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Parametric Performance Analysis of Tall Building under various Seismic Zone and Soil Condition

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Abstract: In our research we will analyse the effect of earthquake forces with different soil condition. In this project seismic analysis of RC frame structure is conducted with the aid of StaadPro software. Three different types of RC frame structures like G+9, G+14 and G +19 storey RC buildings has analyzed. Different loading conditions like dead load, live load, seismic load is applied as per the provisions made by IS 1893:2002 (Part II), IS 456:200 and IS 875: 1987 (Part 1 , Part 2). Evaluation of structural response (i.e .bending moment, shear force, displacement and storey drift) has made in this work. Shear forces and Bending moment at critical sections have examined with the provision of software analysis. The advancement in Seismic analysis bring us to think about the seismic evaluation of various RC buildings under various zones. It has been observed that the our county is rapidly changing its earthquake impact in the respected cities and hence it become very import to analysis the same building in various seismic zone and soil condition. As we are aware that soil conditions vary from place to place and hence it is necessary to check the effect of different soils.

Keywords: Tall building, Seismic analysis, soil condition, RC Building, Structural Response analysis, India Standard.

I. INTRODUCTION

In the present era the construction of tall building is trendy because of the development of cities and lack of space in a certain location. But, the problem rises in the construction of tall building is that, it have necessary to consider lateral forces. The major considerable lateral force is earthquake because it is unpredictable, and it must have to consider in tall building design. Now a days whole world is damaging from effects of seismic Hazards. So, there is require to investigate the seismic behaviour and soil condition of that place is necessary throughout the construction process. In tall buildings the effect of lateral forces have to be given due consideration because of exceed the lateral loads have potential to undesirable Vibrations, stresses, deflection, bending and instability in the buildings. In present days there is high demand of tall buildings due to increasing urbanization and rapidly rise population, and earthquakes forces have the potential for causing the damages to those tall structures. Since earthquake forces are in nature and cannot be predictable, so that engineering tools need to be sharpened for analysing structures under the action of these forces. Earthquake loads are required to be carefully modelled so as to assess the genuine behaviour of structure with a clear understanding that damage is expected but it should be regulated. Analysing the structure for various earthquake intensities and checking for multiple criteria at each level has become a necessary exercise for the last couple of decades.

II. SEISMIC ANALYSIS

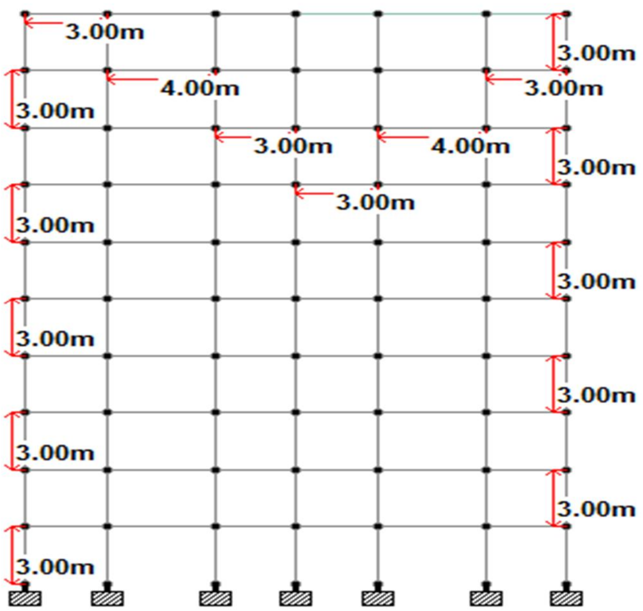
The mass of the building being structured controls seismic plan notwithstanding the building solidness, because earthquake induces inertia forces that are proportional to the building mass. Designing tall buildings to behave elastically during earthquakes without damage may build the project economically non-viable. As a result, it may be essential for the structure to go through damage and thereby dissipate the energy input to it during the earthquake. Therefore it is necessary, the traditional earthquake-resistant design philosophy preferable to the normal buildings should be able to resist.

III. OBJECTIVE OF PROJECT

A. To analyze a multistoried RC framed building for available earthquake considering different earthquake zone(i.e., I, III, IV, V)
B. Evaluation of performance of RC frame building under seismic zone.
C. Compare the performance of structure in different seismic zone & soil condition.

IV. MODELING OF STRUCTURE

In our research paper we are using Staadpro for modeling of the structure. We have made the model of 10storey, 15storey, & 20storey building on Staadpro for the analysis of seismic response (using Is1893:2000) of our structure with different-different zones and with different soil condition. All structure have same plane with 6 bay building and the height of each storey is 3m. In all the structure we are using the column size .4m x .4m and the beam size .45m x .4m with all the supports are fixed. And we considered these load cases 1) Dead Load, 2) Live Load & 3) Lateral Load due to Earthquake. A lateral load is applied on structure and dead load at each element. As per the IS857 (Part II) Impose load is applied and the model is created with these specifications as shown below.



