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Study of Multi Storey Building for Different Soil Type by Dynamic Analysis

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Abstract:
At present a major importance has given to earthquake resistant structures in India for human safety. India is a sub-continent which is having more than 60% area in earthquake prone zone. The present study deals with the comparison of base shear of multi storied buildings with dimensions 22.5m X 22.5m at Earthquake zone III and different types of soils as per IS:1893(part: I):2002.The buildings were analyzed by software STAAD Pro. The result obtained in term of percentage change in base shear and peak story shear.

Keywords: Peak story shear and base shear

1. INTRODUCTION

A six storey building for a commercial complex has plan dimensions as shown in Table. The building is located in seismic zone III with different soil condition like hard, medium and soft. The building is design for seismic loads as per IS 1893(Part 1): 2002. The buildings were analyzed using software STAAD Pro. At ground floor, slabs are not provided and the floor will directly rest on ground. Preliminary sizes of structural components are assumed by experience. All dimensions are in mm, unless specified otherwise.

2. PROBLEM DESCRIPTION

- **DATA**

S.NO.	Description	
1.	Depth of foundation	1.1 m
2.	Size of the building	22.5m X 22.5m
3.	Beam	0.3m X 0.6m
4.	Column	0.5m X 0.5M
5.	Slab thickness	100mm
6.	Support Condition	Fixed
7.	Seismic Zone	III
8.	Seismic intensity	moderate
9.	Unit wt. of masonry wall	20
10.	Unit wt. of concrete	25
11.	External Wall Thickness with plaster	230mm
12.	Yield strength of distribution bar ($f_y$sec)	Fe415
13.	Yield strength of main bar ($f_y$main)	Fe415
14.	Grade of concrete	M25

- **LOADING CONSIDERATION**

S.NO.	Description	Story	Terrace
1.	Dead Load		
a.	Slab Load	2.5 KN/m^2	2.5 KN/m^2
b.	Finish Load	1.0 KN/m^2	3.0 KN/m^2
c.	Wall Load		
i.	Floor wall (height 4.4 m)	21.6 KN/m	
ii.	Ground floor wall (height 3.5 m)	17.2 KN/m	
iii.	Ground floor wall (height 0.7 m)	3.5 KN/m	
iv.	Terrace parapet (height 1.0 m)		4.9 KN/m
2.	Live Load	4 KN/m^2	1.5 KN/m^2

- **SEISMIC SPECIFICATION**

S.NO.	**DESCRIPTION**	**SYMBOL**	**ZONE III**
1.	IMPORTANCE FACTOR	I	1.5
2.	ZONE FACTOR	Z	0.16
3.	RESPONSE REDUCTION FACTOR	RF	5
4.	DAMPING	DM	0.05
5.	TIME PERIOD	T_a	0.97
6.	SOIL TYPE	SS	
a.		HARD	1
b.		MEDIUM	2
c.		SOFT	3

- **LOAD COMBIMATION**

S.NO.	LOAD COMBINATION
1.	1.5(DL + LL)
2.	1.2(DL + LL + EQ-X DIR.)
3.	1.2(DL + LL – EQ-X DIR.)
4.	1.2(DL + LL + EQ-Z DIR.)
5.	1.2(DL + LL – EQ-Z DIR.)
6.	1.5(DL + EQ-X DIR.)
7.	1.5(DL – EQ-X DIR.)
8.	1.5(DL + EQ-Z DIR.)
9.	1.5(DL – EQ-Z DIR.)
10.	0.9DL + 1.5EQ-X DIR.
11.	0.9DL – 1.5EQ-X DIR.
12.	0.9DL + 1.5EQ-Z DIR.
13.	0.9DL – 1.5EQ-Z DIR.

