Dynamic Soil Properties for Microzonation of Delhi, India: A Review

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Abstract

The city of Delhi in India has witness some minor seismic activities in the past as Delhi has come in the highly sensitive area for earth quake. The city Delhi, India's capital, has witnessed minor seismic shaking in the past during many earthquakes .The broad differences in depths of the bedrock as well as groundwater table coupled with vegetation at various locations in Delhi need seismic microzonation analysis. Dynamic type soil such as shear velocity, modulus resultant as well as damping quality of soils are the specific and appropriate main contributions for conducting even a preliminary ground analysis, which is an necessary input in problems with concentration study; due to its soaring cost as well as lack of the required expertise, the shear wave velocity also isn't determined systematically. Stress controlled cycle have tested on the molded sample by using the high voltage in combination of the silt mixture. These systems are used to generate modulus reduction and tested on the dumping configuration.

Keywords: Dynamic, Soil, Microzonation, River, Velocity, Damping, Sand, Shear wave, Temperature.

Introduction

The earth quake is natural activity and sometimes it becomes disaster because of its intensity. There had been many occasion reported in which lot of people had lost their life apart from destruction of the property. The strangest thing about the seismic activities is that prediction is not correct all time, and earthquake has been counted among dangerous natural activity. There are many big cities in the world that have been witness of earth quake and its enormous destructive power. In case of the Delhi, if earthquake has strike with high intensity .it very much certain that it would have become a reason of the great damage and substantial loss of the life and livelihood. Numerous earthquakes of magnitudes range from 3 to 7.7 have been experiential in and surrounding Delhi over the last centuries.

According to India's seismic hazard map, Delhi is located in seismic zone IV with an average intensity of 0.24 g zero-period. This has considered as well established reality that a thorough lively analysis and construction environment design taking into explanation the behavior of local soil accumulation decreases the damages of the life and livelihood of life [1].

Shear velocity or bulk strain at lower stresses is the majority crucial key variable in the evaluation of manufacturing problems connecting earthquake technology, chiefly in microzonation analysis. As a high spending for determining the site-specific amplification factor, the wave velocity contour of a site is widely accepted. Due to cost constraints and lack of trained personnel, dynamic in situ testing is typically not performed in most geotechnical research program. As a result, several attempts have been put in efforts in background to compare shear strength parameters /or shear module values with the other easily accessible soil parameters such as N.

In order to avoid local analysis as well as also to look at the physical relationship among soil index as well as shear velocity, multiple model correlations were applied to determine the shear wave velocity utilizing numerous soil indexes. The most widespread relations are being built on the N value obtain by the normal testing process. Similar lines between shear velocity and sand as well as silty sand/sandy slit amounts are based on empirical correlations to represent the two main soil types present in Delhi, as shown in Fig. 1[2].

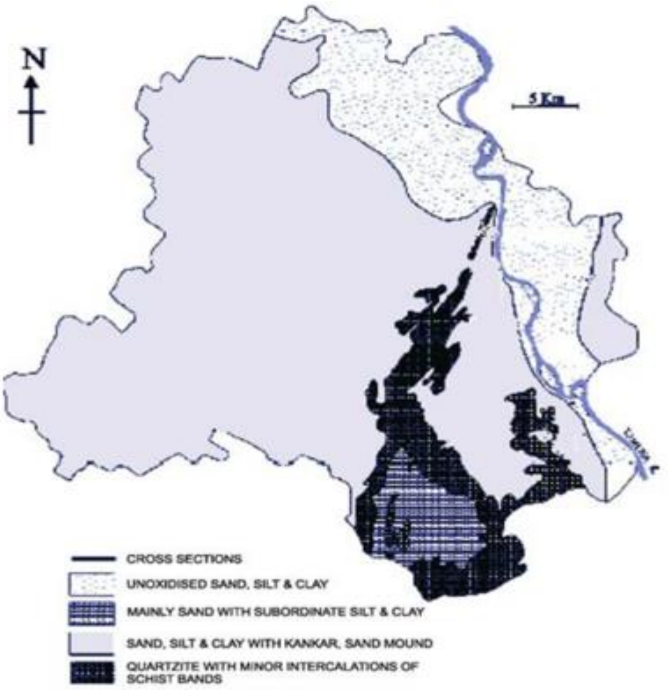

Fig. 1: Geological Map of Delhi

It is generally proved that shear strain amplitude in cyclic loading is a factor of the shear modulus and depends upon the damping frequency. Modulation reductions along with damping curve of the regional soil have been analysis for the ground examinations[3].

