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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 hilly region's fast urbanisation and economic growth have hastened real estate development and increased population density there significantly. As a result, there is a significant public pressure in that area for the construction of tall structures. In a hilly area, the shortage of flat land forces development to take place on hills. When subjected to lateral stresses brought on by an earthquake, hill structures perform differently from those in plains. This study involved the seismic analysis of a RCC building on spaced, sloping ground with or without a shear wall..

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

I. INTRODUCTION

The hilly region's fast urbanisation and economic expansion have hastened real estate development and increased population density there significantly. As a result, there is a significant public pressure in that area for the construction of tall buildings. In a steep environment, the lack of flat land forces development to take place on slopes. If subjected to lateral stresses brought on by an earthquake, hill structures perform differently from those in plains. Such structures differ in mass and stiffness along the vertical and horizontal axes, causing the centres of mass and rigidity to diverge at different levels.

In addition, because of the steep terrain, these structures may also have setbacks since their columns have uneven heights at the same floor level and rest at different points along the slope. By including a shear wall, multi-story structures' seismic resilience can be enhanced. One of the most often utilised lateral load resisting techniques in high-rise structures is the shear wall system. Shear walls are particularly useful because of their high in-plane stiffness and strength, which may be utilised to sustain gravity loads while simultaneously resisting heavy horizontal stresses.

High rise buildings must be sufficiently rigid to withstand lateral stresses brought on by wind or seismic activity. Due to their high bearing capacity, high ductility, and high rigidity, reinforced concrete shear walls are intended for structures located in seismic zones.

As a result of the enormous beam and column dimensions and substantial reinforcement at the beam-column joints seen in high rise structures, there is a lot of clogging at these joints and it is challenging to insert and vibrate concrete at all these locations, that doesn't improve building safety. Due to these practical issues, high-rise structures must have shear walls.

Buildings made using structural walls are nearly always more rigid than those built with framed walls, which lowers the risk of excessive deformation and subsequent damage. Multi-story RC processes were capable of withstanding both vertical and horizontal loads. In such structures without shear walls, the diameters of the beams and columns are quite large. Shear barriers may become necessary in order to manage significant deflection and save money. Shear and overturning moments in walls are caused by lateral forces, or the forces delivered horizontally to a building as a result of winds or earthquakes.

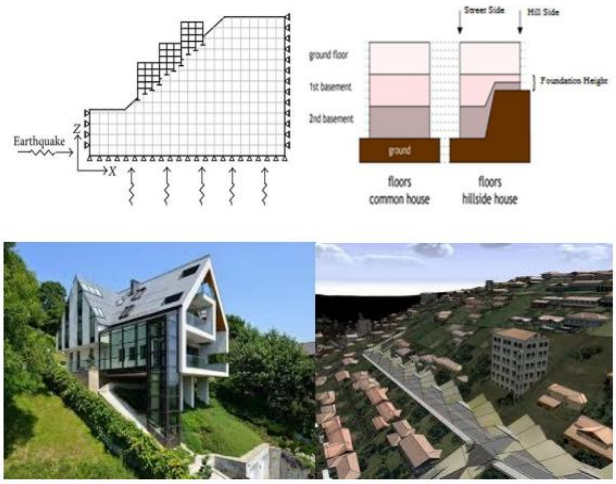

Fig 1. Buildings on sloping ground.

II. RELATED WORK

Asnhuman et al. (2011) research was done on high-rise buildings' lateral-load resisting systems. According to the study, shear walls had extremely high plane stiffness and strength, which allowed them to withstand significant horizontal loads as well as gravity loads. Based on the building's elastic and elasto-plastic behaviours, a shear wall placement solution for multi-story buildings was identified. A 15-story structure in zone IV had its earthquake load calculated and applied to it.

Azam and Hosur (2013) conducted a research on the evaluation of the seismic performance of a multi-story R.C. framed structure with a shear wall. Using the ETAB programme, elastic and inelastic analyses were performed to assess the seismic performance of R.C. framed buildings of 6, 12, 24, and 36 stories. For each type of storey, eight models with a plan area of 30 m × 20 m and a height of 3 m was created.

Chandurkar (2013) used the programme ETAB v. 9.5.0 to perform a research on the seismic analysis of RCC buildings with and without shear walls. They analysed factors including lateral displacement, narrative drift, and the expense necessary for a shear wall to be cost-effective and efficient. The programme was used to study a model of a ten storey building with 3 meters between each floor. It was supposed that the structures were fastened at the bottom. Model 1 was a bare-framed structure, Model 2 was a dual system with a shear wall wall on either side, Model 3 had a shear wall on a corner with a L=4.5 m, and Model 4 had a shear wall on a corner with a L=2 m.