DL= Dead Load
LL= Live Load
EQ-X DIR = Earthquake load in X- Direction
EQ-Z DIR = Earthquake load in Z- Direction

3. ANALYSIS OF RESULTS

- **FIGURES**

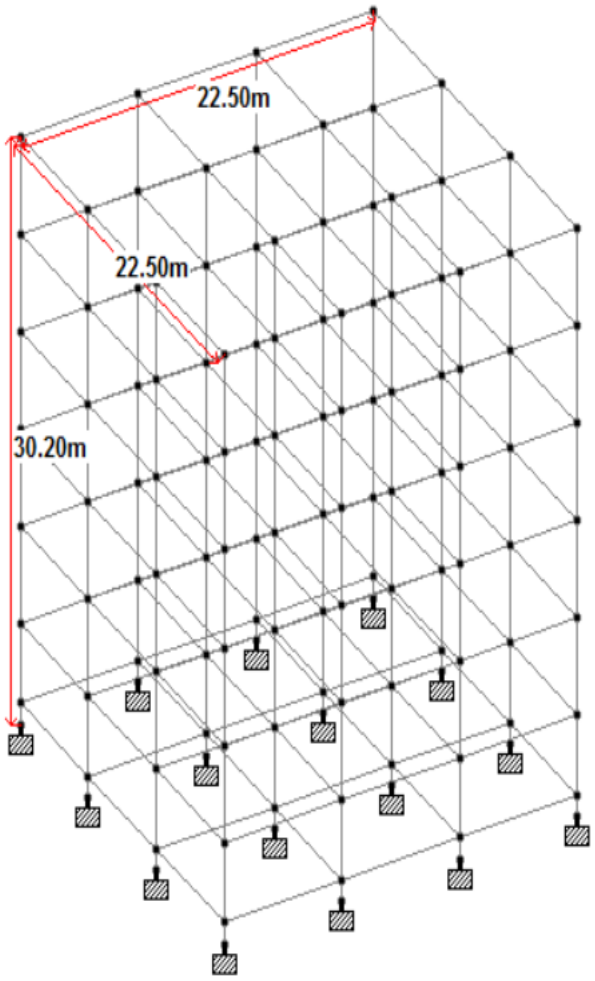


Figure.1. Elevation of 6 storey building

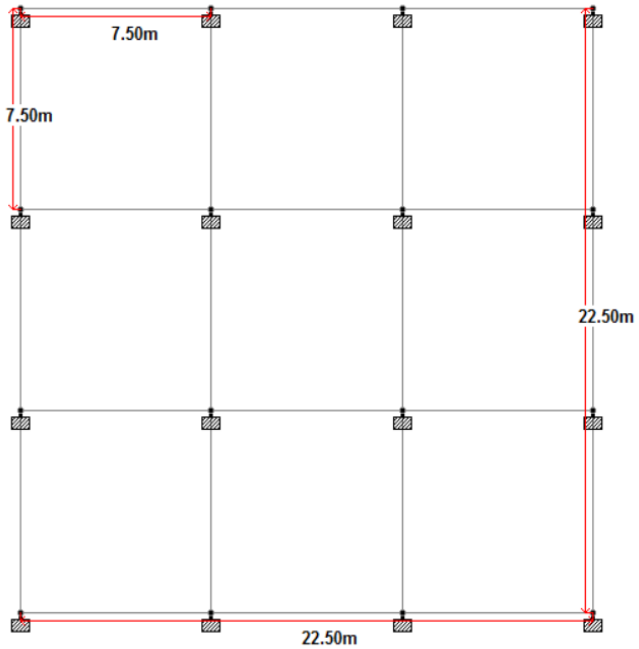
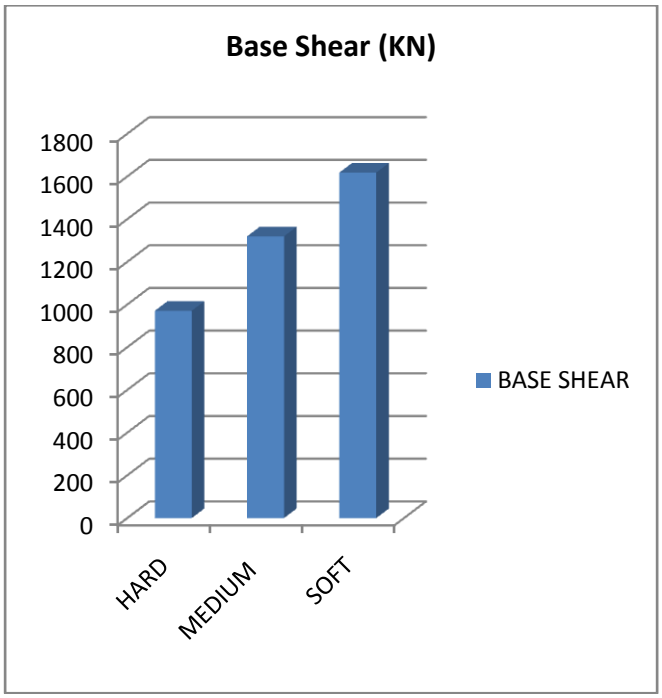
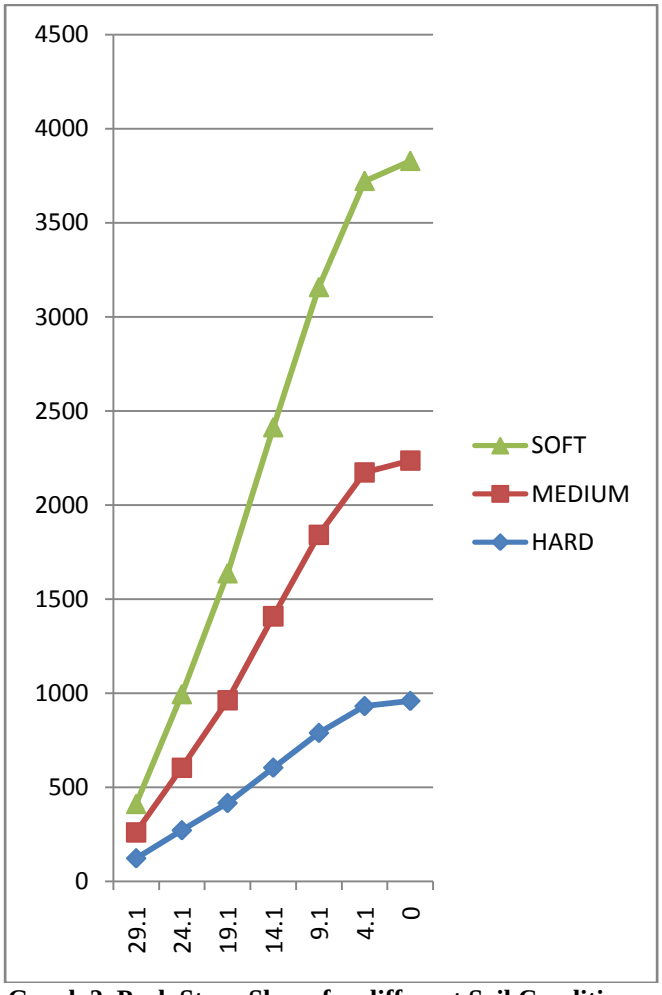


Figure.2. Plan of Structure

- **GRAPHS**



Graph.1. Comparison of Base Shear of Building for Different Soil Condition



Graph.2. Peak Story Shear for different Soil Condition

- **TABLES**

Table.1. End Shears (KN) For Basic Load Cases for Hard Soil

S.NO.	LOAD CASE	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	DEAD LOAD	113.644	129.457	200.95	200.95	129.456	113.644
2.	LIVE LOAD	27.065	29.186	28.125	28.125	29.186	27.065
3.	EQ X DIR.	52.465	-52.465	45.841	-45.841	52.465	-52.465
4.	EQ Z DIR.	0.88	-0.88	0.742	-0.742	0.817	-0.817

