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Research Paper

NON LINEAR TIME HISTORY ANALYSIS OF G+10 IRREGULAR BUILDING IN DIFFERENT SEISMIC ZONES AND DIFFERENT SOIL CONDITIONS

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Abstract In India, soil conditions are different in different regions which plays important role during earthquake shaking. Soil having number of layers at various depths at different locations doesn't show same response during earthquake. This study presents the procedure for seismic performance estimation of high-rise buildings based on a concept of the time history method. In 3D analytical model of 110 storied buildings have been generated irregular buildings Models and analyzed using structural analysis tool ETABS. The analytical model of the building includes all important components that influence the mass, strength, stiffness and deformability of the structure.

In current study, analysis of plan irregularity of building and consideration of soil structure interaction under seismic loading. Aimed with purpose, the plan irregular building (G+10) is analyzed by using ETABS subjected to the combination of gravity load and seismic load under all seismic zone. Compare the same building with the help of time history analysis by consideration of different soil condition structure interaction it is analyzed by using the ETABS software. The results like displacement, shear, torsion, bending, time period, frequency etc are analyzed with the help of ETABS Software.

Key words: soil conditions, ETABS, strength, stiffness, time history analysis

1. INTRODUCTION

Earthquake is known to be one of the most destructive phenomenon experienced on earth. It is caused due to a sudden release of energy in the earth's crust which results in seismic waves. When the seismic waves reach the foundation level of the structure, it experiences horizontal and vertical motion at ground surface level. Due to this, earthquake is responsible for the damage to various man-made structures like buildings, bridges, roads, dams, etc. It also causes landslides, liquefaction, slope-instability and overall loss of life and property. Most of the time earthquakes are caused by the slippage along a fault in the earth's crust. When the fault ruptures in the earth's crust, the seismic waves will travel away from the source known as focus, in all direction to the ground surface. As they travel through different geological materials, the waves are reflected and refracted. Throughout the whole journey from the bedrock to the ground surface, the waves may experience amplification.

Soil conditions in India

The type of soil mainly constituting the foundation are categorized into three types

Type I - Rock or Hard Soil

Very much reviewed rock and sand rock and sand rock blends with or without mud folio, and clayey sands ineffectively evaluated or sand earth blends (GB, CW, SB, SW, and SC) having N over 30, where N is the standard infiltration esteem.

Type II - Medium Soil

All soils with N between 10 and 30, and poorly graded sands or gravelly sands with little or no fines (SP) with N>15

Type III - Soft Soil

All drifts other than SP with N<10. The above order depends on IS1498-1970 [IS 1498, 1970], which utilizes prefixes and additions to arrange the sort and subgroup as abridged in Table 2 and Table 3. These prefixes and postfixes are utilized as a gathering image as indicated by the order of the drifts.

Objectives of the study

Here the present work aims at the study of following objectives

1. To study the behavior of a building under the action of seismic loads and wind loads.
2. To study the results of building under Zone and Zone V using ETABS Software.
3. The building model within the study has four storey's with constant storey height of 3m.
4. Six models are used to analyze with constant bay lengths and also the number of Bays and the bay width along two horizontal directions are kept constant in each model for convenience.
5. Different values of zone factor are taken and their corresponding effects are interpreted within the results.
6. Also the different values of wind speeds are taken for the wind analysis and their corresponding effects of building structure are also interpreted within the results.

2. LITERATURE SURVEY

Arun Babu M, Ajisha R (2018), "Analysis of Multistoried Building in Different Seismic Zones with Different Soil Conditions": The foundation of a building is the substructure through which loads of the whole structure are transmitted to the soil. There are various types of soil present in India. The types of soil play a major role while designing a structure. Here the analysis and design of the building are done by varying the type of soil. The difference in the analysis of structure is studied. After that, the seismic analysis for various zones is carried out for the same soil conditions, and also by changing the model of the building, the same is done. And the difference is studied.

