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Seismic analysis of RCC building with or without shear wall on plain and slopping ground

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Abstract- The economic growth and rapid urbanization in hilly region has greatly increased the population density in the hilly region by speeding up the development of real estate. As a result, the development of multi-story structures is in high demand in that area. Construction on sloping terrain is necessary in mountainous areas due to a lack of flat land. When confronted to earthquake lateral stresses, hill structures perform differently from those in the lowlands. The mass and stiffness of these structures change vertically and horizontally, causing the mass and rigidity centres to diverge on different levels. The steep slope of these structures also causes them to slant back toward the slope, yet at the same time they could have setback, since the column of hill building rests at different elevations on the slope. In this study, the seismic analysis of RCC building with or without shear wall on plain and slopping ground has been done.

Keywords- Seismic analysis, RCC building, shear wall, plain ground, slopping ground.

I. INTRODUCTION

The economic growth and rapid urbanization in hilly region has greatly increased the population density in the hilly region by speeding up the development of real estate. As a result, the development of multi-story structures is in high demand in that area. Construction on sloping terrain is necessary in mountainous areas due to a lack of flat land. When confronted to earthquake lateral stresses, hill structures perform differently from those in the lowlands. The mass and stiffness of these structures change vertically and horizontally, causing the mass and rigidity centres to diverge on different levels. The steep slope of these structures also causes them to slant back toward the slope, yet at the same time they could have setback, since the column of hill building rests at different elevations on the slope. A shear wall could enhance the seismic response of multi-story structures. "In high-rise structures, shear walls is one of the most frequent lateral load-resisting methods. Shear walls can resist huge horizontal loads while still supporting gravity loads due to their high plane stiffness and strength."

"High-rise structures must have sufficient stiffness to withstand lateral stresses imposed by wind or seismic disturbances. Because of its high carrying capacity, high ductility, and stiffness, reinforced concrete shear walls are ideal for structures in seismic zones." Buildings with several stories are more difficult to put and vibrate concrete at, because of the huge spans between beams and columns and the substantial reinforcing at beam-column intersections. This compromises the structural integrity of the structure and makes it less safe. These issues need the use of shear walls in high-rise structures, which are currently lacking.

Compared to framed constructions, buildings with structural walls are usually always more rigid, minimising the risk of damage from extreme deformation. For both vertical and horizontal loads, multi-story RC structures are suitable. Beam and column diameters are large in such structures because shear walls are not used. Shear barriers may become essential in the future for controlling significant deflections while also saving money.

Shear and overturning moments in walls are caused by lateral forces, or the horizontal forces given to a building by winds or earthquakes. "As if you were attaching a piece of paper to a frame and changing the geometry of the frame from a rectangle to a Parallelogram, the shear forces tend to rip the wall." Racking seems to be the process of transforming a rectangle into a parallelogram. In the case of shear walls, the wall tends to be forced down and away from the force at its end. This action acts as a counterweight to the forces of gravity. High stresses, sway movement, and vibration can all be caused by lateral loads. As a result, the structure's strength against vertical loads is critical. The only main lateral factors that influence the buildings are earthquakes and wind.

The job of systems or structures that resist lateral loads is to move or deform without collapsing in order to absorb the energy generated by these lateral forces. A tall or high-rise building's structural shape is determined only by the placement of its key structural parts in order to withstand the different combinations of lateral stresses and gravity loads most effectively. For higher structures, structural considerations become more critical and it is imperative that a suitable structural form or lateral loading system be used. Comparing the efficiency of high-rise buildings constructed for the same function and of the same height and material may be done by comparing their weight per square foot.

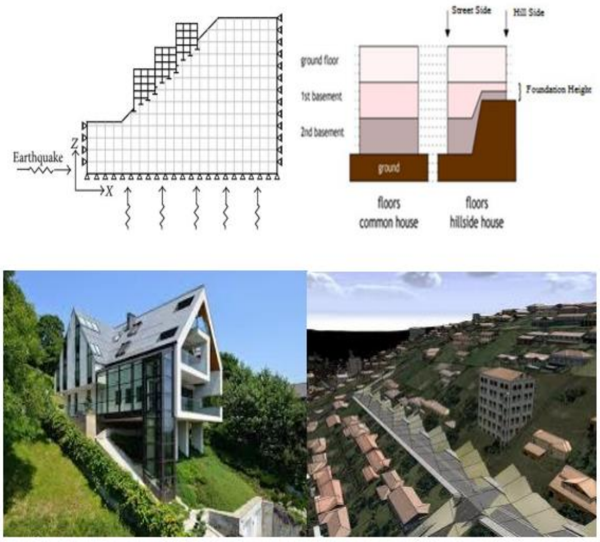

Fig 1. Buildings on sloping ground.

