The economic growth & rapid urbanization in hilly region has accelerated the real estate development. Due to this, population density in the hilly region has increased enormously. Therefore; there is popular & pressing demand for the construction of multi-storey buildings on hill slope in and around the cities. The adobe burnt brick, stone masonry & dressed stone masonry buildings are generally made over level ground in hilly regions. Since level land in hilly regions is very limited, there is a pressing demand to construct buildings on hill slope. Hence construction of multi-storey RC Frame buildings on hill slope is the only feasible choice to accommodate increasing demand of residential & commercial activities.

1. SINIFICANCE OF STUDY

It is observed from the past earthquakes, buildings in hilly regions have experienced high degree of demand leading to collapse though they have been designed for safety of the occupants against natural hazards. Hence, while adopting practice of multi-storey buildings in these hilly & seismically active areas, almost care should be taken, making these buildings earthquake resistant.

During past earthquakes, reinforced concrete (RC) frame buildings that have columns of different heights within one storey, suffered more damage in the shorter columns as compared to taller columns in the same storey. One example of buildings with short columns in buildings on a sloping ground can be seen in the figure (2.1) given



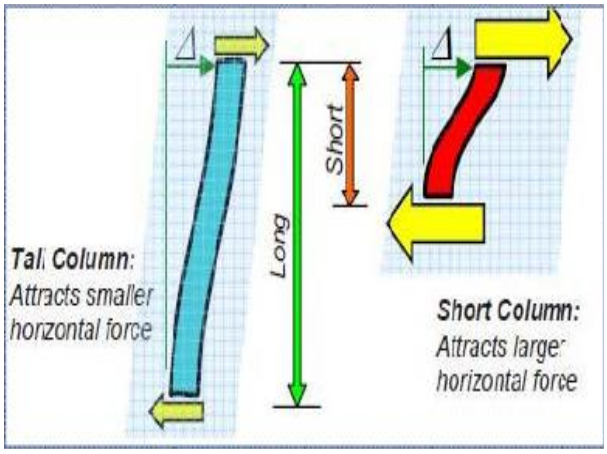


Fig. 2.1 Building frame with Short column **Fig. 2.2 Structural behavior of short column under lateral load**

2. SCOPE OF STUDY

Three dimensional space frame analysis is carried out for three different configurations such as;

1. Step back Building
2. Step back-Setback Building
3. Setback Building

Dynamic response of these buildings, in terms of time period, base shear & top floor displacement is presented & compared within the considered configuration as well as with other configurations. At the end, a suitable configuration of building to be used in hilly area is suggested.

4. BUILDING CONFIGURATION

Three different configurations are considered,

1. Step back (Resting on sloping ground)
2. Step back-Setback (Resting on sloping ground)
3. Setback (Resting on plain ground)

The building shown in figure 4.1 having step back configuration is labeled STEP6.

Step back-Setback configuration of building is shown in fig 4.2, are designed as STPSET6. Setback building resting on plain ground & labeled SET6, as shown in fig 4.3.

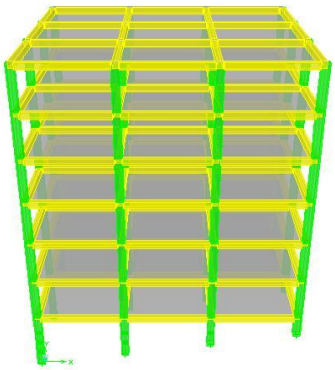


Fig.4.1 Stepback building

Fig.4.2 Stepback-setback Building

Fig.4.3 Setback Building

Table 4.1 Properties of members of different configurations of building

Sr. No.	Building Configuration	Size of column	Size of beam
1.	Step back Buildings (STEP6)	400 x 400 mm	300 x 450 mm
2.	Stepback & Setback Building (STEPSET6)	400 x 400 mm	300 x 450 mm
3.	Setback Building (SET6)	400 x 400 mm	300 x 450 mm

5. METHOD OF ANALYSIS

The seismic analysis of all buildings are carried out by Seismic coefficient method by using

IS 1893(part I) -2002. The other parameters used in seismic analysis

a) Moderate seismic zone-III

b) Zone Factor = 0.16.

c) Importance Factor = 1

d) Response Reduction Factor = 5

Analyses of results In all, thirty six buildings have been analyzed for seismic load. The seismic force was applied in X & Y direction independently.

