Parametric Study of Three Dimension RCC Frame Structure for During Earthquake Condition

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Abstract. In India's seismically active region, the necessity for earthquake-resistant structures is highlighted by seismic waves that alter the motion of the earth. Response spectrum analysis combines modal responses via techniques including CQC, and ABS, taking into account a variety of response modes. This study compares earthquake loads using various soil types in Zone III and evaluates building performance during seismic events. The primary goal of the entire project is to analyse the seismic response of multistory buildings. Staad Pro Software does load calculations in order to analyse the entire structure. The outcomes turned out to be incredibly exact and precise. A G+7 and G+10 storey building was examined for every potential load combination (seismic, live, and dead loads) during my analysis and design process. The highly interactive and user-friendly user interface of Staad. Pro allows. Numerous factors that may impact earthquake ground movements and associated reaction spectra are included in analytical approaches for site response analysis. To ensure that assessments of earthquake ground motons at the site are reliable, it is crucial to look into how these parameters affect site reaction analysis. The parametric study presented in this work looks into how site factors affect ground motion during earthquakes. We calculated the response reduction of the common moment-resisting body case and the unique moment-resisting frame values Tall Construction's seismic reaction using the Staad Pro programme.

Keywords-: Earthquake engineering, responses spectrum, parametric study, base shear, tall building.

1 Introduction

The equivalent lateral pressure is the specific concept utilised in earthquake engineering. The dynamics analysis of a system determines its maximum displacement or member stresses, and it makes further changes to the part static and part dynamic analysis. Seismic waves have amazing effects as they travel through certain soil strata at the same time. Form is demonstrated by earthquakes, but it is also supported by the soil mass and the goddess. Because of this, it alters the earth's motion. In India, earthquake-resistant buildings are now highly valued when it comes to human life and safety [1-3]. India has more than 65% of its land incline towards earthquakes because of its geological location, which places it under the subcontinent. These days, it's common practice to assess and layout dwellings for static forces because of the availability of far less expensive computer systems and specialised apps that can be utilised for the evaluation [4-6]. However, dynamic assessment takes a lot of time and requires additional information about the shape's mass as well as a grasp of structural dynamics in order to translate the analytical conclusions. In urban India, reinforced concrete (RC) buildings are the most popular type of construction. Throughout their lives, these structures are susceptible to a variety of stresses, including static forces from falling and stationary objects and dynamic forces from earthquakes [7-10]. The purpose of this specific comparative observation on dynamic assessment is to ensure that the seismic layout for important and typical shaking depth is safe. It also aims to eliminate the issue that arises from the interaction of axial pressure and its corresponding bending 2d when using the unsigned reaction spectrum and CQC method in Staad-pro. In order to present accurate results for the dynamic assessment of the response spectrum in absolute and SRSS approaches, as well as to disclose joint displacements, guide reactions, Member forces, base shear, and lateral load, this check will provide comprehensive guidance for STAAD Pro software programme evaluation [11,12]. The project assesses tall Construction's seismic reaction using the Staad Pro programme, utilizing manual load estimates and STAAD Pro software for structural analysis. The code of exercise is used for designing the restriction kingdom in Indian fashion. Customers may effortlessly manipulate the burden numbers and dimensions, as well as sketch the frame, thanks to Seasoned's highly intuitive and dynamic human interface [13-15]. After that, it uses our code to analyse the shape overall and in the particular seismic area, all in compliance with the specified criteria. In addition to creating and analysing a G+4, G+9, G+14, and G+19 storey building, I had validated for every imaginable load combination, including dead, live, wind, and seismic loads. Statta Ad. The user-friendly, interactive interface of Seasoned allows customers to control the burden values and dimensions and design the frame with ease. Next, it assesses the form overall and, using our code, the shape within the designated seismic area, in compliance with the intended criteria [16-20]. It was able to determine parameters such as axial pressure, shear force, bending moment, and lateral forces with ease. The fact that the earthquake occurred in a multi-story building suggests that inadequately designed and built systems could perhaps collapse completely [21-23]. For this reason, it is important to consider seismic analysis while designing earthquake-resistant structures in order to guarantee safety against the seismic pressures of multistory buildings. Response reduction is taken into consideration in seismic analysis for two scenarios: ordinary second resisting bodies and special moment resisting bodies. Examining seismic shape analysis for both static and dynamic evaluation in normal moment-resisting frames and unusual moment-resisting bodies is the main objective of this work. Structural seismic evaluation employs equal parts response spectrum analysis and static analysis [24-26]. For the seismic assessment, we took into consideration a 15-story residential building with a G+9 rating that is located in area II. With the aid of the Staad.Pro software, the full form was examined by computer. Using deflection diagrams for both static and dynamic evaluation, we calculated the response reduction of the common moment-resisting body case and the unique moment-resisting frame values [27]. In order to withstand the earthquake hundreds, the unique moment of resistance that has been constructed is correct Environmental sustainability in construction [28,29].

