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Design and Analysis of Multi Storied Building by Changing Different Shapes of Shearwall for Zone IV & V Under Plain and Sloping Ground Condition

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Abstract- In India, very few buildings are designed properly by structural engineers. Proper analysis and design of building structures that are subjected to static and dynamic loads is very important. Another important factor in the analysis of these systems is obtaining acceptable accuracy in the results. The object of this study is to model and analyze shear wall-frame structures having different thickness and location of wall in the structure and we will also discuss effect of soft storey and opening in shear wall.Shear wall has high in plane stiffness and strength which may be used to at the same time resist large horizontal loads and support gravity loads. For the buildings on sloping ground, the peak of columns below plinth level isn't same that affects the performance of building throughout earthquake. So to enhance the seismic performance of building on sloping ground the shear walls play important role.

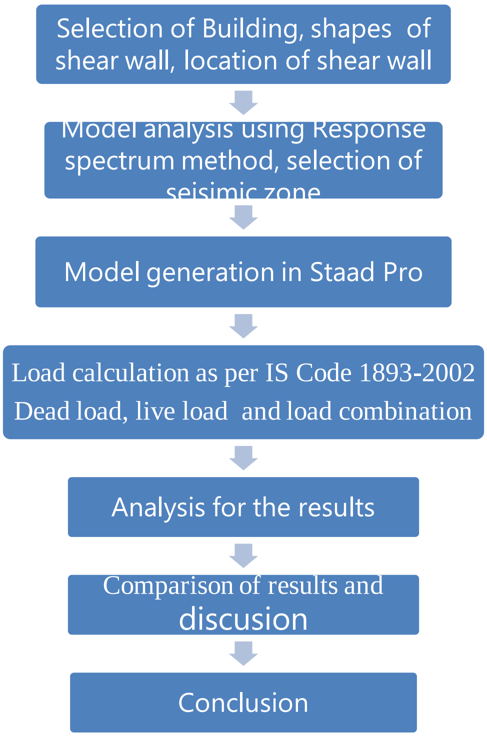
Keywords- RC wall, masonry wall, framed structure, Seismic analysis, Shear wall,

I. INTRODUCTION

The economic growth and rapid urbanization in hilly region has accelerated the real estate development and resulted in increase in population density in the hilly region enormously. Therefore, there is popular and pressing demand for the construction of multi-storey buildings in that region. A scarcity of plain ground in hilly area compels the construction activity on sloping ground. Hill buildings behave different from those in plains when subjected to lateral loads due to earthquake. Such buildings have mass and stiffness varying along the vertical and horizontal planes, resulting the centre of mass and centre of rigidity do not coincide on various floors.

Also due to hilly slope these buildings step back towards the hill slope and at the same time they may have setback also, having unequal heights at the same floor level the column of hill building rests at different levels on the slope. The seismic response of multi-storey buildings can be improved by incorporating a shear wall. Shear walls systems are one of the most commonly used lateral load resisting systems in high-rise buildings. Shearwalls have very high in plane stiffness and strength, which can be used to Simultaneously resist large horizontal loads and Support gravity loads, making them quite advantageous. Shear wall has high in plane stiffness and strength which may be used to at the same time resist large horizontal loads and support gravity loads. For the buildings on sloping ground, the peak of columns below plinth level isn't same that affects the performance of building throughout earthquake. So to enhance the seismic performance of building on sloping ground the shear walls play important role.

Hence during this study the try is created to analyse the multi-storey buildings on plain and sloping ground with and while not shear walls. The performance of the building with numerous configurations of shear walls was studied. For all shear walls configurations under issues the length of shear wall up 2 principal directions in arrange is kept equal. The RCC building models having G+15 storeys with shear walls and while not shear walls resting on plain and sloping ground are thought of for the study. The response spectrum analysis of building is applied using structural engineering software system Staad pro V8i (SS4) and also the seismic performance of building with numerous shear walls configurations is compared with reference to parameters like base shear, lateral displacement, period of time and member forces.



