GEOTECHNICAL SITE CHARACTERIZATION FOR VIJAYAWADA URBAN

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ABSTRACT: *Geographical statistics of India show that almost 54% of the land is vulnerable to earthquakes, which insists on the immediate call for the Seismic Hazard Anlaysis of different regions of the country. Even though the zoning of the country has been done it offers a very vague idea of the earthquake hazard in any particular region due to the lack of database in India with regard to the earthquakes prior to historical period.Geotechnical Site Characterisation is an important task in the Seismic Hazard Analysis for finding out the soil startification. In this paper, the region of interest is Vijayawada city which falls in zone III according to IS 1893: 2002. It is the 34th largest town in India (population wise), and the 3rd largest town in Andhra Pradesh. Using the borehole data collected, soil profiles and the grain size distribution curves have been developed. The predmominant soil in all the Northern, Eastern, Western and Southern parts of the city have been found out.Using this data, the locations that may be prone to liquefaction are also identified.*

1. INTRODUCTION

Vijayawada is located at 16.52°N Latitude 80.62°E Longitude and the average elevation of the land of the city of Vijayawada is about 39 feet above the sea level. Topography is the most prominent feature of Vijayawada Geography. The landscape is marked by undulating small and medium sized hillocks with extensive plain lands between them. The Krishna River is a dominant part of the geography of Vijayawada and runs through the city. Although the hills here are a continuation of the Eastern Ghat chains, they, in general have a low elevation compared to the rest of the Ghats. Vijayawada is the only city in the world with two rivers Krishna, Budameru, and three canals. This city which falls in zone III according to IS 1893: 2002 has and is one among the 38 cities mentioned by Government of India where detailed geotechnical site characterization and ground response studies are at most required.

2. GEOLOGY AND SEISMICITY

The Vijayawada area has varied lithological formations ranging in age from Achaean crystallines to recent alluvium. Depending upon the occurrence of these rock formations the area can be divided into three lithological provinces. i) The north and western part occupied by crystalline group of rocks comprising of Khondalites, Peninsular gneisses, Dharwars and Proterozoic group of rocks, ii) North-eastern and central part occupied by Sandstones of Gondwana group and iii) Eastern and southern part occupied by River and Coastal Alluvia. There are four types of soils in the area, viz., Black cotton soils (58%), Sandy clay loams (23%), Red loamy soils (17%), and Sandy soils (2%). The sandy soils form a fringe along the coast. The black cotton soil is most extensive and occurs in Western part. The sandy clay loams are formed along river.

Findings from geologists and environmental imbalance and irregularities have shown that the city is likely to be hit by earthquakes every year.

(For instance the 2009,Andaman Islands earthquake 7.6 on Ritcher scale).Table 1 gives the seismic sources ie, faults and lineaments in and around Vijayawada city at 300kms radius.

Considering these aspects, it will be very important to carry out the detailed site characterization using geological, geophysical and geotechnical data and to carry out the ground response studies. The results of the findings will be useful to local governmental organizations, builders and researchers to enhance knowledge on earthquake resistant construction. Geologists can use the data to understand seismic activity of the region.

3. GEOTECHNICAL INFORMATION

Geotechnical Characterization is an important task in the Seismic Hazard Analysis.Local soil conditions has significant role on amplification of seismic waves, and being experienced in the past earthquakes (Ansal et al., 2004; Slob et al., 2002; Olieveira, 2004; Street et al., 2001). The nature and depth of the soil layers have a great influence on the intensity at ground level. Therefore, the site response has become one of the most relevant tasks in the seismic hazard analysis. Hence, the main objective of site characterization is to test for the subsurface soil properties and type of soil. Liquefaction, which is one of the important geotechnical ground failures during earthquakes, can also be estimated by using the geotechnical site data.

Detailed borehole data has been collected for different locations in Vijayawada.These data points spread throughout mostly in Vijayawada Urban and some rural locations like Enikepadu, Kanuru etc. The collected data is then synthesised and was brought to a common platform needed for the geotechnical characterization and liquefaction study.

The average bore hole depth is about 10m and in some areas like Kanuru and Sri chaitanya Kalasala Road data has been taken upto a depth of 15-20m. The least water table depths vary from 0-7 m.Figure 1 shows the ground water contour map of the study region.