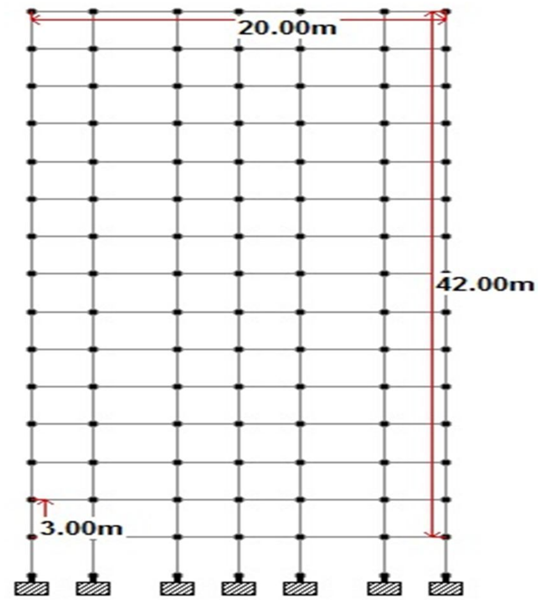


Fig 1.1 Elevation of G+9 RC Frame Fig 1.2 Elevation of (g+14) Frame

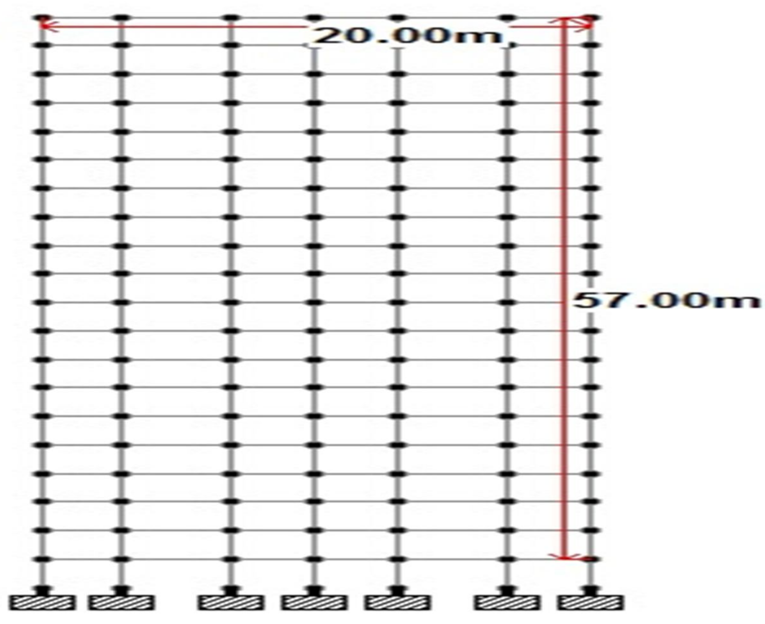


Fig 1.3 Elevation of G+19 RC Frame

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V. ANALYSIS OF STRUCTURE

Analysis the behavior of structure with Staad.Pro for different seismic zones as per IS1893 recommendation. After setting up all the load and load combination assigning them for each member. The load cases which we have assign are shown below.

Load case no	Load cases
1	EQX
2	EQZ
3	DL
4	LL
5	RLL
6	1.5(DL+LL)
7	1.2(DL+LL+EQX)
8	1.2(DL+LL-EQX)
9	1.2(DL+LL+EQZ)
10	1.2(DL+LL-EQZ)
11	1.5(DL+EQX)
12	1.5(DL-EQX)
13	1.5(DL+EQZ)
14	1.5(DL-EQZ)
15	0.9DL+1.5EQX
16	0.9DL-1.5EQX
17	0.9DL+1.5EQZ
18	0.9DL-1.5EQZ

Table 1.1 Load and load combination

After assigning all the load and combination of load, run the analysis. Using these data Staad.Pro do the computation which is based on the data assigned for each member.

VI. RESULT AND DISCUSSION

The Parametric Performance Analysis of Tall Building under Various Seismic Zone & Soil Condition of RCC frame obtained 10, 15 &20 storey without shear wall. The analysis of 10, 15 &20 storey RC frame was performed under static and dynamics loads by using StaadPro V8i software subsequently results are obtained for shear force, bending moment, storey drift and deflection. Which is analyse with 10storey, 15storey, and 20storey height in different soil condition in different seismic zones which is used under the various loading which carried out for RC frames. The main objective for this study is to find the percentage changes in the storey drift, shear force, bending moment & deflection for 10, 15 & 20 storey. After the analysis was performed the result we obtain which is shown below as graphical and tabular form.