3D analysis as well as torsional impact has been allotted by using response spectrum technique for this study. Dynamic response of those buildings, in terms of base shear, basic period, roof displacement and member forces is given, and compared inside the thought of configuration of shear walls further like model while not shear walls on plain and sloping ground and at the tip, efficient positioning of shear walls configuration to be used is recommended. The seismic analysis of all buildings is carried by Response Spectrum technique in accordance with IS: 1893 (Part 1): 2002. As per codal provisions dynamic results are normalized by multiplying with a base shear ratio Vb/VB , wherever Vb is that the base shear analysis supported period given by empirical equation and, VB is that the base shear from dynamic analysis , if Vb/VB ratio is over one. Damping thought of for all modes of vibration was 5 %. For crucial the seismic response of the buildings in numerous directions for ground motion the response spectrum analysis was conducted in longitudinal and transverse direction (X and Y). Building analysis is finished seismic zone 4 & 5.**The following models of building are considered on plain ground.**

Model 1 without shear wall
Model 2 with straight shape shear walls
Model 3 with L shape shear walls
Model 4 with C shape shear walls
Model 5 with combined straight, L and C shape shear walls

The following models of building are considered on sloping ground.

Model 1 without shear wall
Model 2 with straight shape shear walls
Model 3 with L shape shear walls
Model 4 with C shape shear walls
Model 5 with combined straight, L and C shape shear walls

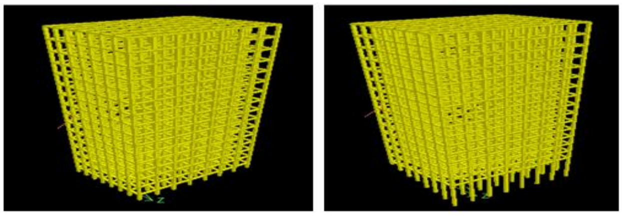


Figure. 1: Building without shear wall on plain and sloping ground.

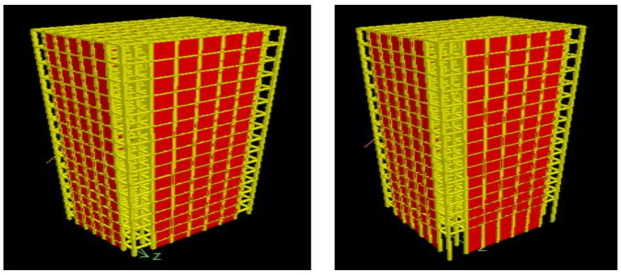


Figure. 2: Building with straight shape shear wall on plain and sloping ground.

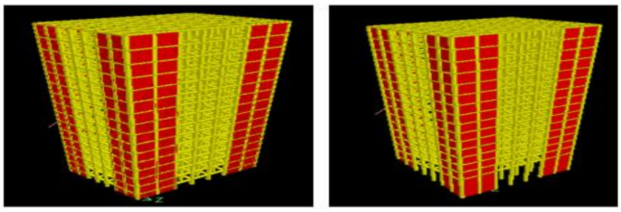


Figure. 3: Building with L shape shear wall on plain and sloping ground.

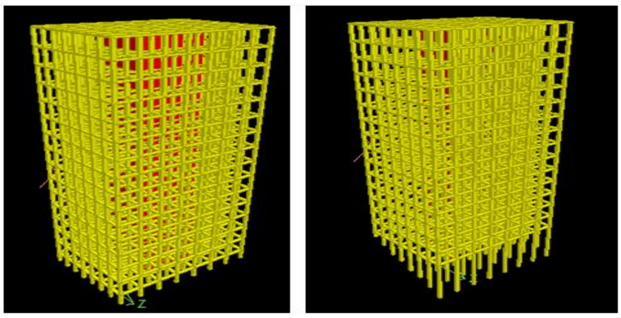


Fig. 4: Building with C shape shear wall on plain and sloping ground.