- *Measurement Of Shear Wave Velocity* :

In site calculation of shear velocity using geophysical method is the safest way to calculate Gmax. Geophysical technique were depends on the assumption that velocity of generation of a wave in any elastically active body depends on the elasticity module, the ratio of Poisson and the material density. Methods implementing wave propagation principles are either intrusive or non-intrusive in assessing the difference of depth Vs. In the present analysis, a number of the method is available to analyses the shear velocity and the method available with the researchers are non destructive method, no intrusive technique, and spectral method based upon surface waves. The findings of the each method have compared with a vigil of the experts of the domain and trying to found out the variation of the 10 to 15 percentage in the results[4].

The SASW method is a validated method of calculating shear strength parameters and progressively used. This test involves three steps: firstly field testing secondly dispersal measurements and third is inversion. A detailed outline of the test measures, variables upsetting the results in addition to these results have clearly mentioned in the details part of the text revelation. details of the reversal processes is well known in the literature to be essentially equal to half of the wavelengths and velocity of the shear wave as approximately 1.1 times the phase amplitude in existing research, as a first estimation in the inversion method.

- *Standard Penetration Tests:*

For the penetration test, more than 1500 sites have been marked to carry out the procedural steps for the penetration test. These sites have marked in the area owned by the private as well as public. Although, a minor difference have been found in the results that have been measured from these sites and experts have different opinion over the results. However, at the same test site, a substantial dispersion has been observed between the findings of the various agencies and the recorded N quality is not consistent amongst different organizations. In view of this, no attempts have been made to test the correlation relation from the positions where supervised experiments were conducted based on the entire dataset including N values..

- *Correlation between Vs and N value:*

Numerous correlations sandwiched between Vs and N principles calculated in the area are recorded in the literature. These relationships are often expressed as follows:

$$V_s = AN^B, \quad (1)$$

Where A, B are fixed parameters and a correlation coefficient R is also correlated with this. Typically the pattern observed is that for the same amount of soil, when A increases B decreases.

