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Study and Behaviour of Wind Evaluation of Multi-Storey Building with Floating Columns

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Abstract: Tall buildings often face space constraints due to the current surge in urbanization. The structure can be affected by wind gusts in both directions. These gusts have the potential to impact the structure from both directions. Over the past few years, the structure has experienced effects from these gusts in both directions. These designs aim to enhance the visual perspective of the projects they undertake. The variability in floor height causes a discontinuity in the stiffness of the structure at the level of the soft story. This phenomenon is caused by floor height fluctuations. In the even If winds expose this discontinuity, it could potentially cause buildings to This study aimed to perform a static analysis of three-dimensional building frames, which included G+7 storeys, floating columns, and soft storey elements. elements. The other sixty-four examples feature floating columns at a single level, with the soft storey varying directly from the ground (G) story to the G+7 storey. Eight of the instances include centre floating columns on any one of the storeys, while sixty-four of the other cases have floating columns at a certain level. This instance considers a total of seventy-three instances. Furthermore, we construct a simple example where neither the storeys nor any of the column's float, adhering to the previously stated conditions. We conducted the analysis using the maximum node displacements (resultant), maximum moments, maximum shear force, maximum axial force, and maximum storey drift. It is necessary to do an analysis of the findings in order to arrive at technical conclusions.
Keyword: floating columns, G+7 storey, maximum node displacements (resultant), maximum moments, maximum shear force, maximum axial force, and maximum storey drift.

I. INTRODUCTION

The most fundamental factor that differentiates the design of high-rise structures from low- to medium- rise buildings is the potential lateral loading from wind or earthquakes. However, this is not the only factor that causes these differences. This situation arises due to the transfer of lateral loads by wind and earthquakes. To be more specific, this is because high-rise structures are built to withstand higher heights than other types of buildings. Wind loads have a minimal influence on the design of buildings that are up to about ten stories tall and have proportions that are typical of the structure. There are certain exceptions to this rule. However, when elevating the building to a height exceeding this limit, the structural sections' size will increase, necessitating structural reorganization to withstand wind loads. This is because the structural sections will expand from their original size. Towering building structures are more likely to deflect and wobble in response to wind loads. This is because tall buildings are more efficient and lighter than other buildings.

A. Objectives

The main objective of this work is to analyze the building frames with floatingcolumns and soft storeys under wind loads. The structures, under which conditions are relatively more secure, is to be determined. The building frames are analyzed using software STAAD.Pro. Following are the considerations on basis of which we will analyze the results-

1) Maximum node displacements,
2) Maximum moments.
3) Maximum shear force, Maximum axial force, and Maximum storey drift.

B. Scope of study

The main objective of this study is to compare seismic response of G+20 structure modelled with and without FC having construction sequence analysis (CSA) method in combination with the seismic load analysis in different zones. Under seismic Zone III, investigates the behaviour of multi-story buildings with and without FCs.

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Storey drift, displacement, and storey shear are discovered using the response spectrum approach. The floating column structure is more vulnerable to movement than a standard column structure In every scenario, displacement rises from lower to higher storeys.

C. Floating column and storey drift

It is often expected that the load will be transferred to the ground by way of a column, which is a vertical component that begins at the level of the foundation. The term "floating column" refers to a vertical component that is supported by a beam, which is a component that is oriented horizontally relative to the vertical component. The lowest level of the vertical element is where you will find this beam. The load transmission channel is interrupted in buildings that feature columns that hang or float on beams at an intermediate level and do not run all the way to the foundation. These kinds of buildings are referred to as multi-story buildings. The reason behind this is that the beams are unable to reach the base during construction. A soft storey, which is also sometimes referred to as a weak storey, is a storey that has a much lower resistance, or stiffness, than the stories that are positioned above or below it in the context of a structure. using STAAD Pro, analyze the structural model under various wind load scenarios, comparing the results for both scenarios to assess the impact of floating columns on wind resistance and structural performance. To predict the wind evaluation of a multi-story building with and without floating columns