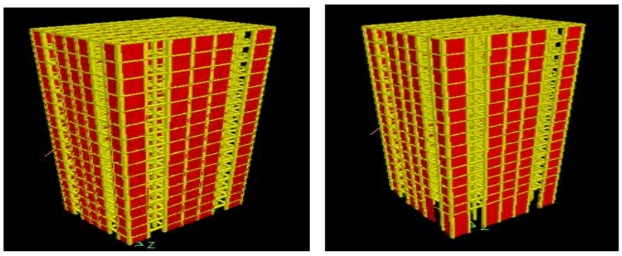


Figure. 5: Building with combined straight, L and C shape shear wall on plain and sloping ground.

III. RESULT

Plain Ground

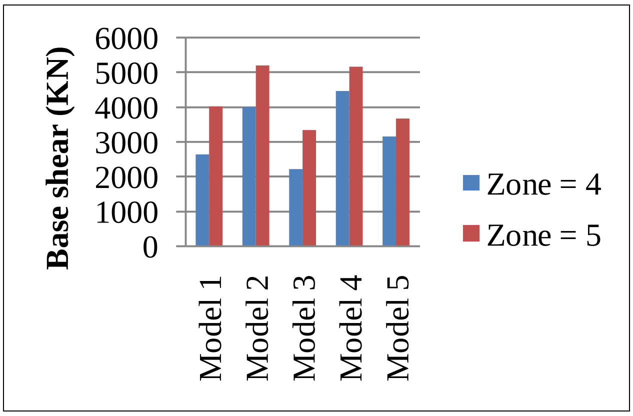


Figure. 6: Variation of base shear for building on levelled ground.

2) Fundamental time period

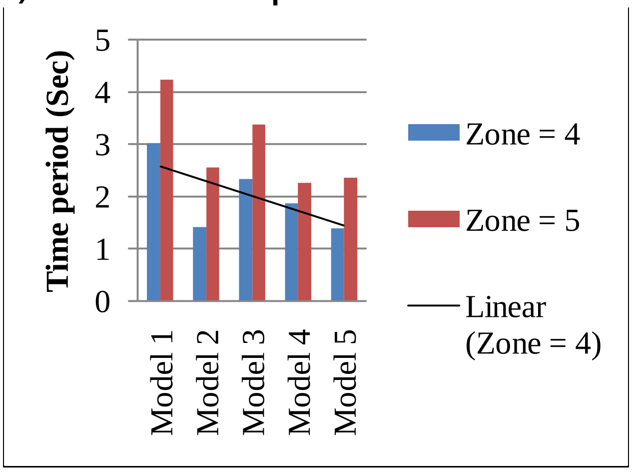


Figure. 7: Variation of time period for building on levelled ground.

3) Member forces

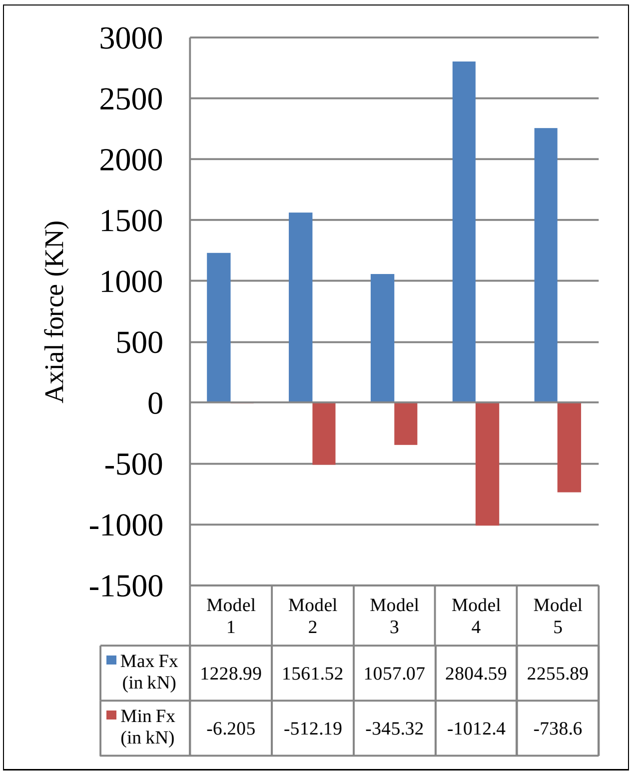


Figure. 8 Axial forces in column for building on levelled ground for zone 4.

