© 2018 IJSRSET | Volume 4 | Issue 7 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

Comparative Analysis of Multistoried RCC Building on A Sloping Ground And Flat Ground

Prof. Pratiksha Thombre, Sagar P. Budhabaware, Deepak B. Dahake, Sonali A. Dhokpande, Karuna K. Misal , Khushboo P. Hajare

Department of Civil Engineering, S.S.P.A.C.E, Wardha, Maharashtra, India

ABSTRACT

India has track record of catastrophic earthquakes, at various regions, which left behind loss of many lives and heavy destruction to property and economy. Analysis of buildings in hill region is somewhat different than the buildings on leveled ground, since the column of the hill building rests at different levels on the slope. Generally buildings may be failed by bending moments, shear forces acting on members of the building. By keeping these failures in mind, we designed beams, columns, footings by considering maximum loads on members. For loads calculation, substitute frame method is used for reducing the complexity of calculations and saving time. This total G +3 residential building analysis with only manual calculations based on values here taken from the standard code books (IS 456:2000, IS 1893:2016, IS 875:part1 & 2)

Keywords : Seismic Analysis, Maximum Axial Force, Maximum Bending Moment And Maximum Shear Force

I. INTRODUCTION

Earthquake is the most disastrous due to its unpredictability and huge power of devastation. Earthquakes themselves do not kill people, rather the colossal loss of human lives and properties occur due to the destruction of structures. Building structures collapse during severe earthquakes, and cause direct loss of human lives. The hilly area is more prone to seismic activity e.g. northeast region of India. In this hilly regions, traditionally material like, the adobe, brunt brick, stone masonry and dressed stone masonry, timber reinforced concrete, bamboo, etc. are used which is locally available, is used for the construction of houses. The scarcity of plain ground in hilly areas compels construction activity on sloping ground resulting in various important buildings. Hill buildings constructed in masonry with mud mortar/cement mortar without conforming to seismic codal provisions have proved unsafe and, resulted in loss of life and property when subjected to earthquake ground motions. In this region the construction of multistory RC framed buildings on hill slopes has a popular and pressing demand, due to its economic growth and rapid urbanization. This growth in construction activity is adding to tremendous increase in population density. Also there is scarcity of ground in hilly regions so reinforced cement concrete buildings such as hospital buildings, residential buildings are constructed in the sloping areas, hence construction of multistoried R.C.

II. SCOPE & OBJECTIVE

- To analysis a multistory RCC building.
- Comparison between manually analysis and STADD analysis.
- To analysis the seismic force compare with sloping and flat ground.
- To analysis maximum axial force at X-direction.
- To analysis maximum bending moment about Y&Z direction.
- To analysis maximum shear force about Y&Z direction.

III. METHODOLOGY

This present work deals with study of behavior of sloping ground building different inclination (0^0, 10^0, 15^0, 30^0) under earthquake forces. The comparison of sloping ground and flat ground building under seismic forces is done. Here G+ 3 storey is taken and same live load is applied in three the buildings for its behavior and comparison. The framed buildings are subjected to vibrations because of earthquake and therefore seismic analysis is essential for these building frames. The fixed base system is analyzed by employing in three building frames in seismic zone IV by means of STAAD Pro.Software.

3.1 STEP FOR COMPARISION

Comparisons of results in terms of horizontal reaction,

bending moments, axial force. Following steps are adopted in this study.

Step-1 Selection of building geometry and Seismic zone: The behavior of three the models is studied for seismic zone IV of India as per IS code 1893 (Part 1):2002 for which zone factor (Z) is 0.24.

Step-2 Formation of load combination Types of Primary Loads and Load Combinations: The structural systems are subjected to Primary Load Cases as per IS 875:1987 and IS 1893:2002.Six primary load case and thirteen load combinations used for analysis.

Step-3 Modelling of building frames using STADD Pro. Software.

Step-4 Comparative study of manual and STADD analysis.

Step-5 Analysis of three the building frames are done under seismic zone IV for each load combination.

Step-6 Comparative study of results in terms of axial force, bending moments and shear force.

IV. MODELLING

STADD Pro. Software is used in modeling of building frames. STADD stands for structural analysis and design Program and it is general purpose software for performing the analysis and design of a wide variety of structures. The basic activities which are to be carried out to achieve this goal:

a. Geometry of the structure.
b. Providing material and member properties.
c. Applying load and support condition.