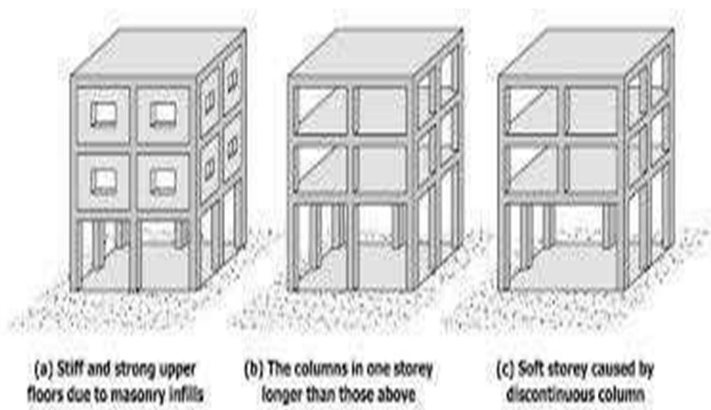

Figure 1: Floating building

II. LITERATURE REVIEW

The connected and alike literature has been studied and mentioned in following sections:

U. Arya et al. The researchers concluded, after completing a wind study on building frames constructed on sloping terrain, that the maximum axial force increases with an increase in the land slope. They arrived at this conclusion after successfully completing the wind study. This was the conclusion that the researchers came to as a result of their investigation, the researchers came to this conclusion. An increase in wind speed could potentially lead to a decrease in the maximum support response at the windward column. This is due to the constant increase in wind speed.

P. Kheyari et al. ANSYS's computational fluid dynamics software successfully assisted in the challenging task of estimating the wind load that a tall building would receive in the presence of interference effects. ANSYS made this software available to its users. The case study results reveal that the downwind structure experiences the most significant interference effects.

B. D. Prajapati et al. The researchers concluded that displacement is within the acceptable range for all three types of buildings they considered during their investigation into the effects of earthquakes and wind on multi-story reinforced concrete structures, steel structures, and composite structures. This was the conclusion that they reached. When compared to the building of a structure that does not integrate composite materials, the construction of a structure that is constructed using composite materials requires the use of structural steel sections that are of a much smaller size. This happens because the span and loading don't change during the erection of the structure.

When compared to other structures, composite structures have a lower overall weight, which results in a reduction in the cost of both the structure and the foundation. Composite structures are often used in construction. Structures made of composite materials are also more cost-effective. This is due to the fact that the composite structure is made up of composite materials, which is the cause of this.

III. METHODOLOGY

A. *Classification of cases*

1) Group 1: In this group only a normal case of G+7 storey has been analyzed. Normal case in which neither floating columns are present nor any soft storey is present. Height of buildings is 24 m.
2) Group 2: In this group**,** buildings in which only a particular storey level has floating columns. No soft storey at any level in any case of this group. Height of buildings is 24 m.
3) Group 3: In this group, buildings in which a particular storey has floating columns with soft storey being varied from ground storey to G+7 storey level. Height of buildings is 25 m.

B. *Wind load*

Towering building structures are more likely to deflect and wobble in response to wind loads. This is because tall buildings are more efficient and lighter than other buildings. Because of this increased possibility, wind loads are more likely to occur.

We use a restricted time frame of around three seconds to determine the fundamental wind speed, which is based on the peak gust velocity that averages over a period of three seconds.

$Vz=Vb \times k1 \times k2 \times k3$

Where, k1 = risk coefficient

k2= terrain, height and structure size factor k3 =topography factor

To calculate the design wind pressure at any height higher than the mean ground level, use the following link between wind pressure and wind velocity.This link refers to the relationship between wind pressure and wind velocity.

$Pz = 0.6\,(Vz)^2$

C. *Structural Modelling*

STAAD. Pro serves as a software package for structural modelling and analysis. The arrangement shown in Figure 1, measuring 72 square metres (12 m × 6 m), is universally suitable for all cases of Group 1, Group 2, and Group 3. Figure 2, 3, 4, and 5 show several models for creating frames tailored to different groups.

