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Comparative Study on Wind Analysis of Multi Story RCC, Steel and Composite Structures: A Review

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Abstract: ***Now a days the tall structures like skyscrapers are widely adopted in major cities in India. Many major cities are very close to the coastal area which is big problem for high rise multi story buildings. The manual analysis of such a complex structure are too hectic & time consuming. So the wind analysis of such structures is done by ETABS Software. In this study three different shapes such as rectangular, L and C shape of RCC, Steel and Composite structures with and without bracing are modelled and analysed by the ETABS. The behaviour of G+25 story building has been studied. The parameters like Story displacement, Story drift and Time period are compared. After comparing all the results we can conclude that which structures is suitable under the wind effect.***

Keywords: ETABS, Composite structure, Story drift, Story displacement, Wind Analysis.

I. INTRODUCTION

Over the last two decades wind engineering has increasingly focused on the low rise and high rise structures. The recent trends in construction have given most importance to vertical growth, as the city grows in vertical aspect there is need to design structure which has given more importance to vertical growth. The vertical growth in structure can be fulfilled by constructing the high rise structure. The rapid increase of the urban population in developing countries such as India, has forced the revaluation of the importance of high rise buildings. The structural systems of high rise buildings are usually sensitive to the effects of wind.

For design of structure as safe it is important to have knowledge of various types of loads and its effect on structure. Therefore it is essential to have knowledge of their worst combination to which it may be subjected during its life span. And also to have knowledge about lateral loads such as earthquake and wind load. Now a day's many tall structures and high rise towers are being built all around the world. Wind plays an important role in design of tall structures because of its dynamic nature. Effect of wind is predominant on tall structures depending on location of the structure, height of the structure.

The effect of lateral load is very important to consider for high rise composite structure. In some cases the effect of wind is found greater than earthquake effect. It depends on the zone factor defined by codes. Lateral loads due to wind which acting on multi story building can cause shake in the upper stories. This could be effect caused due to wind at upper stories as the wind intensity is increasing with graduating heights. Thus the multi-story building also act as a portal frame the moment concentrating at base due to lateral wind forces are greater. Thus it is important to nullify displacement in lateral direction by appropriate design. The effect of shape is playing an important role in wind analysis

Wind force depends upon terrain and topography of location as well as the nature of wind, size and shape of structure and dynamic properties of building. It is very important to consider fluctuating component of wind pressure while designing. The performance of a structure can be improved when a wind acts by improving the shape of the structure by providing curved edges so that the wind load will be less.

II. LITERATURE REVIEW

A. Alkesh balerao et al. (2016)

They have presented the work on effect of structural shape of wind analysis of multi storied Rcc structures, In this study Multi-story (G+25) structure with different shape is modelled in the ETABS 2015 software, to check its lateral load stability in concern with the wind load. Four models having different structural shape is analysed for displacement and story drift and the effect of wind is analysed for different structural shape. All considered structure is compiled using RCC frame design system. The study concluded that the effective shape to resist wind load is rectangular shape structure for G+25 consideration. Generally symmetrical structure is preferred for high rise buildings and RCC structure is preferred for stiffness and durability in high rise structure. [1]

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B. Amol S. Raja at el. (2016)

They have presented the work on Wind Analysis of High Rise Building with Different Bracing Systems, this paper consist of G+19 storied Rcc building model is used with a constant configuration and with different bracing system such as diagonal bracing, X-bracing, V-bracing, chevron bracing at different locations. A structural analysis of the reinforced concrete building is performed by using software STAAD-Pro and different parameters are studied and compared. The different parameters include shear force and bending moment in the building. The study concludes that different bracing systems at different location of the structure can be effectively used to reduce excessive bending moment in column due to wind loading and also the bracing systems can effectively improve the performance of structure without adding considerable extra dead load to the structure. [2]

C. Shaikh Muffassir et al (2016)

They Presented the work on Study Of Wind Analysis Of Multi-Story composite Structure For Plan Irregularity. In this study the comparison of impact of wind for Square, Rectangular, U-shape, and H-shape building structure is presented. The modelling and analysis is done by using ETABS. The parameters such as story displacement, story drift, and time period are studied. They concluded that the displacement in U-shape structure increases abruptly as increase in height of story so the U-shape structure is not preferable in wind prone zone. Overall analysis suggests rectangular structure for along wind or across wind direction is preferable due to large stiffness and less displacement against wind. [3]