Chaitanya (2013) examined the G+11-story residential building's load-bearing walls of precast reinforced concrete. Using ETABS software, this study examined a load-bearing wall and a one-way slab for gravity and lateral load. Different wall forces, displacements, and moments that had been calculated for various load combinations were subjected to analysis. For a one acre plot with 350 apartments, a G+11 storey shear wall building was taken into consideration.

III. PROBLEM IDENTIFICATION

In order to transfer lateral stresses from external walls, floors, and roofs to the ground foundation in a direction parallel with their planes, a shear wall must have a rigid vertical diaphragm. Shear walls will be strong and stiff enough to withstand horizontal forces provided they be properly planned and constructed.

In high-rise structures vulnerable to lateral wind and seismic stresses, shear walls are particularly crucial. In the current study, several studies on the performance of shear walls based on their location, orientation, and construction materials were reviewed.

Buildings must be made and designed to be flexible and light in order to withstand earthquakes. As a result, they are better able to absorb and disperse the energy generated by its movement during an earthquake. Keep the walls and partitions light in earthquake-prone areas to make the homes earthquake-resistant.

IV. OBJECTIVES OF STUDY

- To study the effect of positioning of shear wall on seismic performance of buildings resting on plain and sloping ground.
- To perform the response spectrum analysis of building using Staad pro ss4.
- To compare the performance of building on plain and slopping ground.
- To study the effect of shear wall on building on plain and slopping ground.
- To compare the building on plain and slopping ground with or without shear wall.

V. METHODOLOGY

Shear walls can support gravity loads while also withstanding heavy horizontal loads due to their high in plane stiffness and strength. Buildings on sloped terrain will function differently during earthquakes because to the different heights of the columns below plinth level. Shear walls thus play a crucial role in improving the seismic performance of buildings on sloped ground.

In response to this, an assessment of inter structures on flat and sloping terrain with and without shear walls is attempted in this study. It must have been investigated how well the structure performed with different shear wall layouts. The length of the shear wall with in two main plan directions is kept consistent for all shear wall configurations under consideration. For the study, the G+15-story RCC building models both with and without shear walls, lying on straight and sloping ground, are taken into consideration.

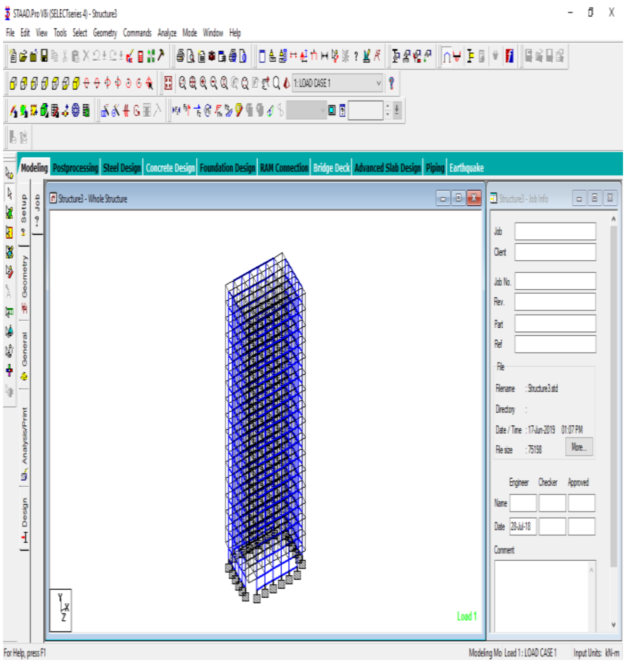

Fig 2. Generation of structure.

The seismic performance of buildings with different shear wall layouts is examined with regard to characteristics including base shear, lateral displacement, time period, and member forces using the structural engineering programme Staad Pro V8i (SS4).

The input file may be used to generate the structure, or the GUI may ask for the coordinates. The GUI creation process is depicted in the image below.

VI. RESEARCH FINDINGS

The results of present study are divided into two categories as follows:-

1. Plain Ground:
The following are the findings from the current study on how well buildings perform during seismic events on plain ground.

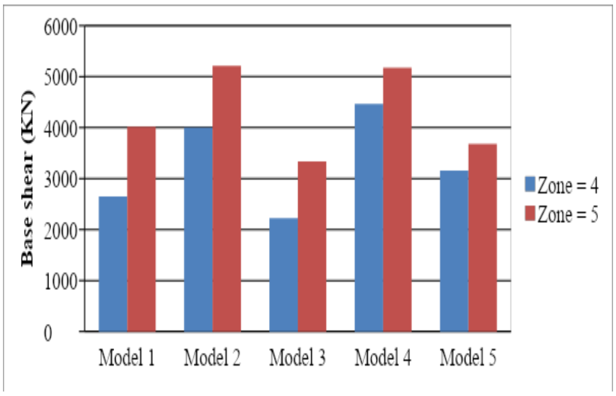

Fig 3. Variation of base shear for building on levelled ground.