2 Methodology

The dynamics analysis of a system determines its maximum displacement or member stresses, and it makes further changes to the part dynamic analysis [30]. The goal to understand how the structure behaves when dead load, living load, and seismic load are applied to it, this study compares the evaluation of two-story structures, the G+7 and the G+10, taking into account seismic zones of III and soil type. The staad Pro software program is utilized for the completion of modelling and analysis. The overall plan and elevation of the four various height G+7 and G+10RCC multi-story framed buildings are taken into consideration for analysis in order to determine the realistic behaviour during an earthquake [31]. The Response Spectrum seismic analysis methods is used to model the RCC multi-story framed building for zone III. Staad Pro is used to provide fixed support for all building models. Geometric specification of structure was presented in Table 1.

Table 1: Structure's geometric specifications

Structure's Geometric Specifications	
Specifications Item	Properties of Item
Number of Storey The number of stores is a overall inventory.	G+7 and G+10
The whole height of the structure	25m and 34m
Average height in storeys	3m
The standard height in storeys	4m
Floor Diaphragm	Rigid
The number of bays along a specific length.	6
The number of bays along the width	8
The bays are Spaced along their length.	3m
The text explains the concept of bay spacing along width.	3m
The beam size is a crucial aspect of project	450x600mm

The beam shape is a crucial aspect of a projector's design.	Rectangular
The column size is a design.	650x650mm
Column Shape is a design.	Rectangular

The structure's geometric specifications include two designs: G+7 (eight floors) and G+10 (eleven floors), with total heights of 25m and 34m respectively. Floors average 3m in height, with a standard height of 4m. The design features a rigid floor diaphragm, six bays along the length, and eight bays across the width, all with a uniform spacing of 3m. Beams are sized at 450x600mm and columns at 650x650mm, both rectangular in shape, ensuring structural integrity and consistency in the building's design.

3 Results and Discussion

Response spectrum analysis combines modal responses via techniques including CQC taking into account a variety of response modes. This study compares earthquake loads using various soil types in Zone III. A G+7 and G+10 storey building was examined for every potential load combination (seismic, live, and dead loads) during my analysis and design process. The highly interactive and user-friendly user interface of Staad.Pro allows. Numerous factors that may impact earthquake ground movements and associated reaction spectra are included in analytical approaches for site response analysis. To ensure that assessments of earthquake ground motons at the site are reliable, it is crucial to look into how these parameters affect site reaction analysis. The parametric study presented in this work looks into how site factors affect ground motion during earthquakes. A comparative analysis is conducted between base shear and building response spectrum analysis. The analysis's findings are listed below the results of the comparison study are also listed below.
The tables provide information on how reinforced cement concrete (RCC) structures behave seismically when they are located in various seismic zones and types of soil. Base shear values for the G+7 RCC construction in Zone III are shown in Table 2, which takes into account both soft and hard soil types. The base shear results for the G+10 RCC construction in the same zone—but with a hard soil type—are the main subject of Table 3.

Table 2: Base shear results for G+7 RCC structure in zone III with hard and soft soil types

Story	**Level In Meter**	**Base shear for G+7**	
		Hard	**Soft**
8	25.00	204	298
7	22.00	402	539
6	19.00	556	856
5	16.00	669	1075
4	13.00	756	1258
3	10.00	854	1398
2	7.00	930	1498
1	4.00	952	1534
BASE	0.00	952	1534

Data on base shear values for a G+7 building are shown in the table, which compares soft and hard ground conditions at various elevations. The building's resistance to lateral forces is measured by base shear. Table 2 shows the level in metres and the related base shear values in hard and soft conditions for each story, starting from the ground (BASE) and going up to the eighth story. Because the mass below each level decreases, the base shear values often drop as the stories get taller, indicating less force at higher levels. Because buildings on softer soils may have to withstand higher seismic forces, the values are higher in soft ground conditions than in hard ground situations.