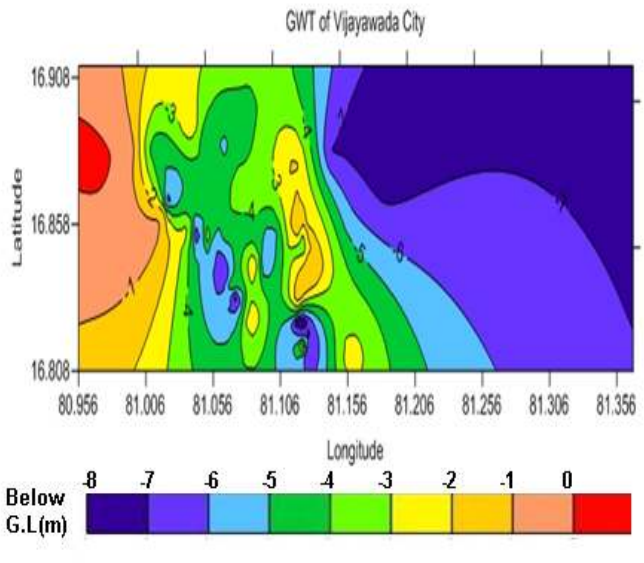


Figure 1 Ground Water Table Map of Vijayawada Region

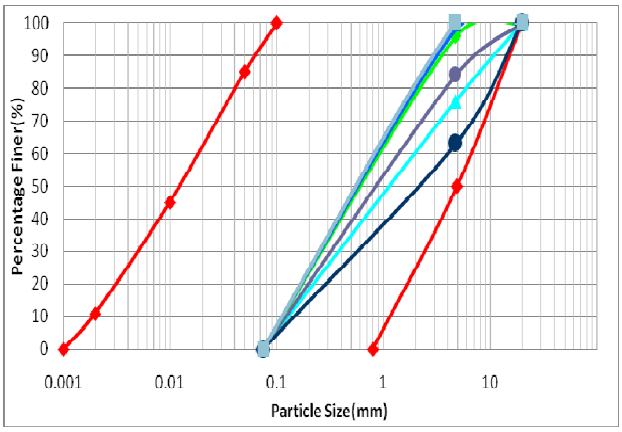
3.2. Grain Size Distribution (GSD) Curves

GSD curves are useful in representing the distribution of grain sizes in a soil sample. Using the geotechnical data, grain size distribution (GSD) curves are drawn at four different depths (4, 6, 8 and 10m) for different locations in Vijayawada. The GSD curves at Kothapeta, Suryaraopeta, and Pantakalava etcare shown in Figures 2 (a, b, c, d) at four different depths. These curves can be used in the preliminary assessment of the liquefaction potential.

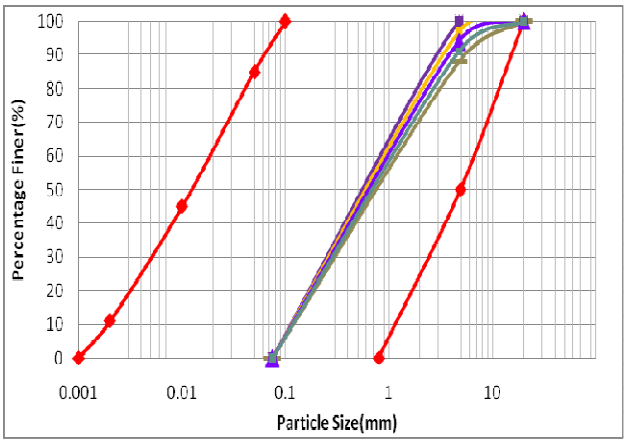
Based on the geotechnical borehole data, soil profiles are prepared to study the sub soil heterogeneity. The water table levels are also provided in the soil sections given.The reliability of the final microzonation maps depends on the assessment of representative soil strata. Figure 3 shows typical such soil profiles at some locations with corrected SPT values at different depths. Figure 4 shows the horizontal cross-section at few locations i.e, from Benz Circle to Barathi Nagar, Auto Nagar to Stella College and YV Rao hospital to SBI office.