Anujdomale, L.G. Kalurkar (2018), "Seismic Analysis of RCC And Steel Frame Structure by Using ETABS": The residential housing sector (G+3, G+6, etc.) use of steel has increased, but RCC construction still predominates the Indian construction business.The study aims to compare the seismic performance of G+6 and G+9 frames for `both steel and RCC. For the current study, all frames are analyzed under the equivalent static method. This comparative study concludes that steel frames are most effective than the concrete as it has the highest strength to weight ratio.

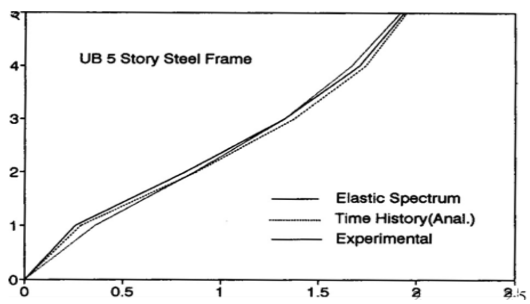
3. METHODOLOGY USED

Time History analysis

Once damping ratios of the visco elastically damped structure are evaluated, seismic response analyses can be carried out using available dynamic analysis programs. Figure 4.9 shows a typical time history response prediction and test result of a five story model under 0.6g Hachinohe earthquake (Chang et al. 1995). In this study, the VE damper assemblies are modelled as truss elements in the modified computer program ETABS with the inclusion of modal strain energy method. Similar studies have been carried out extensively and the results conclude that the elastic time-history response of visco elastically damped structures can be well predicted if damping ratios of the structure can first be accurately predicted.

Shows an experimentally obtained and numerically simulated time-history responses of a 3 story steel frame with added VE dampers under 0.8g El earthquake (Chang et al. 1996). The structural members and VE damper assemblies are modelled as bi-linear beam and column elements and truss elements, respectively, in Drain2D+. It can be seen that, in general, the analytical result predicts

The overall structural response well even though the structural members had experienced inelastic deformation during previous tests (Chang et al. 1996).



Lateral Displ.(cm)

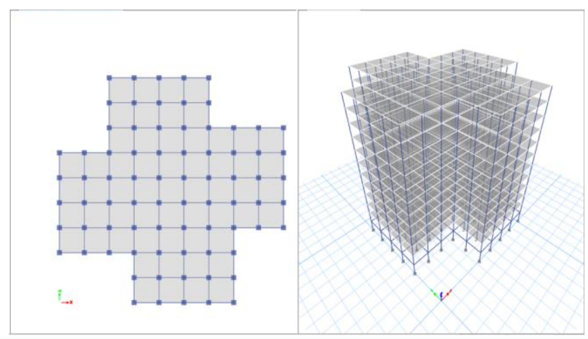
4. DESIGN CONSIDERATIONS AND MODEL OF BUILDING

In the present study, analysis of G+ 10 stories building in various seismic zones is carried out in ETABS.

Basic parameters considered for the analysis are

1. Grade of concrete : M30
2. Grade of Reinforcing steel : HYSD Fe500
3. Dimensions of beam : 800mmX600mm
4. Dimensions of column : 800mmX800mm
5. Thickness of slab : 180mm
6. Height of bottom story : 3m
7. Height of Remaining story : 3m
8. Live load : 3.55 KN/m^2
9. Dead load : 2 KN/m^2
10. Density of concrete : 25 KN/m^3
11. Seismic Zones : All seismic Zones
12. Site type : I, II, III
13. Importance factor : 1.5
14. Response reduction factor : 5
15. Damping Ratio : 5%
16. Structure class : C
17. Basic wind speed : 55m/s
18. Risk coefficient (K1) : 1.08
19. Terrain size coefficient (K2) : 1.14
20. Topography factor (K3) : 1.36
21. Wind design code : IS 875: 1987 (Part 3)
22. RCC design code : IS 456:2000
23. Steel design code : IS 800: 2007
24. Earth quake design code : IS 1893 : 2002 (Part 1)

