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Analysis of a RCC frame Tall Structure using Staad Pro on Different Seismic Zones Considering Ground Slopes

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Abstract – *The hilly areas in north east India contained seismic activity. Due to hilly areas building are required to be constructed on sloping ground due to lack of plain ground. The buildings are irregularly situated on hilly slopes in earthquake areas therefore many damages occurred when earthquake are affected, this may be causes lot human disaster and also affect the economic growth of these areas... In this paper we analyzed using Staad Pro comparison between sloping ground, with different slope and plain ground building using Response Spectrum Method as per IS 1893-2000 The dynamic response, Maximum displacement in columns are analyzed with different configurations of sloping ground.*

Keywords— Seismic, Multistoried building, Sloping ground

I Introduction

India has track record of catastrophic earthquakes, at various regions, which left behind loss of many lives and heavy destruction to property and economy. Investigation of buildings in hilly region is somewhat different than the buildings on leveled ground, since the column of the hill building rest at different levels on the slope. Such building have mass and stiffness varying along the vertical and horizontal planes resulting the center of mass and center of rigidity do not coincide on various floors, hence they demand torsional analysis, in addition to lateral forces under the action of earthquakes. The unsymmetrical building require great attention in the analysis and design under the action of seismic excitation. Past earthquake in which, buildings located near the edge of a stretch of hills or on sloping ground suffered serious damages. The shorter column attracts more forces and undergoes damage, when subjected to earthquakes. The other problems associated with hill buildings, additional lateral earth pressure at various levels, slope instability, different soil profile yielding unequal settlement of foundation.

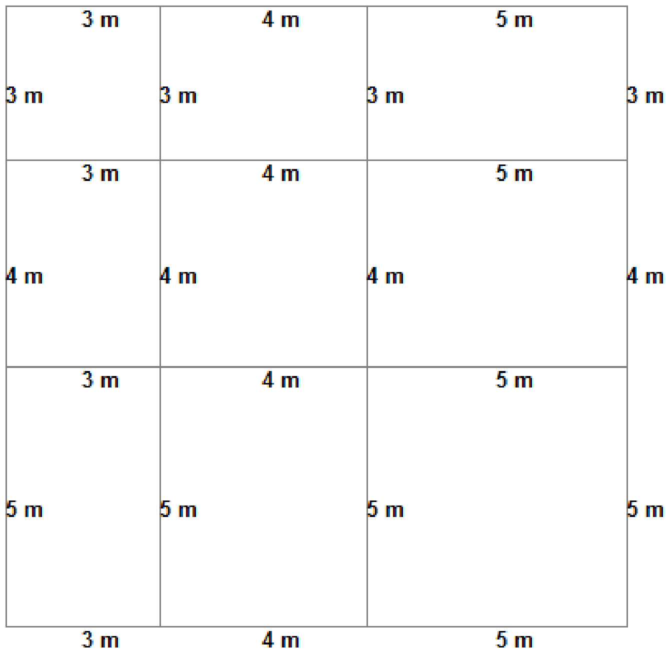


Fig. 1.1 plan

STRUCTURAL MODELLING A RCC medium rise building of 10 stories with floor height 3 m subjected to earthquake lading in V has been considered. In this regard STAAD Pro V8i software has been considered as tool to perform. Effect of sloping effect of the ground on behaviour of structural frames is analysed.

The plan for the above building shown in figure has been considered to carry out the study the dimension of the building are 12m x 12m. Generally in such cases the building is to be analysed for the earthquake force because maximum lateral force induced in building is due to earthquake load. The structural effect of the building on various sloping ground is to be studied.

This STUDY deals with comparative analysis of seismic behavior on tall structures G+10 building frame with three different soil types and different slope of ground as 0^0, 7^0 and 14^0. Under the Earthquake effect as per IS 1893(part I) - 2002 static analysis. A comparison of analysis results in terms of Maximum displacements, Maximum bending moment, Maximum shear force has been carried out.