II. OBJECTIVES OF STUDY

- The purpose of this research is to examine how different shear wall placements affect the seismic resistance of structures on flat and sloped surfaces. To use Staad pro ss4 for a building's reaction spectrum study.
- The purpose of this study is to evaluate the efficiency of construction on flat and sloped surfaces.
- The purpose of this research is to examine how shear walls affect construction on flat and sloped surfaces.
- The purpose of this study is to evaluate the differences between constructing a structure on flat and sloping ground, with and without a shear wall.

III. METHODOLOGY

Shear wall rigidity and strength that may be employed in a wide range of applications to resist enormous horizontal loads and support gravity loads concurrently A building's earthquake effectiveness is affected by the difference in column heights below its plinth level for structures built on sloping land. As a result, shear walls play a critical role in improving the seismic performance of buildings on sloping terrain.

That is why we are attempting to examine multi-story structures on flat and sloping land, with and without shear walls, in this investigation. The building's performance under various shear wall designs was examined. The length of the shear wall in the two main axes of the design is kept constant for all shear wall configurations under consideration. Models of RCC buildings with G+15 floors lying on flat or sloping ground, with or without shear walls, were taken into account for the research. "It really is possible to compare the seismic performance of a structure with various shear wall layouts using structural engineering software Staad Pro V8i (SS4) and factors such as base shear, lateral displacement, time period and member forces."

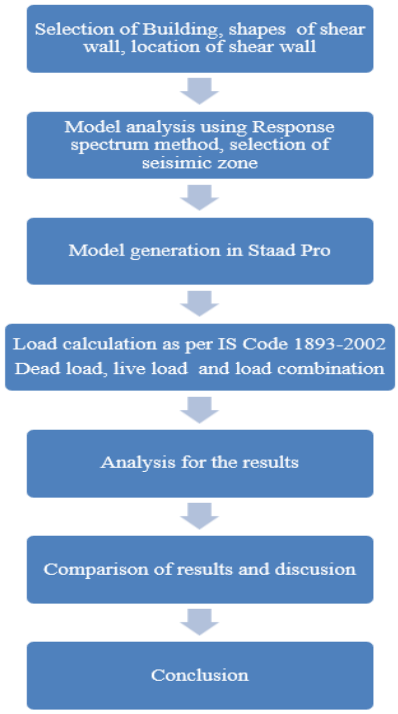

Fig 2.

1. Structure and Analytical Model:
The model is a G+15 RCC structure, with six bays in each direction and a bay width of 3.5m. Keeping a constant 3.1m per-floor story height and 1.5m plinth height is standard. Beams and columns of 0.3 by 0.5 metres and 0.45 by 0.45 metres, respectively, make up the RCC structure. Slab thickness is taken at 120mm. The models are examined on levelled as well as sloping terrain. In this analysis, they evaluate both frames on level terrain and frames on sloped land, as seen in Figures 3.1 and 3.2. Grade M20 concrete and Fe 415 steel are utilised in construction.

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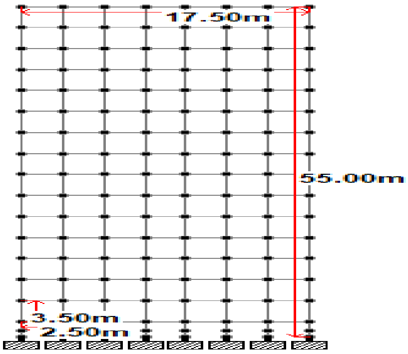

"Fig 3. Building frame on levelled ground.

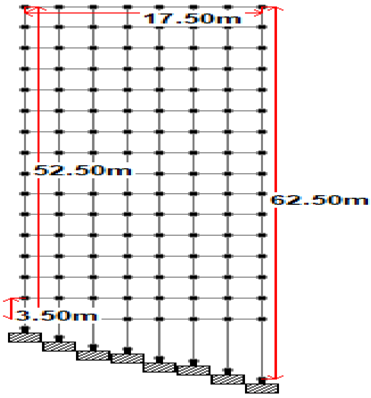

Fig 4. Building frame on slopping ground.

