A REVIEW: SEISMIC ANALYSIS OF BUILDING ON SLOPING GROUND

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***Abstract: In** some part of India& world hill area is more to seismic activity. EgHimalaya, Uttarakhand, saputara etc. in this study I will investigate the seismic performance of building with regular & irregular structure. They type structure is consist with shear wall intellection for step back set back building with different height like (5 to 15 story) with different ground slope of (3 to 40 degree). The main object of this study to understand to behavior of building on seismic, wind, time history, response spectrum analysis with different location or different earthquake zone (1,2,3,4,5). Then also carried out static and dynamic properties of building its carried out using of finite analysis software etabes, stadd pro, sap2000 etc. measure displacement, torsion effect, maximum force has been reviewed in paper.*

Keywords- Sloping ground, static & dynamic behavior, set back and step back building, regularities and irregularities of building.

I. INTRODUCTION

In the review of study when many modern constructions using shear wall is provided to resist lateral force & earthquake existing force. when economy of construction & development of hill areas are increase. Then they will re construction of building to optimum use of construction material & method of construction. But earthquake is not kill people it is due to the destruction of structure collapse of building during earthquake and cause direct loss of human lives then biggest challenge to design the building in sloping ground. But there is a development of unsymmetrical nature of these building and eccentricity is different in the alignment of the center of mass and center of stiffness at every floor. They set back structure will divided in part then calculate (transverse shear force & torsion) effect, and then difficult calculation of center of gravity and moment of inertia. They simply fly approach of degree of freedom at each point per floor in either translation direction, & elastic seismic analysis of irregular & unsymmetrical structure they will change at every floor. The adequacy of translation frigidity of column foundation under lateral loads in step back building & natural ground steep slope.

II. SUMMARY

- The author will don't consider the shear wall actual position then lateral force will increase then torsion effect increases. [02]
- Then author will consider the proper fixed support then earthquake is high then directly damaged structure. [04]
- In frame structure they many types of frame they will not mention frame type and frames direction. [01]
- In author will always consider scale factor is "1" but different zone they scale factor value will changes. [07]
- In author paper they consider cross section area of outer and inner side beam is same but loading condition is inner and outer side both are change then they will not consider. [10]
- More then paper they will not consider wind forces, but in sloped area wind action is high and cyclonic region also not mention. [11]
- But they all paper perfectly calculate different time history and response spectrum analysis. [14]

III. LITERATURE REVIEW

Paper Title – "Seismic Response of RC Framed Buildings Resting on Hill Slopes"

Authors - Zaid Mohammad, Abdul Baqib and Mohammed Arif in this study Framed structures constructed on hill slopes show different structural behavior than that on the plain ground. Since these buildings are unsymmetrical in nature, hence attract large amount of shear forces and torsional moments, and show unequal distribution due to varying column lengths. In present study, two different configurations of hill buildings have been modelled and analyzed using ETABS v 9.0 finite element code. A parametric study has been carried out, in which hill buildings are geometrically varied in height and length. In all, eighteen analytical models have been subjected to seismic forces along and across hill slope direction and analyzed by using Response Spectrum Method. The dynamic parameters obtained from analyses have been discussed in terms of shear forces induced in the columns at foundation level, fundamental time periods, maximum top storey displacements, storey drifts and storey shear in buildings, and compared within the considered configurations of hill buildings. At last, the suitability of different configurations of hill buildings has been suggested.

Authors - Prasad Ramesh VaidyaThis study investigates the seismic performance of shear wall building on sloping ground. The main objective is to understand the behavior of the building on sloping ground for various positions of shear walls and to study the effectiveness of shear wall on sloping ground. The performance of building has been studied with the help of four mathematical models. Model one is of frame type structural system and other three models are of dual type (shear wall- frame interaction) structural system with three different positions of shear walls. Response spectrum analysis is carried out by using finite element software SAP 2000. The performance of building with respect to displacement, story drift and maximum forces in columns has been presented in this paper. Bending moment and shear force along sloping side is found to be minimum for model II (shear wall towards shorter column), whereas on other side model IV (Shear wall located symmetrically in plan) gives minimum shear force and bending moment. There is maximum of 59.33% reduction in shear force and about 64.02% reduction in bending moment is observed for model II along sloping side as compared with frame type structural system.

