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ANALYSIS ON IMPACT OF WIND LOAD ON MULTI STOREY (G+5) BUILDING IN DIFFERENT TERRAIN CATEGEORIES BY USING STAAD.PRO

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Abstract:

In building structures wind is critical load and needs to be considered for safety and serviceability of structures. As we construct high rise buildings wind force acting on the surface of the structure increases. As we go higher, wind excitation becomes one of the most precarious forces acting on the surface of the structure and if the plan geometry is irregular, it can induce torsion. This can be life-threatening to the structure, so it is essential to analyse and understand such forces during designing. That analysed design work is very useful for further study of wind. So as per the provision of Indian standards IS875:2015(part3) wind load is considered under different terrain categories. The structural results of analysis are used to verify the structure fitness for use. Computer software's are also being used for the calculation of forces, bending moment, stress, strain &deformation or deflection for a complex structural system. STAAD. Pro is one of the leading software's for the design of structures. In this project we considered a G+5 structure in STAAD pro. The structure is analysed as per Indian standards. The main objective of this project is to compare the variations of lateral displacement, maximum bending moment, maximum shear force and maximum deflection of the same structure in different terrain categories.

KEY WORDS: Wind Load, Terrain, Multi storey building, Design Analysis and STAAD.Pro

1. INTRODUCTION:

In India residents are increasing gradually for that reason multi story buildings are best choice for construction in Metro cities where a smaller amount of property is presented. As designer knows multi story structure provides large floor area in small area and it is beneficial also. Hence, it is required to assemble high rise structure. If high rise structures are constructed than many structural troubles come to pass, such as lateral load effect, lateral displacement and stiffness etc. Normally for high rise structure wind and earth quake load effects are prevailing. Therefore, for high rise structure it is essential to have knowledge of different loads and its effect on structure. There are many types of effect worked on structure and causes for failure. The effect of lateral load is very important to consider such as earthquake and wind loads. In some cases, the wind load is important than earthquake load which depends on place and zone factor, for design of high-rise structures wind load is a critical parameter especially for taller structures constructed in non-seismic area. For the analysis of wind load most of the countries are developed its own standards and related specification for effective analysis and design of structures. For this analysis we use software like STAAD.Pro for both design and analysis purpose. As we know that STAAD.Pro is an analysis & design software package for structural engineering used in performing the analysis & design of wide variety of types of structures. It allows structural engineers to analyze & design virtually any type of structure through its flexible Modelling environment, advanced features & fluent data collaboration. STAAD.Pro may be utilized for analyzing and designing practically all types of structures like buildings, Bridges, towers, transportation, industrial and utility structures. So, we are using STAAD.Pro for designing and analyzing of our structure. To learn the analysis and design of wind load. **The observations made from this study was the behavior of structure under wind load, to make the study of effect of wind load on structures in different terrain categories, to show the comparative results of structure by considering different loads in different terrain categories.**

2. MATERIALS AND METHODS:

Here we are using STAAD.Pro an analysis software.

STAAD is powerful design software licensed by Bentley STAAD stands for Structural Aided Analysis and Design. Any object which is stable under a given loading can be considered as structure. So first find the outline of structure, whereas analysis is the estimation of what are the type of loads that acts on the beam and calculation of shear force and bending moment comes under analysis stage. Design phase is designing the type of material and its dimensions to resist the load. This we do after the analysis. To calculate SFD and BMD a complex loading beam it takes about an hour. So, when it comes in to the building with several members it will take a week. STAAD pro is a very powerful tool which does this job in just an hour`s STAAD is best alternative for high rise buildings. Nowadays most of the high-rise buildings are designed by STAAD which makes a compulsion for a civil engineer to know about this software. This software can be used to carry RCC, steel, bridge, truss etc according to various country codes. The following parameters were considered