Sr. No.	Building Configuration	Base shear (kN)		Top storey Displacement (m)		Time Period (Sec)
		X-Dir	Y-Dir	X-Dir	Y-Dir	
1.	STEP6	997.47	1257.49	0.0286	0.0293	**1.40**
2.	STEPSET6	862.28	1157.31	0.0235	0.0281	**1.29**
3.	SET6	527.82	526.82	0.0188	0.0212	**1.11**

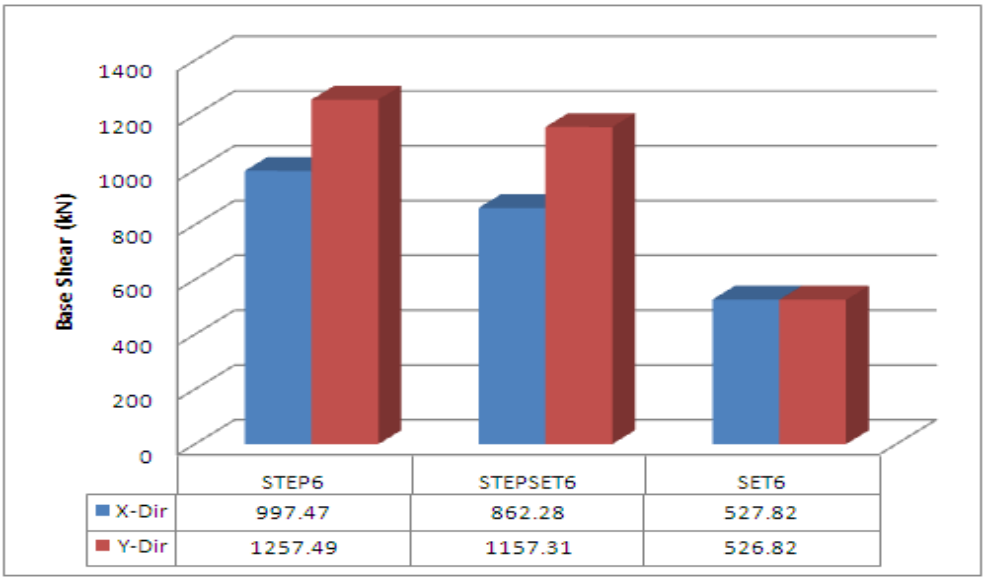


Fig.5.1 Comparison of Base Shear in X & Y Direction

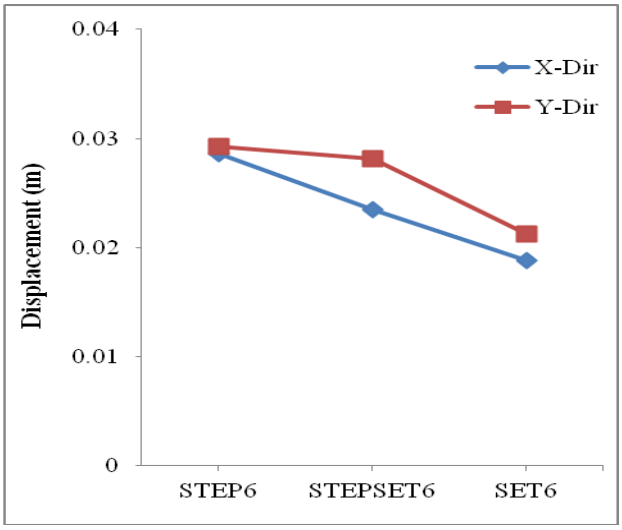


Fig.5.2 Comparison of Roof Displacement in X & Y Direction

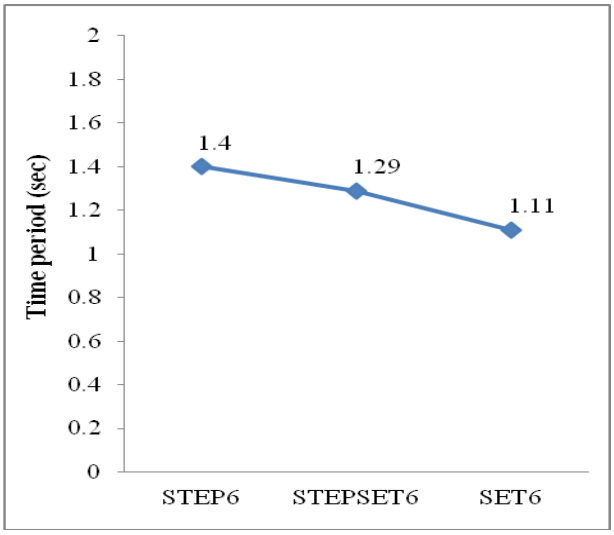


Fig.5.3 Comparison of Fundamental Time period

6. CONCLUSIONS

Analysis of three configuration of building is carried on sloping & leveled ground. The following conclusions may be drawn from this study.

1) The maximum base shear is induced in Step back-Setback building & least in Setback building on leveled ground.

2) Top storey displacement of Step back building is quite high as compared to Step back-Setback building resting on sloping ground.

3) Stepback-Setback building may be Favored on sloping group.

4) Fundamental time period is more in Step back-Setback building & least in Setback building on leveled ground.

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