The data of various structural elements and the loadings considered of the building is as follows:

- No. of floors = 04
- Length of building =10.25m
- Width of building =10.52m
- Height of building =13.5m
- Size of column =0.3*0.6m
- Size of beam =0.23*0.38m
- External plaster =0.015
- Internal plaster =0.012
- Live load =3Kn/m^2
- Zone factor =0.24(Zone IV)
- Importance factor I = 1
- Response spectrum factor R =3

4.1 Plan and Elevation Of G+3 Building On Flat Ground.

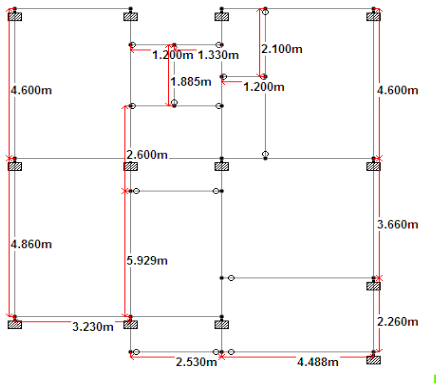


Fig 4.1.1. Plan of residential building

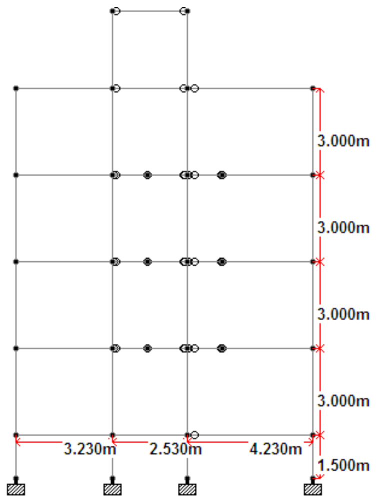


Fig 4.1.2 . Elevation of residential building

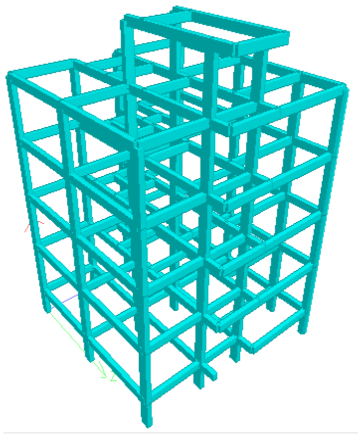


Fig 4.1.3 . Structural model of building

4.2 Elevation Of G+3 Building On Sloped Ground.

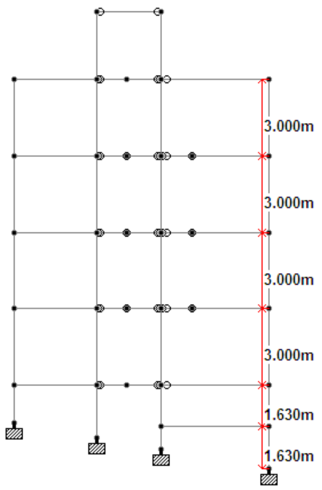


Fig 4.2.1 . Elevation of residential building on 10 deg. Slope

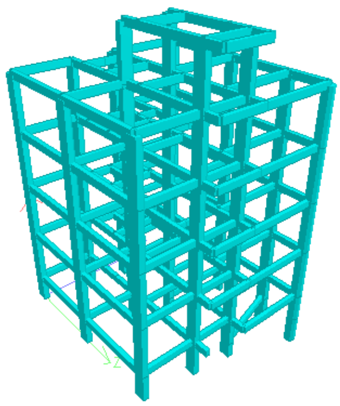


Fig 4.2.2 . Structural model of building on 10 deg. slope

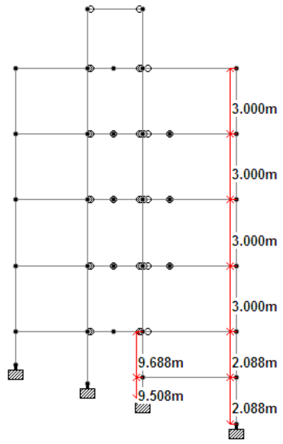


Fig 4.12 . Elevation of residential building on 15 deg. Slope

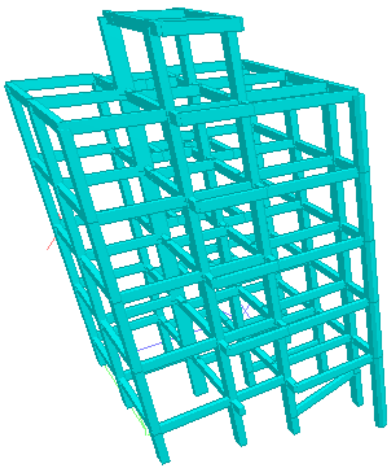


Fig 4.2.2 . Structural model of building on 15 deg. slope

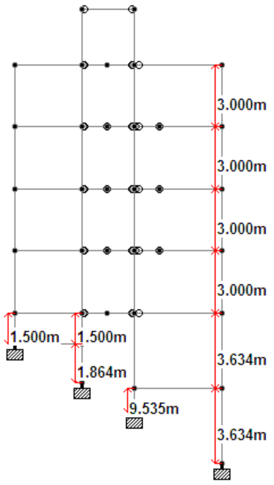


Fig 4.2.1 . Elevation of residential building on 30 deg. Slope

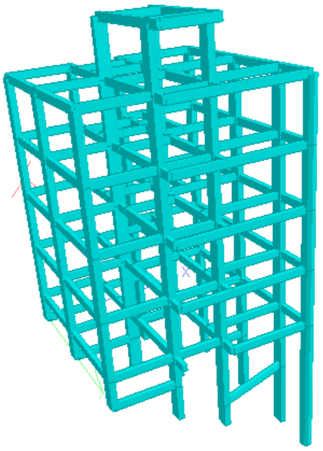


Fig 4.2.2 . Structural model of building on 30 deg. slope

Colum n No.	Max axial force Fx (kn/m)			
	Flat ground	10 degree	15 degree	30 degree
1	565.249	566.256	566.287	566.311
2	752.303	754.391	758.055	767.683
3	932.753	1087.186	952.266	966.091
4	662.41	684.053	690.019	715.874
5	944.462	947.236	949.238	954.032
6	1469.672	1469.174	1467.97	1466.579
7	1703.003	1694.105	1711.051	1712.907
8	957.661	967.02	972.205	988.617
9	632.708	633.03	634.863	637.61
10	1196.104	1206.545	1203.968	1214.26
11	1170.894	1243.333	1184.208	1193.255
12	736.452	743.478	744.954	750.594
13	461.971	493.425	508.135	555.408

V. LITERATURE REVIEW

