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A LITERATURE REVIEW ON DEVELOPMENT OF GEOTECHNICAL SITE CHARACTERIZATION MODEL FOR NORTH AND CENTERAL GUJARAT REGION

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Abstract: Due to vast diversity of soil in Gujarat region it is required to analyze each site in order to know the geo-technical attributes of that site. This process of evaluating geo-technical properties is time consuming and costly. Our aim is to study this varying ground condition, synthesize geo-technical attributes, carryout site characterization for the region and development empirical relationship between various sets of engineering properties and putting them on GIS based model so that it can provide a platform to technical persons or agencies to access this indicative geotechnical properties and use them as a guide for their respective work regarding geotechnical investigation It will also guide for making their work plan and arrangement of resources. This will play a pivotal role in providing indicative geo-technical properties of Gujarat region.

Keywords: Site characterization, GIS, Geo-technical properties

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INTRODUCTION

Geotechnical characterization of a project site for engineering applications is indispensable in engineering geology and geotechnical engineering. It is well-recognized that there are many unavoidable variabilities and uncertainties in site characterization, such as inherent variability of soil and rock properties, measurement errors, statistical uncertainty, and transformation uncertainty when the information of interest is not measured directly, but estimated through a transformation model and other measured information (e.g., Whitman, 1984; Phoon and Kulhawy, 1999a, 1999b; Baecher and Christian, 2003; Wang et al., 2010a; Cao and Wang, 2013). The inherent variability is also known as the actual variability since soil and rock are natural materials, and their properties vary spatially and are affected by various geological process that they have undergone in their geological histories. Y. Wang, et al. (2013) consolidated recent advancement in Bayesian studies in site characterization and developed a robust framework for direct quantification of the actual variability of various soil and rock properties when estimated using different field or laboratory tests. To facilitate formulation of prior distribution and likelihood function, the procedure of geotechnical site characterization was revisited from a Bayesian perspective, and the occurrence and propagation of inherent variability, statistical uncertainty, measurement errors, and transformation uncertainty during characterization of a project site were mapped explicitly to different stages in site investigation. Based on the mapping, a robust Bayesian inverse analysis framework was developed that stream lines the formulation of likelihood functions for various soil and rock properties when estimated using different field or laboratory tests.[12] (Yu Wang et al., 2013)

DIFFERENT ATTRIBUTES FOR CHARACTERIZATION

SPT & DCPT Value Based Characterization

Y. Wang & Z. Cao (2008) had developed a Markov Chain Monte Carlo Simulation (MCMCS)-based approach for probabilistic characterization of undrained Young's modulus, Eu, of clay using standard penetration tests (SPT). Prior knowledge (e.g., previous engineering experience) and project-specific test data (e.g., SPT test data) are integrated probabilistically under a Bayesian framework and transformed into a large number, as many as needed, of equivalent samples of Eu. Then, conventional statistical analysis is carried out to estimate statistics of Eu. This allows a proper selection of characteristic value of the soil property in the implementation of probabilistic design codes (e.g., LRFD or MRFD in North America and Eurocode 7in Europe) and reliability analysis in geotechnical engineering practice. The proposed approach effectively tackles the difficulty in generating meaningful statistics from the usually limited amount of soil/rock property data obtained during geotechnical site investigation. [12]

Michael R. Lewis et al. (2008) stated that the CPT has enhanced their capability to perform subsurface exploration within Bechtel. Utilizing the CPT early in a project adds flexibility to the program and allows greater site coverage with a given budget in a shorter period of time. Initial program development following the suggestions of Sowers provides a reasonable starting point. Properly verified site-specific correlations between CPT parameters and laboratory testing add a dimension that can be very powerful when assessing site conditions and performing design related activities. The key component however in any exploration program is still effective communication with decision makers at all levels of the program. Full time geotechnical oversight will enhance and facilitate the needed communication and will allow quick and early decisions to be made during the program. With these attributes, utilizing the CPT will result in a program that allows maximum flexibility and affords superior stratigraphic definition through continuous or near continuous data, excellent repeatability and data reliability, and time and cost savings. The result is more high quality data, including "pinpoint" sampling and testing of targeted strata. While there will always be a need for soil borings and laboratory testing, the amount should decrease with increased use of the CPT. However, knowledge about the subsurface conditions will increase. This has been commonly recognized as far back as 1978 (Schmertmann, 1978): "Although engineers with much CPT experience in a local area sometimes conduct site investigations without actual sampling, in general one must obtain appropriate samples for the proper interpretation of CPT data. But, prior CPT data can greatly reduce sampling requirements."