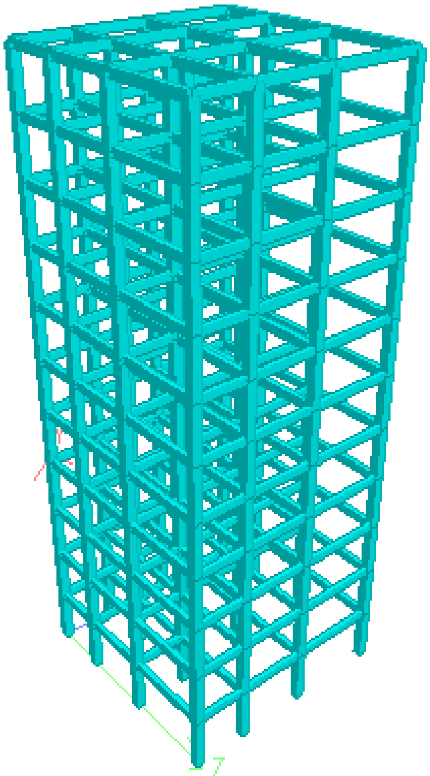
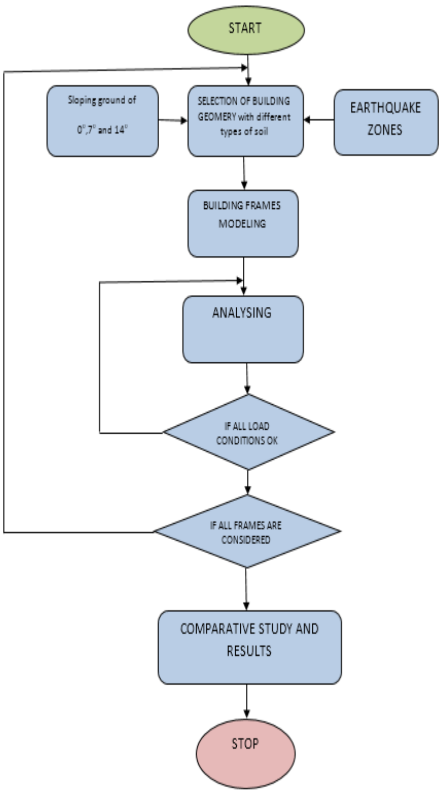


Fig. 2 structural modelling in staad pro



Result analysis-

Maximum displacement (mm)

Table 3.1: Maximum displacement in 0 degree slope

Soil Type	Maximum displacement (mm) in 0^0 sloping ground in X direction			
	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Soft	100.03	158.77	237.10	354.58
Medium	81.86	131.70	193.48	291.10
Hard	60.75	95.93	142.83	213.18

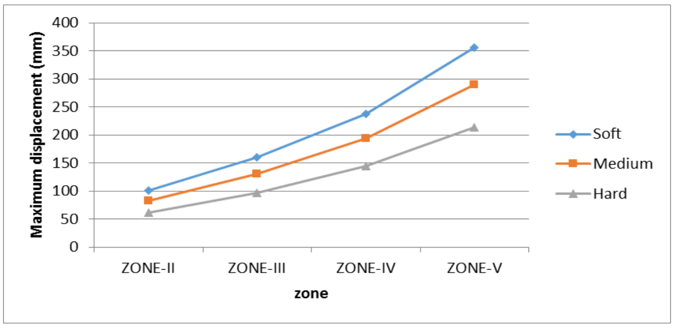


Fig 3.1: Maximum displacement in 0 degree slope

Table 3.2: Maximum shear force kN in 0 degree slope

Soil Type	Maximum Shear force (kN) in 0^0 slope			
	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Soft	158.5	231.9	331.8	474.7
Medium	135.8	195.0	273.3	396.9
Hard	111.5	153.4	212.0	301.9

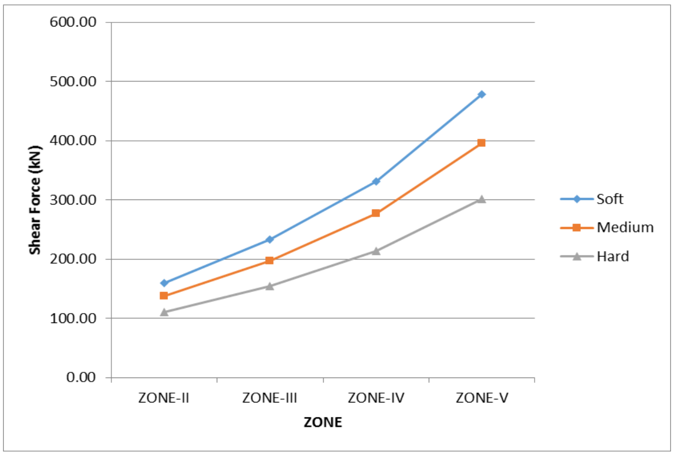


Fig 3.2: Maximum shear force kN in o degree slope

Table 3.3: Maximum Bending moment (kN-m) in 0 degree slope

Soil Type	Maximum Bending Moment (kN-m) in 0^0 sloping ground			
	Zone-II	Zone-III	Zone-IV	Zone- V
Soft	209.45	324.76	477.88	718.66
Medium	175.08	267.18	392.3	584.5
Hard	141.22	201.42	295.76	430.62

