Preparation and Characterization of Model Clay Ground for Centrifuge Tests

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Reduced scale normally consolidated clay beds are often required for centrifuge tests. The centrifuge time required for the preparation of such clay beds is often very long, and may take several days for high plastic clays. An alternate method, using seepage forces, is often used prior to final consolidation in the centrifuge. The required hydraulic gradient is usually generated by high water pressure at the top of the clay bed. This method tends to cause hydraulic fracturing at corners when rectangular containers are used. Another method called suction induced seepage consolidation method is described in this paper. Several site investigation tools are available to obtain the strength profile of a clay sample prepared in the centrifuge. The most commonly used tools are in-flight vane shear apparatus and mini cone penetrometer. The difficulties involved while using these tools are brought out. The present study uses a T-bar penetrometer, which overcomes the limitations of other tools. A procedure to obtain the T-bar factor is suggested. The strength profile obtained on samples obtained by suction induced seepage consolidation is also discussed.

KEYWORDS: Geotechnical centrifuge, normally consolidated clays, seepage, hydraulic consolidation, shear strength.

Dynamic Properties and Ground Response Analysis of Silchar Soil on North-East India

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Effects of earthquake depend on local soil conditions, which include the dynamic properties of soil and the response of different soil layers as earthquake waves travel towards the earth's surface from the source. In the present analysis, behaviour of the soil profile at a particular site at Silchar is considered. Seismologically Silchar is located in zone V and geographically it is located in the southern part of Assam. Earthquakes of magnitude 5 to 6 are common in Silchar because of existence of some active faults in the periphery of the town. Laboratory tests with cyclic triaxial apparatus were carried out to determine the dynamic properties viz. shear modulus and damping ratio of the soil samples. Variations of the said properties with different strain levels were obtained. The response of the profile was calculated from the recorded acceleration-time history data of N.E. India earthquakes of 1988 and 1997 of magnitudes 7.2 and 5.6 on Richter scale with a hypocentral distance of 254.0 km and 65.4 km respectively from Silchar town. The acceleration time history was given as input motion and spectral ordinates at the ground surface were found out. The analyses were carried out using non -linear one dimensional soil models.

KEYWORDS: Shear Modulus, Damping Ratio, Ground response, Cyclic Triaxial Test.

Behaviour of 2 × 2 Pile Group under Static and Cyclic Lateral Loading

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The results of cyclic lateral load tests conducted on model single pile and 2 × 2 pile group embedded in soft clay are presented in this paper and compared with the behaviour under static loading. The effects of spacing, number of cycles of loading and cyclic load level on load – deflection behaviour of the pile group are investigated. Group interaction effect under cyclic lateral loading is predominant for groups with spacing less than seven times the diameter of the pile. It is found that when the cyclic load level exceeding 0.5 times of static ultimate capacity, it produce large deflections of the pile group. The effect of cyclic loading is more predominant for the pile group than for the single pile. Block mode of failure occurs for closely spaced pile groups under cyclic lateral loading.

KEYWORDS: Nonlinear, Critical spacing, Earthquake, Group interaction, Block failure

Skirted Granular Pile Foundation for High Water Table Areas

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Short rigid composite foundation with granular core is being proposed for lowlands based on the concept of skirted granular pile along with well steining. The proposed foundation is similar to a short pipe pile except that the granular infill is much stronger and stiffer than the original ground. The steining is relatively incompressible and hence settles more than the granular core. Therefore, the outer and inner surfaces of the steining resist the applied load by positive resistance, the granular infill would be subjected to down-drag or negative skin resistance because of which larger loads are transferred through its base. Parametric study quantifies the effects of various parameters on the settlement of the proposed foundation. Model tests were also conducted for the validation of theoretical result. It is observed that there is good agreement between measured and predicted settlements.

KEYWORDS: Foundations, soil-structure interaction, model testing, lowlands

Soil-Structure Interaction Analysis of a Braced Deep Excavation

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Soil-structure interaction mechanisms that affect the behaviour of a deep excavation, supported by a combination of diaphragm wall, tie-back anchors and props, are investigated with the help of finite element analyses. A well-documented case study of a deep excavation in downtown Chicago was selected for back analysis because of the availability of good-quality data on local geology and soil properties. In the finite element analysis, both non-linear elastic and elastoplastic models were used to describe the various soil layers and key aspects of the construction, such as sequential excavation of layers, installation of pre-stressed tie-back anchors and props and dewatering of the excavation, were modelled. Input parameters were first calibrated using the back analysis and then used for establishing key mechanisms of soil-structure interaction. A parametric study was also conducted to identify key parameters that influence the mechanisms of soil-structure interaction. It was found that realistic modelling of construction effects is essential for obtaining accurate estimates of deformation and stresses. Ground movements around the deep excavation were found to be influenced mainly by the stiffness of the soil and the stiffness of the retaining wall.

KEYWORDS: Excavation, diaphragm wall, finite element method, soil-structure interaction, lateral displacement, settlement.

Interaction Analysis of Building Frame Supported on Pile Group

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(*Indian Geotechnical Journal, Vol. 38, No. 4, October 2008, pp.483-501*)

The effect of the soil-structure interaction on a simple single storeyed and two bay space frame resting on pile groups with flexible cap is examined in this paper by resorting to more a rational approach and realistic assumptions based on three dimensional finite element analysis. Elements of superstructure and that of substructure are descretized using 20 node isoparametric continuum elements while interfaces between the soil and pile are modeled using 16 node isoparametric interface elements. After carrying out an independent analysis for the structure on the premise of fixed column bases, stiffness of the pile foundation are worked out separately and used in the interactive analysis of superstructure frame to quantify the effect of soil- structure interaction on the response of the superstructure. The investigation considers the interaction between pile cap and underlying soil. In the parametric study presented here, effect of pile spacing and pile configuration along with the number and diameter of pile is evaluated on the response of superstructure. Effect of soil-structure interaction is found to be quite significant for the type of foundation used in the study.

KEYWORDS: Soil-Structure Interaction (SSI), Pile Group, Spacing, Number of Piles, Configurations of Pile Group, Top Displacement of Frame, and B.M. in Columns

TECHNICAL NOTE

Analysis of Rigid Piles in Clays

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A simple method for estimating the ultimate lateral capacity of an unrestrained, vertical rigid pile in cohesive soil is presented. The reliability of this method and some of the widely used methods proposed by Broms (1964), Budhu and Davies (1988) and Rao and Rao (1995) for estimating the lateral load capacity are statistically examined using the data of 69 published pile load tests. Compared to all other methods, the proposed method is in better agreement with the tests data.

KEYWORDS: Rigid piles, Pile deflection, Embedment length, Lateral load capacity

TECHNICAL NOTE

An Approach to Predict Ultimate Bearing Capacity of Surface Footings Using Artificial Neural Network

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An approach to predict Ultimate Bearing Capacity (UBC) of surface footings using Artificial Neural Network (ANN) is developed in this study. A total of 1660 different data sets were collected from the technical literature. Training data sets comprises 1180 data entries, and the remaining data (480) are divided between the testing and validation sets. A detailed study was carried out, considering one hidden layers for the architecture of neural network. The performance of the 9-15-1 architecture was the best possible architecture for this problem. A comparison between the UBC of soils predicted through the ANN and experimental data showed that the ANN was successful in training the relationship between the input and output data with the mean square error (MSE) of 14.83%. The results indicated that ANNs can be used to predict the UBC of soil.

KEYWORDS: Artificial Neural Networks (ANNs), Backpropagation (BP), Ultimate Bearing Capacity (UBC), Mean Square Error (MSE).