"Table 1. Building description.

S.no	Specification	Plain	Slopping
1	Plain dimensions	24.5 x 17.5 m	24.5 x 17.5 m
2	Length in x-direction	24.5 m	24.5 m
3	Length in z-direction	17.5 m	17.5 m
4	Floor to floor height	3.1 m	3.1 m
5	No. of stories	16	16
6	Plinth level	1.5 m	1.5 m
7	Soil type	Hard	Hard
8	Seismic zone	4 & 5	4 & 5
9	Zone	Zone IV= 0.24 Zone V= 0.36	Zone IV= 0.24 Zone V= 0.36
10	Response zone factor (RF)	5	5
11	Importance factor (I)	1	1
12	Rock and soil site factor (SS)	2	1
13	Type of structure (ST)	1	1
14	Damping ratio	0.05	0.05
15	Grade of concrete	M 20	M 20
16	Grade of steel	Fe 415	Fe 415
17	Beam size	0.3 x 0.5 m	0.3 x 0.5 m
18	Column size	0.45 x 0.45 m	0.45 x 0.45 m
19	Shear wall location	Straight, C shape, Corner and all (Straight, C shape, Corner)	Straight, C shape, Corner and all (Straight, C shape, Corner)

2. Loads:

2.1 Dead loads:

Self-weight calculates using section characteristics and material constants that are given by the user. In addition to the additional dead weight placed on beams by floor finishes and water proofing, also comes the additional weight of a wall.

Dead load on floor = 5 kN/m^2

2.2 Live Loads:

Live load on floor = 4 kN/m^2

IV. RESULTS AND DISCUSSION

1. Plain Ground:

The results obtained from present study for seismic performance of building on plain ground are presented for different models.

1.1 Base shear: It is clear from the findings of this study that adding a shear wall to an RCC frame increases the base shear as the lateral stiffness rises. In addition, there's a significant decrease in lateral movement of the structure. Since the base shear is likewise increased when zone 4 is changed to zone 5, this effect may be considered to be due to the addition of a shear wall. The basal shear value for the Model 3 (C-shape) shear wall is the lowest of any other shear wall construction in zones 4 and 5.

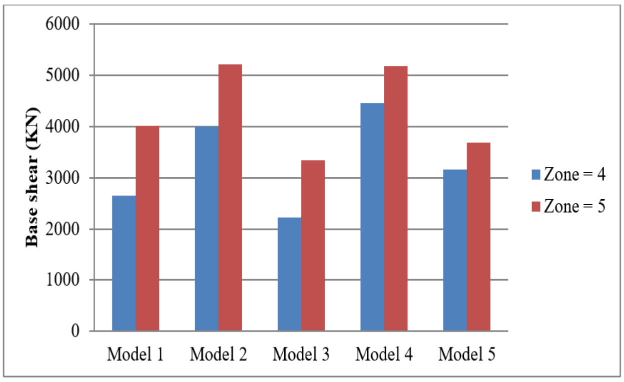

Fig 5. Variation of base shear for building on levelled ground.

2. Sloping Ground:
The findings of the current study for the seismic performance of buildings on sloping terrain.

2.1 Base shear: It is clear from the findings of this study that adding a shear wall to an RCC frame increases the base shear as the lateral stiffness rises. In addition, there is a significant decrease in lateral movement of the structure. Since the base shear is likewise increased when zone 4 is changed to zone 5, that effect may be considered to be due to the addition of a shear wall. The basal shear value for the Model 3 (C-shape) shear wall is the lowest of any other shear wall construction in zones 4 and 5.

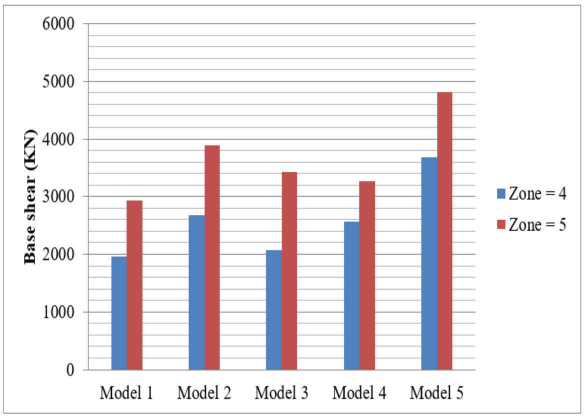

Fig 6. Variation of base shear for building on slopping ground.