Table.2. End Shears (KN) For Basic Load Cases for Medium Soil

S.NO.	LOAD CASE	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	DEAD LOAD	113.644	129.457	200.95	200.95	129.456	113.644
2.	LIVE LOAD	27.065	29.186	28.125	28.125	29.186	27.065
3.	EQ X DIR.	72.287	-72.287	63.171	-63.171	72.288	-72.288
4.	EQ Z DIR.	1.213	-1.213	1.023	-1.023	1.127	-1.127

Table.3. End Shears (KN) For Basic Load Cases for Soft Soil

S.NO.	LOAD CASE	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	DEAD LOAD	113.644	129.457	200.95	200.95	129.456	113.644
2.	LIVE LOAD	27.065	29.186	28.125	28.125	29.186	27.065
3.	EQ X DIR.	89.837	-89.837	78.519	-78.519	89.838	-89.838
4.	EQ Z DIR.	1.508	-1.508	1.272	-1.272	1.401	-1.401

Table.4. Factored End Shears (KN) for Load Combinations for Hard Soil

S.NO.	LOAD COMBINATION	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	1.5(DL+LL)	211.063	237.964	343.612	343.613	237.963	211.062
2.	1.2(DL+LL+EQ-X)	231.808	253.329	329.899	329.9	253.329	231.808
3.	1.2(DL+LL-EQ-X)	105.893	127.413	219.881	219.88	127.412	105.892
4.	1.5(DL+EQ-X)	249.164	272.883	370.186	370.187	272.882	249.163
5.	1.5(DL-EQ-X)	91.769	115.488	232.662	232.663	115.487	91.768
6.	0.9DL + 1.5EQ-X	180.977	195.209	249.617	249.617	195.209	180.977
7.	0.9DL – 1.5EQ-X	23.582	37.814	112.093	112.093	37.813	23.582

Table.5. Factored End Shears (KN) for Load Combinations for Medium Soil

S.NO.	LOAD COMBINATION	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	1.5(DL+LL)	211.063	237.964	343.612	343.613	237.963	211.062
2.	1.2(DL+LL+EQ-X)	255.595	277.116	350.695	350.695	277.116	255.595
3.	1.2(DL+LL-EQ-X)	82.106	103.626	199.08	199.085	103.625	82.106
4.	1.5(DL+EQ-X)	278.897	302.616	396.181	396.181	302.616	278.897
5.	1.5(DL-EQ-X)	62.035	85.754	206.668	206.669	85.753	62.034
6.	0.9DL + 1.5EQ-X	210.711	224.942	275.611	275.611	224.942	210.711
7.	0.9DL – 1.5EQ-X	-6.151	8.08	86.098	86.099	8.079	-6.152

Table.6. Factored End Shears (KN) for Load Combinations for Soft Soil

S.NO.	LOAD COMBINATION	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	1.5(DL+LL)	211.063	237.964	343.612	343.613	237.963	211.062
2.	1.2(DL+LL+EQ-X)	276.655	298.176	369.113	369.113	298.176	276.655
3.	1.2(DL+LL-EQ-X)	61.046	82.566	180.66	180.66	82.565	61.045
4.	1.5(DL+EQ-X)	305.222	328.941	419.203	419.204	328.941	305.222
5.	1.5(DL-EQ-X)	35.71	59.429	183.646	183.646	59.428	35.709
6.	0.9DL + 1.5EQ-X	237.036	251.267	298.633	298.634	251.268	237.03
7.	0.9DL – 1.5EQ-X	-32.477	-18.245	63.076	63.076	-18.246	-32.477

Table.7. End Moment (KN-m) For Basic Load Cases for Hard Soil

S.NO.	LOAD CASE	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	DEAD LOAD	128.477	-187.775	279.768	-279.768	187.774	-128.476
2.	LIVE LOAD	37.273	-45.226	44.223	-44.223	45.226	-37.272
3.	EQ X DIR.	206.27	-187.219	171.904	-171.904	187.219	-206.27
4.	EQ Z DIR.	3.454	-3.15	2.774	-2.792	2.916	-3.215

