EFFECT OF SOIL CONDITION ON TALL BUILDINGS BY USING SEISMIC LOADING CONDITIONS

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Abstract *Because earthquakes are not frequent and might strike at any point in a building's lifetime, designing it to minimize damage during a seismic tremor is very costly. This research used programming ETABS Software to investigate and outline an existing G+23 surrounding structure.*

The building's seismic design follows the guidelines laid forth by IS 1893(Part 1):2002 for Zones II and V. Examining the variation in steel rate, maximum shear constraint, highest bowing minute, and largest avoidance in different seismic zones are the main objectives of the article. Different types of soil have distinct "higher" and "lower" zones, and different varieties thrive in different environments. Model stiffness, time period, tale drift, story shear, story bending, and torsion are all examined.

Keywords: G+23, story relocations, most extreme shear constrain, great twisting minute, most extreme redirection, etc,.

1. Introduction

One of the most devastating natural disasters that humans have ever faced is the earthquake. An abrupt discharge of energy from the Earth's crust causes seismic waves, which in turn generate this phenomenon. Seismic waves cause both horizontal and vertical movement at ground level when they reach a building's foundation. Buildings, bridges, roads, dams, and other man-made infrastructure may be damaged or destroyed by earthquakes [1] . Landslides, liquefaction, slope instability, and general property and life loss are all consequences of this. Slippage along a crustal fault is the most common source of earthquakes. Seismic waves, emitted when a crack opens in the Earth's crust, will scatter outward in all directions until they reach the surface [2, 3] . The waves undergo reflection and refraction as they pass through various geological materials. The waves may be amplified all the way from the base to the surface of the earth.

Soil conditions in India

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

Type I - Rock or Hard Soil

Blends of sand, rock, and clayey sands that have not been adequately appraised or sand earth blends (GB, CW, SB, SW, and SC) with a N value more than 30, where N is the standard infiltration esteem; and mixes of these materials with or without mud folio [4].

Type II - Medium Soil

Soils containing nitrogen in the range of 10 to 30 and sands or gravel with low or nonexistent particles (SP) and nitrogen levels more than 15

Type III - Soft Soil

Other than SP, all drifts with N<10. The preceding hierarchy is based on the abbreviations in Tables 2 and 3 and the main text of IS1498-1970 [IS 1498, 1970], which uses prefixes and adds to organize the sort and subgroup. The sequence of the drifts determines the use of these prefixes and postfixes as a collecting picture.

Objectives of the study

Here, the examination of the following goals is the goal of the current work.

1. To investigate how a structure reacts when subjected to wind and seismic forces.
2. To explore the outcomes of construction in Zone and Zone V using the ETABS software.
3. Each of the four stories of the study's building model is 3 meters tall.
4. For the sake of simplicity, six models are used for analysis, all of which maintain constant bay lengths, number of bays, and breadth along two horizontal directions.
5. We analyze the impacts of different values of the zone factor within the data.
6. The wind analysis accounts for varying wind speeds and their impacts on building structures are explained in the findings.

2. Literature survey

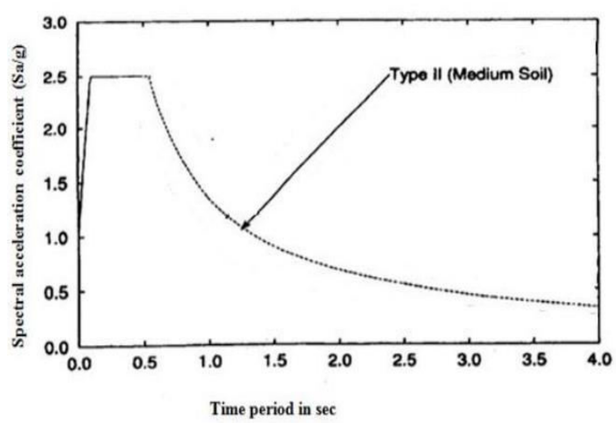
The article "Analysis of Multistory Building in Different Seismic Zones with Different Soil Conditions" was written by Arun Babu and Ajisha in 2018. The substructure that transfers the building's overall loads to the ground is known as the foundation. India is home to a wide variety of soil types. In the process of building a structure, the many kinds of soil are crucial. Here, changing the soil type allows for study and design of the construction. It examines the dissimilarity in structural analysis. Then, using the same soil conditions and a different building model, the seismic analysis is repeated for other zones. And researchers look at the distinction [5].