V. CONCLUSION

From the above discussion following conclusions can be made: There was a noticeable rise in the base shear when shear walls were used on flat and sloped ground, according to the findings of this study. Construction takes less time and moves less laterally when built on sloping land. A shear wall may be shown to have an influence on the base shear, and this can be noticed when the seismic zone changes from IV to V.

Model 3 (L-shape) has the lowest base shear among all other shear wall designs in zones IV and V of a structure with plain ground. In contrast, the model 1 (without shear wall) has the lowest base shear among all other shear wall configurations in zones IV and V with sloping land.

REFERENCES

[1] Asnhuman.S, DipenduBhunia, Bhavin Ranjiyani (2011), "Solution of shear wall location in multi-storey building" International Journal of Civil and Structural Engineering Research.
[2] Shaik Kamal Mohammed Azam, Vinod Hosur (2013), "Seismic performance evaluation of multistoried RC framed buildings with shear wall." Journal of Scientific & Engineering Research, Volume 4, Issue 1.
[3] P.P.Chandurkar, Dr.P.S.Pajgade (2013), "Seismic analysis of RCC building with and without shear wall." International Journal of Modern Engineering Research, Vol.3.
[4] Chaitanya Kumar J.D., Lute Venkat (2013), "Analysis of multi storey building with precast load bearing walls" International Journal of Civil and Structural Engineering, Volume 4.
[5] Lakshmi K.O., Jayasree Ramanujan, Bindu Sunil, LajuKottallil, Prof.Mercy Joseph Poweth (2014), "Effect of shear wall location in buildings subjected to seismic loads." ISOI Journal of Engineering and Computer Science.
[6] M.S.Aainawala, Dr.P.S.Pajgade (2014) "Design of multistoried R.C.C. buildings with and without shear walls." International Journal of Engineering Sciences and Research Technology.
[7] Tarunshrivastava, Prof. Anubhav Rai, Prof. Yogesh Kumar Bajpai (2015), "Effectiveness of shear wall-frame structure subjected to wind loading in multi-storey building." International Journal of Computational Engineering Research, Vol.5.
[8] Mohd Atif, Prof. LaxmikantVairagade, Vikrant Nair (2015), "Comparative study on seismic analysis of multi storey building stiffened with bracing and shear wall" International Research Journal of Engineering and Technology, Vol. 2.
[9] Prasad Ramesh Vaidya (2015), "Seismic analysis of building with shear wall on sloping ground" International Journal of Civil and Structural Engineering Research, Vol.2.
[10] Jamal Ali, Abdul Qadir Bhatti, Mansoor Khalid, Junaid Waheed and Shaqran Zuberi (2015), "Analyze the effectiveness of shear walls in controlling lateral drift for medium to high rise structures (10 – 25 Storeys)." International Conference on Geological and Civil Engineering.
[11] Sunil Kumar Kalyani, Vishwanath. B.Patil (2015), Effect of Shear Wall Sections on Multi-storey Building with Satellite Bus-Stop having Floating Columns with Top Soft Storey, International Journal for Innovative Research in Science & Technology, Volume 2, Issue 02, pp. 169-174.
[12] MD Afroz Patel, Shaik Abdulla (2016), A Study on Positioning of Different Shapes of Shear Walls in L Shaped Building Subjected to Seismic Forces, International Journal of Engineering Research & Technology, Vol. 5 Issue 07, pp.480-487
[13] Dr.MD. Subhan (2016), Design of Shear Walls in Response Spectrum method and to Study Effect of Vertical Stiffness Irregularity on Multi-Storey, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Special Issue 9, 927-934.
[14] Sumanth G, Vasantha. (2016), Comparative Seismic Behaviour Analysis of Structure With Shear Wall At

Different Locations, International Research Journal of Engineering and Technology, Volume: 03 Issue: 08, 413-419.

[15] N. K. Meshram, Gauravi M. Munde (2018), Seismic Analysis of Shear Wall at Different Location on Multi-storey RCC Building, International Journal of Interdisciplinary Innovative Research & Development, Vol. 02 Issue 02,7-28.

[16] S. P. Sharma, J. P. Bhandar (2015), Literature Review on the Seismic Performance of Multi-Storey Building with Different Locations of Shear Wall and Diagrid, International Journal of Science and Research, Volume 6 Issue 6, 583-590.