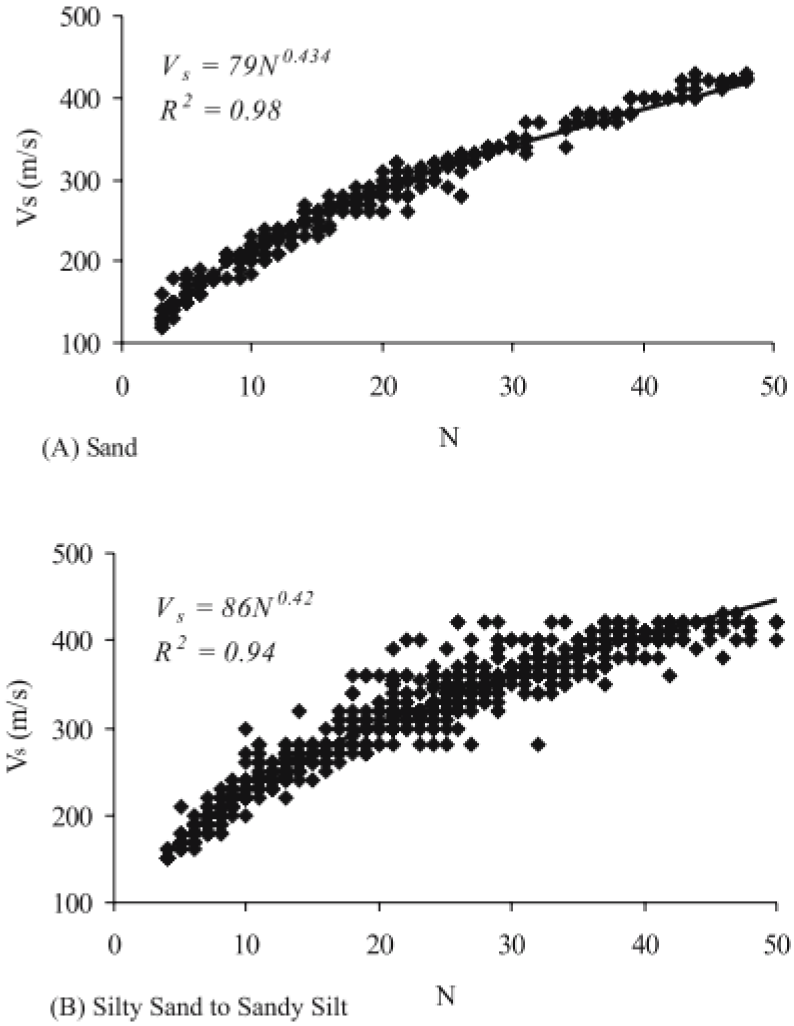

Fig. 2: Correlation Developed Between Vs and N for (A) Sand, (B) Sandy Silt/Silty Sand

Some researchers also use geological age and form of soil to strengthen correlations between the velocities of the shear wave as well as the N quantity. Experimental results for solid soils are additional robust for sandy type soils and have demonstrated superior velocities of shear waves than soil. Contrary to the recorded sandy soils have shown better association and senior speeds than consistent soils. In relation, the soil type is being used as an extra parameter and the Vs, gravel Vs, sand Vs, clay are measured. It has also been found that in tertiary, Vs is greater, less in diluvia and less in alluvial soil. It has been indicated that clay soils provide greater shear velocity than deserts and that if effective stress is included with the regression, the opinion of the shear velocity could be improved.

Due to poor reliability, N values below 2 and above 50 are discarded in the regression analysis when constructing the correlations. Uncorrected N principles are used at the same depth to establish the regression association with shear wave velocity. Correlations are formed on the basis of N values alone, and are formed for two various types of soil: one only one of its kind of sand and the other consisting of silt soil to silty sand as in Fig. 2.

The common parameters use for choosing the penetration in addition to Vs measurements are: The locations for penetration tests are in peripheral radius of 6 m of the shear velocity test location, and (ii) shear capacities are within the uniform layer and the corresponding test intervals and vales have taken at the differences of the 1.5 m each .Since the shear velocity for a specific layer is steady from the test results; shear wave velocity outline is also transfer to an interval of 1.5 m using a weighted mean process. In each category, the entire database is complete into pair of shear velocity and no of the observations to expand the regression equations between number of observation and shear velocity. For the production of the association between Vs and N, a simple linear equation for regression analysis is carried out as optional by several preceding researchers [7].

- *Strain dependent modulus reduction and damping curves:*

In common, with the rise in size, the damping ratio decreases. The soil response was essentially linear at greater depths (> 65m), and it retains the same patterns of stiffness and reaction during the earthquake. Relative density does not have any important impact on the dynamic characteristics of large strain soils (> 2 per cent), yet it has a strong impact at low stress levels. The geophysical seismic studies do not supply a reasonable estimate of material damping and can only be reliably calculated by laboratory research.To distinguish the complex property of soils, stress-controlled triaxial cyclic test have been performed on specimens formed using different mixtures of Yamuna sand and non-plastic fines (obtain from Delhi silt washing). In general, Delhi soils consist of different amounts of Yamuna sand and silt, with some small fractions of clay as well as kankar. In the current analysis certain minor constituents are not listed[8].

