"BEHAVIOUR OF MULTI-STOREY TWIN STRUCTURE CONNECTION OF THE BEAMS AT DIFFERENT LEVEL: A MINI REVIEW"

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Abstract - *Two tall structures connected to one another to form a group known as a Twin Tower Structure. Generally, Analysis of Single tower type structure is easily done by structural engineers, but with the twin type structure, so many minute things need to be taken care of. Unusual building structural systems with a connection beam is new approach of building seen in both residential and commercial complexes, and many of them include a shared parking space on one, several, or lower floors or basements.*

There are ambiguities related with Height, Width, Geometry, Connection, etc. Behavioral aspect of Twin tower type structure is to be analyzed thoroughly for the Earthquake and Wind loading scenarios. This paper summarizes the work done upon the Twin tower type structures, although very few researchers have published the detailed analysis. For precise location of bridging the connection between towers parameters like storey displacement, storey shear and storey drift under seismic and wind conditions have been summarized here.

***Key Words*: Twin tower, Connecting beams, Response Spectrum Analysis, Base shear, Storey displacement, Storey drift, ETABS.**

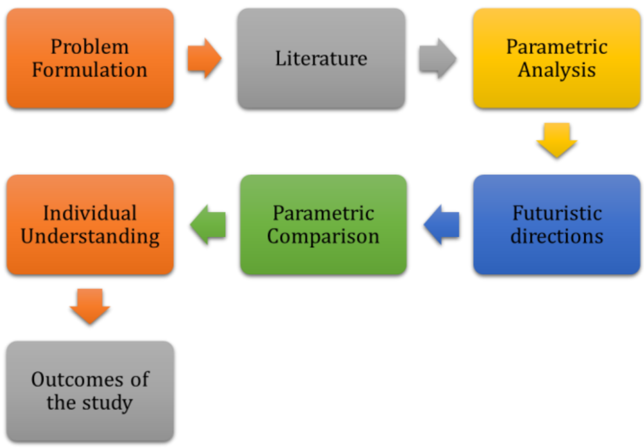
1. INTRODUCTION

In recent years, high-rise buildings architectural designs have become more innovative and striking, which has contributed to the variety of their exteriors and their dynamic behavior. Due to a lack of available land in populous places, especially in large cities, an increasing number of high-rise buildings are also being constructed in relatively close proximity. The standard definition of a tall structure is one whose structural study and design have been impacted by lateral loads, specifically sway brought on by such loads [5].

A complex structure known as a Twin tower connected building consists of two single towers that are joined by beams as the main structural elements [3]. The bottom, middle, and top of the two adjacent buildings serve as a structural link, making the structures strong enough to support this type of structure and resist seismic and wind loads [3]. When one tower experiences tragedies like fire, the connection facilitates communication between several towers and serves as a crucial route of escape [4]. High-rise linked structures have simple and proven static performance. The safety of a buildings structural and non-structural components must be guaranteed by an effective design, which also mentions the load independently.

The lateral loads caused by seismic are greater than dead or live (imposed) loads for very tall buildings because wind pressure rises with height. The amount of side sway between two adjacent stories of a building brought on by lateral (wind and seismic) load is known as lateral (storey) drift [1]. When a wall experiences wind or earthquake loads, its horizontal displacement between supports is referred to as deflection. The amount of sag caused by gravity or another vertical loading is known as a structural member vertical deflection. Wind resistance is one of the main issues in design practice since they are typically constructed to considerable heights in order to achieve a grand appearance [7].In finite-element models, several researchers have evaluated the dynamic response behaviors of tall buildings under wind and earthquake loadings. Seismological research has been done on the Taipei Financial Center, one of the tallest buildings in the world. In that study, a mega-frame system in a finite-element model was used to construct the towering building [8].

2. METHODOLOGY FOR REVIEW



3. BEHAVIOUR ANALYSIS OF STRUCTURE UNDER SEISMIC LOAD

3.1 Base shear in twin tower

1) The maximum base shear is reduced by 17% when the twin structure is 54 m tall [1].

2) Time-history analysis (2001 Bhuj earthquake) yields the maximum base shear value at 0.4H + 0.6H of structure and width of 0.6B in a 40-storey structure with 3.5-meter floor height [3].

3) Get the maximum value of the base shear at the 5th storey connection beam with an 8-meter span in a 10-storey structure [4].

4) When analyzing the structure, it was discovered that there are incrementally five stories (16 m in height) in both towers and two stories (8 m in depth) in the common basement. Its effect on the base shear has been increasing by an average of 12–14% and 18–20%, respectively [5].