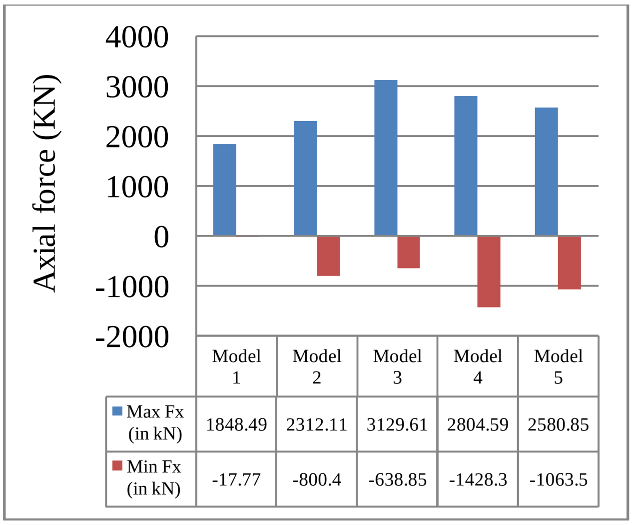
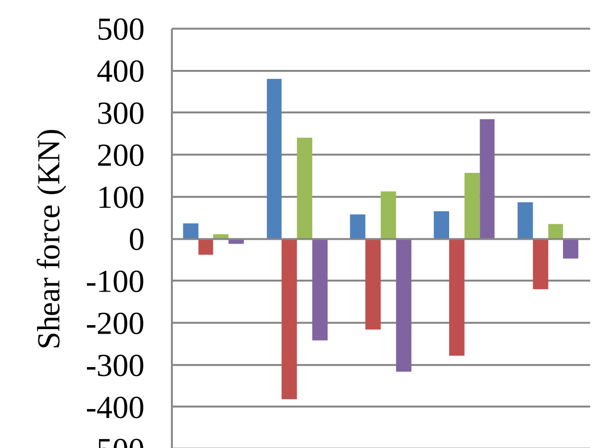
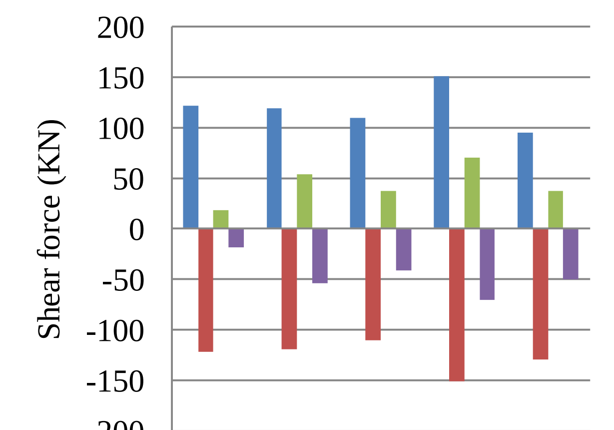


Figure. 9: Axial forces in column for building on levelled ground for zone 5.