Table 1 Seismic Source In and Around Vijayawada Area (SEISAT 2000)

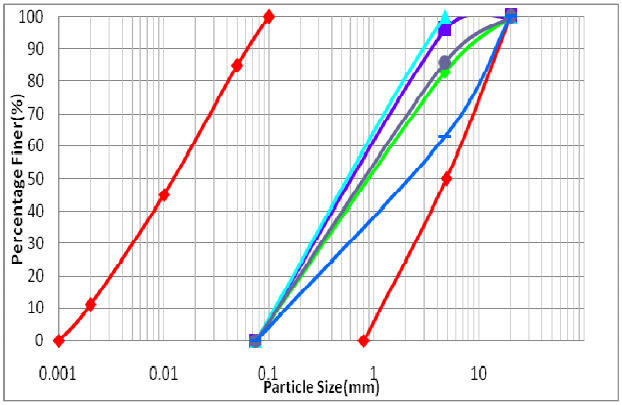
S.No	Faults/lineaments	Fault/lineament length km	Lat(start)	Long(start)	Lat(end)	Long(end)
1	Kaddam fault	301	76.618	20.678	79.324	18.827
2	Musi lineament	296	78.337	17.526	80.997	17.245
3	Kinnerasani godavari fault	188	79.305	18.718	80.993	17.354
4	Godavari valley fault	211	79.651	19.746	80.972	17.849
5	Kolleru lake fault	72	80.868	17.026	80.487	17.672
6	Chandragutti-kurnool lineament	332	74.996	14.593	77.983	16.163
7	Bennihalla lineament	271	75.523	15.766	77.964	16.566
8	Raichur -nagar karnool fault	181	77.354	16.368	78.977	16.576
9	Gani-kalva fault	91	77.597	15.508	78.409	15.751
10	Pyapalli fault	25.5	77.711	15.319	77.944	15.233
11	Karkambadi-swarnamukhi fault	93	79.283	13.654	80.112	14.101
12	Karempudi-nakirekallu lineament	145.4	79.533	16.195	80.84	16.124
13	Bhavanasi river fault	82.14	78.092	16.18	78.831	15.947
14	Tirumala fault	24	79.315	13.653	79.414	13.865
15	Gundla kamma fault	76	79.51	16.473	80.066	15.788
16	Addanki-nujividu fault	45.51	80.064	15.746	80.35	16.153
17	Badvel fault	44.4	79.342	14.659	78.942	14.928
18	Nallavagu fault	41	78.611	16.379	78.985	16.295
19	Papaghani fault	39	78.61	14.43	78.957	14.763
20	Kadiri fault	35.52	78.003	14.031	78.321	14.323
21	Armakur fault	32	78.47	15.874	78.751	15.761
22	Rudravagu fault	26	78.811	16.052	79.046	16.055
23	Nekkantivagu fault	22	78.591	16.284	78.788	16.233
24	Gulcheru fault	20	78.494	14.251	78.668	14.337
25	Nizampatnam nagayalanka fault	27	80.561	15.939	80.802	16.008
26	Vasishta-godavari fault	59	81.439	16.405	81.969	16.633