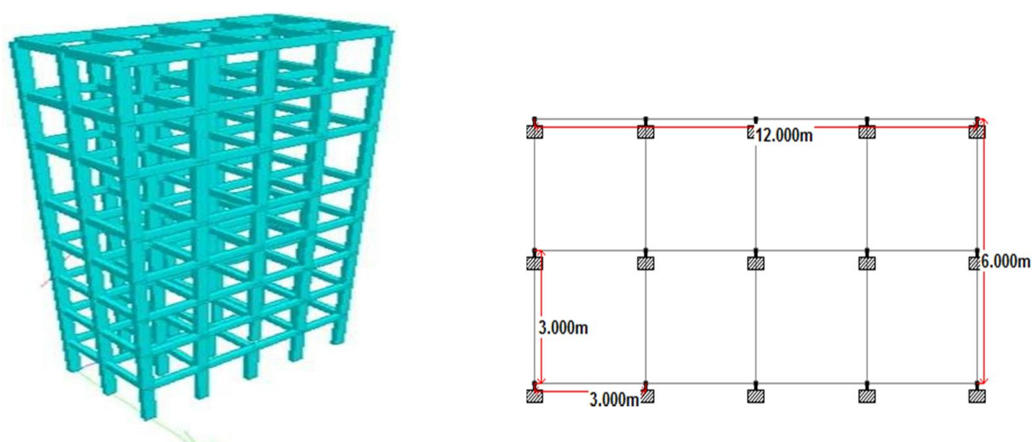

Figure 2:3D modelling

IV. RESULTS AND DISCUSSIONS

1) Wind pressures are influenced by structural height and configuration.
2) Results indicate significant differences based on column placement.
3) Floating columns cause notable structural robustness variations.
4) Future studies on buckling effects and wind load variations are recommended.

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a) Group 1

Table 1: Group 1 behavior

Max. Node disp. (Res.) (mm.)	Max. B.M. Mz (kNm)	Max. Axial Force Fx (kN)	Max. S.F. Fy (kN)
17.299	51.537	883.648	44.372

b) Group 2

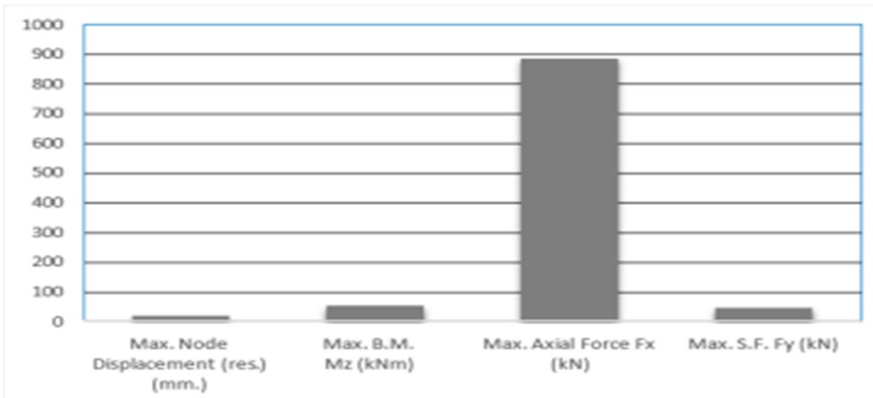

Figure 3: Group 1 building

Table 2: Group 2 building

Floating column at	Max. Node disp. (Res.) (mm.)	Max. B.M.: Mz (kNm)	Max. Axial Force: Fx (kN)	Max. S.F. : Fy (kN)
G	19.363	130.945	1192.881	108.099
G+1	19.125	54.291	112.327	62.307
G+2	18.956	47.416	103.829	57.816
G+3	18.724	41.432	96.377	53.958
G+4	18.383	36.191	90.899	50.627
G+5	17.985	35.210	87.784	47.606
G+6	17.694	35.111	86.029	44.683
G+7	17.429	35.112	85.400	30.325

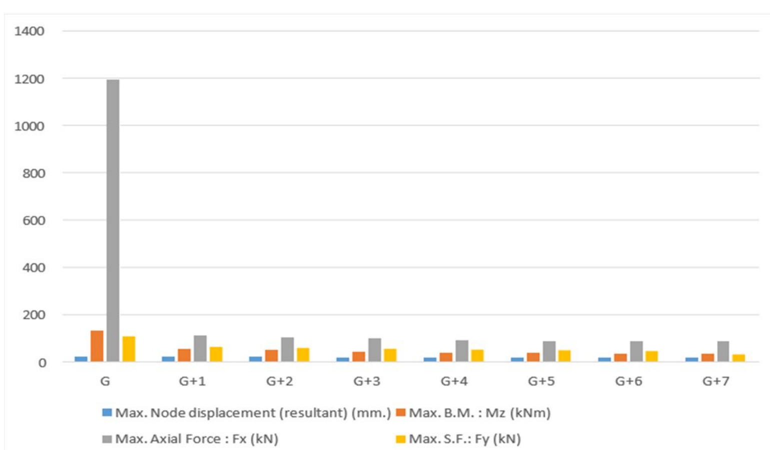

Figure 4: Group 2 Buildings

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c) *Group3*

Table 3: Group 3 Building

Soft Storey at	Max. Node disp. (Res.) (mm.)	Max. B.M.: Mz (kNm)	Max. Axial Force: Fx (kN)	Max. S.F. : Fy (kN)
G	22.844	127.811	1179.706	106.459
G+1	20.559	60.112	697.324	55.255
G+2	22.483	82.236	695.789	69.182
G+3	22.449	81.440	697.94	68.646
G+4	23.365	81.02	699.166	68.351
G+5	22.899	80.764	699.858	68.173
G+6	22.331	80.613	700.205	68.067
G+7	21.882	80.610	700.840	68.066