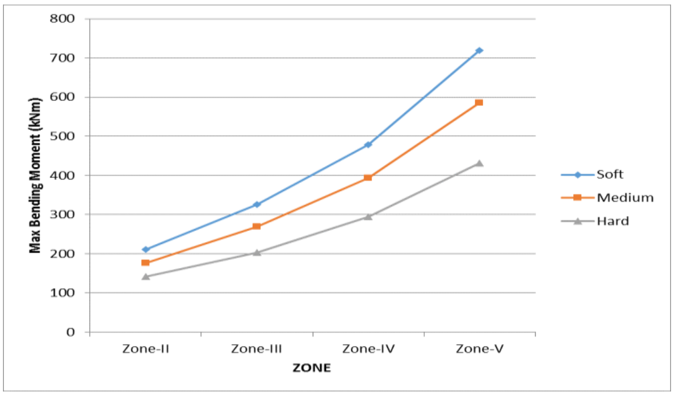


Fig 3.3: Maximum bending moment (kNm) in 0 degree slope

Max Displacement in 7 degree slope-
Table 3.4: Maximum displacement in X direction 7 degree slope

Soil Type	Maximum Displacement (mm) in 7^0 Sloping Ground in X direction			
	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Soft	92.99	147.37	221.79	329.48
Medium	76.18	122.47	182.44	268.95
Hard	56.65	91.19	131.58	197.66

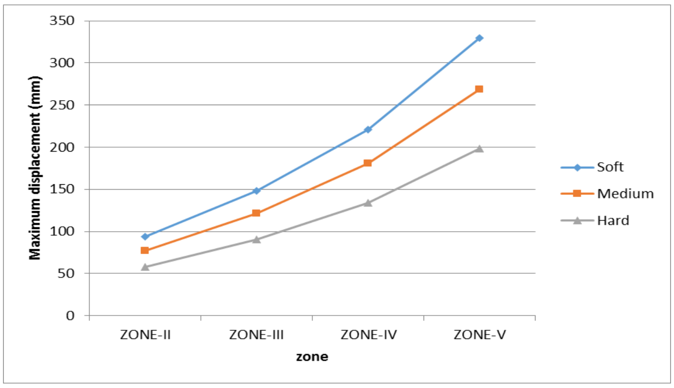


Fig 3.4: Maximum displacement

Maximum shear force in 7 degree slope
Table 3.5: Maximum shear force in 7 degree slope

Soil Type	Maximum Shear force (kN) in 7^0 slope			
	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Soft	300.137	461.214	681.381	101.631
Medium	250.543	381.175	557.893	824.40
Hard	192.922	287.963	417.035	612.76

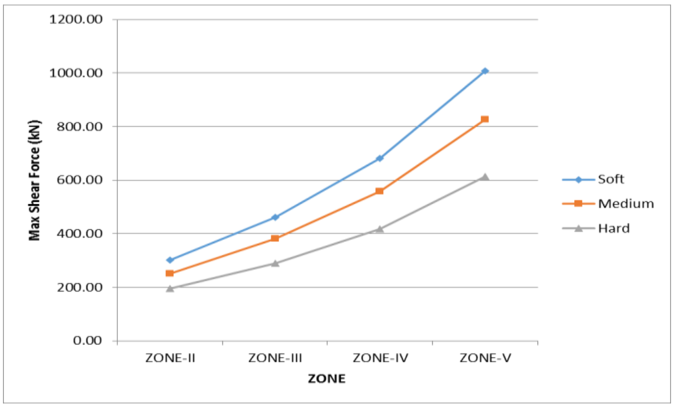


Fig 3.5 : Maximum shear force graph

Max. bending moment (kNm) in 7 Degree Slope
Table 3.6: Maximum bending moment in 7 degree slope

Soil Type	Bending moment (kN-m) in 7^0 degree			
	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Soft	256.34	433.30	654.36	982.52
Medium	227.50	341.16	533.92	804.79
Hard	197.11	254.34	358.51	592.15

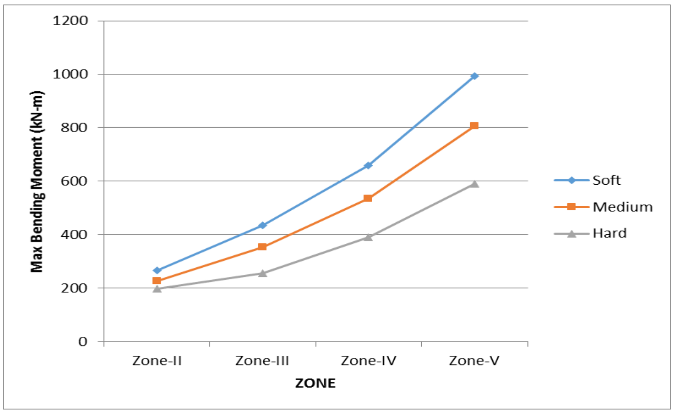


Fig 3.6: Maximum bending moment graph

Max displacement (mm) in X direction.
Table 3.7: Maximum displacement in 14 degree slope