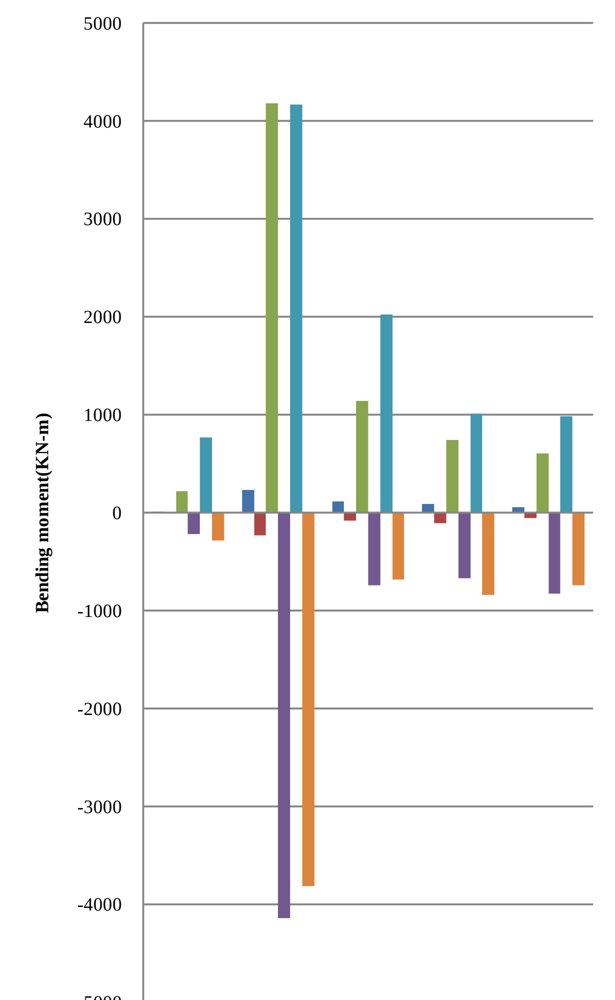
	Model 1	Model 2	Model 3	Model 4	Model 5
Max Fy (in kN)	37.86	382	58.23	66.24	87.64
Min Fy (in kN)	-37.86	-381.97	-215.11	-278.24	-119.89
Max Fz (in kN)	12.01	240.92	113.62	156.87	35.18
Min Fz (in kN)	-12.01	-240.92	-315.44	285.62	-46.25

Figure. 10: Shear forces in column for building on levelled ground for zone 4.



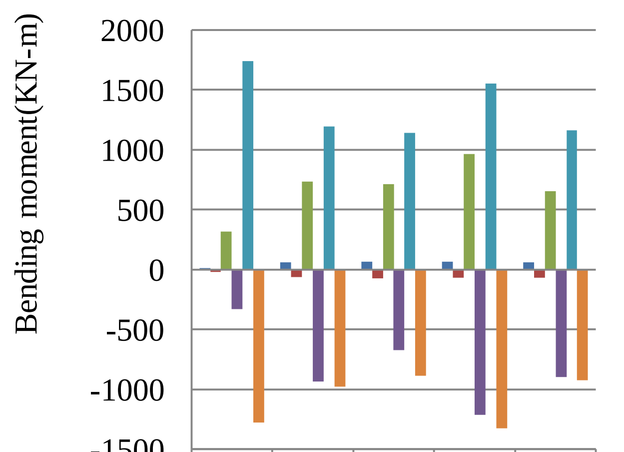
	Model 1	Model 2	Model 3	Model 4	Model 5
Max Fy (in kN)	121.59	119.35	109.97	151.16	95.13
Min Fy (in kN)	-121.59	-119.35	-110.52	-151.18	-129.26
Max Fz (in kN)	18.29	53.85	37.67	70.32	37.63
Min Fz (in kN)	-18.29	-53.85	-41.12	-70.31	-50

Figure. 11: Shear forces in column for building on levelled ground for zone 5



	Model 1	Model 2	Model 3	Model 4	Model 5
Max Mx (in kNm)	9.93	229.8	114.26	87.21	57.96
Min Mx (in kNm)	-9.93	-229	-84.23	-110.14	-57.9
Max My (in kNm)	216.6	4181.9	1141.24	745.34	605
Min My (in kNm)	-216.6	-4144.7	-742.3	-671.6	-827
Max Mz (in kNm)	771.1	4171.03	2023.11	1013.58	984.9
Min Mz (in kN)	-284.1	-3814	-684.1	-842.3	-744.4

Figure. 12: Bending moment in column for building on levelled ground for zone 4.



	Model 1	Model 2	Model 3	Model 4	Model 5
Max Mx (in kNm)	15.13	61.43	69.71	65.39	63.45
Min Mx (in kNm)	-15	-61.4	-69.7	-65.3	-63.4
Max My (in kNm)	321.2	736.85	715.06	967.6	655.01
Min My (in kNm)	-329.8	-930.8	-672.5	-1210	-894
Max Mz (in kNm)	1742.37	1197.28	1145.7	1554.4	1163.59
Min Mz (in kN)	-1274	-976	-882.2	-1323	-922.9

