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An Investigation of Irregularly Plane Building Consider Belt Wall At Varying Level Of Structure

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Abstract: *The structural integrity and stability of irregularly shaped buildings pose significant challenges in architectural engineering, particularly when considering the incorporation of belt walls at varying levels within the structure. This study aims to investigate the behavior of such buildings through comprehensive analysis and experimentation. By examining the interplay between irregular building shapes and the presence of belt walls at different structural levels, this research seeks to improve our Expectations of how these causes affects the overall stability and performance of the structure. Utilizing advanced computational simulations and experimental testing, various scenarios are explored to assess the effectiveness of belt walls in mitigating structural vulnerabilities and enhancing resilience against external forces, including seismic events. The findings of this investigation offer valuable insights into optimizing the design and construction of irregularly shaped buildings with belt walls, contributing to the development of safer and more sustainable architectural solutions in urban environments. In this research work using ETABS for modeling and analysis work. Prepare 17 number of floor in each model. To control basic parameters those are involve in deformation of model choose belt wall. Belt walls are located at different floor. On the basis of belt wall location divide the models in different cases. For analysis purpose consider load combination of earthquake load and dead load recommended as per IS code. In the last compare the result parameters with models consider belt wall at different level of structure.*

Keyword: *Belt wall, high-rise structure, ETABS, Irregularly shaped buildings, Structural analysis, Building stability, Seismic considerations etc.*

I. INTRODUCTION

As essential structures in modern cities and metropolises, because of their essential purpose. High-rise structures have to be considered more complicated comparing with low-rise ones because of large variety of structural components they contain & numerous aspects whose impacts have a greater impact on high-rise structures than on low-rise ones. The interplay between gravity and lateral forces in skyscrapers requires some serious structural gymnastics. It's fascinating how engineers need to balance stability, rigidity, and strength to ensure these towering structures stand tall against everything from the forces of nature to the test of time. High-rise structures are an acceptable solution to this issue due to shortage of land in cities and the rising rates of urbanization over the past several decades . The competition to build the highest and most recognizable structure in a world, area, nation, or city, where certain large structures are seen as tourist attractions in addition to the pride they provide to the city and country, such as the Eiffel Tower, Burj Khalifa, etc. As a result, complexly designed tall buildings, such those that are twisted, slanted, tapered, and aerodynamically structured, are frequently employed in today's high-rise structures.

High-Rise structure

High-rise structures, also known as skyscrapers, represent a pinnacle of architectural and engineering achievement, towering above the urban landscape as symbols of human ingenuity and progress. These buildings typically rise to significant heights, often defined as having multiple floors beyond what is considered standard for the surrounding area. The concept of high-rise buildings traces its origins back to ancient civilizations, where structures such as the Great Pyramid of Giza showcased early attempts at reaching great heights. High-rise construction really took off in the end of 19th to early 20th centuries, especially in cities like Chicago and New York. Technological advancements such as the development of steel-frame construction and elevators revolutionized building design, enabling architects and engineers to create taller and more ambitious structures.

Belt wall

A belt wall, also known as a retaining wall, is a construction designed to maintain and support soil or other materials. It is also utilize in civil engineering and building tasks to stop erosion, level surfaces, stabilize slopes, and give buildings and infrastructure structural support. Belt walls are typically constructed of concrete, steel, or masonry and can vary in design and configuration based on the specific requirements of the site and project. The term "belt" in belt wall refers to a horizontal element or reinforcement that strengthens the wall and helps distribute loads evenly. This reinforcement can take various forms, such as steel beams, concrete beams, or reinforced concrete slabs, depending on the design and engineering specifications.