Building Model in EATBS

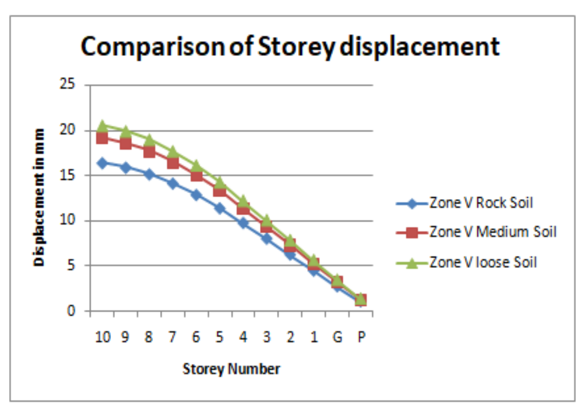


G+10 Floor model in ETABS Software

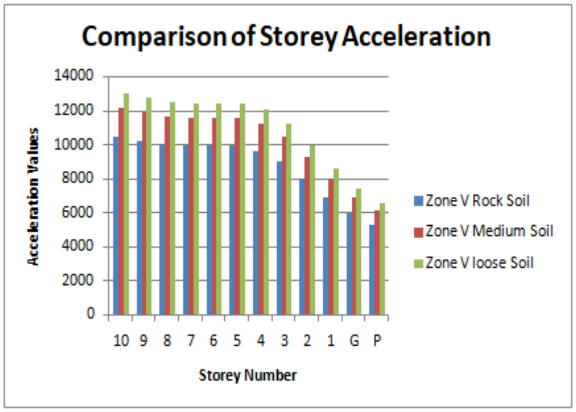
5. RESULTS AND ANALYSIS

Zone V

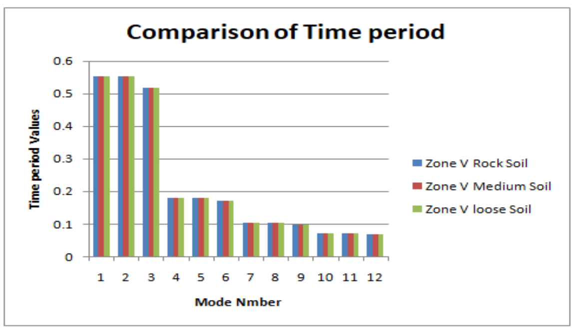
Comparison of storey displacement



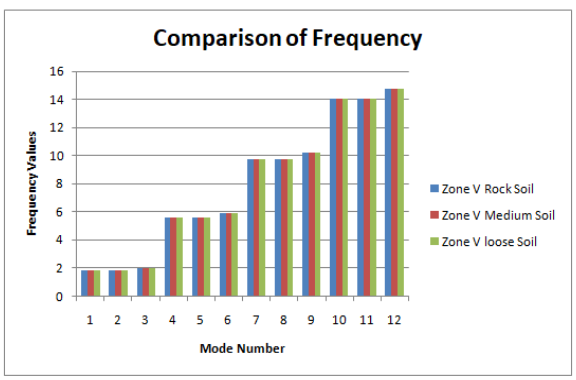
Storey Acceleration



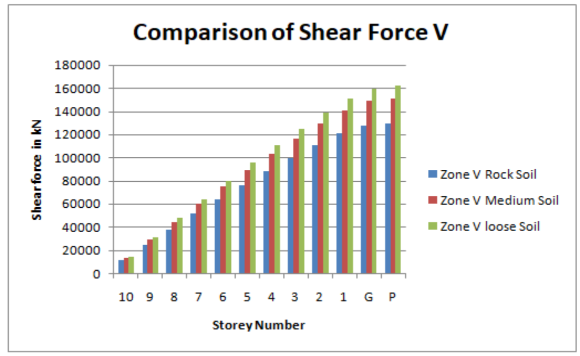
Time period



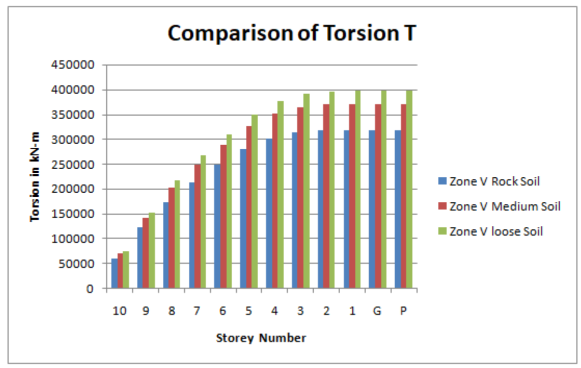
Frequency values



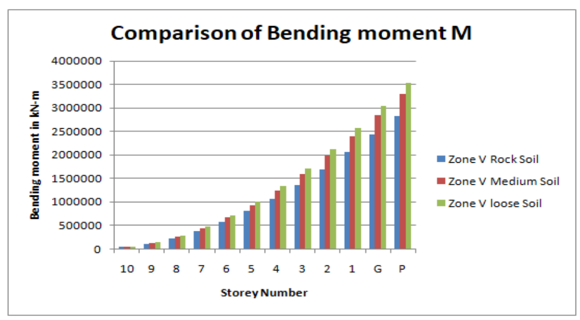
Shear force V values



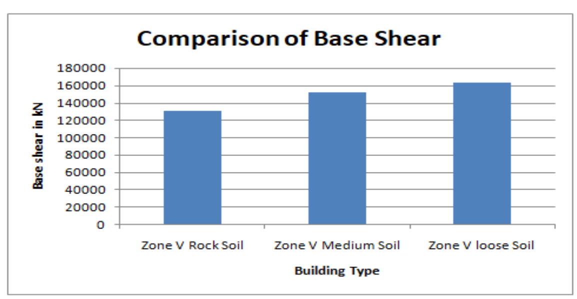
Torsion T values



Bending moment M values

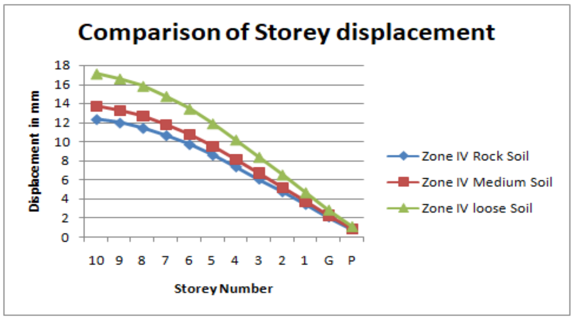


Base shear Values

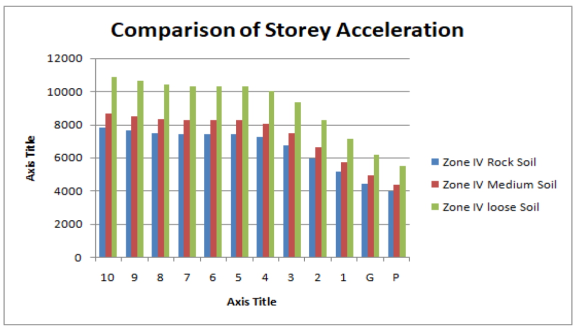