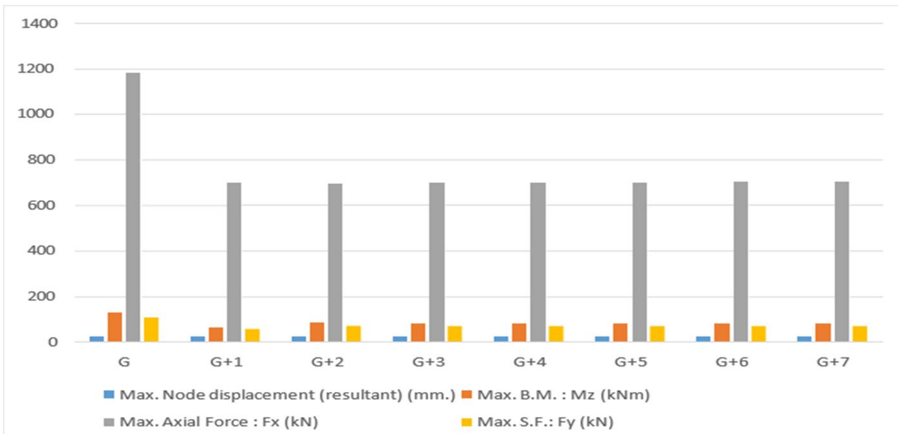

Figure 4: Group 3 building

A. *Maximum Storey Drift*

Storey	Group1	Group2	Group 3							
			CASE 1-8	CASE 9-16	CASE 17-24	CASE 25-32	CASE 33-40	CASE 41-48	CASE 49-56	CASE 57-64
G	0.436	0.529	1.049	0.853	0.846	0.847	0.846	0.846	0.846	0.846
G+1	0.693	0.821	0.940	1.490	1.250	1.241	1.241	1.240	1.240	1.240
G+2	0.739	0.874	1.297	1.316	1.562	1.315	1.305	1.303	1.303	1.302
G+3	0.728	0.864	1.283	1.285	1.303	1.552	1.302	1.292	1.290	1.290
G+4	0.647	0.768	1.195	1.196	1.195	1.216	1.445	1.211	1.202	1.202
G+5	0.502	0.592	0.923	0.924	0.925	0.925	0.943	1.113	0.936	0.931
G+6	0.342	0.347	0.621	0.623	0.623	0.625	0.625	0.638	0.748	0.636
G+7	0.177	0.260	0.386	0.387	0.389	0.389	0.389	0.388	0.395	0.476

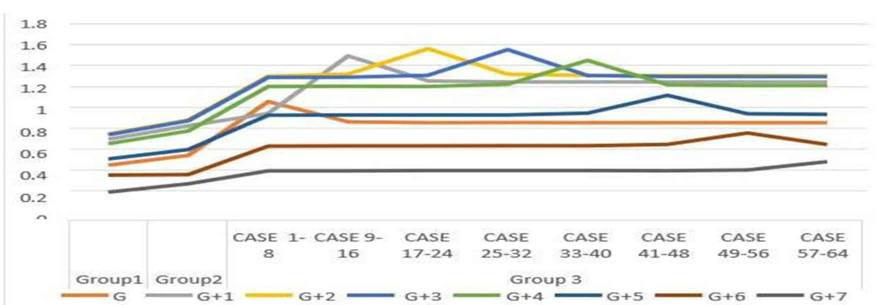

Figure 5: Storey Drift

V. CONCLUSIONS

1) The analysis emphasizes the importance of considering wind loads when designing high-rise G+7 buildings with and without floating columns. The use of advanced modeling techniques aids in better understanding and mitigating potential risks .
2) When floating columns are present at the highest level of a building that contains non- soft floors, the structures produce the greatest nodal displacement. This is because floating columns give the building a more rigid appearance.
3) The floating columns are the ones responsible for the most nodal displacement, which explains why this is the case.Wind loads exert an influence, leading to a concentration of larger drift values up to the G+7 story level. This is due to the impact that wind loads have on the structure.
4) Providing good floor space index but risky & vulnerability of the building increases.
5) We can conclude that wind loads have the greatest potential to cause storey drift based on the assumption that floating columns and soft storey are both located at the G+2 storey level.
6) Wind loads exert an influence, leading to a concentration of larger drift values up to the G+4 story level. This is due to the impact that wind loads have on the structure