Soil Type	Maximum displacement (mm) in 14^0 sloping ground in x direction			
	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Soft	97.85	154.79	233.05	351.93
Medium	82.92	127.11	191.02	285.40
Hard	63.11	97.37	143.06	212.45

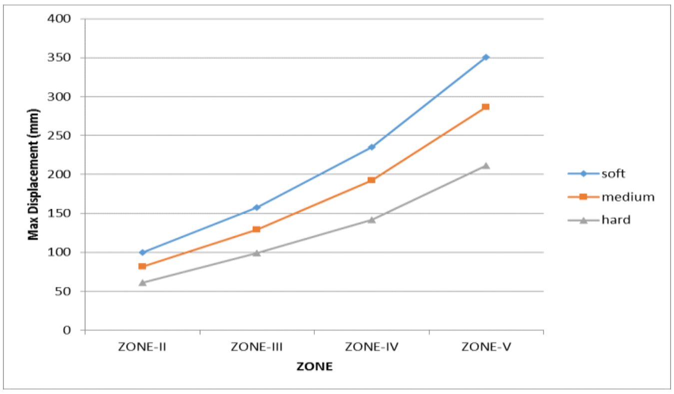


Fig 3.7: Maximum displacement

Max Shear Force in 14 Degree Slope
Table 3.8: Maximum shear force in 14 degree slope

Soil Type	Maximum Shear force (kN) in 14^0 slope			
	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Soft	176.4	247.64	352.27	502.68
Medium	155.05	211.45	293.68	417.80
Hard	132.36	172.51	228.39	321.22

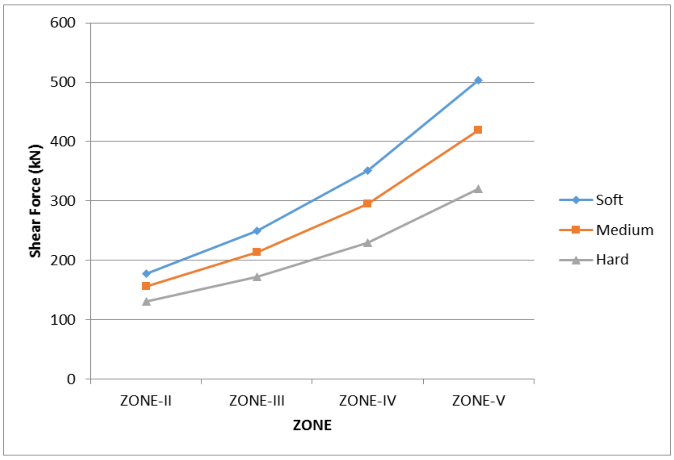


Fig 3.8: Maximum shear force graph

3 Max. bending moment (kNm) in 14 Degree Slope
Table 5.25: Maximum bending moment in 14 degree slope

Soil Type	Max bending Moment (kNm) in 14^0 sloping slope			
	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Soft	Zone-II	Zone-III	Zone-IV	Zone-V
Medium	255.41	360.82	544.64	820.35
Hard	229.19	298.38	442.25	666.82

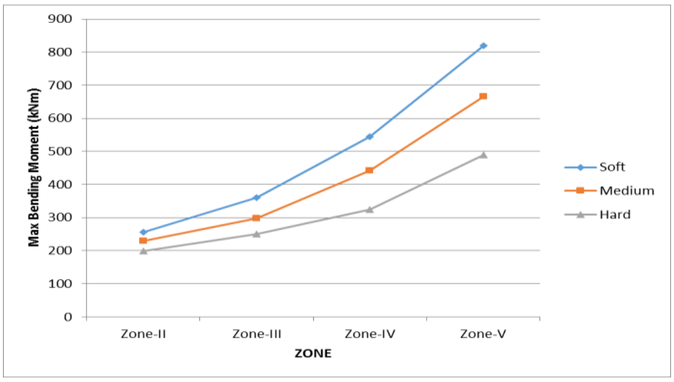


Fig 5.25: Maximum bending moment graph

Conclusion-

As per the results

Results shows that as the slope is increasing bending moment is also increasing also as the effect of soil and seismic zones shows their impact.

Shear force is increasing as seismic zones are increasing also the soil is also showing its effects.

As the slope is increasing displacement is increasing.

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