5.2 SLOPING GROUND

1) Base shear

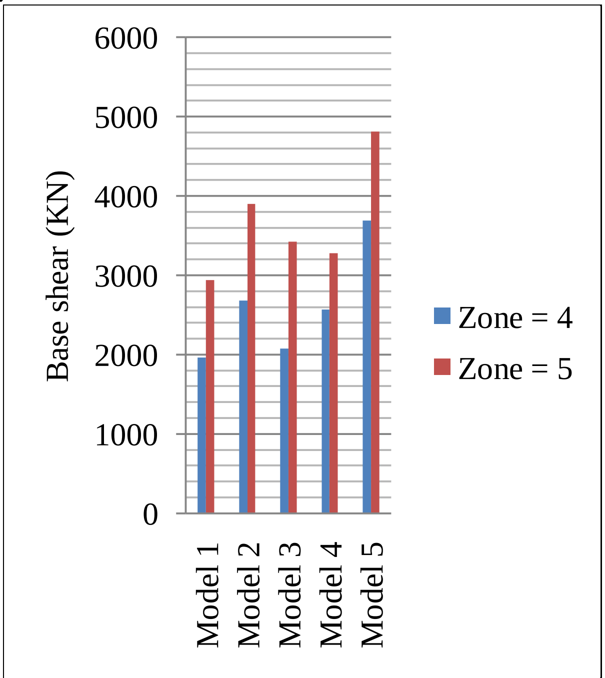
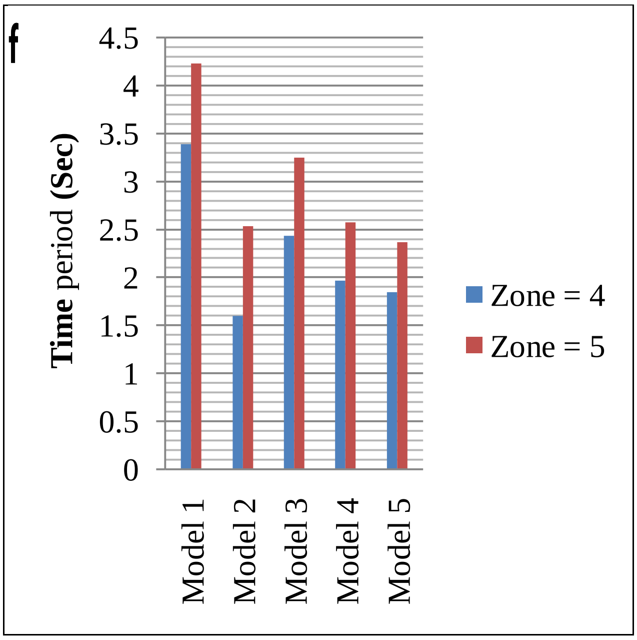


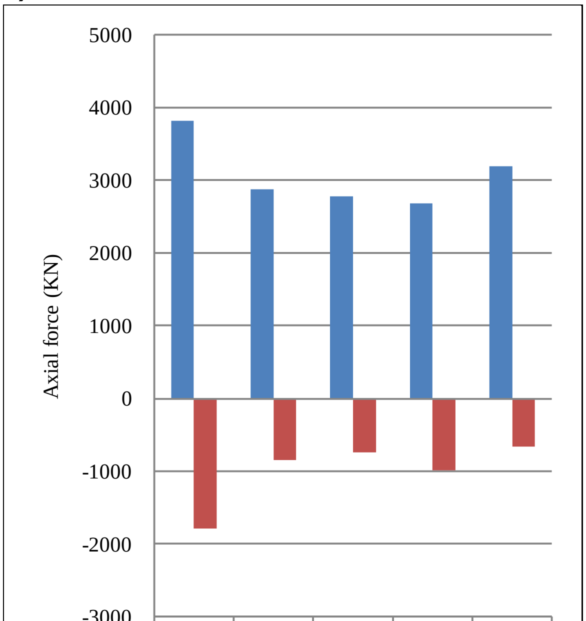
Figure. 13: Variation of base shear for building on slopping ground.