In their 2018 article titled "Seismic Analysis of RCC And Steel Frame Structure by Using ETABS," Anujdomale and L.G. Kalurkar discuss: While steel has seen an uptick in the G+3, G+6, etc., residential housing market, RCC remains the gold standard in India's building industry. G+6 and G+9 seismic performance comparisons for steel and RCC are the primary objectives of the research [7]. In this investigation, the corresponding static approach is applied to each frame. Due of its superior strength-to-weight ratio, steel frames outperform concrete in this comparison.

3. Methodology Used

Response spectrum method

Earthquake ground movements as shown by the maximum response of an idealized system with one degree of freedom, given a period and damping. Part 1 of this study follows the guidelines laid forth by code IS 1893-2002. Here, you should input the soil type and seismic zone factor according to IS 1893-2002 (part 1). For the analysis in ETABS 2013, the standard response spectra for the kind of soil that is being investigated are applied to the building. The typical response spectrum for medium soil types, shown below as a plot of time vs spectral acceleration coefficient (Sa/g), is as follows.



Response spectrum for medium soil type for 5% damping

This method allows for the incorporation of a building's many frequency-domain patterns of response. Except for very basic or extremely complicated buildings, this is a requirement of many construction regulations. One way to describe a structure's reaction is as a set of interrelated forms, or modes, which, when applied to a vibrating string, correspond to the "harmonic" and which may be found by computational analysis [8] . An approximation of the structure's overall response is obtained by reading the response from the design spectrum for each mode, taking into account the modal mass and modal frequency. Here, we need to determine the building's response to pressures acting in all three spatial dimensions (X, Y, and Z). The following are examples of combination methods:

1. Adding up the absolute peak values.
2. SRSS, or square root of the sum of squares, is the second formula.
3. Complete quadratic combination (CQC)—an approach that outperforms SRSS for modes with tight spacing.

Due to the loss of phase information during the generation of the response spectrum, the result of a linear dynamic analysis using the same ground motion as input and a response spectrum analysis using the same ground motion as input usually yields different results [9].

When dealing with buildings that are too tall, too irregular, or too important to a society, the response spectrum technique becomes inadequate. Instead, more complicated analyses, including non-linear static or dynamic analysis, are typically necessary.

4. Design considerations and model of building

In the present study, analysis of G+ 23 stories building in Zone II and Zone V seismic zones is carried out in ETABS.

Basic parameters considered for the analysis are

1. Grade of concrete : M40
2. Grade of Reinforcing steel : HYSD Fe500
3. Dimensions of beam
   1st floor to 8th floor : 600mmX400mm
   9th floor to 16th floor : 550mmX350mm
   17th floor to 24th floor : 500mmX300mm
4. Dimensions of column