Zone IV

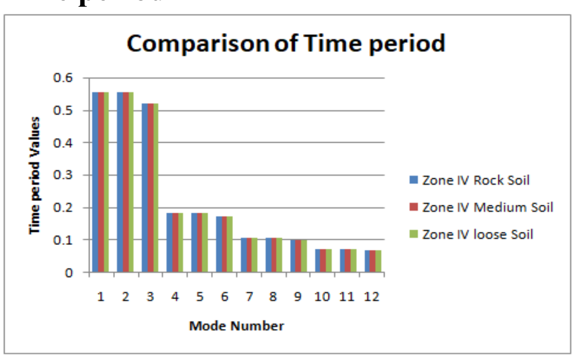
Comparison of storey displacement



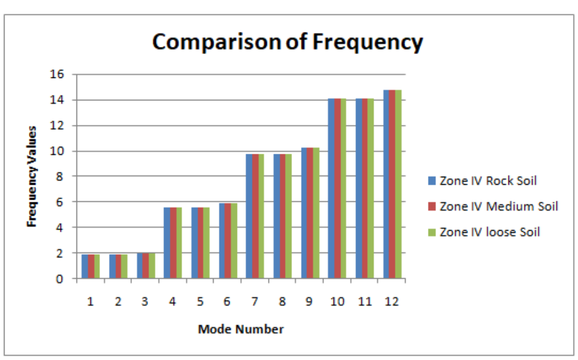
Storey Acceleration



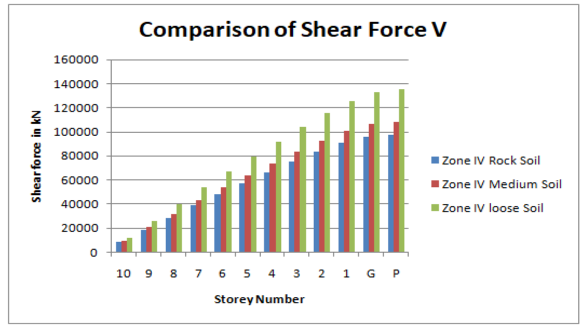
Time period



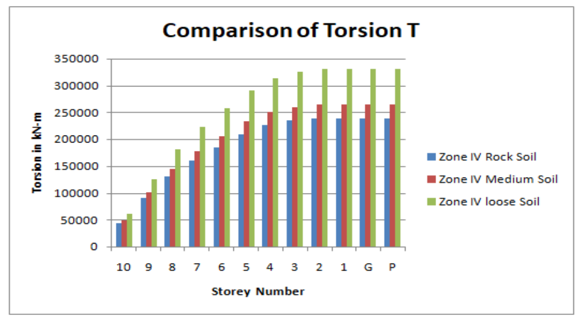
Frequency values



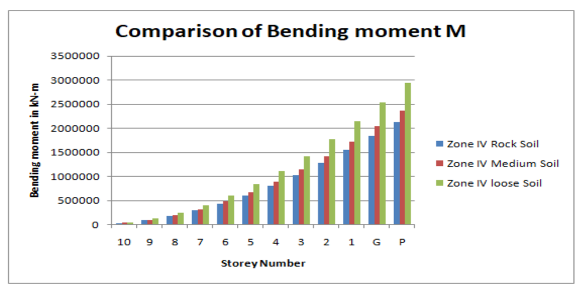
Shear force V values



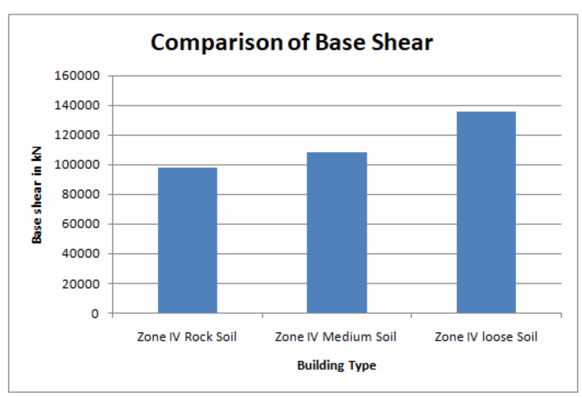
Torsion T values



Bending moment M values

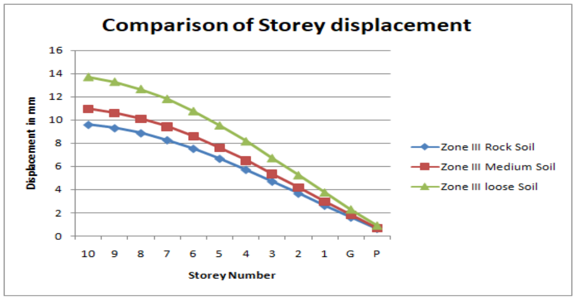


Base shear Values

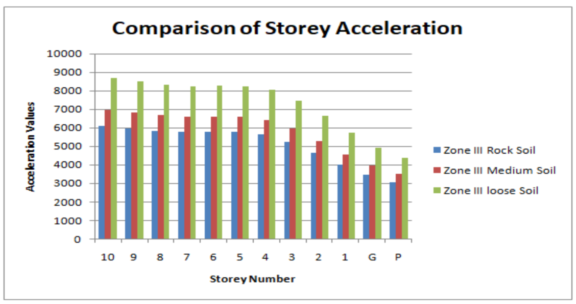


Zone III

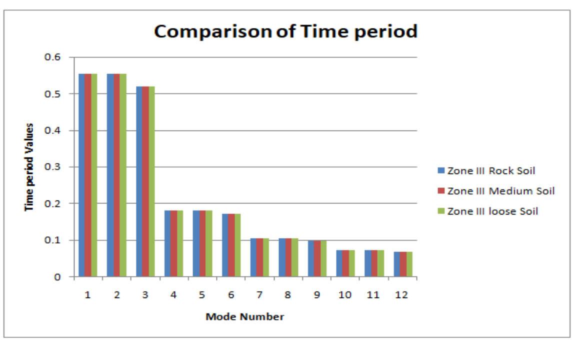
Comparison of storey displacement



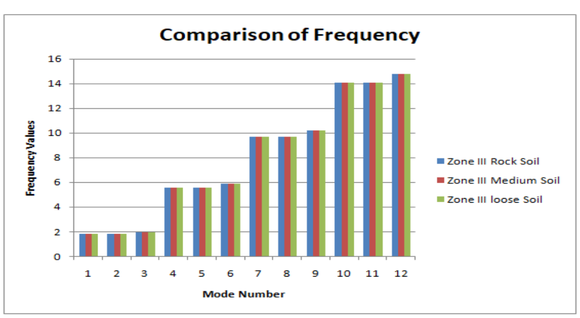
Storey Acceleration