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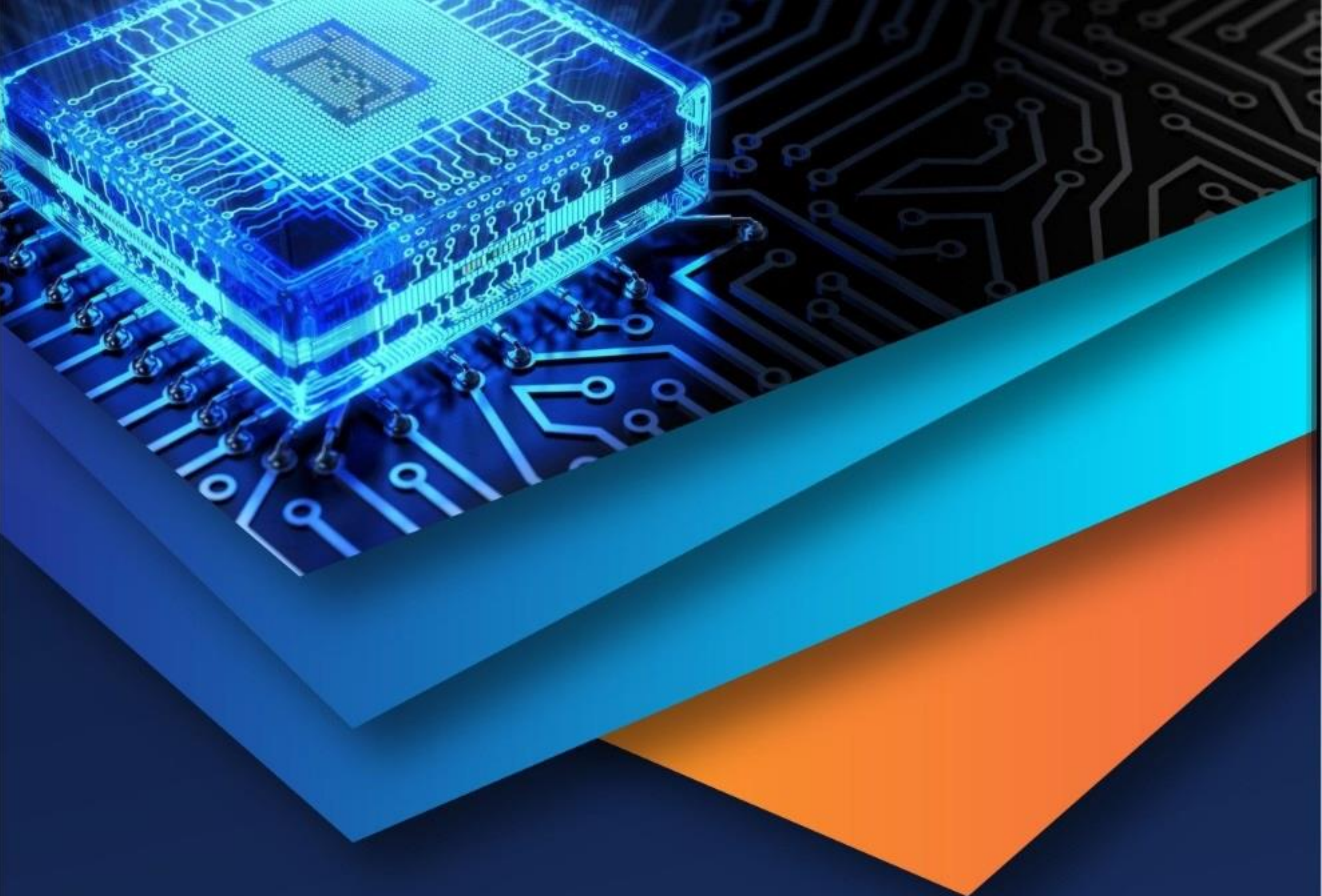

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