1st floor to 8th floor : 600mmX600mm

9th floor to 16th floor : 550mmX550mm

17th floor to 24th floor : 500mmX500mm

5. Thickness of slab

1st floor to 8th floor : 180mm

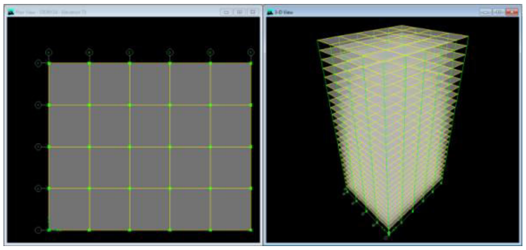
9th floor to 16th floor : 150mm

17th floor to 24th floor : 125mm

6. Height of bottom story : 4m
7. Height of Remaining story : 3m
8. Live load : 3 KN/m^2
9. Dead load : 2 KN/m^2
10. Floor finishing load : 1.5 KN/m^2
11. Density of concrete : 25 KN/m^3
12. Seismic Zones : Zone 2 and Zone 5
13. Seismic coefficient factor
a. Zone 2 : 0.10
b. Zone 5 : 0.36
14. Site type : I, II, III
15. Importance factor : 1.5
16. Response reduction factor : 5
17. Damping Ratio : 5%
18. Structure class : C
19. Basic wind speed : 39m/s
20. Risk coefficient (K1) : 1.08
21. Terrain size coefficient (K2): 1.14
22. Topography factor (K3) : 1.36

23. Wind design code : IS 875: 1987 (Part 3)
24. RCC design code : IS 456:2000
25. Steel design code : IS 800: 2007
26. Earth quake design code : IS 1893 : 2002 (Part 1)