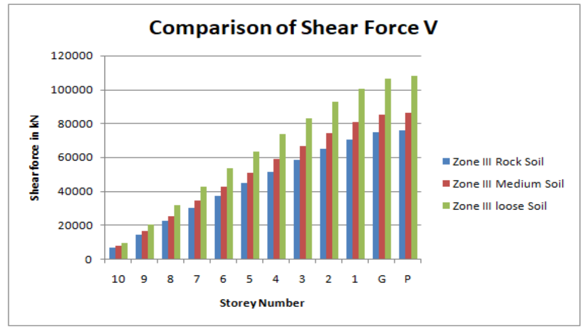
Time period



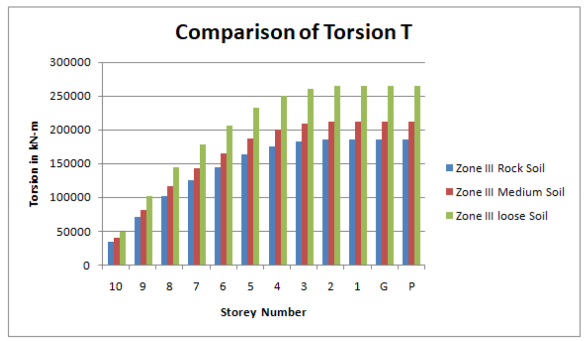
Frequency values



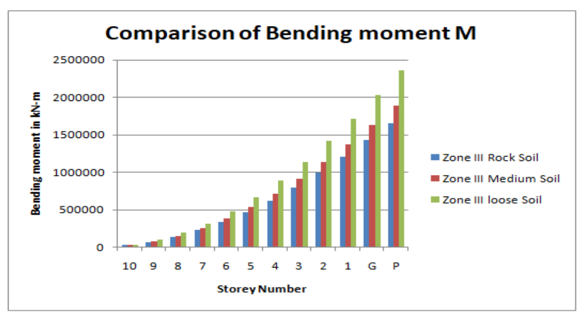
Shear force V values



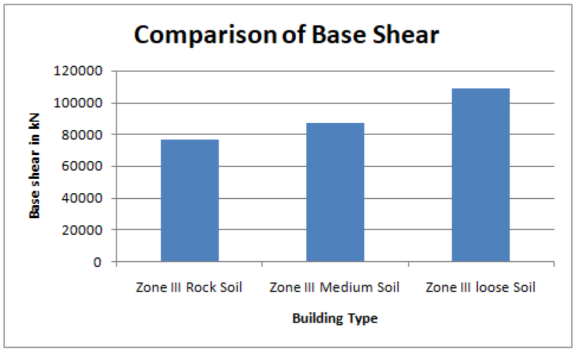
Torsion T values



Bending moment M values

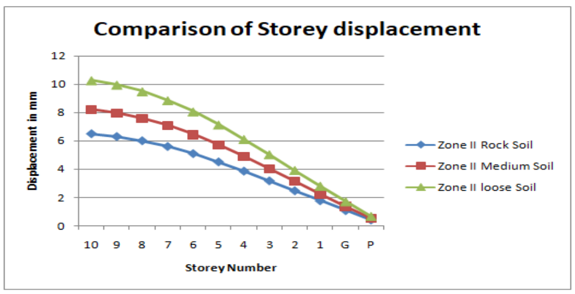


Base shear Values

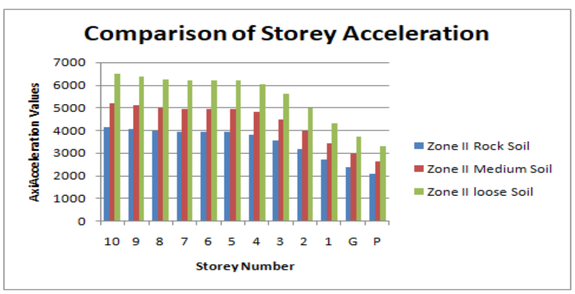


Zone II

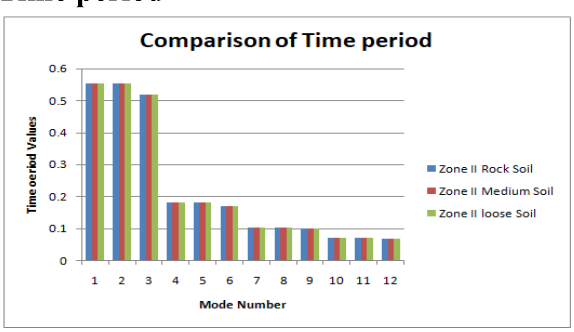
Comparison of storey displacement



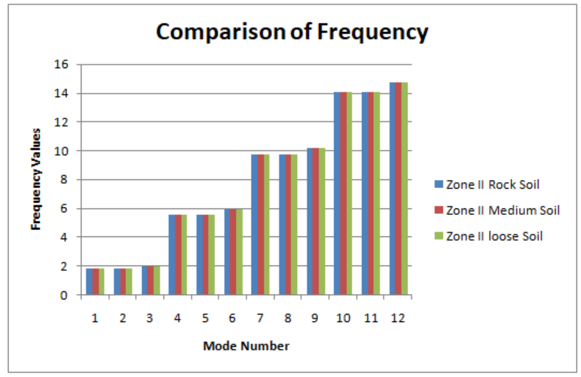
Storey Acceleration



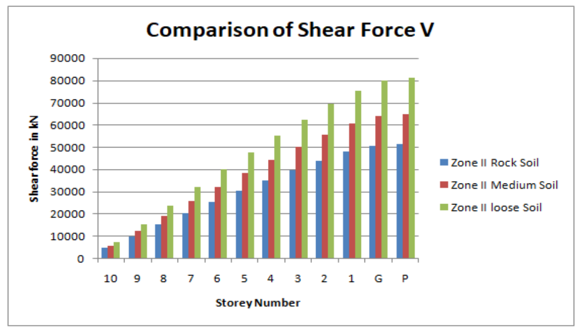
Time period



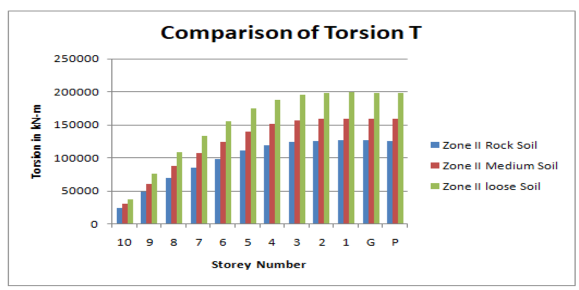
Frequency values



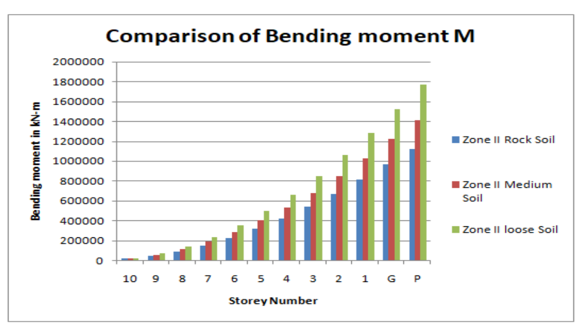
