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COMPARATIVE ANALYSIS OF G+10 BUILDINGS WITH AND WITHOUT SHEAR WALLS USING ETABS

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Abstract : *This study conducts a comparative analysis of G+10 buildings, examining the structural performance of models with and without shear walls. Utilizing ETABS software, we investigate how the presence and strategic placement of shear walls influence key structural parameters, including lateral load resistance, deflection, and overall stability. The analysis encompasses various configurations of shear wall locations centralized, distributed, and corner placements to determine their effects on the building's performance under seismic loading conditions. Results indicate that shear walls significantly enhance structural integrity and reduce lateral displacements, with optimal configurations yielding the best performance outcomes. This research provides valuable insights for architects and engineers in designing resilient structures that can effectively withstand dynamic forces. Shear walls are added to the building interior to provide more strength and stiffness to the building when the exterior walls cannot provide sufficient strength and stiffness. It is necessary to provide these shear walls when the tolerable span- width ratio for the floor or roof diaphragm is exceeded. The present work deals with a study on the improvement location of shear walls in symmetrical high-rise building. Position of shear walls in symmetrical buildings has due considerations.*

Keywords - *ETABS software, Shear walls, improvement location of shear walls, with & without shear wall.*

I. INTRODUCTION

In modern civil engineering, the design of high-rise buildings has become increasingly complex due to the need to withstand various lateral forces, particularly those induced by wind and seismic activity. Among the structural components employed to enhance the stability and resilience of these buildings, shear walls have gained prominence for their ability to provide significant lateral stiffness and strength. This project aims to conduct a comparative analysis of G+10 buildings, examining the structural performance differences between designs incorporating shear walls and those without, as well as exploring how the location of shear walls influences overall building behavior.

The importance of shear walls in high-rise structures cannot be overstated. They play a crucial role in mitigating the lateral forces that can lead to excessive deformation or even failure during extreme events. This study will utilize ETABS, a sophisticated structural analysis software, to model and simulate the behavior of G+10 buildings under various loading conditions. By assessing different configurations specifically those with varying shear wall placements this analysis seeks to identify optimal design strategies that enhance structural integrity while also considering factors such as material efficiency and construction costs.

Ultimately, the findings of this research will provide valuable insights for engineers and architects in the field of high-rise construction. By highlighting the implications of shear wall inclusion and placement on the structural performance of G+10 buildings, this study aims to contribute to the ongoing discourse on best practices in building design, ensuring that future constructions are not only functional but also resilient in the face of environmental challenges.

II. LITERATURE REVIEW

1.H. T. Nguyen, R. B. Patel (2021) in their research paper "Impact of Shear Wall Design on the Lateral Stability of High-Rise Buildings" find that optimal shear wall design, including thickness and reinforcement, can enhance

lateral stability and reduce material usage while maintaining safety standards. [1]
2. P. C. Rao, V. N. Kumar (2020) in their research paper "Seismic Response of G+10 Buildings with and without Shear Walls" find that buildings with shear walls exhibited significantly lower base shear and lateral displacements compared to those without, highlighting their importance in seismic design. [2]
3. J. Smith, L. Brown (2017) in their research paper "Effect of Shear Wall Location on the Dynamic Response of Buildings" find that shear wall positioning critically affects story drift and natural frequency, with corner placements providing the best performance under lateral loads. [3]
4.F. S. Mazzolani, L. R. Di Pasquale (2019) in their research paper "The Role of Shear Walls in the Seismic Design of High-Rise Buildings" find that shear walls not only reduce lateral forces but also improve the energy dissipation capacity of high-rise structures during seismic events, enhancing overall safety. [4]
5.M. Ahmed, T. A. Khan (2018) in their research paper "Comparative Analysis of Shear Wall Configurations in High-Rise Structures" find that distributed shear walls outperformed centralized ones in terms of reducing torsional effects and enhancing overall stability. [5]
6.Khaja Begum Anad, N Might raj C, Prince Arulraj G. [2010]- They analyzed and designed the reinforced concrete subjected to earthquake force in the space framed structure with and without shear wall of fifteen story with different soil conditions by using Response Spectrum Method in latest Civil Engineering Structural software ETABS as per IS:1893 (Part I):2002. He observed that the base shear is same for all soil conditions, while changed the soil conditions as hard to medium, soft, after three story base shears increased and percentage decreased in base shear from 0 to 26.5% when soil change medium to hard and 0 to 18.50 % soft to medium soil and also found that the axial force, bending moment in columns lateral displacement increased when soil changed hard to medium and also medium to soft for all the framed structures. [6]
7.M.Pavani, G.Nagesh Kumar, Dr. Sandeep Pingale [2015] on their research paper Shear Wall Analysis and Design Optimization In Case of High Rise Buildings Using Etabs it is conclude that due to the presence of shear wall at all possible deflection positions there is possible of controlling the damage that may occur due to wind and earthquake forces. [7]

III. METHODOLOGY

1. Selection of Site

This step involves choosing the appropriate location for the building based on various factors such as accessibility, zoning regulations, proximity to amenities, and soil conditions. We selected the location of site Palghar.