Table.8. End Moment (KN-m) For Basic Load Cases for Medium Soil

S.NO.	LOAD CASE	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	DEAD LOAD	128.477	-187.775	279.768	-279.768	187.774	-128.476
2.	LIVE LOAD	37.273	-45.226	44.223	-44.223	45.226	-37.272
3.	EQ X DIR.	284.193	-257.964	236.89	-236.89	257.964	284.194
4.	EQ Z DIR.	4.759	-4.34	3.824	-3.849	4.019	-4.431

Table.9. End Moment (KN-m) For Basic Load Cases for Soft Soil

S.NO.	LOAD CASE	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	DEAD LOAD	128.477	-187.775	279.768	-279.768	187.774	-128.476
2.	LIVE LOAD	37.273	-45.226	44.223	-44.223	45.226	-37.272
3.	EQ X DIR.	353.179	-320.604	294.446	-294.446	320.605	-353.179
4.	EQ Z DIR.	5.916	-5.396	4.756	-4.786	4.998	-5.51

Table.10. Factored End Moment (KN-m) for Load Combinations for Hard Soil

S.NO.	LOAD COMBINATION	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	1.5(DL+LL)	248.624	-349.502	485.985	-485.985	349.5	-248.622
2.	1.2(DL+LL+EQ-X)	446.423	-54.939	595.073	-182.503	504.263	48.626
3.	1.2(DL+LL-EQ-X)	-48.626	-504.263	182.503	595.073	54.939	-446.423
4.	1.5(DL+EQ-X)	502.119	-0.833	677.508	-161.795	562.49	116.691
5.	1.5(DL-EQ-X)	-116.689	-562.49	161.795	-677.508	0.832	-502.119
6.	0.9DL + 1.5EQ-X	425.033	111.831	509.647	6.066	449.825	193.777
7.	0.9DL – 1.5EQ-X	-193.775	-449.826	-6.066	-509.647	-111.832	-425.033

Table.11. Factored End Moment (KN-m) for Load Combinations for Medium Soil

S.NO.	LOAD COMBINATION	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	1.5(DL+LL)	248.624	-349.502	485.985	-485.985	349.5	-248.622
2.	1.2(DL+LL+EQ-X)	539.931	29.956	673.056	-104.52	589.158	142.135
3.	1.2(DL+LL-EQ-X)	-142.135	-589.158	104.52	-673.056	-29.956	-539.931
4.	1.5(DL+EQ-X)	619.005	105.284	774.987	-64.316	668.608	233.577
5.	1.5(DL-EQ-X)	-233.575	-668.608	64.316	-774.987	-105.286	-619.005
6.	0.9DL + 1.5EQ-X	541.919	217.949	607.126	103.544	555.943	310.662
7.	0.9DL – 1.5EQ-X	-310.661	-555.943	-103.545	-607.126	-217.95	-541.919

Table.12. Factored End Moment (KN-m) for Load Combinations for Soft Soil

S.NO.	LOAD COMBINATION	BEAM 57		BEAM 58		BEAM 59	
		LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
1.	1.5(DL+LL)	248.624	-349.502	485.985	-485.985	349.5	-248.622
2.	1.2(DL+LL+EQ-X)	622.714	105.124	742.124	-35.453	664.326	224.917
3.	1.2(DL+LL-EQ-X)	-224.917	-664.326	35.453	-742.124	-105.124	-622.714
4.	1.5(DL+EQ-X)	722.483	199.245	861.321	22.018	762.568	337.055
5.	1.5(DL-EQ-X)	-337.053	-762.568	-22.018	-861.321	-199.247	-722.483
6.	0.9DL + 1.5EQ-X	645.397	311.909	693.46	189.878	649.904	414.14
7.	0.9DL – 1.5EQ-X	-414.139	-649.904	-189.879	-693.46	-311.911	-645.397