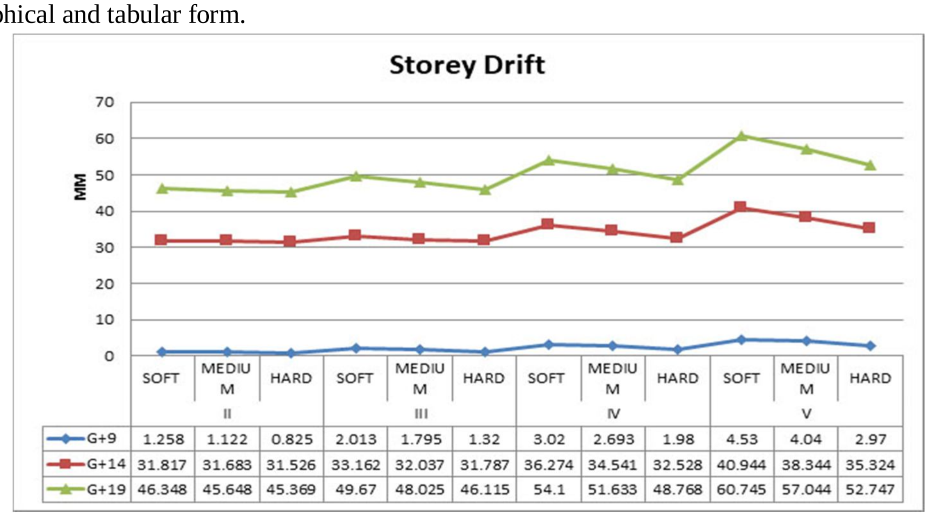

Fig 1.4 Storey Drift Graph

STOREY DRIFT				
Structures	Max. (mm)	Zone & Soil Condition	Min. (mm)	Zone & Soil Condition
G+19	60.745	V & Soft	45.369	II & Hard
G+14	40.944	V & Soft	31.526	II & Hard
G+9	4.53	V & Soft	0.825	II & Hard

Table 1.3 Deflection

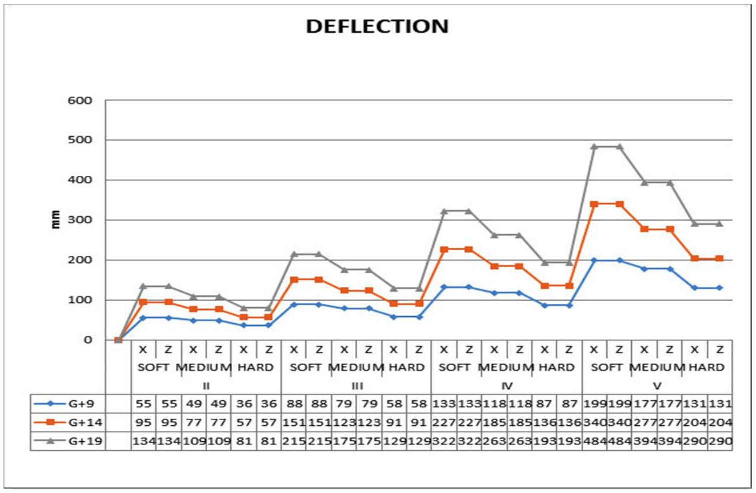

Fig 1.5 Deflection Graph

DEFLECTION				
Structures	Max. (mm)	Zone & Soil Condition	Min. (mm)	Zone & Soil Condition
G+19	484	V & Soft	81	II & Hard
G+14	340	V & Soft	57	II & Hard
G+9	199	V & Soft	36	II & Hard