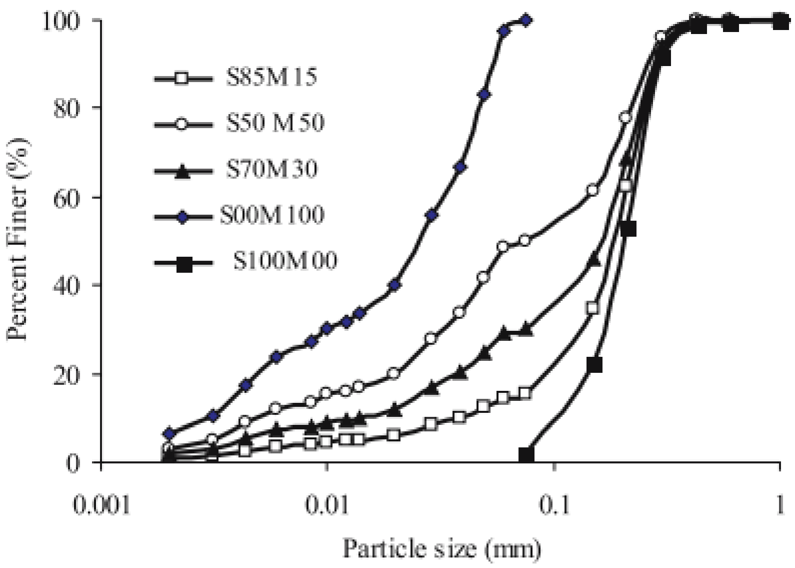

Fig. 3 Grain Size Distribution Curves of Different Sand-Silt Mixtures Used

- *Grain Size Distribution:*

The size of grain allocation for the various sand silt mixtures used in this learn is depicted in Fig. 3, and the size of grain parameter are known alongside the other index properties in table 1. Delhi silt is obtained by washing the non-plastic silt fraction through a sieve of 0.075 mm. The fines are observed to be non-plastic in most cases, particularly in fluvial beds.

- *Preparation of Sample:*

The modules' reducing and stiffness curves are consider as less responsive to the sample research process, the degree of contamination and the drainage situation. Remoulded samples are packed under compression in seven layers using a damp tamping process. Membrane adjustment is not regarded for fine and rough grain of soils, as membrane absorption per unit area is neglected. Correction for the area is also not regarded for the cyclic loading outcomes according to best practise[9].

- *Saturation and consolidation:*

All specimens became inundated to accomplish higher infiltration at designated back pressure along with time by moving carbon dioxide as well as desired vapor. Incremental saturation of the back pressure according to BS: 1377 (1990). The same conditions have been adopted for the almost all specimen under the observation.

is adopt for saturation in addition to all specimens are inundated using a back pressure of 312 ± 1 kPa to achieve Skempton pore pressure parameter B above 0.97. For all studies, back pressure is maintained constant to reduce the influence of back pressure on the modulus as well as damping. Both specimen are measured at vacuum ratio (e) of 0.78 and isotropically condensed to 100 and 150 kPa effective confining pressure[10].

Table 1: Index Properties of Sand-Silt Mixtures

Geotechnical properties	$FC = 0\%$ ($S100M00$)	$FC = 15\%$ ($S85M15$)	$FC = 30\%$ ($S70M30$)	$FC = 50\%$ ($S50M50$)	$FC = 100\%$ ($S00M100$)
Specific gravity (G_s)	2.660	2.668	2.675	2.685	2.710
Uniformity coefficient (C_u)	2.0	5.3	19	28	10.7
Coefficient of curvature (C_c)	1.20	2.30	1.90	1.30	1.04
D_{10} (mm)	0.110	0.040	0.010	0.005	0.003
D_{50} (mm)	0.210	0.185	0.160	0.078	0.026
Maximum density, γ_{dmax} (kN/m^3)	17.2	18.2	19.1	19.7	17.0
Minimum density, γ_{dmin} (kN/m^3)	13.2	14.1	14.2	14.0	12.2
Maximum void ratio (e_{max})	1.015	0.892	0.884	0.918	1.221
Minimum void ratio (e_{min})	0.546	0.466	0.401	0.363	0.594

CONCLUSION

Complex soil characteristics needed for practical microzonation from a earthquake engineering viewpoint are provided on the basis of comprehensive well planned field as well as laboratory tests that take into consideration the dissimilar soil circumstances encounter in Delhi. Combined with judicially selected borelogs, comprehensive SASW research is used to establish Vs–N association for the Delhi area and is compare to other recorded principles in the text. Cyclic triaxial stress and strain regulated test as per ASTM suggested that modulus decrease, damping behavior can be approximated by inferior bound sand values. Due to the lack of adequate equipment, This wrapping up is depends only on capacity at large strains and no try have been made to reduce the pre defined measures. The result discussed here can be further used in the microzonation map used by the various organizations.

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