D. Kintali Sai Nanda Kishore at el. (2015)

They have presented the work on Comparative Study of Wind Analysis with Horizontal Irregularities in Multi-Storied Buildings. The modelling and analysis is carried out by using staad pro. This analysis mainly deals with the study of a Regular, L, and U shaped plan using Staad pro. Maximum shear forces, bending moments, and maximum story displacement are computed and then compared for all the analysed cases. They concluded that Bending moments in Beams and columns show a rise in the Regular Shape, L shape, U shape values as the story height reduces. Story drift in Z directions rise gradually as the story height is decreased. Drift in U shape building rise to more than 4.5 times of Regular Shape building. Bending moments in Beams and Columns due to wind forces are observed to have much larger values compared to that due to static loads. [4]

E. Sayali Gawal et al (2015)

They have presented the work on Effects of Shape on Wind Forces of High Rise Buildings Using Gust Factor Approach. In this study different shapes of building such as square, rectangular, elliptical and circular shapes are considered. The height of building is 150 m having equal plan area, equal stiffness of column are considered for wind load analysis. The modelling is done by using Etabs software. The different parameters such as story drift, story shear and axial forces in columns are studied. They concluded that Buildings having circular or elliptical plan forms have a smaller surface perpendicular to the wind direction, the wind pressure is less than in prismatic buildings. And also with the change in shape of building from square to elliptical the wind intensity, story drifts, the lateral displacements, story shear of the building decreased. Hence it is conclude that wind load is reduced by maximum percentage with an elliptical plan.[5]

F. Syed Rehan et al (2014)

They Presented the work on analysis and design of (G+15) Stories under the effect of earthquake and wind for Composite, Steel and RCC structure. The modelling and analysis is done by using Staad pro. And they compare the result of Composite, RCC and steel building such as story displacement, story drift and Maximum bending moment and shear forces. They suggest that composite structure is better option compare to RCC and Steel. [6]

G. Jawad Ahmed et al 2013

They presented the work on Wind Analysis and Design of Multi Bay Multi Story 3D RC Frame. In this study wind analysis on buildings with different number of storys is done using ETABS software. The research work includes a total number of forty five models of multi story buildings. The models are categorized based on aspect ratio of the building. With an aspect ratio of 1, fifteen models are used with five story, fifteen story and thirty five story height. Five different case are used in the model with five story as mentioned, bare frame with wall loads, shear wall in X and Y direction, RC double diagonal bracing in X and Y direction. Similarly the fifteen and thirty five story models were analysed. Also the same numbers of models were analyzed with aspect ratios of 1.5 and 2.0. A comparison of lateral displacements and maximum story drifts in X and Y directions are made for all the models. They

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concluded that RC shear wall acts as better lateral load resisting element when compared to the RC double diagonal bracing. The presence of RC shear wall influences the overall behaviour of structures when subjected to lateral forces. Hence RC shear wall can be considered as displacement and drift control structural element. The concept of using RC shear wall is one of the advantageous concepts which can be used to strengthen structure. Since the lateral displacement is less for five and fifteen storey buildings. Thus the design of buildings of low to medium height the wind effects can be ignored which is usually practiced. [7]

H. Alfa rasikan et al 2013

They presented the work on wind behaviour of buildings with and without shear wall. In this study modelling is done by using staad pro. The models of 15 and 20 story building is considered with and without shear wall and the displacement of buildings were compared. They concluded that the displacement for a 15 story building with shear wall was 20.18% less than the 15 story building without shear wall and the displacement for a 20 story building with shear wall was 14.6% less than the20 story building without shear wall. Hence it is found that building with shear wall resist the wind load effectively. [8]