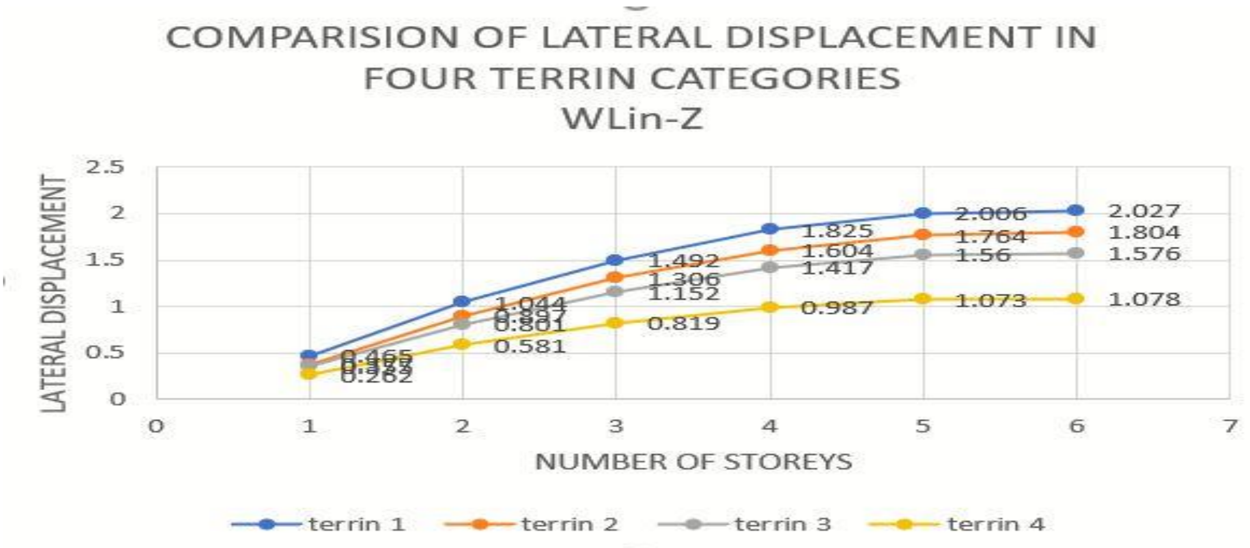
- Area of building = 416.64 sq.m
- Length of the building = 24.8m
- Width of the building = 16.8m
- Storey height = 3m
- Size of column = 400mm*400mm
- Size of beam = 250mm*300mm
- Thickness of slab = 150mm
- Thickness of outer walls = 230mm
- Thickness of inner walls = 150mm
- Support condition = Fixed
- Grade of concrete = M25
- Grade of steel = Fe415
- Type of building = Residential

3. RESULTS AND ANALYSIS

The STAAD.Pro was used here for the analysis of G+5 building under different terrains ans wind loads. The results of this analysis discussed here.

Table 1. shows Comparison of lateral displacement from storey to storey under the load WL in -Z

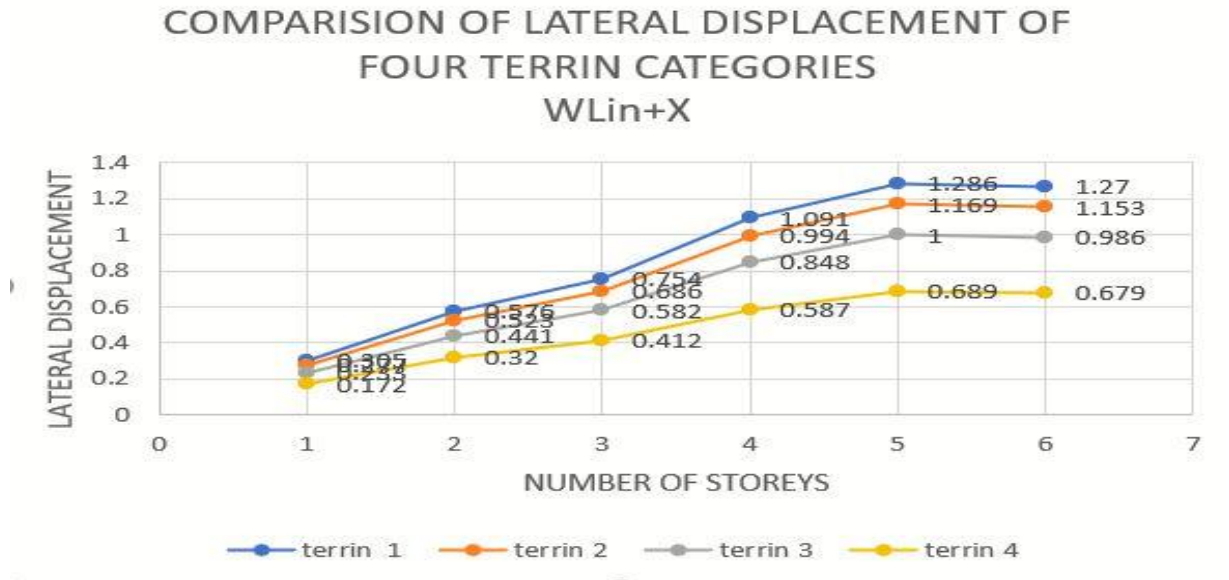
sno	Number of The storey	load	TERRAIN-1				TERRAIN-2				TERRAIN-3				TERRAIN-4			
			Lateral Displacement				Lateral Displacement				Lateral Displacement				Lateral Displacement			
			X	Y	Z	R	X	Y	Z	R	X	Y	Z	R	X	Y	Z	R
1.	Storey1	**WL-Z**	0.010	0.004	**-0.465**	0.465	-0.001	0.004	**-0.377**	0.377	0.008	0.003	**-0.0355**	0.355	0.006	0.002	**-0.262**	0.262
2.	Storey2	**WL-Z**	0.021	0.007	**-1.044**	1.044	0.007	0.006	**-0.897**	0.897	0.016	0.005	**-0.801**	0.801	0.012	0.004	**-0.581**	0.581
3.	Storey3	**WL-Z**	0.053	0.008	**-1.492**	1.493	0.036	0.008	**-1.305**	1.306	0.041	0.007	**-1.152**	1.152	0.029	0.004	**-0.819**	0.819
4.	Storey4	**WL-Z**	0.030	0.009	**-1.825**	1.826	0.013	0.008	**-1.604**	1.604	0.023	0.007	**-1.417**	1.417	0.016	0.005	**-0.987**	0.987
5.	Storey 5	**WL-Z**	0.023	0.009	**-2.006**	2.006	0.006	0.009	**-1.764**	1.764	0.018	0.007	**-1.560**	1.560	0.012	0.005	**-1.073**	1.073
6.	Storey 6	**WL-Z**	0.028	0.009	**-2.027**	2.027	0.015	0.009	**-1.804**	1.804	0.021	0.007	**-1.576**	1.576	0.015	0.005	**-1.078**	1.078



