Research article on Correlations of CBR-A Literature

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Abstract

This paper summarizes the ongoing researches about the California bearing ratio which is most use in direct method to assess the stiffness modulus and shear strength of sub grade in the design of flexible pavement. Many studies regarding CBR values of different types of soil , that have been carried out earlier were studied, it has been found that CBR value varies with different properties possessed by the soil.CBR value of soil depends on many factors like maximum dry density (MDD),optimum moisture content(OMC),liquid limit(LL), unconfined compressive strength, percent fines etc. Determination of CBR is a bit lengthy and time consuming process so a correlation can be developed between the CBR values and Index properties of soil, so that the sub grade strength can be determined.

Keywords: *CBR, liquid limit, optimum moisture content, maximum dry density*

1. Introduction

1.1 General Introduction

Presently India's infrastructure is growing rapidly. Large number of new urban and lightly trafficked roads are being constructed or planned. The CBR or California bearing ratio is the well known, common and trustful test currently used in road construction. The test is being used for many years and these familiar organizations involved in the interpretation of results, consequent road design and construction.

California bearing ratio mainly comes under the use of civil engineers particularly for those working in pavement construction to determine stiffness modulus and shear strength of sub- grade. It shows comparison of strength of sub-grade material to the strength of standard crushed rock referred in % age values. This method was basically developed at California Division of Highways in 1930s to give an assessment of the relative stability of fine crushed rock base material. The CBR values are used by the engineers to design the thickness of pavement layer to be laid on the top of the sub-grade. The lower CBR value sub-grade will have more thickness of pavement as compared to the sub-grade that has higher CBR value. In this method the soil sample is compacted in a standard mould and then a plunger is allowed to penetrate into the soil at a specified penetration rate. Load Vs penetration curve is plotted from the result of penetration and then compared with the bearing resistance of standard crushed rock.

1.2 Problem statement

Soil is diverse in formation and character, therefore accurate prediction of its engineering behavior is of research interest in civil engineering area. The engineering behavior of soils varies from place to place and also with time. Many attempts are made to predict CBR value from the index properties of soil. Hence determining of factors that influence the soil strength and studying their relationship with California bearing ratio value on representative sample may be considered as good insight of soil behavior.

2. Literature

Talukdar, conducted index tests on 16 different samples collected from different districts of Assam. The correlation was developed between fine- grained soil (ML and MI) and PI, MDD and OMC. It was observed that the CBR value decreases with the increase in the plasticity index and optimum moisture content of soil but increases with the increase in the maximum dry density. There was a slight difference between the CBR value determined in the laboratory and computed by multiple regression models which involves LL, PI, MDD and OMC. The comparison also show that there were some soil samples which have no difference in the laboratory and the computed value of CBR, but the maximum difference observed was 3.67%.

Harini and Naagesh, present the application of ANN and MLR to estimate the CBR of fine-grained soils. The prediction models were developed to correlate CBR with the basic properties of soil i.e. optimum moisture content, maximum dry density, liquid limit, plastic limit, and plasticity index and percentage fines. A total 40 soil samples

were collected from the surroundings of Bangalore city. Out of total 40 soils sample data, 30 were used for training and 10 were used for testing. The research showed that the CBR is best correlated with the liquid limit and percent fines, this model had a high correlation coefficient (CC=0.86) with Least RMSE values. It was concluded from the research that neural network models, which can incorporate additional model parameters, give less scattered parameters than those given by MLR. Therefore ANN model and MLR can be used for correlation of CBR with index properties.

Saklecha et al., presents the application of artificial neural networks to study the strength characterization of foundation soils in a basaltic terrain. In this research, a total of 387 laboratory test data sets were collected for different locations in Wardha district in the state of Maharashtra, India. To get successful network, five models of neural network of neural network with diverse topologies were developed. The models were trained and cross validated until the convergence was achieved in the mean sum of squares of the network errors. The correlation coefficient between predicted CBR and desired CBR was found to be 0.88, which showed a good learning of ANN model. Consequently it could be concluded that the ANNs are found to be able to learn the relation between the strength parameter CBR and mechanical properties of foundation soil.

Datta and Chottopadhyay, checked the validity and applicability of correlation which were used for prediction of CBR for their acceptance in general practice. The predicted and tested values of CBR of various soils were used to check the applicability and limitations of available methods and were presented in this research. It was found that the correlation given by Vinod and Cletus (2008) seems to give good agreement of tested values and predicted values of CBR for CI soils but in case of CL soils, the predicted values are much higher than the experimental values.

$$CBR = -0.889(LL) + 45.616$$

In another case the predicted values from correlation given by Patel and Desai (2010) agree with the tested values particularly for CI soils. But for other soils the predicted values are much lower than the tested values.

3. Proposed work

The main aim of the research work in this dissertation was to concern itself with the prediction of CBR values from soil parameters, so as to reduce the amount of CBR testing done in industry. The CBR was defined by the California division of Highways in the year 1929 so as to develop the California Bearing Ratio test to classify the suitability of soil for using the soil as sub grade or base course material for the construction of Highway. This test was adopted by the US Corps of Engineers for the determination of sub grade for the use of airfield construction during World War II. This test measures the shearing resistance of soil Sub grade under the controlled moisture and density conditions. The California bearing ratio is a penetration test which is used for evaluation of sub grade strength of roads and pavements. The results so obtained are compared with the empirical Curves to determine the thickness of pavements and its components. The CBR test is obtained as the ratio of unit load required that will affect the certain depth of penetration into a compacted sample at certain water content and density to the standard unit load required the same depth of penetration in a standard sample of crushed stone. The CBR number is based on the load ratio for a penetration of depth up to 2.5mm. However, if the CBR value at penetration of 5mm is larger, the test should be Redone .however if the second test gives also a large number at 5mm penetration, the CBR for 5mm shall be used.

4. Conclusion

After going through number of researches, I conclude that before going to built any civil engineering project on any type of soil its CBR values must be studied with the Index Properties of soil and a correlation should be developed as the CBR test is a bit laborious and time consuming and also we shall be fully aware about the type of soil on which the project is to be design. Further it can be concluded that in India a relationship could be established with between MDD and soaked CBR value by Model developed by Simple Linear Regression Analysis. I also conclude that use of Index Properties appears to be reasonable in the estimation of soaked CBR value of fine grained soils.

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