II. OBJECTIVES

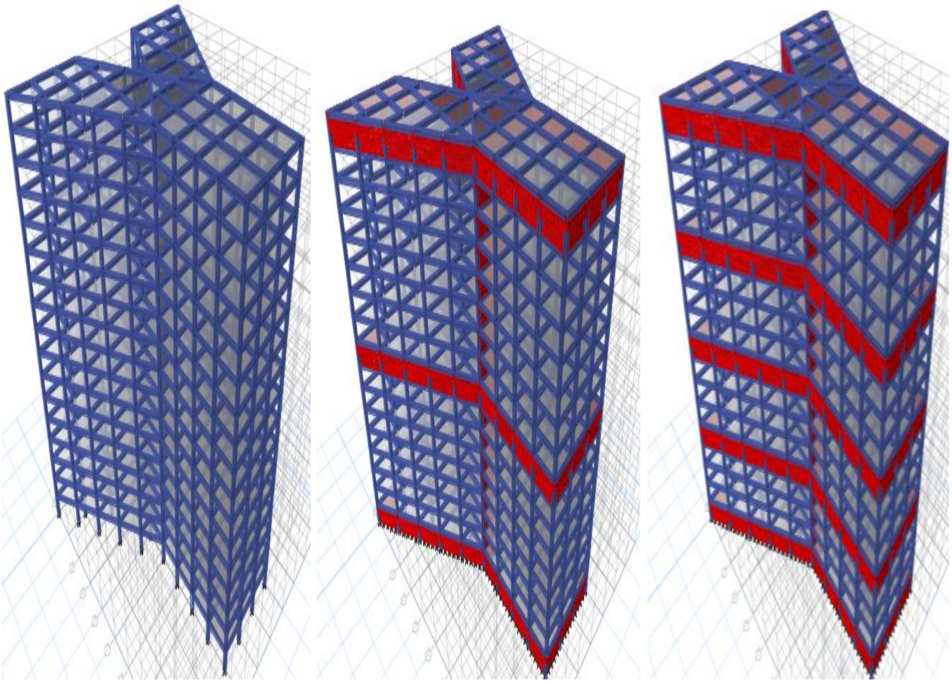
- To get comparative analysis data of models with and without belt wall.
- Assessing the effectiveness of belt walls in redistributing loads and enhancing structural stability.
- Investigating the dynamic response of irregularly shaped buildings with belt walls to external forces, such as seismic events.
- Identifying optimal configurations and placement of belt walls for improving the overall structural performance of such buildings.

III. METHODOLOGY

The proposed work aims to delve into the intricate dynamics of irregularly shaped buildings, particularly focusing on the integration of belt walls at different levels within the structure. Irregularly shaped buildings, while architecturally intriguing, often present unique challenges in terms of structural stability and resilience. By incorporating belt walls strategically at varying levels, this study seeks to explore how such features influence the overall behavior and performance of the building under different loading conditions.

Cases

- **Case-1:** Bare frame of G+16
- **Case-2:** Structure with belt wall applied on Ground, Middle and Top Floor
- **Case-3:** Structure with belt wall applied on 4, 8, 12 and 16 Floor