1. Pawan Pawar and Asst. prof. Deepa Telang Perform an comparative study on seismic analysis of multistoried building resting on a sloping ground and flat ground. This project report comprise of seismic analysis of a RC building with symmetrical plan. Building G+8 is analyze using response spectrum method on various combination of shear wall and different position of building on same slope of ground with seismic zone III and it is analysed by using STADD Pro. V8i. In this paper angle of ground is taken as 170 and kept same for all models. They are compare five parameters i.e. base shear, base moment, absolute displacement, axial fore and bending moment.

2. Sujit Kumar ,Dr. Vivek Garg, Dr. Abhay Sharma has perform effect of sloping ground on structural performance of rcc building under seismic load . In

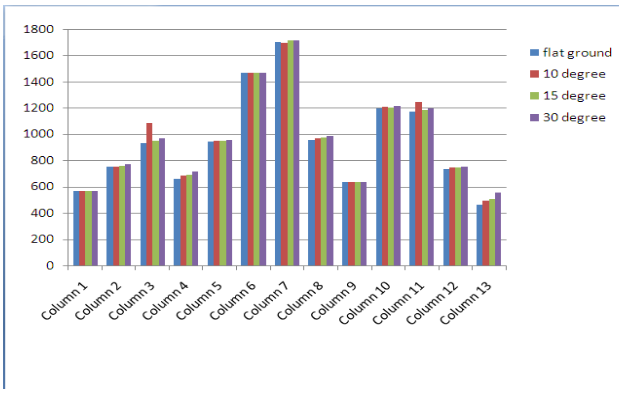
this paper work deals with study of behavior of sloping ground building frames considering different inclination (7.5o, 15o) under earthquake forces. The comparison of sloping ground and plane ground building under seismic forces is done. Here G+4 storey is taken and same live load is applied in three the buildings for its behavior and comparison. The result of various analyze for different ground slopes are presented and a comparative study between result of different slopes and plane ground is made to analysis of sloping ground on structural forces. In this work horizontal reaction and bending moment in footing of structure , bending moment in columns and are compared for different ground slopes under different seismic load.

3. Roser J. Robert and Ranjana M. Ghate has perform Seismic Analysis of Multistoried RCC Building on Sloping Ground. The present work is focused on the comparison of the behavior of the building rested on sloped surface and on flat surface with same intensity of seismic load on both the buildings. The parameters which are mainly focused on are storey displacement and base shear. In this study the storey displacements for both the buildings is been evaluated in +X and –X direction as well as in +Z and –Z direction. Similarly the base shear is been calculated and compared for both the buildings rested on sloped surface and flat surface under the same seismic loading.