Graph 1. represents the lateral displacement from storey to storey under the load WL in -Z

Table 2. shows Comparison of lateral displacement from storey to storey under the load WL in +X

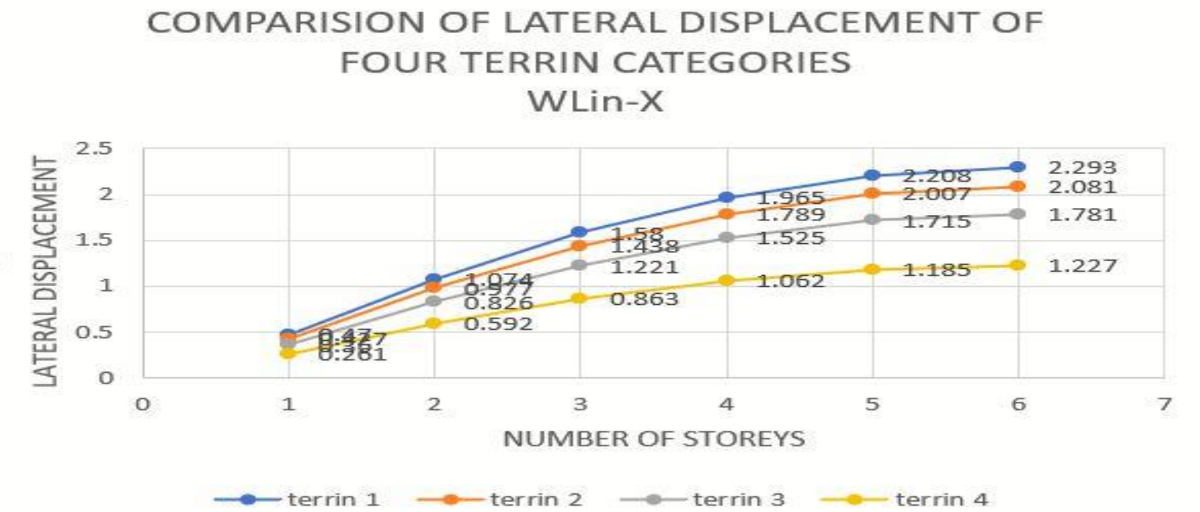
sno	Number of The storey	load	TERRAIN-1				TERRAIN-2				TERRAIN-3				TERRAIN-4			
			Lateral Displacement				Lateral Displacement				Lateral Displacement				Lateral Displacement			
			X	Y	Z	R	X	Y	Z	R	X	Y	Z	R	X	Y	Z	R
1.	Storey1	WL+X	**0.305**	0.005	0.180	0.354	**0.277**	0.004	0.163	0.322	**0.233**	0.004	0.139	0.271	**0.172**	0.003	0.098	0.198
2.	Storey2	WL+X	**0.576**	0.008	0.972	0.744	**0.523**	0.008	0.429	0.677	**0.441**	0.007	0.365	0.573	**0.320**	0.004	0.256	0.410
3.	Storey3	WL+X	**0.754**	0.011	0.741	1.058	**0.686**	0.010	0.674	0.962	**0.582**	0.009	0.574	0.818	**0.412**	0.006	0.402	0.576
4.	Storey4	WL+X	**1.091**	0.012	0.941	1.440	**0.994**	0.011	0.855	1.311	**0.848**	0.010	0.729	1.118	**0.587**	0.007	0.509	0.777
5.	Storey 5	WL+X	**1.286**	0.013	1.090	1.686	**1.169**	0.012	0.991	1.532	**1.000**	0.010	0.845	1.309	**0.689**	0.007	0.588	0.705
6.	Storey 6	WL+X	**1.270**	0.013	1.205	1.751	**1.153**	0.012	1.095	1.590	**0.986**	0.010	0.935	1.359	**0.679**	0.007	0.649	0.939