Building Model in EATBS



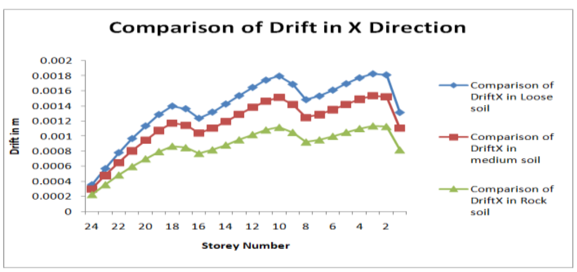
G+23 Floor model in ETABS Software

5. Results and analysis

Zone II

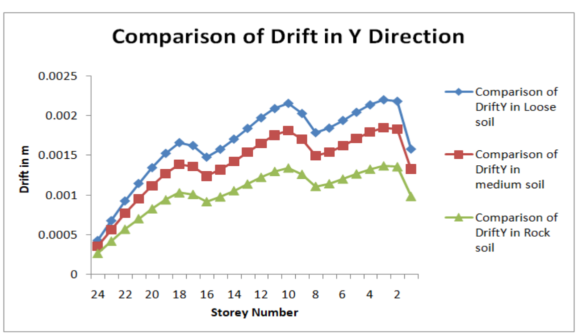
Storey Drift

X Direction



Comparison of Drift in X Direction

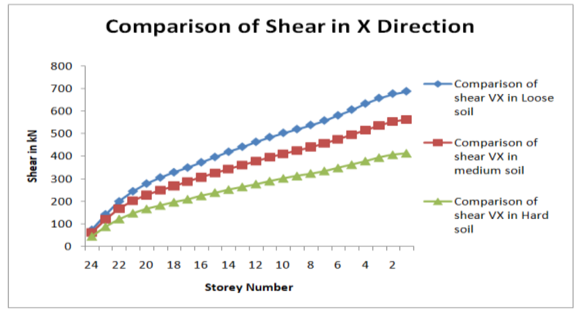
Y Direction



Comparison of Drift in Y Direction

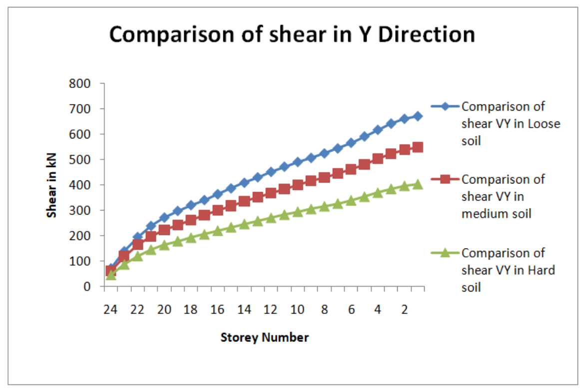
Storey Shear

X Direction



Comparison of shear in X Direction

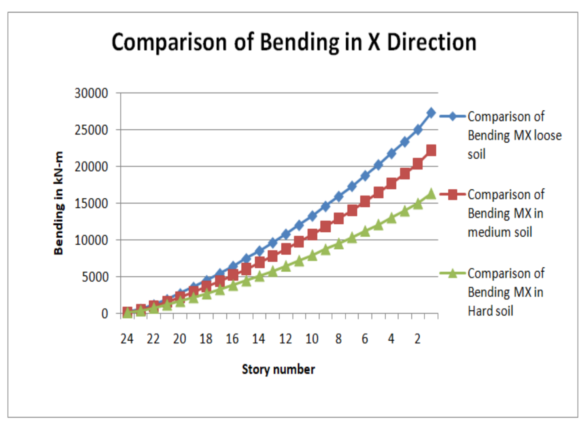
Y Direction



Comparison of shear in X Direction

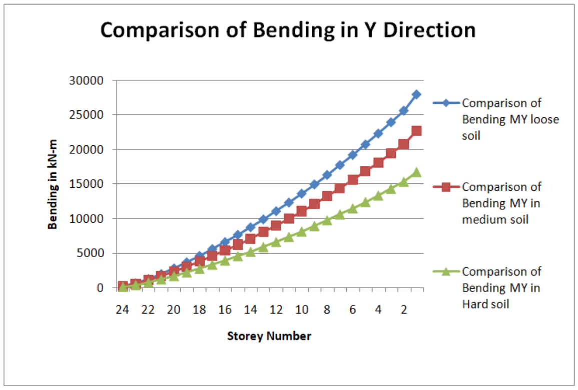
Storey Bending

X Direction



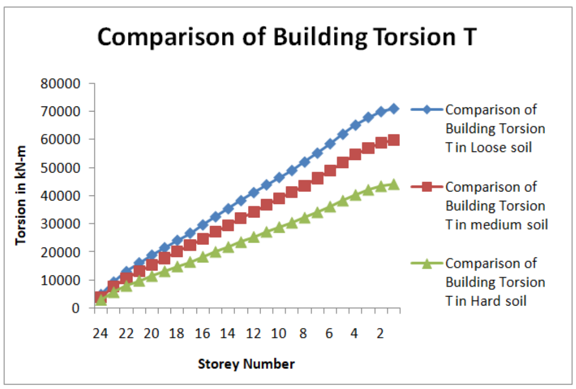
Comparison of Bending in X Direction

Y Direction



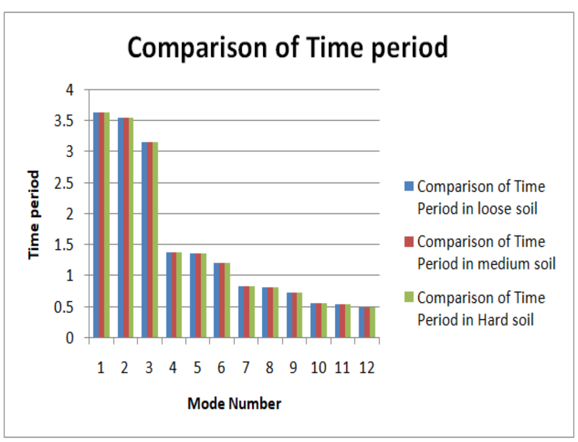
Comparison of Bending in Y Direction

Building Torsion



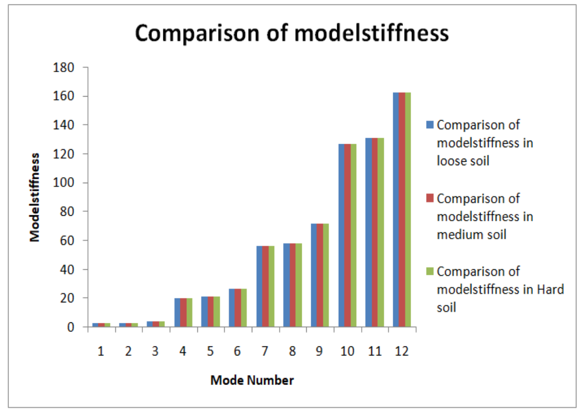
Comparison of Building Torsion

Time period



Comparison of Time period

Model stiffness

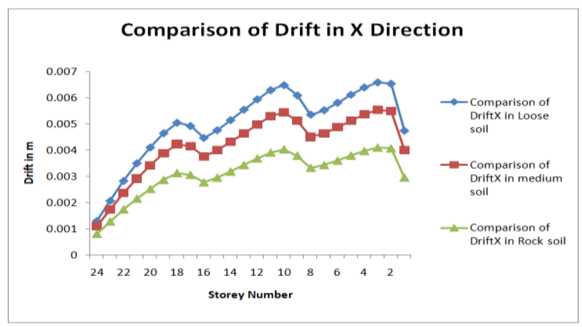


Comparison of model stiffness