6. RESULT

From analyzing the above models of various slope of ground, three parameters are compared i.e. maximum axial force, maximum bending moment and shear force.

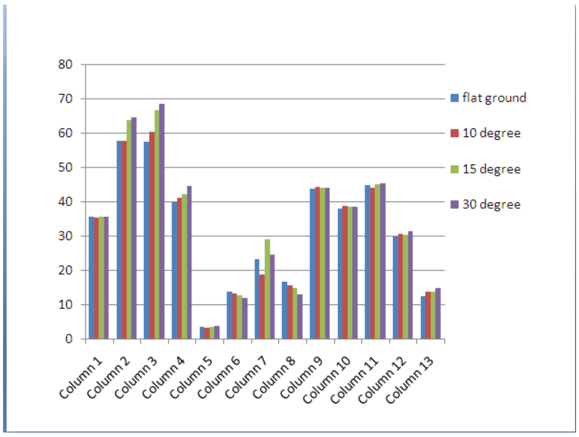
Comparison of axial force between various slope of ground.



Above graph shows the maximum axial forces is increases with increasing the slope of ground

Comparison of maximum bending moment between various slope of ground in Y-direction.

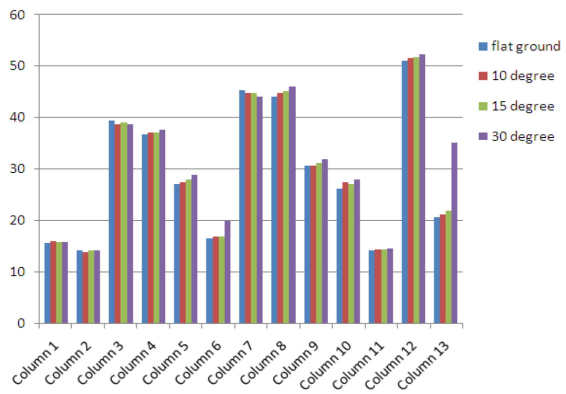
Column No.	Max bending moment at Y-direction My (kn/m²)			
	Flat ground	10 degree	15 degree	30 degree
1	35.525	35.229	35.487	35.471
2	57.744	57.535	63.714	64.357
3	57.401	60.378	66.631	68.3
4	39.753	40.983	41.945	44.428
5	3.443	3.82	3.528	3.676
6	13.764	13.133	12.667	11.954
7	23.119	18.656	28.975	24.421
8	16.68	15.624	14.637	12.96
9	43.755	44.176	43.897	44.016
10	37.91	38.644	38.31	38.523
11	44.632	44	45.034	45.184
12	29.68	30.613	30.374	31.344
13	12.338	13.793	13.81	14.748



Above graph shows the maximum bending moment in Y-direction is increases with increasing the slope of ground

Comparision of maximum bending moment between various slope of ground in Z-direction.

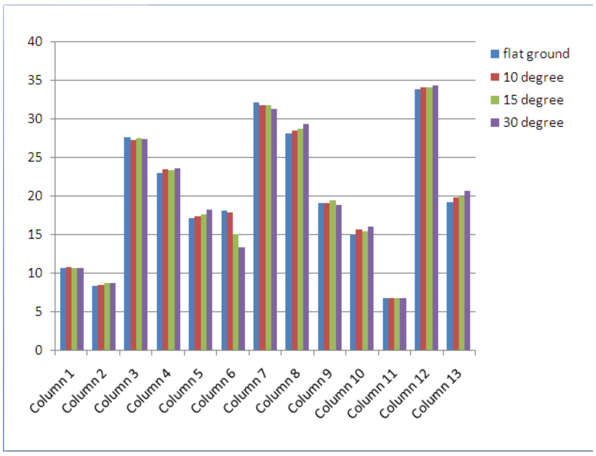
Column No.	Max bending moment at Z-direction Mz (kn/m^2)			
	Flat ground	10 degree	15 degree	30 degree
1	15.67	15.945	15.759	15.678
2	14.08	13.876	14.166	14.16
3	39.434	38.732	39.11	38.771
4	36.652	37.101	37.107	37.552
5	27.029	27.432	27.87	28.843
6	16.393	16.792	16.878	19.857
7	45.343	44.862	44.714	44.084
8	44.114	44.749	45.048	46.076
9	30.6	30.566	31.201	31.88
10	26.186	27.347	27.014	27.928
11	14.223	14.387	14.337	14.468
12	51.033	51.662	51.702	52.323
13	20.211	21.132	21.775	35.026



Above graph shows the maximum bending moment in Z-direction is increases with increasing the slope of ground

Comparision of maximum shear force between various slope of ground in Y-direction.