Shear force V values



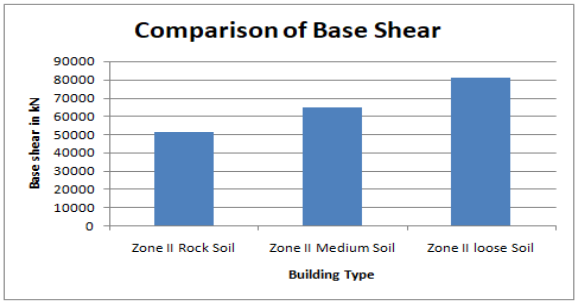
Torsion T values



Bending moment M values



Base shear Values



6. CONCLUSIONS

In the present project report seismic design analysis of a G+10 building with different soil conditions is carried out. Building is modelled as a 3D frame using ETABS software which is analysed by time history method. Following conclusions have been drawn from the seismic analysis and design of the building.

1. The storey displacement has less values for hard soil condition then medium soil and loose soil in all seismic condition for G+10 building.
2. As per the storey acceleration the building model exist in loose soil has high acceleration values than the remaining soil conditions namely medium and rock soils in all seismic zones.
3. The storey shear values has increases from storey 1 to storey 10 and it has higher intensity for loose soil condition than rock and medium soil case in all seismic zones.
4. The storey bending values are increasing from storey 1 to storey 10 and it is observed with higher values in loose soil condition than medium and rock soil case in all seismic zones.
5. The building torsion values also increases from storey 1 to storey 10 in case hard soil condition it has higher values when we compared with remaining soil case in all seismic zones.
6. From the results of time period and frequency it is clearly shows that by changing the soil condition there no change in the intensities in all seismic zones.
7. The case of building with mass soil is more conservative than the case of building without mass soil.
8. Static and dynamic seismic forces have been analyzed for the structure for different soil conditions, the different soil conditions are directly affecting the design parameters of the foundation such as length, width, depth and reinforcement of the foundations, it also affects the displacement and storey drift of the structure.
9. Structures have been designed for hard, medium, and soft soil conditions

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