Zone V

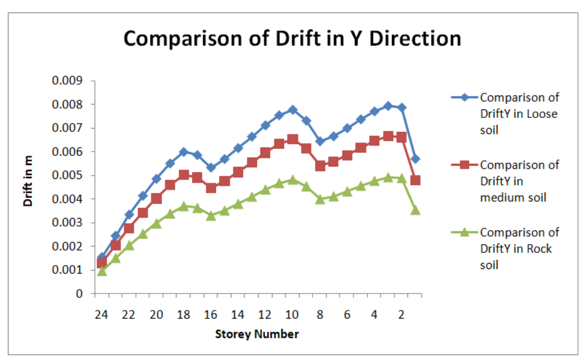
Storey Drift

X Direction



Comparison of Drift in X Direction

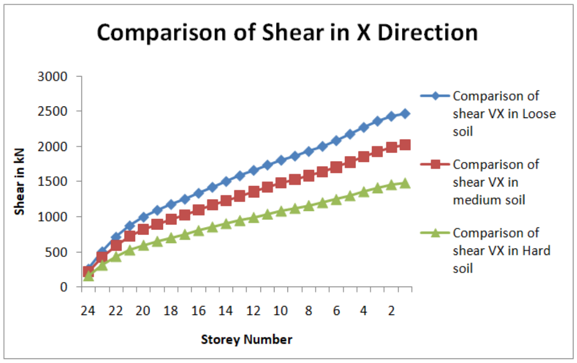
Y Direction



Comparison of Drift in Y Direction

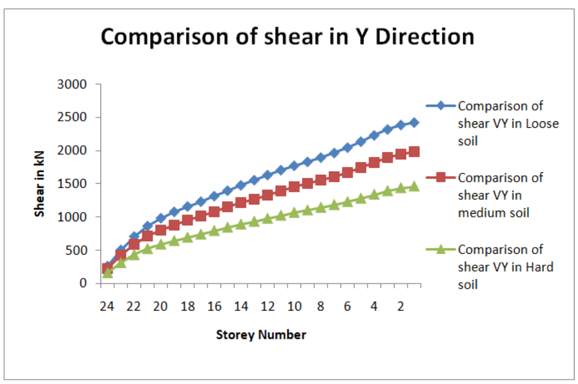
Storey Shear

X Direction



Comparison of shear in X Direction

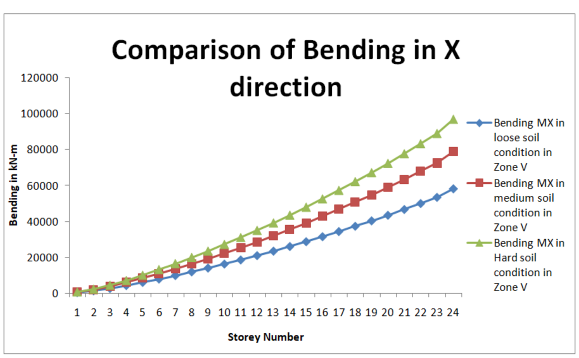
Y Direction



Comparison of shear in X Direction

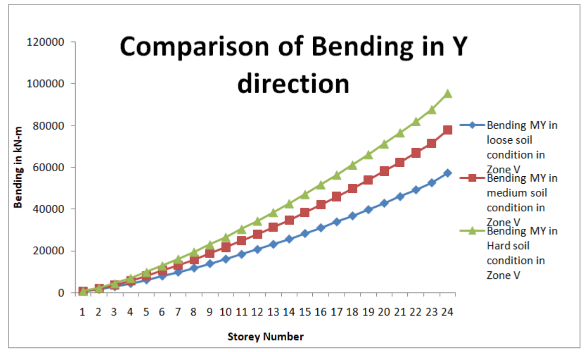
Storey Bending

X Direction



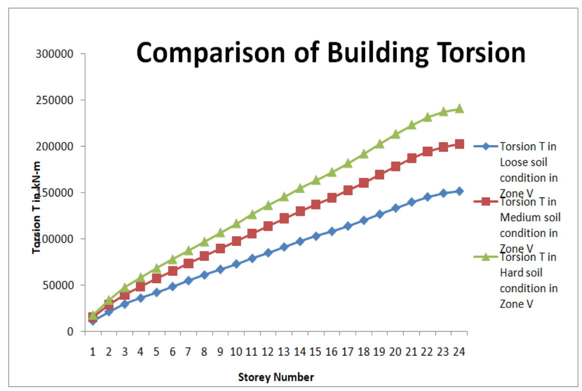
Comparison of Bending in X Direction

Y Direction



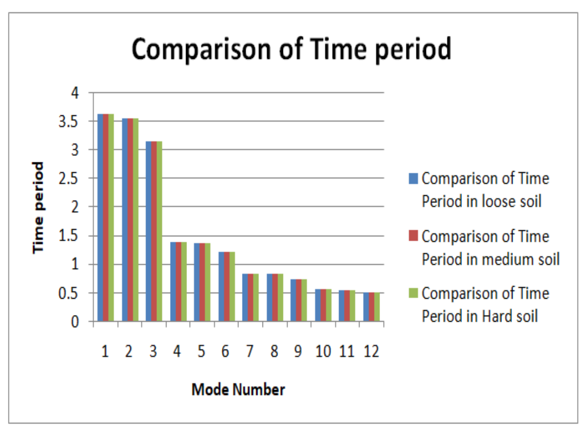
Comparison of Bending in Y Direction

Building Torsion



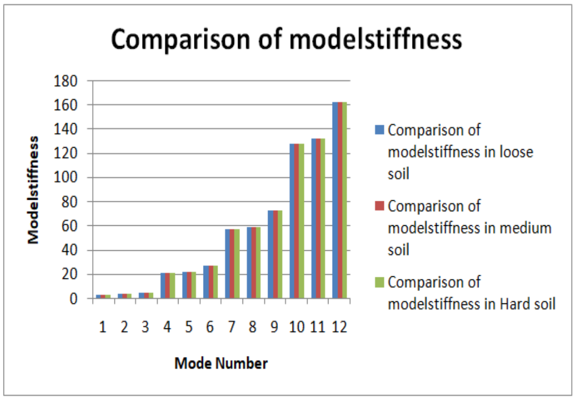
Comparison of Building Torsion

Time period



Comparison of Time period

Model stiffness



Comparison of model stiffness

6. Conclusions

This project report details the results of a seismic design study for a G+24 building on a variety of soil types. The building is analyzed using the Response Spectrum approach after being modeled as a 3D frame in the ETABS program. Seismic study and the building's design led to the following results.

1. In zones II and V seismic conditions, the X- and Y-directional storey drift values for the G+23 building are greater when the earth is hard.
2. From storey 1 to storey 24, the X and Y shear values grow, and in the case of hard soil, they are more intense than in the cases of loose and medium soil.
3. Observed with larger values in hard soil conditions compared to medium and loose soil instances, the storey bending values increase from storey 1 to storey 24.
4. In the case of hard soil, the building torsion values are larger compared to the other soil situations, and they grow from story 1 to storey 24.
5. There is no change in the intensities in Zone II and Zone V conditions when the soil condition is changed, according to the findings of the time period and frequency.

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