i) Case-1 **ii) Case-2** **iii) Case-3**

Figure 1 3D View of Unsymmetrical Model in Different cases

IV. RESULT AND DISCUSSION

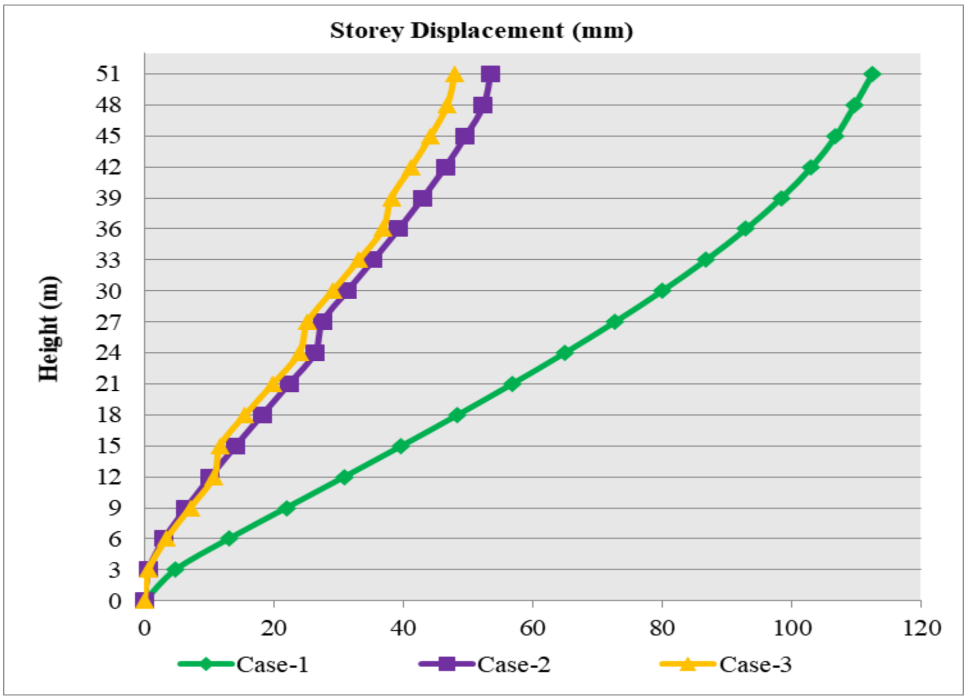


Figure 2 Combine Storey Displacement of Unsymmetrical structure

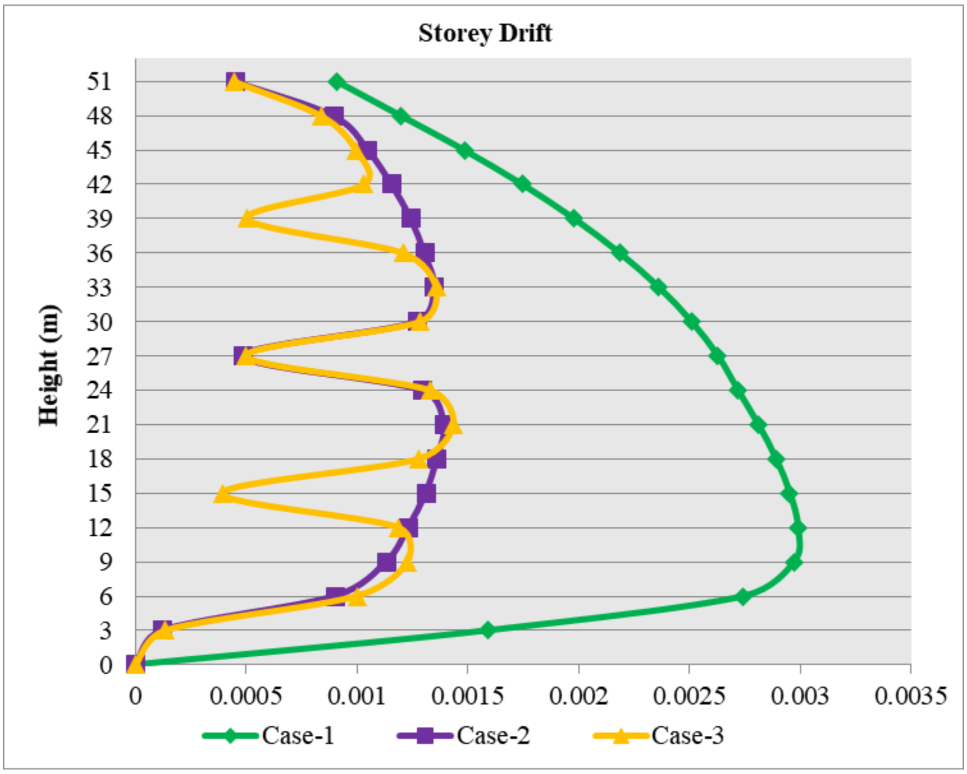


Figure 3 Combine Storey drift of Unsymmetrical structure

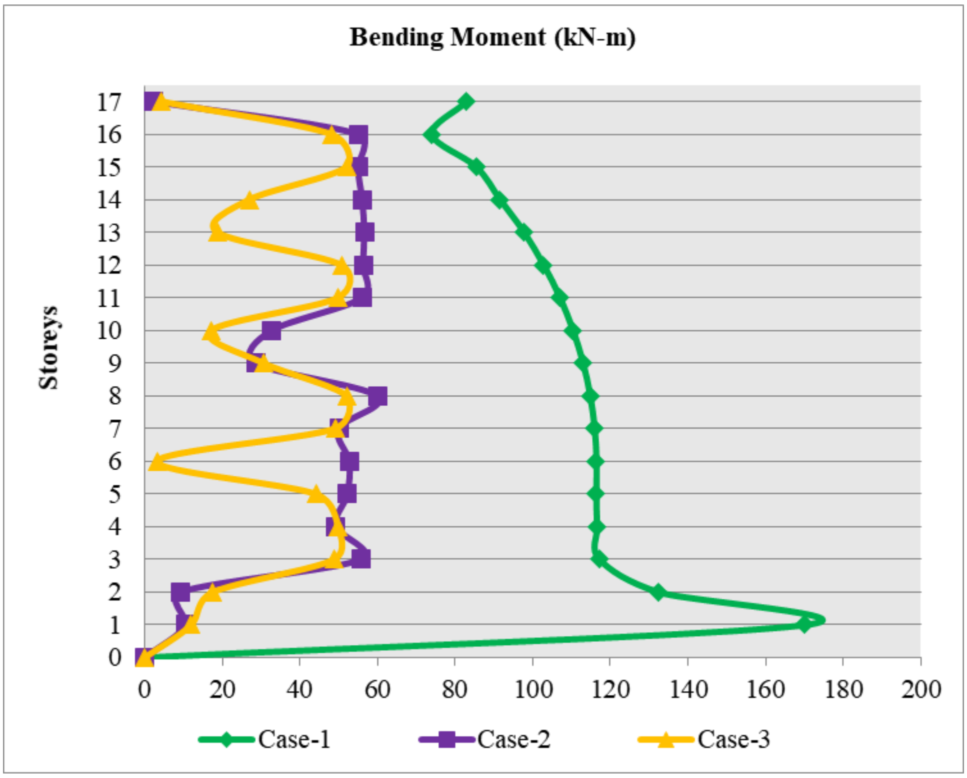


Figure 4 Combine Bending Moment of Unsymmetrical structure

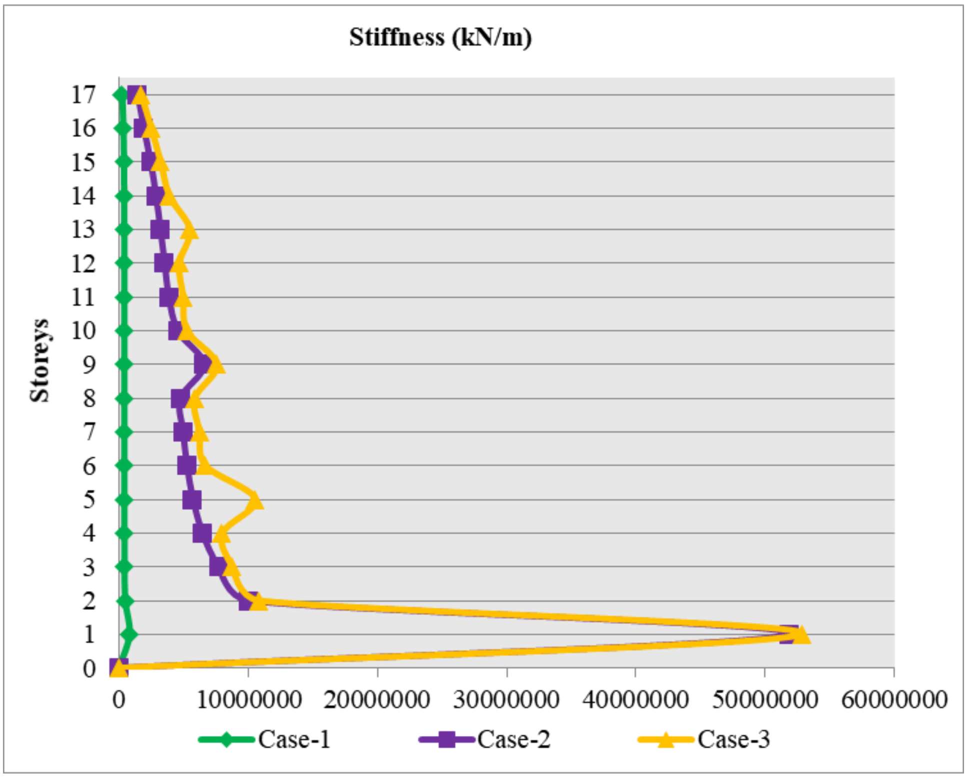


Figure 5 Combine Stiffness of Unsymmetrical structure

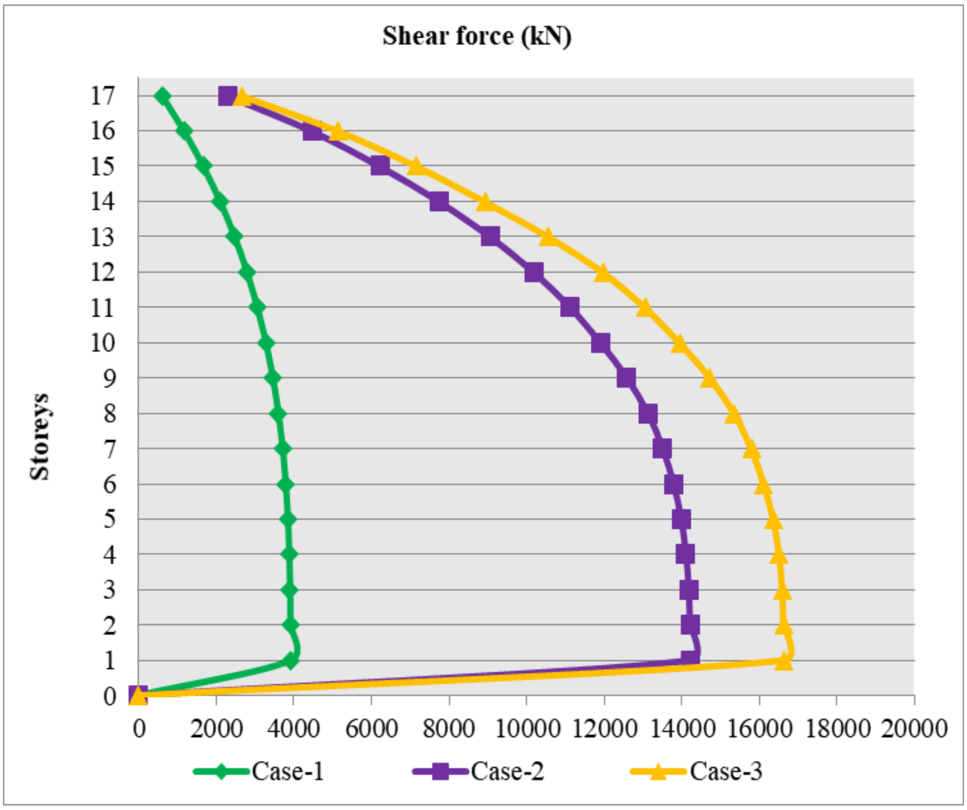


Figure 6 Combine Shear force of Unsymmetrical structure

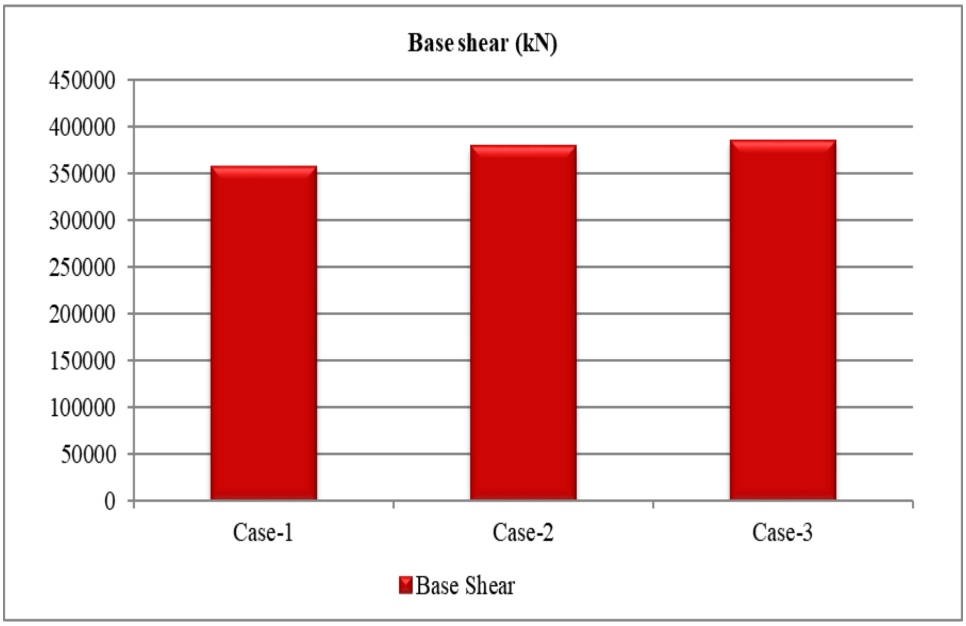


Figure 7 Combine Base Shear of Unsymmetrical structure

V. CONCLUSION

Storey displacement for bare frame of 17 floors linearly increased with increment in height of structure. Maximum displacement in bare frame was 112.46mm. Similarly, when consider belt walls at ground, mid and top levels of structure occurred maximum storey displacement was 53.45mm. In addition, in last case belt walls applied at not only ground, top and bottom, at 5th, 