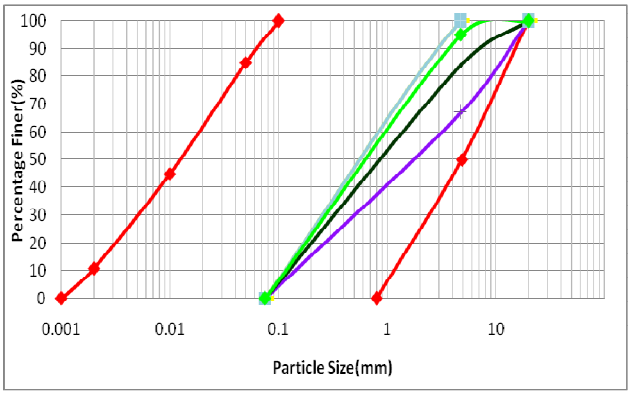
a.1



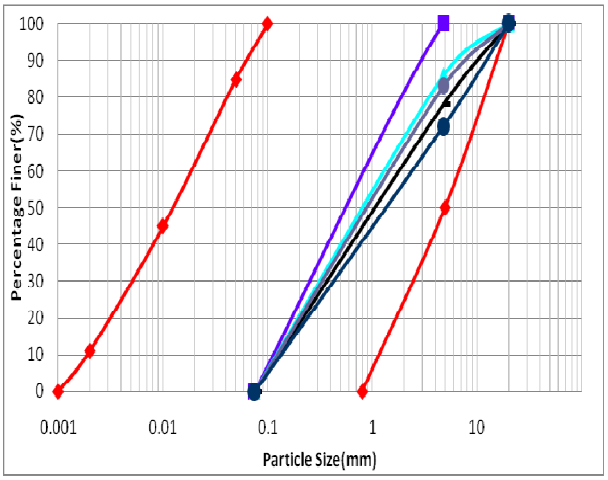
b



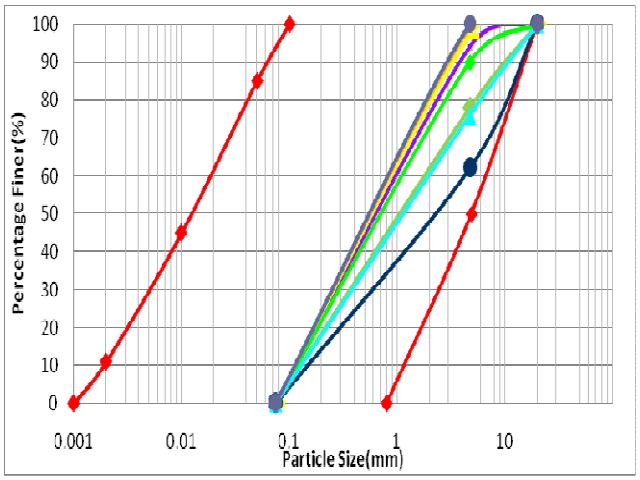
a.2



c



a.3



d

Figure 2 GSD Curves at (a) (1, 2&3) 4 m, (b) 6 m, and (c) 8 m (d) 10.0 m

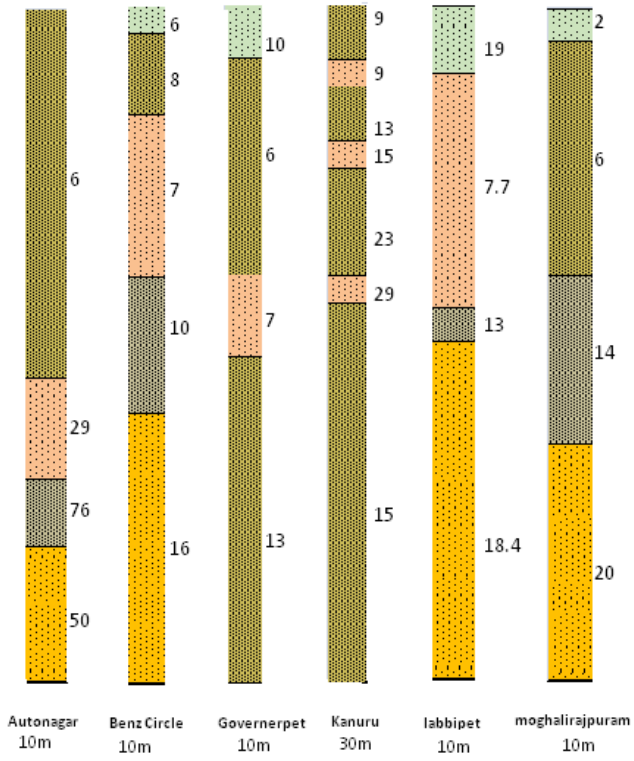
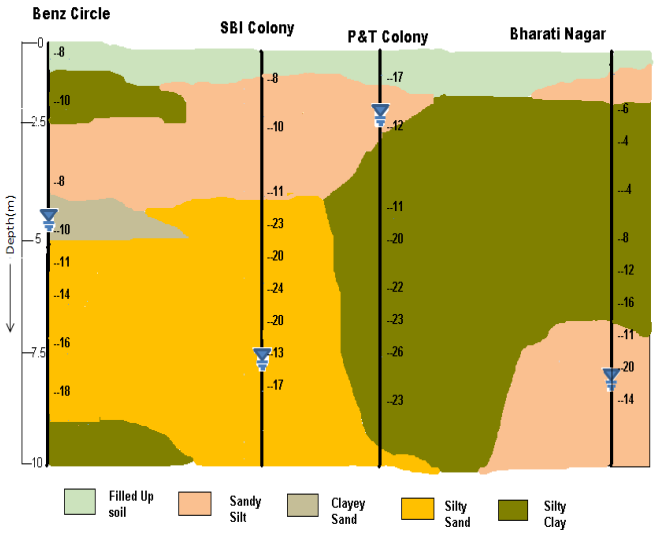
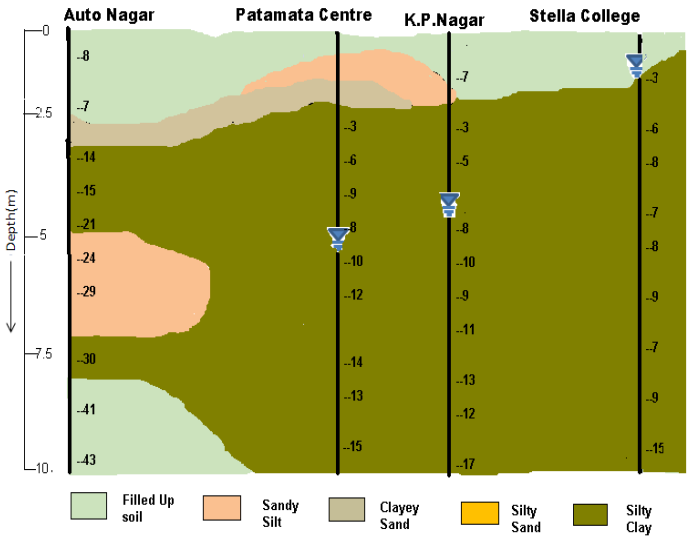