Graph 2. represents the lateral displacement from storey to storey under the load WL in +X

Table 3. shows Comparison of lateral displacement from storey to storey under the load WL in -X

sno	Number of The storey	load	TERRAIN-1				TERRAIN-2				TERRAIN-3				TERRAIN-4			
			Lateral Displacement				Lateral Displacement				Lateral Displacement				Lateral Displacement			
			X	Y	Z	R	X	Y	Z	R	X	Y	Z	R	X	Y	Z	R
1.	Storey1	WL-X	-0.470	0.007	0.183	0.504	-0.427	0.006	0.166	0.458	-0.360	0.005	0.141	0.387	-0.261	0.003	0.099	0.279
2.	Storey2	WL-X	-1.074	0.011	0.479	1.176	-0.977	0.010	0.436	1.070	-0.826	0.007	0.371	0.906	-0.592	0.006	0.261	0.647
3.	Storey3	WL-X	-1.580	0.014	0.757	1.752	-1.438	0.012	0.688	1.595	-1.221	0.011	0.586	1.354	-0.363	0.007	0.411	0.955
4.	Storey4	WL-X	-1.965	0.015	0.954	2.184	-1.789	0.014	0.867	1.988	-1.525	0.012	0.739	1.694	-1.062	0.008	0.516	1.181
5.	Storey 5	WL-X	-2.208	0.016	1.100	2.467	-2.007	0.014	1.000	2.242	-1.715	0.012	0.853	1.915	-1.185	0.008	0.593	1.325
6.	Storey	WL-X	-2.293	0.016	1.211	2.594	-2.081	0.014	1.101	2.355	-1.781	0.012	0.940	2.014	-1.227	0.008	0.652	1.389



Graph 3. represents the lateral displacement from storey to storey under the load WL in –X

4. CONCLUSIONS

The following conclusions were drawn from the above study,

- The maximum Lateral Displacement in the Node no. 395 +Z direction is observed in Terrain 1 for the case of 1.5(DL+WL in +Z) in the building.
- The maximum Lateral Displacement in the Node no. 445-Z direction is observed in Terrain 1 for the case of 1.5(DL+WL in -Z) in the building.
- The maximum Lateral Displacement in the Node no. 404 +X direction is observed in Terrain 1 for the case of 1.5(DL+WL in +X) in the building.
- The maximum Lateral Displacement in the Node no. 413 -X direction is observed in Terrain 1 for the case of 1.5(DL+WL in -X) in the building.
- The maximum Lateral Displacement in the Node no. 404 +X direction is observed in Terrain 1 for the case of 1.5(DL+WL in +X) in the building.
- The maximum Lateral Displacement in the Node no. 395 +Z direction is observed in Terrain 1 for the case of (WL in +Z) in the building.
- The maximum Lateral Displacement in the Node no. 445 +Z direction is observed in Terrain 1 for the case of (WL in-Z) in the building.
- The maximum Lateral Displacement in the Node no. 404 +X direction is observed in Terrain 1 for the case of (WL in-X) in the building.
- The maximum Lateral Displacement in the Node no. 413 -X direction is observed in Terrain 1 for the case of (WL in -X) in the building.
- We observed that lateral displacement is varies from storey to storey, the maximum lateral displacement is highest in 6th storey of the building in terrain 1.

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