[17] T. Gouthami, Dr. K. Rajashekar (2017), The Behaviour of Shear Wall of High-Rise Building, Under Seismic Load by Adopting Linear Dynamic Analysis, International Journal of Scientific Engineering and Technology Research, Vol.06, Issue 31, 1-6.

[18] Devipriya. J, Hariprasad T R (2014), Seismic Analysis of an Irregular Building With Shearwall at Different Locations, International Journal of Recent Engineering Research and Development, Volume No. 02 – Issue No. 05, 34-40.

[19] SoundariyaTumane, Vinay Mehta (2018), A Study on Time History Analysis of High Rise Building with Infill Panels, International Journal for Research in Applied Science & Engineering Technology, Volume 6 Issue 6, 369-378.

[20] S K Hirde,N K Shelar (2015), Effect of Positioning of RC Shear Walls on Seismic Performance of Buildings Resting on Plain and Sloping Ground, International Journal of Current Engineering and Technology, Vol.5, No.3, 1659- 1665.

[21] Mahdi Hosseini, N.V. Ramana Rao (2016), Seismic Analysis of Multi-Storey Building Structure with Shear Walls at the Center Core and Center of Each Side of the External Perimeter, International Journal of Engineering and Management Research, Volume-6, Issue-6,60-70.

[22] G S S Ram Tej, Dr.DumpaVenkateswarlu (2016), Behaviour Of RCC Building With Shear Wall With Different Characteristic At Seismic Zones, International Journal of Research Sciences and Advanced Engineering, Volume 2, Issue 15,124 – 132.

[23] Vivek Pal, Gaikwad Yogesh, Pawar Chetan, VishwajeetKadlag. Nikhil Maske (2018), Seismic Analysis of RCC building with shear walls using staad pro, International Journal of Advanced Research and Innovative Ides in Education, Vol-4 Issue-3, 1353-1359.

[24] M.Tamim.A.Tanwer (2014), Structural Configuration Optimization Of A Multi-storey Building By Optimum Positioning Of Shear Wall, International Journal Of Civil Engineering And Technology, Volume 5, Issue 6, 55-64.

[25] Mukesh sharma, Girish Sharma, Abhishek Gupta, Ankush Tanta (2017), Review Paper On Seismic Analysis And Behaviour Of Multi-storey RC Building With And Without Shear Walls, International Journal of Technical Innovation in Modern Engineering & Science, Volume 4, Issue 08, 939-943.

[26] Mahdi Hosseini, N. V. Ramana Rao (2015), Earthquakes Analysis of High Rise Buildings with Shear Walls at the Center Core and Center of Each Side of the External Perimeter with Opening, International Journal of Science and Research, Volume 5 Issue 12, 59-71.

[27] Sonali Pandey, Dr. Krishna Murari, Ashish Pathak, Chandan Kumar (2017), A Review on Shear wall in High Rise Buildings, International Journal of Engineering Inventions, Volume 6, Issue 12, 19-21.

[28] Youssef I. Agag, Mohamed E. El Madawy, Raghda I. Halima (2018), The Effect of Shear Walls Positions and Dimensions Variation on the Analysis of Multi-Story Building, International Journal of Scientific Engineering and Research, Volume 7 Issue 2 72-82.

[29] Manohar K, Dr. Jagadish Kori G (2014), Analysis On Seismic Performance Of High Rise Building By Changing The Location Of Shear Wall For Different Soil Condition, International Journal of Emerging Trends in Engineering and Development, Issue 4, Vol.4, 237-245.

[30] Shaik Imran, P. Rajesh (2017), Earthquake Analysis of RCC Buildings on Hilly, International Journal of Advance Engineering and Research Development, Volume 3 Issue 1, 14-26.

[31] Anshuman Nimade, Niraj Soni, Mahesh Patidar, Vikas Joshi (2018), Dynamic Analysis of Flat Slab System in Vertical Irregular Building with & without Shear Wall, International Journal of Research and Scientific Innovation, Volume V, Issue I,132-139

[32] Sandip Doijad, Surekha Bhalchandra (2015), Seismic Behaviour of RC Buildings Constructed on Plain and Sloping Ground with Different Configuration of Shear Walls, Journal of Civil Engineering and Environmental Technology, Volume 2, Number 10, 59-65.