IV. SCOPE OF WORK

- To compare the short and long column effect for each floor level of set back and step back building.
- Effective Shear force for beam and column will calcite for economy purpose
- Compare stiffness of column for different floor level in sloping ground of building.

V. PREVIOUS STUDY

Zaid Mohammad, Abdul Baqib, Mohammed Arif

They considered two buildings on sloping ground and one building is on flat soil. The first two are step back buildings and step back-setback buildings; and third is the setback building. The slope is taken 26º, story height 3.5 with horizontal. Depth of footing was taken 1.5m.

Building confifuration	Perametric variation	Designation of model	Column size(mm)	Beam size(mm)
Step back	4 to 8bays	stepals	Up to 5:400x400 From 6 to 8:450x450	Along slope:300x500
	1 to 5 bays	stepals	all:400x400	
Step back setback	4 to 8 bays	Setals	all:400x400	Across slope:300x450
	1 to 5bays	setacs	all:400x400	

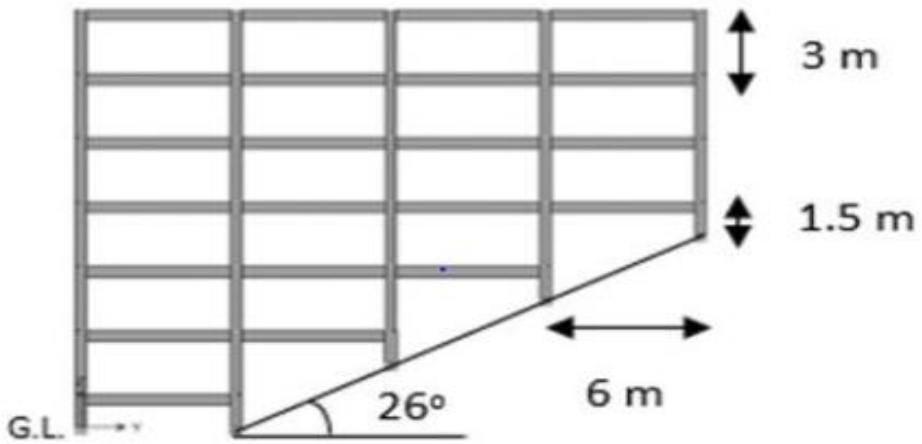

Figure1: - Building in Sloping Ground

Mohammad Abdul Imran Khan

They considered two buildings on sloping ground and one building is on flat soil. The first two are step back buildings and step back-setback buildings; and third is the setback building. The slope is taken 26º, story height 3.5 with horizontal. Depth of footing was taken 1.5m.

Table 5.1: -Basic Data for Modelling

Basic Data	
Structure	Symmetric Regular Building
Plan Dimension	25 x 25 m
Height of Typical Floor	3m
Ground Floor Height	3m
Floors	20
Dimension of Column	600x600mm
Dimension of Beam	230 x 500 mm
Slab Thickness	150mm
Walls	230mm thick brick masonry walls
Shear wall	250mm thick concrete wall
Support	Fixed
Type of soil	Type II, medium soil as per IS:1893
Zone	IV
Live load on typical floor	2.0 KN/m2
Dead load on typical floor	5.5 KN/m2

VI. METHOD AND ANALYSIS

Zaid Mohammad, Abdul, Mohammed Ariftook the materials isotropic, homogeeous in nature. Floor diaphragms are taken as rigid.M25 concrete was used and P-delta effects, creep & shrinkage effects were not considered. Axial deformation was considered for columns. Torsional effect was considered as per IS- 1893:2002. Seismic analysis was performed by Response Spectra Method as per IS 1893:2002. Ordinary moment resisting frame was taken for all these types of buildings in seismic zone III. Response reduction factor and importance factor was taken as 3 and 1 respectively.5% of damping was considered.