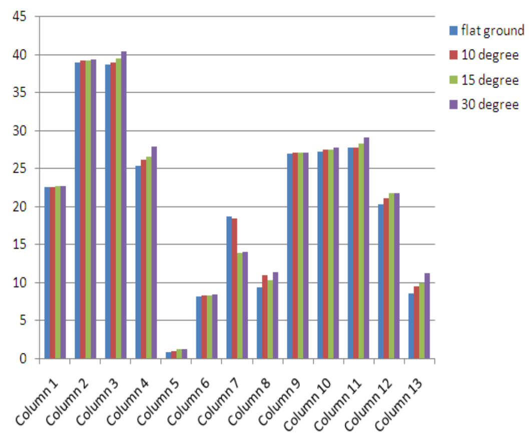
Column No.	Max shear force at Y-direction Fy (kn/m)			
	Flat ground	10 degree	15 degree	30 degree
1	10.607	10.799	10.651	10.591
2	8.347	8.493	8.66	8.677
3	27.642	27.297	27.494	27.352
4	23.036	23.464	23.327	23.622
5	17.155	17.393	17.643	18.206
6	18.11	17.879	15.03	13.301
7	32.158	31.847	31.775	31.367
8	28.172	28.557	28.739	29.34
9	19.067	19.077	19.406	18.809
10	14.929	15.637	15.438	16.001
11	6.717	6.687	6.727	6.743
12	33.901	34.07	34.145	34.432
13	19.155	19.792	19.888	20.707



Above graph shows the maximum shear force in Y-direction is increases with increasing the slope of ground.

Comparision of maximum shear force between various slope of ground in Z-direction.

Column No.	Max shear force at Z-direction Fz (kn/m)			
	Flat ground	10 degree	15 degree	30 degree
1	22.56	22.619	22.722	22.74
2	38.928	39.276	39.311	39.364
3	38.672	38.937	39.522	40.477
4	25.376	26.178	26.568	27.851
5	0.813	0.972	1.195	1.248
6	8.177	8.272	8.31	4.405
7	18.67	18.483	13.929	14.07
8	9.29	10.934	10.341	11.366
9	27.023	27.064	27.074	27.1
10	27.184	27.441	27.458	27.759
11	27.712	27.82	28.31	29.045
12	20.23	21.133	21.753	21.827
13	8.533	9.422	9.889	11.242



Above graph shows the maximum shear force in Z-direction is increases with increasing the slope of ground.

VI. CONCLUSION

According to the analysis it can concluded.

- Critical bending moment in the column increases with increasing slope of ground.
- The critical horizontal forces of footing increases significantly with increases in slope of ground.
- The building rested on sloped surface is found to be more vulnerable during seismic effect as compared to building rested on flat surface.

VII. REFRESENCES

1. Pawan Pawar, Asst. prof. Deepa Telang, "A comparative study on seismic analysis of multistoried bulding resting on a sloping ground and flat ground" .IJSRD, Vol.4 May 2016
2. Sujit Kumar ,Dr. Vivek Garg, Dr. Abhay Sharma, "Effect of sloping ground on structural performance of RCC building under seismic load". IJSET Vol.2 Aug, 2014.
3. Roser J. Robert, Ranjana M. Ghate, "Seismic Analysis of Multistoried RCC Building on Sloping Ground". IJREST Vol. 3 Dec, 2016.
4. B.G. Birajdar, Seismic Analysis of buildings resting on sloping ground‖ 2004.

5. Ajay Kumar Sreerama, “Earthquake behavior of reinforced concrete framed buildings on hill slopes‖ 2013
6. Pandey. A. D, Seismic soil-structure interaction of buildings on hill slopes‖ 2011.
7. IS 1893 (Part 1):2002 Criteria For Earthquake Resistant Design of Structures.
8. IS 456:2000 Plain and Reinforced Concrete-Code of Practice.
9. Government of Bureau of Indian Standards: IS-875, part 1 (1987), Dead Loads on Buildings and Structures, New Delhi, India.
10. Government of Bureau of Indian Standards: IS-875, part 2 (1987), Live Loads on Buildings and Structures, New Delhi, India.