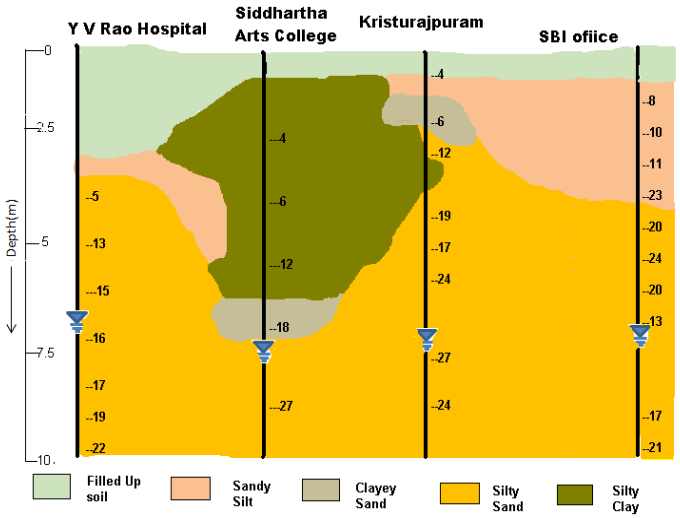
Figure 3 Soil Profiles At Some Locations With Corrected Spt N Values



(a)



(b)



(c)

Figure 4 (a, b, c): Soil Profiles of Vijayawada Region

The Vijayawada area has been divided into four regions East,West,North and South.It has been identified that in the Southern region silty clay was highly predominnat in the depths between 2m to 8m along with few traces of silty sand and sandy silt.The Northern side silty clay is abundant.Eastern part consisted of silty clay upto a depth of 5m and the from 5-8m silty sand is present.In the Western region some places like Seetharamapuram had rock at a

depth of 5m and in the other locations in the western part sandy silt and silty clay was prevalent in between 2-5m and below 5m silty clay is present.

4. CONCLUSION

- Liquefaction one of the important geotechnical ground failures during earthquakes, can be estimated.
- The results are useful to local governmental organizations, builders and researchers to enhance knowledge on earthquake resistant construction.
- The seismic activity of Viajaywada region can be understood.

5. REFERENCES

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