Mohammad Abdul Imran Khananalyses the seismic behavior of these building located in seismic zone III by Seismic Coefficient Method as per IS 1893:2002. Response reduction factor and importance factor was taken as 5 and 1 respectively. Minimum six modes were analyzed for each type of building.

VII. ANALYSIS OF RESULT

Zaid Mohammad, Abdul, Mohammed Arifobserved that the along x direction time period and top storey displacement is increased for step back building as the height increases. Dynamic response i.e fundamental time period, base shear, top storey displacement for step back building along x direction is shown in table.

Table 5.2: Result for Time Period, Displacement and Base Shear

DESIGNATION	NO OF BAYS	HEIGHT	FTP by RSA(SEC)		FTP as per IS 1893 (SEC)		Max. top storey displacement (mm)		Base shear ratio (λ)	
			Along	Across	Along	Across	Along	Across	Along	Across
STEPALS 4	4	13.5	0.252	0.575	0.248	0.543	4.29	28.37	1.338	1.457
STEPALS 5	5	16.5	0.267	0.708	0.271	0.664	4.81	32.49	1.312	1.324
STEPALS 6	6	19.5	0.281	0.833	0.293	0.785	5.46	35.12	1.330	1.256
STEPALS 7	7	22.5	0.294	0.961	0.312	0.906	6.05	39.02	1.335	1.205
STEPALS 8	8	25.5	0.306	1.089	0.331	1.026	6.64	42.88	1.339	1.158

The value of fundamental time period estimated by empirical formula as per IS 1893:2002 is lower than the value of fundamental time period obtained in dynamic analysis. The value of base shear, fundamental time period is higher in Y direction than the corresponding values when earthquake force acts in x direction. Time period in dynamic analysis is greater than that calculated by empirical formula as per IS 1893:2002. The value of normalized shear force in columns, base shear, top storey displacement, time period for step back building along Y direction is shown in table.

Table 5.3: Result for Time Period, Displacement and Base Shear

DESIGNATION	NO OF BAYS	HEIGHT	FTP by RSA(SEC)		FTP as per IS 1893 (SEC)		Max. top storey displacement (mm)		Base shear ratio (λ)	
			Along	Across	Along	Across	Along	Across	Along	Across
STEPALS 4	4	13.5	0.252	0.575	0.248	0.543	4.29	28.37	1.338	1.457
STEPALS 5	5	16.5	0.253	0.632	0.271	0.664	4.62	23.66	1.326	1.240
STEPALS 6	6	19.5	0.253	0.663	0.293	0.785	4.82	20.43	1.311	1.100
STEPALS 7	7	22.5	0.253	0.683	0.312	0.906	4.84	18.11	1.280	1.025
STEPALS 8	8	25.5	0.253	0.695	0.331	1.026	4.78	15.57	1.249	0.923

In Y direction, variation of shear force is found less significant. Time period in dynamic analysis of this type of building is not affected by the height of building. Uniform section for columns from top to bottom is sufficient. The value of time period, base shear ratio, top storey displacement in Y direction is shown in table.

Table 5.4: Result for Time Period, Displacement and Base Shear

DESIGNATION	NO OF BAYS	HEIGHT	FTP by RSA(SEC)		FTP as per IS 1893 (SEC)		Max. top storey displacement (mm)		Base shear ratio (λ)	
			Along	Across	Along	Across	Along	Across	Along	Across
STEPALS 4	1	16.5	0.267	0.708	0.271	0.664	4.81	32.39	1.312	1.323
STEPALS 5	2	16.5	0.285	0.605	0.271	0.469	5.30	32.68	1.320	1.592
STEPALS 6	3	16.5	0.294	0.539	0.271	0.383	5.53	27.32	1.324	1.570
STEPALS 7	4	16.5	0.299	0.495	0.271	0.332	5.69	23.53	1.326	1.646
STEPALS 8	5	16.5	0.303	0.462	0.271	0.297	5.78	19.95	1.326	1.685

Mohammad Abdul Imran Khanobserved that the along x direction time period and top storey displacement is increased for step back building as the height increases. Dynamic response i.e fundamental time period, base shear, top storey displacement for step back building along x direction is shown in table.