Table 3: Base shear results for G+10 RCC building Situated in zone III with a hard and soil Source soil type

Story of Building	**The level in meters of measuring the distance between two points.**	**Base shear for G+10**	
		Hard	**Soft**
11	34.00	187	269
10	31.00	378	553
9	28.00	541	802
8	25.00	665	1020
7	22.00	759	1220
6	19.00	836	1382
5	16.00	910	1537

4	13.00	998	1651
3	10.00	1059	1750
2	7.00	1109	1830
1	4.00	1140	1860
BASE	0.00	1140	1860

Table 3 compares the hard along with soft soil conditions at different levels, starting at the base and going up to the eleventh storey, for a G+10 construction. The overall horizontal seismic force that the structure must withstand is reflected in base shear. The results exhibit a pattern where base shear reduces with building height when presented with equivalent levels in metres. The base shear forces are greatest at the lowest levels in both soft and hard ground situations. The decrease in mass above each level is the cause of this base shear drop with height. Interestingly, the base shear values are systematically larger in soft ground than in hard, suggesting that the building is more susceptible to seismic activity in softer soils.

Table 4: Results of storey displacement for G+7 RCC frame building with soil type -hard and soft soil located at Zone IV

Storey	Level in Meter	Displacement in mm	
		Hard Soil	Soft Soil
8	24.00	17.6	28.5
7	21.00	16.8	27.2
6	18.00	15.4	25.1
5	15.00	13.5	21.8
4	12.00	11.2	18.1
3	9.00	8.5	13.3
2	6.00	4.8	8.4
1	3.00	1.6	2.1
BASE	0.00	0.00	0.00

The displacement estimates for an eight-story building located on both soft and hard soil types are displayed in the Table 4. The amount that each story moves in relation to the base—which is thought to be fixed with zero displacement is expressed as displacement, which is expressed in millimetres. For both soil types, displacement rises with building height, as the table shows. At every level, however, the displacement is continuously greater when dealing with soft soil as opposed to hard soil. This pattern emphasises how soil characteristics affect how a building behaves during events like earthquakes or strong winds, highlighting the greater movement and less stability often found in structures built on softer ground.

Table 5: Results of storey displacement for G+10 RCC frame building with soil type -hard and soft located at Zone IV

Storey	Level In Meter	Displacement in mm	
		Hard Soil	Soft Soil
11	33.00	19.915	31.8
10	30.00	19.304	30.7
9	27.00	18.401	29.2
8	24.00	17.200	27.2
7	21.00	15.734	24.6
6	18.00	14.035	21.6
5	15.00	12.124	18.3
4	12.00	10.021	14.6
3	9.00	7.758	10.7
2	6.00	5.418	6.7
1	3.00	2.232	3.0
BASE	0.00	0.00	0.00

Tables 4 and 5, on the other hand, examine the storey displacement results for the G+7 and G+10 RCC frame buildings in Zone IV, respectively, taking into account both soft and hard soil types. Together, these tables offer comprehensive data on seismic responses that helps engineers and designers optimise structural designs for safety and resilience against seismic occurrences in a variety of geological and architectural contexts. The displacement measurements for an eleven-story building are shown in the table, along with information on how the displacement changes at different levels for buildings on both soft and hard soil. The lateral movement that each story experiences in relation to the base, which has zero displacement, is indicated by the displacement values, which are expressed in millimetres. The displacement tendency for both types of soil is shown in the Table 5 as the storey elevation rises. At every level, however, displacements are constantly greater for the construction on soft soil than for the firm soil. As a result, soil conditions play a crucial role in both structural design and analysis. This is because structures on softer ground are generally more flexible and less resistant to lateral pressures like wind or seismic activity.

