CORRELATION BETWEEN CALIFORNIA BEARING RATIO (CBR) AND SOIL PARAMETERS

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Abstract

In this study, laboratory and field compacted soil samples (CL, CH and SC) were characterized using the CBR test and the soil parameters were correlated CBR. The relationship between CBR and undrained shear strength of soil was nonlinear and the test results were compared to the published information in the literature.

1 Introduction

The California Bearing Ratio test was developed by O.J.Porter for the California Highway Department during the 1920s. It is a load-deformation test performed in the laboratory and field and the results are then used with empirical design charts to determine the thickness of flexible pavement, base and other layers for a given loading. In the past decade researchers have developed many correlations between soil parameters and testing methods for a variety of soil types. The California bearing ratio (CBR) test is still used in the design and analysis of both the rigid and flexible pavements. A number of attempts have been made in the past to correlate CBR with index, physical, strength properties. Black, W.P.M (1961) and Gregory and Cross (1989) investigated the CBR relationship based on the bearing capacity approach based on the 0.1 inch penetration results. For saturated cohesive soil, with undrained friction angle (Ø) is equals to zero the relationship will be as follows:

$$CBR = 0.62\, S_u \qquad \text{-----------------------------(1)}$$

Where Su is the undrained shear strength.

2 Objectives

In this study correlation between CBR and various soil parameters was investigated for CL, CH and SC soils. Mainly the correlation between the CBR and Su was studied.

3 Sample Preparations and Soil Properties

Based on the soil types, methods of mixing, about 50 samples were prepared for investigation. The CBR tests were performed unsoked compacted samples. The other soil parameters were determined according to ASTM standards. The LL for the soils varied from 18 to 90. The dry density of the soils varied from 89 to 132 pcf. The CBR values for 0.1 in penetration varied from 0 to 71%.

4 Model Predictions

Based on literature review and from the authors' experience the relationship in Equation (2) was investigated. It was assumed that the CBR will be influenced by the liquid limit(LL), plastic limit(PL), specific gravity(G_s), dry density (γ_d), moisture content(ω), undrained shear strength(S_u) and modulus(E). The nonlinear power relationship is as follows:.

$$CBR = k \times LL^a \times PL^b \times Gs^c \times {\gamma_d}^d \times \omega^e \times {S_u}^f \times E^g \qquad \text{---------------------------- (2)}$$

$$Log\ CBR = LogK + aLogLL + bLogPL + cLogG_s + dLog\gamma_d + eLog\omega + fLogS_u + gLogE$$
-------------------------- (3)

5 Results

Investigating the soil parameters showed good relationship between CBR and Su. Other soil parameters had less influence on the CBR values. Hence the relationship in Equation (2) can be further simplified to Equation (4) as follows: .

$$LogCBR = LogK + hLogS_u \qquad \text{-------------- (4)}$$

$$LogCBR = -0.25 + 1.07\ LogS_u$$

$$CBR = 0.56{S_u}^{1.07} \text{-------------- (6)}$$

The coefficient of correlation was 0.8. The Variation of CBR with Unconfined shear strength is plotted in Figure No.1. The Black's Correlation is also shown Figure No.1.

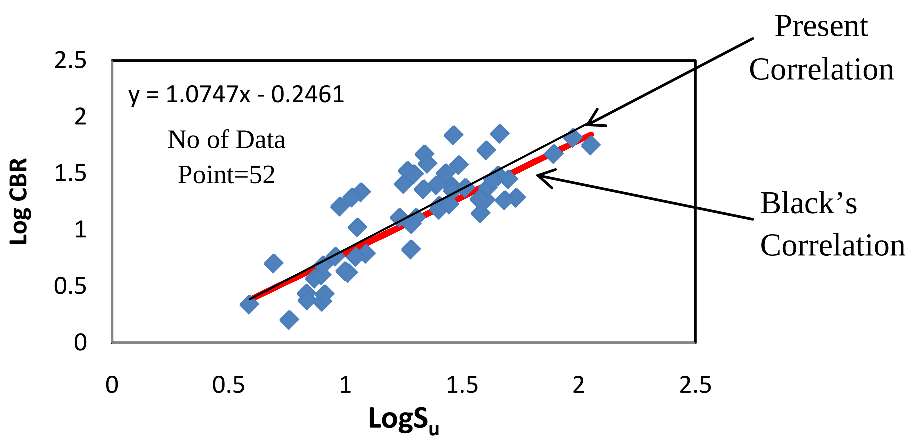

Figure No. 1 Variation of CBR with Unconfined Compressive Strength (S_u)

6 Conclusions

For the soils (CL, CH and SC) studied, the undrained shear strength had better correlations with the CBR than any other soil parameter investigated. The relationship was nonlinear.

7 Acknowledgements

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8 References

1. Black, W.P.M. (1962), "A Method of estimating the California Bearing Ratio of cohesive soils from plasticity data", Geotechnique, Vol. 12, No. 4, pp. 271-282.
2. Gregory, G.H., and Cross, S.A, (1989), "Correlation of California Bearing Ratio with Shear Strength Parameters", Transportation Research Board, Vol.1, pp. 148-153.