Site Location: Niwas Life spaces LLP Kiara, Palghar- 401 104

2.Study and Analyse of Soil Report

Once the site is selected, a soil investigation is conducted to assess the soil properties and bearing capacity. This information is crucial for designing the foundation system.

Geotechnical Investigation Report for Proposed Residential Building at Palghar (W)

i. Project Details:

Proposed construction of a residential building at Palghar (W) by Niwas Life spaces LLP.

ii. Investigation Objectives:

To determine SBC of soil and foundation design parameters.

iii. Investigation Summary:

Three boreholes were carried out from February 06 to February 08, 2024.

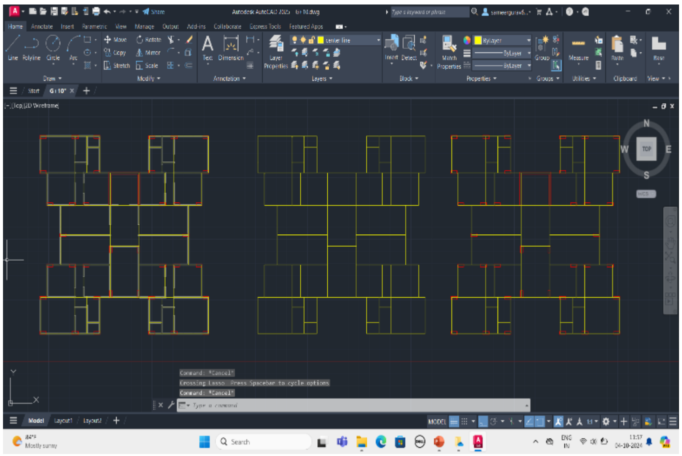
Laboratory test results were received on February 16, 2024.

The report was prepared by M/s SRS Geotech & Construction.

The net safe bearing capacity of the rock stratum was determined to be 806 kN/m^2. The water analysis results showed that the water is not aggressive towards concrete and reinforcement steel.

3. Making of Suitable Plan for the Building in AutoCAD:

Using AutoCAD, the architect or engineer creates the floor plans, elevations, and sections of the building. This plan provides the overall layout and dimensions of the structure



4. Modelling of Structure on Etab:

The structural elements (beams, columns, slabs, etc.) are model in Etab based on the architectural plans. Material properties, loads, and boundary conditions are defined.

5. Analysis Parameters:

The analysis parameters, such as load combinations, analysis type (static or dynamic), and design codes, are specified.

6. Shear Wall Modelling:

If shear walls are used in the design, they are modelled in Etab to assess their contribution to the structural stability.

7. Design Check:

The structural elements are analysed for stresses, deflections, and other parameters. The results are compared with the design codes and standards to ensure the structure's safety and serviceability.

8. Detailing of Structure:

Once the design is approved, the structural elements are detailed, including reinforcement layouts, connection details, and dimensions.

9. Comparison:

1. **Lateral Displacement**: Buildings with shear walls experience significantly lower lateral displacement compared to those without, improving stability during earthquakes.
2. **Story Drift**: Shear walls reduce story drift, making the structure more rigid and minimizing damage to non-structural elements.
3. **Base Shear**: Structures with shear walls can resist higher base shear forces, leading to better load distribution and enhanced seismic performance.
4. **Cost & Space**: While adding shear walls increases construction costs and reduces usable space, they provide superior strength and durability in high-seismic zones.

IV. CONCLUSION

Due to equivalent static method, a building with shear wall having max. displacement 11.84% less in x direction & 29.53% less in y-direction compare to building not having shear wall. Using the response spectrum method, a building with a bracing/shear wall is 19.83% less in the X direction and 48.36% less in the Y direction than a building without a bracing wall.
It is observed that the structural wall should be provided, throughout the height of building for best earth quake performance. Provision of shear wall is most effective in multi storey building. The strength and stiffness of building increases by providing shear wall.
"By placing the SW towards centre of structure leads to lesser value of deflection compare to placing of shear wall at other location." A building must have higher lateral stiffness. Due to this deformation in the building is minimum. Hence, we can say that a building with shear wall reduces maximum displacement.

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