2) Fundamental time period



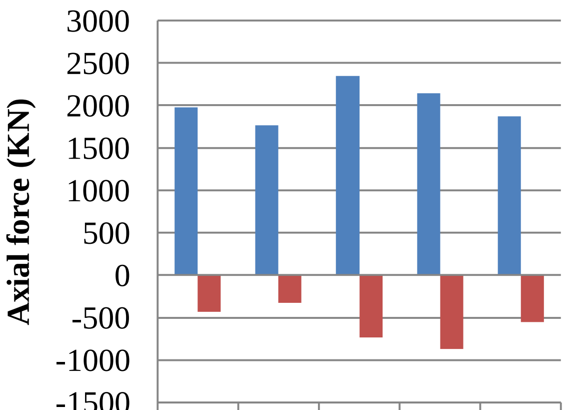
Figue. 14: Variation of time period for building on slopping ground

3) Member forces



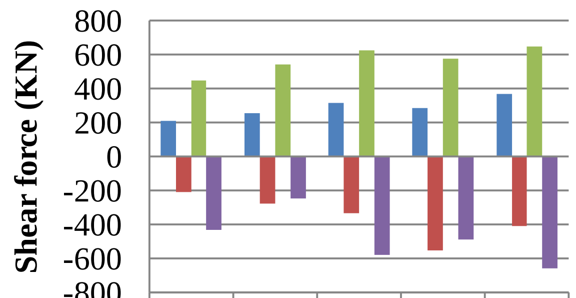
	Model 1	Model 2	Model 3	Model 4	Model 5
Max Fx (in kN)	3820.9	2879.5	2784.3	2684.7	3196.3
Min Fx (in kN)	-1785.	-844.2	-735.2	-988.3	-655.8

Figure. 15: Axial force results for structure on sloping ground for zone 4..



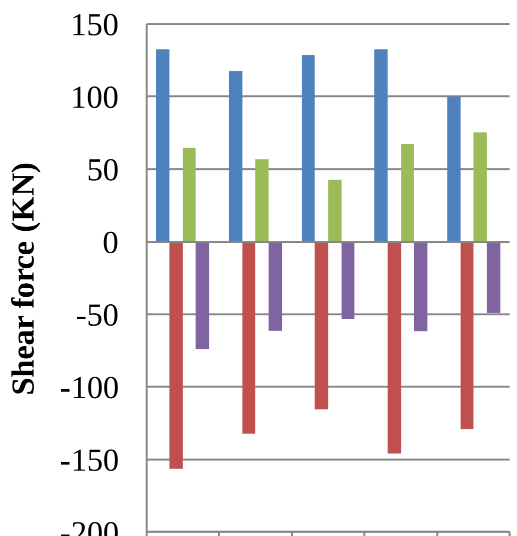
	Model 1	Model 2	Model 3	Model 4	Model 5
Max Fx (in kN)	1981.08	1769.24	2349.87	2145.34	1874.38
Min Fx (in kN)	-432.22	-325.36	-737.24	-874.25	-556.61

Figure. 16: Axial force results for structure on sloping ground for zone 5.



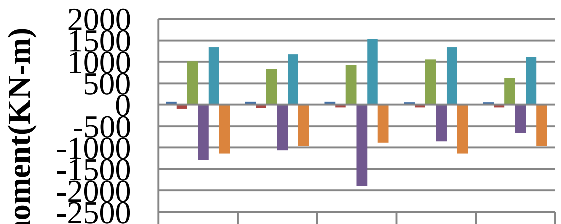
	Model 1	Model 2	Model 3	Model 4	Model 5
Max Fy (in kN)	208.22	256.54	315.85	284.33	368.49
Min Fy (in kN)	-208.41	-279.21	-333.02	-552.39	-410.02
Max Fz (in kN)	449.47	542.61	624.63	578.29	649.82
Min Fz (in kN)	-434.46	-247.91	-582.24	-489.2	-659.31