The inclusion of a shear wall into an RCC frame improves base shear as a result of an increase in lateral stiffness, according to the study's findings. There is a significant decrease in both the structure's time period and its lateral displacement. Thus, it is possible to conclude that the addition of a shear wall increases base shear; this effect also was observed when zone 4 is changed to zone 5. In the case of zone 4 and zone 5, the model 3 (C-shape) shear wall structures has the lowest value of base shear.

2. Member forces:
Proportional to the shear wall, the shear forces and bending moments in columns are likewise decreased, much like in a model on level ground. Figure 4 presents the member forces in terms of axial forces, shear forces, and bending moment.

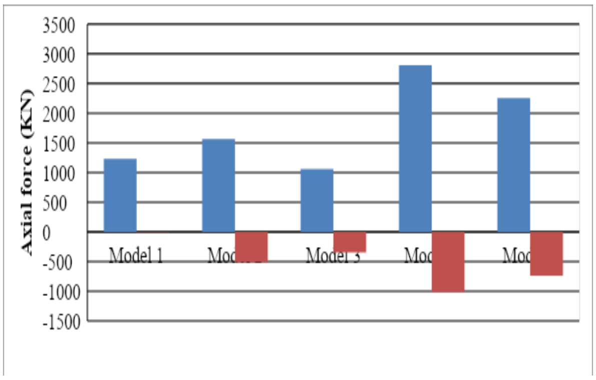

Fig 4. Axial forces in column for building on levelled ground for zone 4.

3. Sloping Ground:
Figure 5 presents the findings from the current study for such seismic performance of buildings on sloping ground for various models.

4. Base Shear:

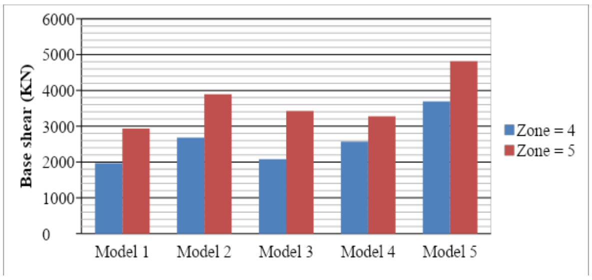

Fig 5. Variation of base shear for building on slopping ground.

The inclusion of a shear wall into an RCC frame improves base shear as a result of an increase in lateral stiffness, according to the study's findings. There has been a significant decrease in both the structure's time period and its lateral displacement. Thus, it is possible to conclude that the addition of a shear wall increases base shear; this effect too is observed when zone 4 is changed to zone 5. In the case of zone 4 and zone 5, the model 3 (C-shape) shear wall structures has the lowest amount of base shear.

5. Member forces:
Proportional to the shear wall, the shear forces and bending moments in columns are also decreased, just like in the model here on sloping ground. Figure 6 presents the member forces, such as the axial forces, shear forces, and bending moment, respectively.

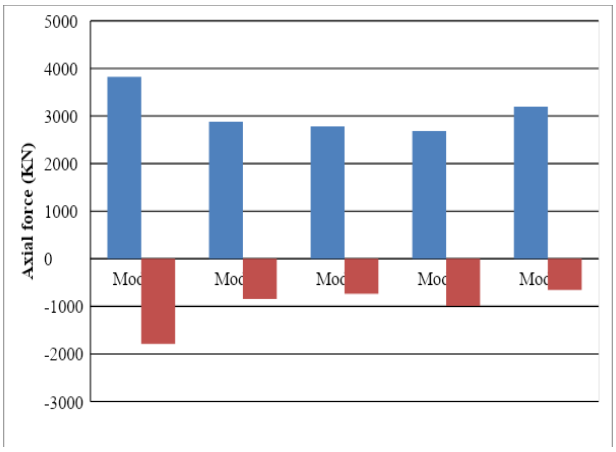

Fig 6. Axial force results for structure on sloping ground for zone 4.

VII. CONCLUSION

Conclusions that can be drawn from the debate above include: According to the study's findings, adding a shear wall to a structure on a plain or sloping ground causes the base shear to rise because the lateral stiffness of the structure increases. When compared to all other shear wall configurations for buildings on flat ground, the model 3 (L-shape) has the lowest base shear value for zones IV and V. However, among all shear wall designs for buildings on sloping ground, model 1 (without a shear wall) has the lowest base shear value for zones IV and V.

"In case of plain ground Model 2 (Straight shape shear wall) has minimum time period for zone IV. Whereas, Model 4 (C shape shear wall) has minimum time period for zone V. In case of slopping ground, Model 2 (Straight shape shear wall) has minimum time period for zone IV. Whereas, Model 5 (combination of all shear wall shape) has minimum time period for zone V."

REFERENCES

[1] Asnhuman.S, Dipendu Bhunia, 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, Laju Kottallil, 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] Tarun shrivastava, 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. Laxmikant Vairagade, 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.