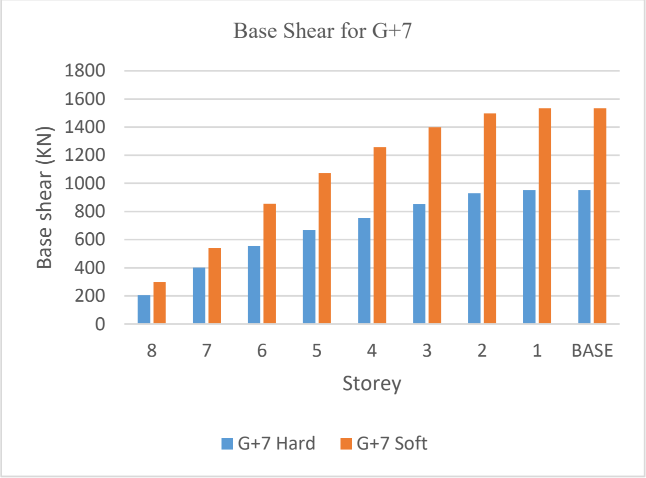

Fig. 1: Base shear for G+7 in hard soil and soft soil

Fig 1 compares load values for a building with a G+7 configurations under two different conditions : hard and soft. This comparison is crucial for understanding how different foundation conditions or construction materials can affect the structural load distribution from the base to the top of the building. The maximum base shear value for soft soil, is higher than that of hard soil in Zone IV for the G+7 RCC frame building construction. When a hard soil and soft soil is built, the lateral force generated by the earthquake is mostly absorbed by this one level, which reduces shear. The Maximum Base Shear for G+7 in Soft Soil Compared to hard Soil.

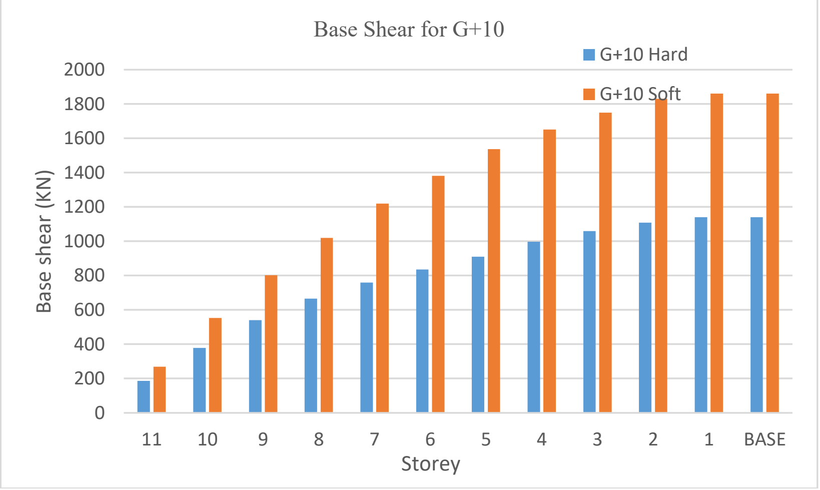

Fig. 2: Base shear for G+10 in hard and soft soil

Base shear values (presumably in kilonewtons or a similar measure of force) across a G+10 building structure, which indicates a ground floor plus ten additional stories. The load values under two distinct conditions, labeled hard and soft likely representing different foundational or material conditions affecting the building's load-bearing characteristics. In Zone IV of the G+10 RCC frame building construction, the maximum base shear value for soft soil is plotted in Fig. 2, which is larger than that of hard soil. In contrast to hard soil, after an earthquake, the lateral stresses are focused in soft

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stores, which causes a stronger lateral base shear. Maximum Base Shear in Soft Soil for G+10 in Comparison to Hard Soil.