9th, 13th and 17th floors for this case storey displacement was 47.97mm. It was concludes that application of belt wall as case-2 reduced storey displacement was 52.47% and when belt walls consider as per case-3 reduced storey displacement was 57.34%.

Storey drift for bare frame of 17 floors linearly increased with increment in height of structure. Maximum drift in bare frame was 0.002988. Similarly, when consider belt walls at ground, mid and top levels of structure occurred maximum storey drift was 0.001392. In addition, in last case belt walls applied at not only ground, top and bottom, at 5th, 9th, 13th and 17th floors for this case storey drift was 0.001437. It was concludes that application of belt wall as case-2 reduced storey drift was 53.41% and when belt walls consider as per case-3 reduced storey drift was 51.90%. In addition, it was noticed that when apply belt wall at any floor drift value for that floor was suddenly very less.

Bending moment for bare frame of 17 floors linearly increased with increment in height of structure. Maximum moment in bare frame was 170.21kN-m. Similarly, when consider belt walls at ground, mid and top levels of structure occurred maximum bending moment was 59.96kN-m. In addition, in last case belt walls applied at not only ground, top and bottom, at 5th, 9th, 13th and 17th floors for this case bending moment was 52.14kN-m. It was concludes that application of belt wall as case-2 reduced bending moment was 64.77% and when belt walls consider as per case-3 reduced bending moment was 69.36%.

Stiffness for bare frame of 17 floors linearly increased with increment in height of structure. Maximum Stiffness in bare frame was 865837.84kN/m. Similarly, when consider belt walls at ground, mid and top levels of structure occurred maximum Stiffness was 51889040.54kN/m. In addition, in last case belt walls applied at not only ground, top and bottom, at 5th, 9th, 13th and 17th floors for this case Stiffness was 52826663.36kN/m. It was concludes that application of belt wall as case-2 enhanced and when belt walls consider as per case-3 enhanced. However, maximum increment occurred due to case-2.

Shear force for bare frame of 17 floors linearly increased with increment in height of structure. Maximum Shear force in bare frame was 3904.44kN. Similarly, when consider belt walls at ground, mid and top levels of structure occurred maximum Shear force was 14215.55kN. And in last case belt walls applied not only at ground, top and bottom, at 5th,9th, 13th and 17th floors for this case shear force was 16641.47kN. It was concludes that application of belt wall as case-2 enhanced and when belt walls consider as per case-3 enhanced. However, maximum increment occurred due to case-2.

Base shear for bare frame of 17 floors linearly increased with increment in height of structure. Maximum Base shear in bare frame was 355524.37kN. Similarly, when consider belt walls at ground, mid and top levels of structure occurred maximum Base shear was 377321.76kN. And in last case belt walls applied at not only ground, top and bottom at 5th, 9th, 13th and 17th floors for this case Base shear was 383687.75kN. It was concludes that application of belt wall as case-2 reduced base shear was 6.13% and when belt walls consider as per case-3 reduced base shear was 7.92%.

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