Table.13. Peak Story Shear of Earthquake zone III for different Soil

S.NO.	HEIGHT	HARD SOIL	MEDIUM SOIL	SOFT SOIL
1.	29.1	123.38	138.58	150.69
2.	24.1	272.34	333.06	390.62
3.	19.1	417.24	546.19	674.38
4.	14.1	605.37	804.61	1003.68
5.	9.1	790.06	1052.77	1315.3
6.	4.1	932.63	1240.69	1548.7
7.	0	960.17	1276.12	1592
8.	-1.1	960.17	1276.12	1592

Table.14. Base Shear of Earthquake zone III for different Soil

S.NO.	HARD SOIL	MEDIUM SOIL	SOFT SOIL
Base Shear	971.14 KN	1320 KN	1618.58 KN

4. CONCLUSION

1. Percentage increase in peak story shear of six storey building for medium soilis 35.92%when compare with the peak story shear of same building for hard soil.
2. Percentage increase in peak storey shear of six story building forsoft soil by 22.62% when compared with same building of medium soil.
3. Percentage increase in peak story shear of six storey building for soft soil is 66.66%when compare with the peak story shear of same building for hard soil.
4. In the base shear of six story building of medium soil is increased by 32.9% when compared with same building of hard soil.
5. In the base shear of six story building of soft soil is increased by 24.75% when compared with same building of medium soil.
6. In the base shear of six story building of soft soil is increased by 65.8% when compared with same building of hard soil.

From the following results it is observed that as peak story shear and base shear increases from soft soil as compare to medium soil as well as medium soil compare to hard soil for the six storey building in earthquake zone III when the building analyzed by software STAAD Pro.

5. REFERENCES

[1]. Amin, M.R. and Hasan, "Effect of storey on multistoried reinforced concrete building frame". In Proceedings of 4th Annual Paper Meet and 1st Civil Engineering Congress, pp.267-272, Dec 2011.

[2]. Anand, N. and Mightraj, C., "Seismic behavior of RCC shear wall under different soil conditions". In Proceedings of the Indian Geotechnical Conference on GEOtrendz, pp. 119-122, Dec 2010.

[3]. A.D. Pandey, Prabhat Kumar and Sharad Sharma, "Seismic soil-structure interaction of buildings on hill slopes", International Journal of Civil and Structural Engineering, 2011, pp.544-555.

[4]. Azzam Katkhoda, Rana Knaa" Optimization in the Selection of Structural Systems for the Design of Reinforced Concrete High-rise Buildings in Resisting Seismic Forces", Sciverse Science Direct, pp.270-275,2012.

[5]. MohdZain Kangda, Manohar D. Mehare, Vipul R.Meshra, "Study of Base Shear and Storey Drift by Dynamic Analysis", (IJEIT) International Journal of Engineering and Innovative Technology, Vol.4, pp. 91-101, Feb. 2015..

[6]. R. M. Jenifer Priyanka, N. Anand, Dr. S. Justin, " Studies on Soil Structure Interaction of Multi Storeyed Buildings with Rigid and Flexible Foundation", (IJETAE) International Journal of Emerging Technology and Advanced Engineering, vol.2, pp. 111-118, Dec 2012.

[7]. Mr. S.Mahesh, Mr. Dr.B.PandurangaRao, "Comparison of analysis and design of regular and irregular configuration of multi-Story building in various seismic zones and various types of soils using ETABS and STAAD", (IOSR) Journal of Mechanical and Civil Engineering, Vol.11, pp. 45-52, Nov- Dec. 2014.

[8]. IS 1893 (Part 1)-2002: Indian Standard Criteria for Earthquake Resistant Design of Structures, Part 1–General Provisions and Buildings (Fifth Revision), Bureau of Indian Standards, New Delhi.

[9]. IS 456 – 2000: Indian standard Criteria for Plain and Reinforce Structure, New Delhi.