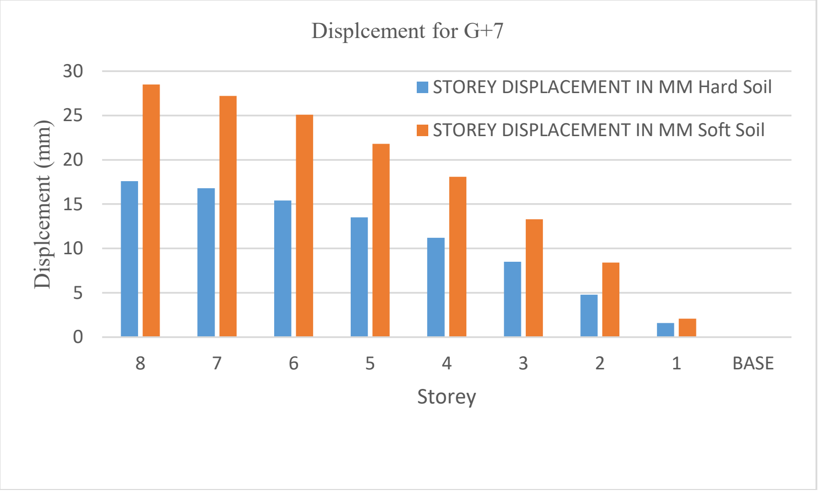

Fig. 3: Displacement vs storey plot for G+7 for both soils hard and soft Soil

Fig. 3 shows the plot of the displacement measurements in millimeters for a building's structure across various storeys, comparing two types of soil conditions: hard Soil and soft Soil. This data is essential for understanding how different foundational conditions affect the structural behavior, particularly in terms of displacement due to loads. The maximum displacement value for soft Soil which is greater as compared to hard in Zone IV for G+7 RCC frame building structure. In with building a hard storey the lateral force induced during earthquake are primarily absorbed by this particular storey leading to lower displacement.

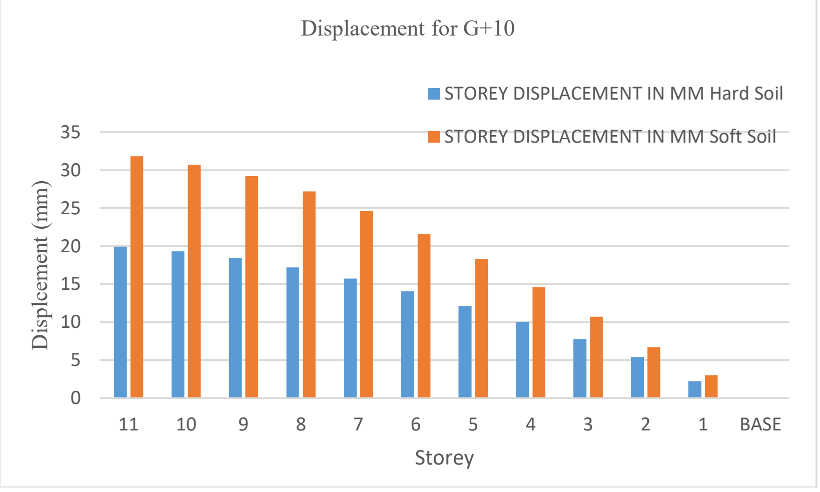

Fig. 4: Displacement vs storey plot for G+10 for both soils hard and soft Soil

The maximum displacement value for soft soil, which is higher than that of hard soil in Zone IV for the G+10 RCC frame building construction, is plotted in the Fig. 4. Higher lateral displacement occurs in soft store during an earthquake than on hard soil because the lateral pressures are concentrated there. The levels of the building, starting from the base and moving up to the 11th storey. It provides a systematic framework for associating each displacement measurement with its respective level within the structure.

5 Conclusion

This study compares earthquake loads using various soil types in Zone III and evaluates building performance during seismic events. The primary goal of the entire project is to analyse the seismic response of multistory buildings. Staad Pro Software does load calculations in order to analyse the entire structure. The parametric study presented in this work looks into how site factors affect ground motion during earthquakes. We calculated the response reduction of the common moment-resisting body case and the unique moment-resisting frame values. Tall Construction's seismic reaction using the Staad Pro programme. A G+7 and G+10 storey building was examined for every potential load combination (seismic, live, and dead loads) during my analysis and design process.

a. The conclusion highlights the significance of soil conditions in determining the behaviour of structures during seismic activity.
b. Compares earthquake loads using various soil types in Zone III. Evaluates building performance during seismic events. Uses Staad Pro Software for load calculations.
c. Parametric study examines site factors' impact on ground motion during earthquakes. Calculates response reduction of common moment-resisting body case and unique moment-resisting frame values. Examines G+7 and G+10 storey building for seismic, live, and dead loads.
d. The seismic study of a G+7 and G+10 RCC frame, which accounts for different soil types like soft and hard, indicates that the base shear of each storey differs substantially. The maximum base shear value in the G+10 building structure increases with increasing base shear, in contrast to the G+7 building structure.
e. The alteration in soil type has a direct effect on the structure's dynamic response. In instance, as the model switches from a hard soil type to a soft one, the base shear of each storey increases considerably.

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