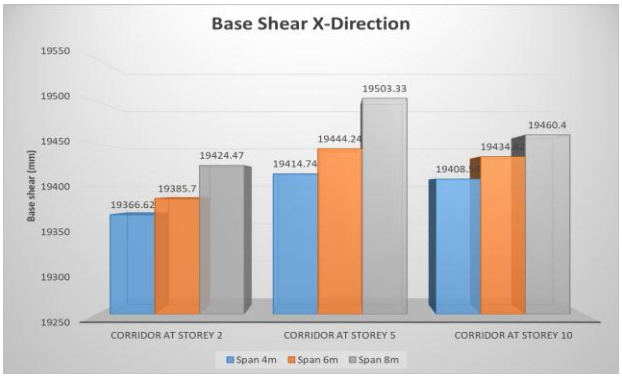


Fig. 1: Base Shear along X-Direction

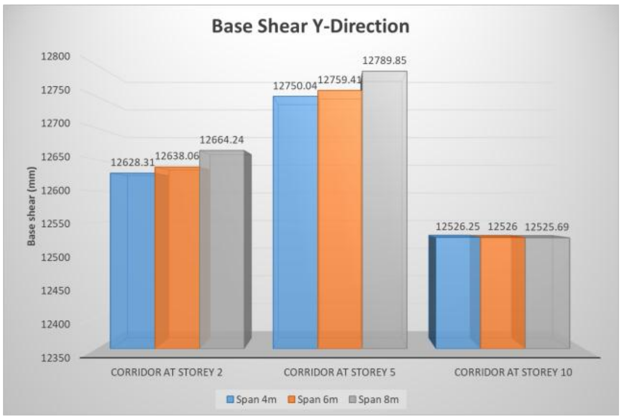


Fig. 2: Base Shear along X-Direction

3.2 Storey Displacement

1) In static earthquake conditions, the maximum storey displacement is within the permissible limit in all cases, whereas in earthquake dynamic conditions, the maximum storey displacement is only within the permissible limit in cases 5 to 8 [1].

2) In the case of a 160-meter-high structure, connecting the top two floors reduces displacement by 6% compared to the case without the structure [2].

3) In the case of 1.0B, the displacement reduces up to 5.65%, 1.66%, and 6.74% in the response spectrum, time history, and wind analysis, respectively, for a 40-storey Storey Building [3].

4) In a 10-storey structure, the connection at the top storey has a minimum value of 4m and a maximum value of 6m [4].

5) However, reducing the number of basements by four reduced displacement by 25-28% in the y-direction in an earthquake by 16-20% when reducing the number of basements by two and 25-30% when reducing the number of basements by five [5].

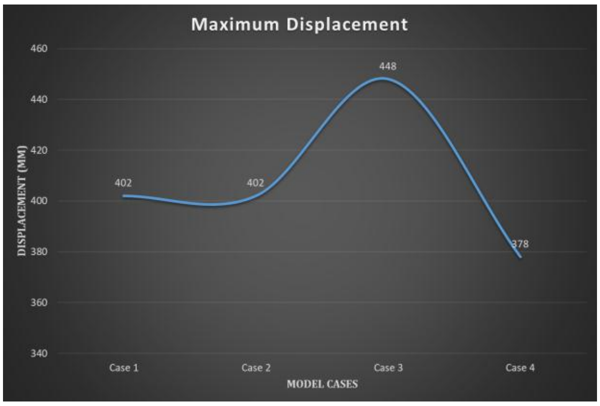


Fig. 3: Maximum storey Displacement

3.3 Storey Drift

1) Under static analysis, the maximum storey drift in an earthquake is within the allowable limit in all eight cases. However, the maximum storey drift in an earthquake under dynamic analysis is within the allowable limit only in cases 5, 6, 7, and 8, while it is exceeded in cases 1, 2, 3, and 4 [1].

2) In a 10-storey structure, the connection of stories at the 5th floor and 4m span results in the least amount of storey drift [4].

3) It is clearly observed that when decreasing the number of stories, the time period has decreased by 30–34%, and in decreasing the basement, the time period has decreased by 2-4%, respectively [5].

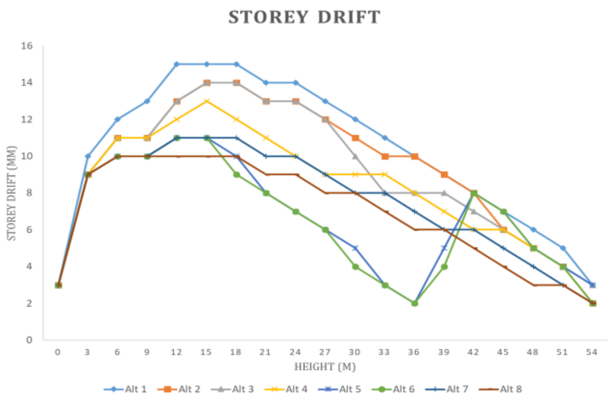


Fig. 4: Storey Drift

4. BEHAVIOUR ANALYSIS OF STRUCTURE UNDER WIND LOAD

4.1 Base shear in wind condition of twin tower

1) The maximum base shear (X-direction) is within the permissible limit only in static wind case 8, as found. However, it was exceeded by about 18% when compared to the allowable value under dynamic wind [1].

2) When the seismic forces and the wind forces act on the tower, these connections serve as the "stiffener" for both towers [6].

3) The maximum base shear increases up to 0.35% in response spectrum analysis and decreases up to 4.87% in time history analysis in the case of a 1.0B for a 40-storey Storey Building [3].

4) The shortest distance occurred in Model 1, where the corridor is on the second storey and spans 4 meters [4].