K. Sudha et al. (2009) stated that Geotechnical investigations have been carried out in two different soil types at Aligarh and Jhansi site, in Uttar Pradesh, India. The SPT, DCPT and grain size analysis data have been integrated with the ERT results. Resistivity values are correlated with the soil matrix and grain size distribution. Linear relationship has been presented between transverse resistance derived from the ERT data and N-values obtained from geotechnical tests at these sites. As these sites represent different soil matrix located in different geological environment, the coefficients of linear fit are different. Therefore, the relationships are site-specific and require an extensive study to establish its validity and limitations, in different geological environment, for its future application. Once such relation is known for a particular location, soil strength can be determined from ERT results. The determination of soil strength using ERT is economic, fast and efficient in comparison to the direct in situ methods used to determine the soil strength for civil engineering purposes and, thus, is very useful in geotechnical investigations.[5]

A back-propagation neural network model and ordinary kriging model has been developed for predicting *Nc* values in the 3D subsurface of Bangalore, India by C. Sun & C. Chung in 2008 . The problem solved is to learn characteristic of the site using the measured *Nc* data. For back-propagation model, the procedures to determine data division, data normalizing technique, network architecture selection, transfer function and number of epochs are outlined. The results indicate that back-propagation model has the ability to predict *Nc* values in 3D subsurface of Bangalore, India with an acceptable degree of accuracy _R=0.945_. In case of geostatistical model, the procedure to determine the semi variogram model that quantifies the spatial variability of *Nc* values in the 3D subsurface of Bangalore, India has been discussed. A new type of cross-validation analysis _Q1=−0.018 and Q2=0.987_ which proves the robustness of the developed ordinary kriging model has been also presented in this study. A comparison between the ANN and geostatistical model indicates that ANN model is superior to geostatistical model for predicting *Nc* values in the subsurface of Bangalore, India.(Samui and G. Sitharam 2010) In order to sensibly estimate the site effects at Gyeongju, near several capable faults, a GTIS within a GIS frame- work was built for the reliable prediction of spatial geotechnical information. Particularly, the subsurface soil structures shown in the 2D basin sections at Gyeongju had very shallow and wide shapes with a value of 0.015 for the ratio of depth-to- width. From acceleration time responses on the ground surface from the 2D seismic response analyses, it was observed that the durations in the interior of the basin near the edge were prolonged primarily because of the surface waves generated by the reflection of shear waves. These results were compared with those of the 2D seismic response analyses. From the comparison results of the response spectra, the differences between the 2D and 1D analyses were scarcely observed at most plain sites in the interior of the basin. However, the larger spectral accelerations of the 2D analyses in the long-period range were partly observed at and near the basin edges. Predominantly, at several sites, the response spectra were very similar. This indicated that a simple 1D analysis method would be appropriate in the plain areas and that the 2D basin effects would be negligible for the interior of the shallow and wide basin.[7]

Electrical Resistivity

M.J.S. Roth et al. (1997) stated that Multi-electrode earth resistivity testing appears to be a valuable tool for geotechnical exploration in areas of karst overlain by clay soils. By using intrusive methods to confirm the interpretation of the results, this test can predict the depth to bedrock and determine trends in the bedrock surface. Electrode spacing can be selected based on the requirements of the project. While the depth of investigation is theoretically unlimited, resolution decreases with increases in electrode spacing. The study presented herein limited electrode spacing to a maximum of 4 m resulting in a maximum depth of investigation of approximately 20 m. However, the reliability of this method is still in question with regard to locating and determining the size of possible voids. Three-dimensional variability, the effects of line orientation, and the smoothing inherent in the inversion process all have significant influence on the results and require further study. The use of three-dimensional resistivity tests may overcome some of these problems.[8]

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