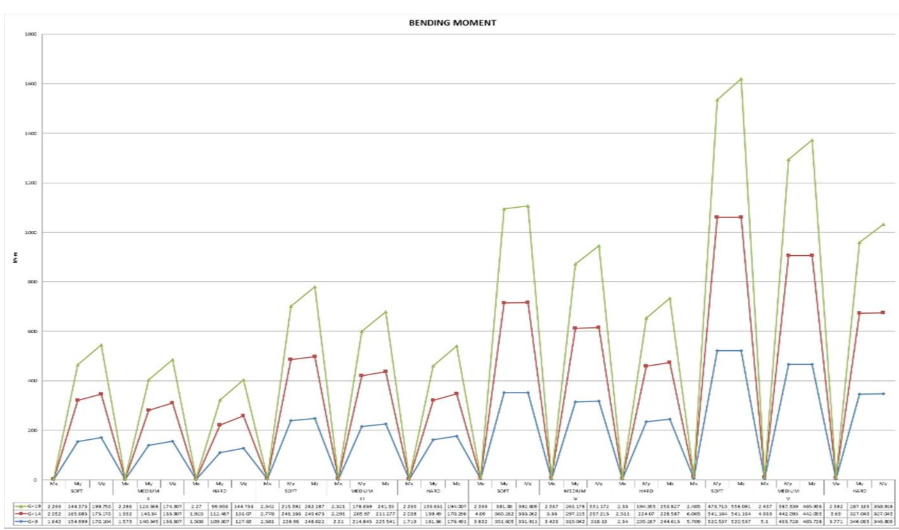

Fig 1.6 Bending moment graph

BENDING MOMENT (Mx)				
Structures	Max. (kN-m)	Zone & Soil Condition	Min. (kN-m)	Zone & Soil Condition
G+19	2.485	V & Soft	2.27	II & Hard
G+14	6.065	V & Soft	1.923	II & Hard
G+9	5.709	V & Soft	1.508	II & Hard

Table 1.4 Bending Moment (Mx)

BENDING MOMENT (My)				
Structures	Max. (kN-m)	Zone & Soil Condition	Min. (kN-m)	Zone & Soil Condition
G+19	473.713	V & Soft	99.936	II & Hard
G+14	541.164	V & Soft	122.487	II & Hard
G+9	520.537	V & Soft	109.307	II & Hard

Table 1.5 Bending Moment (My)

BENDING MOMENT (Mz)				
Structures	Max. (kN-m)	Zone & Soil Condition	Min. (kN-m)	Zone & Soil Condition
G+19	558.091	V & Soft	144.756	II & Hard
G+14	541.164	V & Soft	131.07	II & Hard
G+9	520.537	V & Soft	127.63	II & Hard

Table 1.6 Bending Moment (Mz)

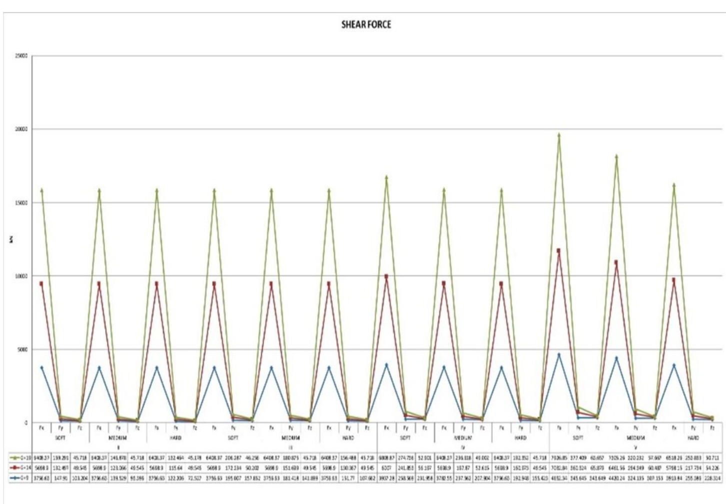

Fig 1.7 Shear Force Graph

SHEAR FORCE(Fx)				
Structures	Max. (kN)	Zone & Soil Condition	Min. (kN)	Zone & Soil Condition
G+19	7925.85	V & Soft	6408.37	II & Hard
G+14	7032.84	V & Soft	5698.9	II & Hard
G+9	4652.34	V & Soft	3756.63	II & Hard

Table 1.7 Shear Force (Fx)

SHEAR FORCE(Fy)				
Structures	Max. (kN)	Zone & Soil Condition	Min. (kN)	Zone & Soil Condition
G+19	377.409	V & Soft	132.464	II & Hard
G+14	360.324	V & Soft	115.64	II & Hard
G+9	345.645	V & Soft	122.206	II & Hard

Table 1.8 Shear Force (Fy)

SHEAR FORCE(Fz)				
Structures	Max. (kN)	Zone & Soil Condition	Min. (kN)	Zone & Soil Condition
G+19	63.657	V & Soft	132.464	II & Hard
G+14	65.879	V & Soft	115.64	II & Hard
G+9	343.649	V & Soft	122.206	II & Hard

Table 1.9 Shear Force (Fz)

VII. CONCLUSION

As the result we have obtained we can conclude that the effect of storey drift, deflection, bending moment and shear force is minimum in seismic zone II with hard soil condition. And the effect of storey drift, deflection, bending moment and shear force maximum in seismic zone V with soft soil condition. On the basis of our results we can also say that as we go towards zone II to V and Soil property hard to soft the structure susceptibility of resisting earthquake decreases.

Thus we can clearly say that the structure constructed on hard shows more resistance to earthquake than soft soil.

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