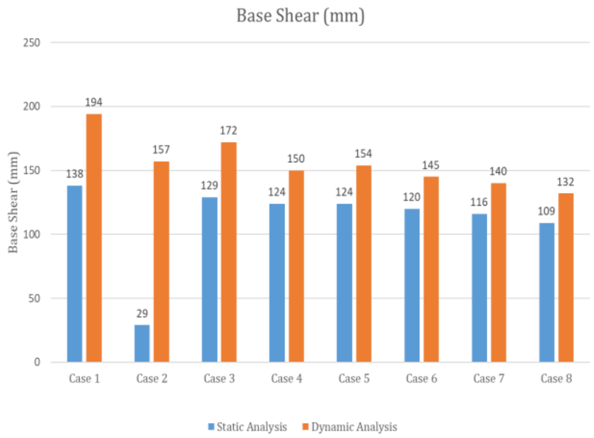


Fig. 5: Base shear under wind condition

4.2 Storey displacement in wind condition

1) The MSD is observed to be between 13–15 mm and 13–14 mm for dynamic analysis with original width of column and increased width of column, respectively [1].

2) In the case of 0.2B, the displacement reduces up to 2.36%, 3.05%, and 2.67% in the response spectrum, time history, and wind analysis, respectively. In the response spectrum and wind analysis for a 40-storey building, and in the case of 1.0B, displacement decreases by up to 6.94% and 8%, respectively, but increases by 1.36% in the time history analysis for a 50-storey building [3].

3) The maximum displacement is determined by the length of the corridor and becomes less variable as the corridor location changes. The minimum displacement is obtained when the corridor is located on the tenth floor [4].

4) The storey displacements and storey shears decreased as the connection level was raised, as the stiffness between the frames increased and greater stability was provided to the multi-tower structure [6].

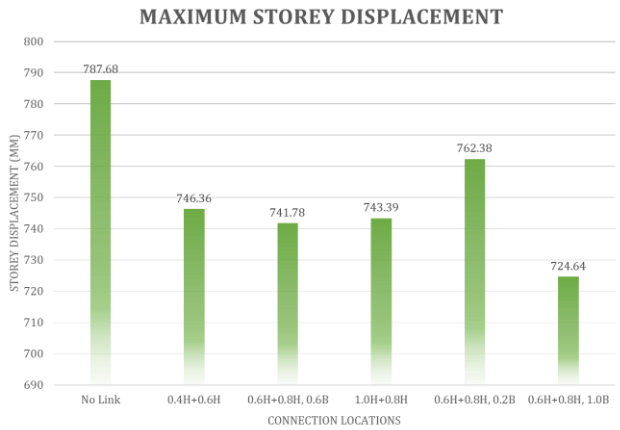


Fig. 6: Displacement under wind condition

4.3 Storey drift in wind condition

1) The storey drift follows a smooth curve in both directions and varies slightly along the corridors span and level of connection [4].

5. FUTURE SCOPE

- Wind dynamic analysis can be used to properly understand how the sky bridge behaves in the wind and over the structure.

- The shape of the building may also be changed for the same reason.

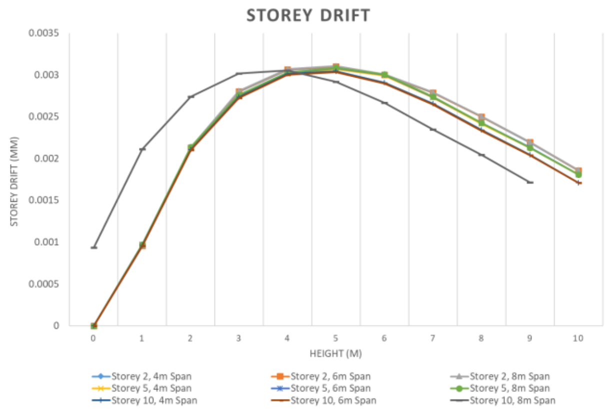


Fig. 7: Storey drift under wind condition

- Altering earthquake and wind parameters, such as zone, soil type, terrain category, etc., can also be used to conduct studies.

- It is possible to conduct additional study on other types of structures, including steel-framed buildings and shear wall-plate slab structures.

6. CONCLUSION

- The study showed that when implemented on the last floor, the link was more effective in strengthening the system and reducing responses.

- Investigation and analysis were done in both longitudinal and transverse directions to determine the impact of beam connections at different height on the induced dynamic responses of twin connected tall buildings.

- The findings that the link stiffens structures most effectively when put at about 0.8 of the building height are supported by this outcome.

- The most undesirable location of the connected beams is at the top of the building structure when considering the induced dynamic responses of twin tall buildings that are horizontally connected at various heights under earthquake loads.

- These results confirm the need for careful consideration in the design of interconnected building systems.

- According to the findings, the horizontal displacement and drift under seismic loading are greater in the longer direction than they are in the shorter direction.

- The results may vary in all the conditions when the position of connections are changed.

- If the connection provided at lower height than no major changes in results.

- Variations in results are also based on the type of materials like RCC members, Steel members.

7. REFERENCES

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