Table 5.5: Displacementfor X-Direction

SR NO	STOREY LEVEL	UX			
		MODEL 1	MODEL 2	MODEL 3	MODEL 4
1	20	201.31	111.64	92.44	75.18
2	19	198.55	106.82	87.47	71.00
3	18	194.88	101.77	82.40	66.70
4	17	190.09	96.47	77.21	62.32
5	16	184.13	90.87	71.87	57.84
6	15	177.01	84.94	66.40	53.29
7	14	168.77	78.70	60.80	48.66
8	13	159.48	72.18	55.10	43.99
9	12	149.19	65.40	49.34	39.32
10	11	137.98	58.43	43.56	34.66
11	10	125.93	51.33	37.81	30.08
12	9	113.09	44.20	32.16	25.60
13	8	99.56	37.13	26.68	21.29
14	7	85.42	30.23	21.44	17.19
15	6	70.82	17.49	16.54	13.37
16	5	55.94	11.96	1.02	9.88
17	4	41.10	7.22	8.12	6.79
18	3	26.82	7.223.49	4.82	4.17
19	2	14.00	3.49	2.28	2.10
20	1	4.17	0.99	0.62	0.65

Mohammad Abdul Imran Khanobserved that the along x direction time period and top storey displacement is increased for step back building as the height increases. Dynamic response i.e fundamental time period, base shear, top storey displacement for step back building along Y direction is shown in table.

Table 5.5: DisplacementforY-Direction

SR NO	STOREY LEVEL	UX			
		MODEL 1	MODEL 2	MODEL 3	MODEL 4
1	20	201.30	111.64	191.02	75.18
2	19	198.55	106.82	188.27	71.00
3	18	194.88	101.77	184.66	66.70
4	17	190.09	96.47	179.99	62.32
5	16	184.13	90.87	174.22	57.84
6	15	177.01	84.94	167.38	53.29
7	14	168.77	78.70	159.50	48.66
8	13	159.48	72.18	150.65	43.99
9	12	149.19	65.40	140.90	39.32
10	11	137.98	58.43	130.29	34.66
11	10	125.93	51.33	118.91	30.08
12	9	113.09	44.20	106.83	25.60
13	8	99.56	37.13	94.10	21.29
14	7	85.42	30.23	80.83	17.19
15	6	70.82	23.64	67.11	13.37
16	5	55.94	17.49	53.14	9.88
17	4	41.10	11.96	39.17	6.79
18	3	26.82	7.22	25.67	4.17
19	2	14.00	3.49	13.48	2.10
20	1	4.17	0.99	4.05	0.65

VIII. CONCLUSION

Different types of building configuration are analyzed and the following conclusion can be made:

- During earthquake, STEP back buildings are more vulnerable than other building configuration.
- Extreme left short column at ground level are damaged most during earthquake in case of Step back and Step Back-Set back buildings.
- Less damage occurs in case of Setback building in flat soil. Detailed study of economic cost for levelling.
- sloping soil and other issues need to be studied.
- Base shear is higher for Step Back-Setback building and lower for Setback building.
- Lateral displacement of top storey is maximum for Step back building.

- On sloping soil Setback- Step back building is favored.
- I will have seen in research paper the author will increase height of building then forces will increase then displacement will be also increase.
- The building in a slender position then story drift will decrease with height of building.
- In Setback building Minimum forces is on short column and maximum force is on long column. but in step back building maximum force is on long column and minimum force is on short column.
- In a building provided shorter column and shear wall, then time period of vibration of short column is less to shear wall
- In step back, building is 40% to 50% reduce base shear value in plane ground building. But 20% base shear value is increase for apply 7 or more rector scale earthquake. And base shear will highly increase for apply response spectrum analysis.
- In sloping ground building more story drift in compare to plane ground building.
- Shear, moment, axial force value is increase of 0 to 90 degrees when earthquake and wind load is applied.

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