Figure. 18: Axial force results for structure on sloping ground for zone 5



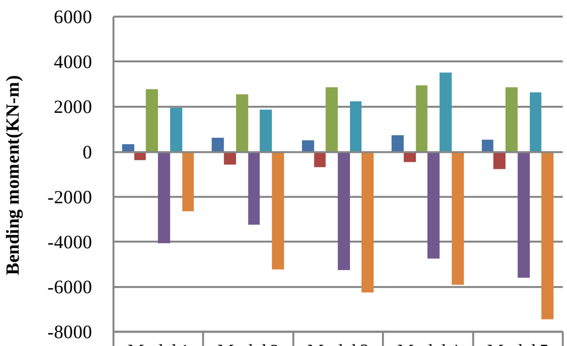
	Model 1	Model 2	Model 3	Model 4	Model 5
Max Fy (in kN)	132.96	117.61	128.74	132.79	100.22
Min Fy (in kN)	-156.2	-132.2	-115.2	-145.8	-128.9
Max Fz (in kN)	64.74	56.82	42.78	67.41	75.63
Min Fz (in kN)	-73.73	-61.22	-53.21	-61.61	-48.7

Figure. 17: Axial force results for structure on sloping ground for zone 4.



	Model 1	Model 2	Model 3	Model 4	Model 5
Max Mx (in kNm)	83.06	70.55	79.45	60.15	63.15
Min Mx (in kNm)	-83.02	-70.53	-62.58	-60.16	-63.12
Max My (in kNm)	1010.8	836.25	923.24	1061.46	627.2
Min My (in kNm)	-1273.3	-1060.4	-1887.4	-849.2	-645.1
Max Mz (in kNm)	1350.73	1183.3	1542.28	1349.4	1125.1
Min Mz (in kN)	-1124.6	-952.3	-874.3	-1122.2	-943.9

Figure. 19: Bending moment results for structure on sloping ground for zone 4.



	Model 1	Model 2	Model 3	Model 4	Model 5
Max Mx (in kNm)	349.02	623.47	532.88	745.51	556.74
Min Mx (in kNm)	-349.03	-551.01	-674.21	-448.3	-749.1
Max My (in kNm)	2783.32	2562.11	2874.36	2971.32	2868.41
Min My (in kNm)	-4053.2	-3229.1	-5233.2	-4721.3	-5584.3
Max Mz (in kNm)	1970.8	1874.1	2246.2	3541.9	2642.5
Min Mz (in kN)	-2645.1	-5231.2	-6233.7	-5888.7	-7424.6

Figure. 20: Bending moment results for structure on sloping ground for zone 5.

IV. CONCLUSION

From the above discussion following conclusions can be made:

1. From the results obtained from this study it is discovered that the incorporation of shear wall up building on plain and slopping ground will increase the base shear because of increase in lateral stiffness.
2. In building with plain and slopping ground the period of structure reduces and there's sizable reduction in lateral displacement of structure additionally. thus it is said that the incorporation of shear wall will increase the base shear this impact is additionally seen in once we modification the zone 4 to zone 5.
3. In building with plain and slopping ground the model three (C-shape) has minimum worth of base shear among all different shear walls configurations just in case of zone four and zone five. All the models with shear walls have about 65% less period of time as compared with model one. Model two (C shape) has minimum period of time for each zone four and five. Just in case of slopping ground, all the models with shear walls have about 500% less period of time as compared with model one. Model three (L shape) has minimum period of time for each zone four and five.
4. In building with plain ground, most axial forces are seen in model one for zone four and zone five. From all the models, model three shown min axial forces for zone four and zone five. it's discovered that most shear forces are seen in model 2 for zone four and zone five. From all the models, model three shown min shear forces for zone four and zone five. it's discovered that most bending moments are seen in model a pair of for zone four and zone five. From all the models, model three shown min shear forces for zone four and zone five. In building with slopping ground it's discovered that most axial forces are seen in model one for zone four and zone five. From all the models, model three shown min axial forces for zone four and zone five. it's discovered that most shear forces are seen in model three for zone four and zone five. From all the models, model two shown minimum shear forces for zone four and zone five. it's discovered that most bending moments are seen in model one for zone four and zone five. From all the models, model three shown min shear forces for zone four and zone five.
5. Hence in case of plain and slope ground building with C- shape and straight shear wall shape perform best.

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