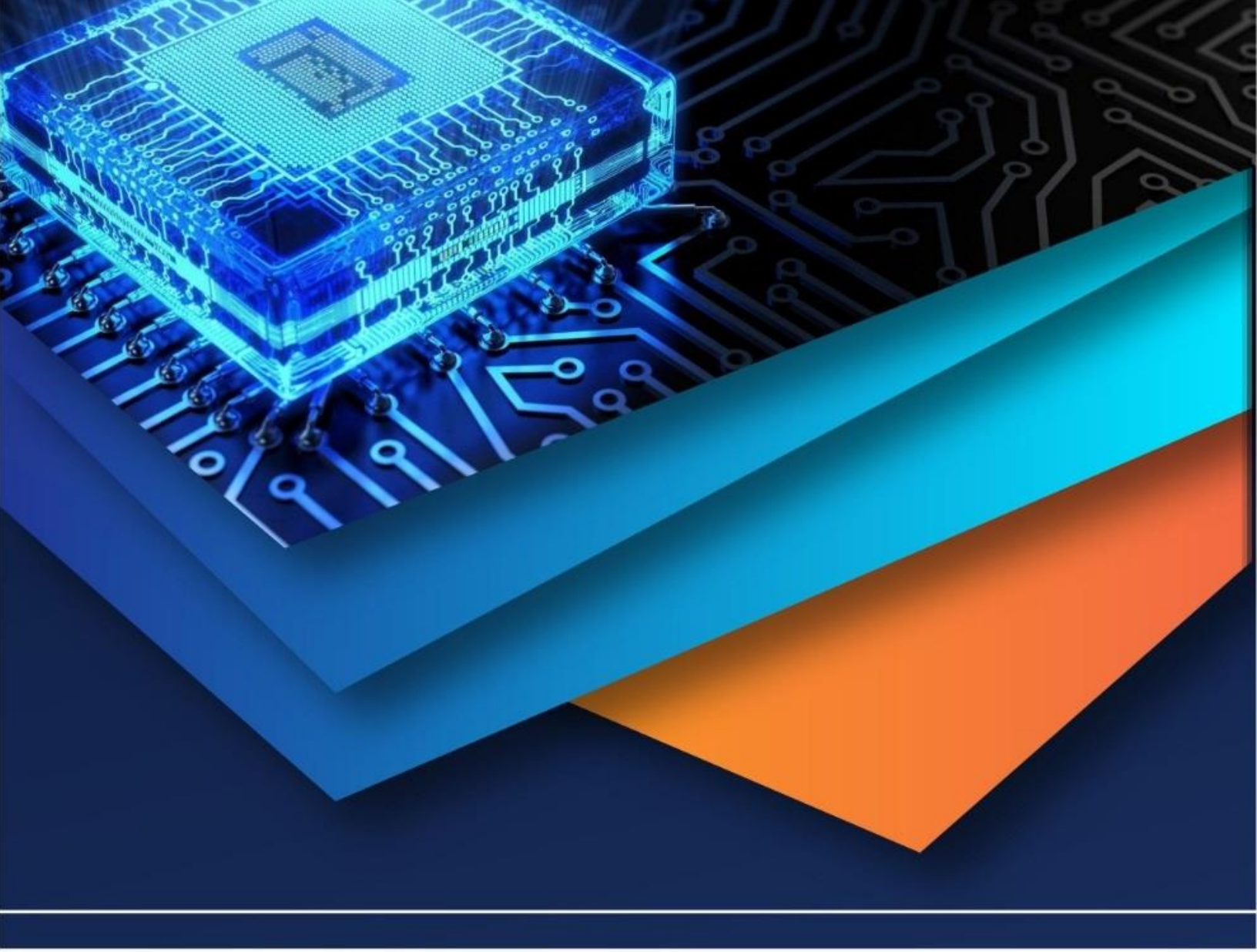
III. CONCLUSION FROM LITERATURE

A. Generally symmetrical structure is preferred for high rise buildings and RCC structure is preferred for stiffness and durability in high rise structure.
B. The most effective shape to resist wind load is rectangular shape structure
C. The change in shape of building effects the wind intensity, story drifts, the lateral displacements and story shear
D. RC shear wall acts as better lateral load resisting element when compared to the RC double diagonal bracing.
E. The presence of RC shear wall influences the overall behaviour of structures when subjected to lateral forces. Hence RC shear wall can be considered as displacement and drift control structural element.
F. The displacement of buildings with shear wall is less than the displacement of buildings without shear wall.
G. The different bracing systems can effectively improve the performance of structure when subjected to wind loading.
H. The displacement in U-shape structure increases abruptly as increase in height of story so the U-shape structure is not preferable in wind prone zone.

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