



A Critical Review of Correlation between different Engineering Properties of Subgrade soil

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Abstract:- In the flexible pavements sub-grade is considered to be an ideal layer to resist wheel load and its CBR value is considered as the strength measuring parameter. Conducting CBR test is an expensive and very time consuming test, so it is very tricky to mould the sample at a desired in-situ density in the laboratory. In the present study attempt is being a develop relationship between DCPT value and CBR and Unconfined compressive strength (UCS). CBR can't be easily measured in the field, assumption of CBR from other simple tests such as Dynamic Cone Penetrometer (DCP) and unconfined compressive strength (UCS). A soil property is a Valuable alternative. So the main objective of this study (1) to classify the soil samples of different region based on index properties. (2) To determine the subgrade strength parameters like California bearing ratio (CBR) (soaked & unsoaked), dynamic cone penetration test (DCPT) & Unconfined compressive strength (UCS). (3) To develop the correlation between different engineering properties of subgrade soil like CBR, DCPT & UCS.

Key words:- California bearing ratio, Dynamic cone penetration, unconfined compressive strength, Subgrade soil

I. INTRODUCTION

Roads are necessary for transportation and economic development of the country. Most of the road network in the country is consisting of flexible pavement. Flexible pavement consists of different layers such as sub-grade, sub-base, base course and surface layer. Sub-grade is the bottom most layer. Design and performance of flexible pavement mainly depends on the strength of sub-grade material. The load from the pavement surface is ultimately transferred to sub-grade and to the sub-base. The sub-grade is designed such that the stress transferred should not exceed elastic limit. Hence, the suitability and stability of sub-grade material is evaluated before construction of pavement. So overcome of this problem another tool can be introduced it's a Known as a DCP (Dynamic cone penetrometer). Even IRC 37 (2012) recommends the following equation to be used to determine the in-situ CBR of subgrade soil based on DCP test:

$$\text{LOG}_{10} \text{CBR} = 2.465 - 1.12 \text{LOG}_{10} N \text{ Where } N = \text{mm/blow}$$

Subgrade soil is a very important parameter to design Flexible and Rigid Pavement. Laboratory investigation of Strength of Subgrade parameter as California Bearing Ratio is an essential method for Design of flexible pavement and K-Value required for design of rigid pavement. Unconfined compressive strength is helpful for finding the value of shear strength parameter of sub grade soil. So this study considers the use of multiple variable regression analysis to predict the California Bearing Ratio (CBR) and k value and unconfined compressive strength, insitu dry density from Dynamic Cone Penetrometer and liquid limit and moisture content of subgrade soil. So this formulation is used for Quick determination of Subgrade strength parameter like CBR (California Bearing Ratio) and some another parameter like DCP (Dynamic cone penetrometer).

II. LITERATURE REVIEW

Mukesh A. Patel et al. (2013)^[1] has developed a Correlation between California bearing ratio (CBR), Unconfined Compressive Strength (UCS) and Modulus of subgrade reaction (K_{PBT}). So value of CBR, UCS & K_{PBT} increases with increase in cement content in soil. The CBR, PBT, UCS & DCP tests were conducted on natural soil & stabilized soil by adding cement (1 to 5% in increment of 1%) & Flyash (10 to 50% in increment of 10%) and also Maximum dry density and optimum moisture content were obtained for each proportion by modified compaction test procedure. So it is found that based on experimental analysis develop the multiple variable correlations between PBT, UCS, CBR & DCP. The value of CBR, UCS & modulus of sub grade reaction (K_{PBT}) increases with increase in cement & flyash content in soil so this correlation is helpful for consultants/engineers in quick determination of CBR, UCS & K-value.

Sunanda Bhattacharjee et al. (2014)^[2] have carried out work on Conventional CBR and DCP method in mould. So generally in the most of cases laboratory CBR by DCP is higher than conventional laboratory IS method. Laboratory CBR by IS and DCP method both are always higher at 100% MDD compared to 97% MDD. So CBR value of Dynamic compaction is slightly higher than Static compaction for both the methods. CBR values of subgrade, increase at OMC-2% and decrease at +2% compared with OMC condition.

Gill K. Setal. (2010)^[3] have carried out work on CBR Value Estimation Using Dynamic Cone Penetrometer. So, the relation is developed between CBR index value for tests conducted under different conditions and compaction level or Field density and similarly laboratory soaked CBR value can be calculated after developing a correlation between CBR_I (CBR_{LS}/CBR_{DCPS}) and compaction level. So Construction of embankment or strengthening of existing pavement a Dynamic cone penetration tool is very valuable to determine the subgrade strength parameter in terms of CBR value.

Bandyopadhyay, K et al. (2010)^[4] have carried out work on Laboratory and Field CBR by DCP and IS method. This paper presents the comparison between laboratory (soaked and unsoaked) and field CBR by DCP and conventional IS code method for service road work at Sreebhumi end of Ultadanga flyover under 'JNNURM' scheme executed by Kolkata Metropolitan Development Authority. So the difference between laboratory CBR values by IS and DCP method are 4 to 10% for unsoaked and 22 to 24% for 4 days soaked condition. The Field CBR values by IS: 2720 (Part 31) method was 13 to 21% higher than DCP CBR in respect to IS method at the field.

Dr. Dilip Kumar (2014)^[5] developed relation between California Bearing Ratio (CBR) with other properties of soil. CBR value of fine grained soil bears important relation with Plasticity index (PI), Maximum Dry Density and Optimum moisture content. CBR value increases with the decrease in Plasticity index and Optimum Moisture content of soil. But it increases with the increase in the Maximum dry density. So there is a minor difference between the CBR value determined in the laboratory and determined by means of multiple linear regression model involving LL, PL, PI, MDD and OMC and type of soil used in this study is ML and MI.

P. G. Rakaraddi et al. (2015)^[6] Established the relationship between CBR with different type of soil properties. So additional, if the available soil is of poor quality, suitable admixture or additive are mixed with soil and resulting strength of soil is assessed by CBR value which is so cumbersome. To overcome these problems, the other methods such as regression based models (simple & multiple) are used in this study. From simple correlation method CBR can be predicted by soil properties. Soil liquid limit considered higher priority for predicting soaked CBR value followed by MDD, OMC and PI based on assessment factor R^2 . So CBR correlated with WL, WP, fines and specific gravity generated equation like $CBR = 0.275LL + 0.118PL + 0.033F + 5.106G$ and with $R^2 = 0.961$ gives a good value.

Tapas Kumar Roy (2013)^[7] developed Influence of sand on strength properties of cohesive Soil for sub grade. As results Plasticity Index shows a lesser value with increase of sand content as Liquid Limit and MDD values of all the two types of alluvial soils shows a significant increase in the values of MDD with addition of any of the three types of sands used. So such value in unsoaked condition become nearly doubled for addition of fines and up to 15% compare to that of tested soils and may be identified as cost effective mix proportion because of reducing the thickness of different layers of flexible pavement due to improvement in the CBR value.

Pawan Kumar et al. (2014)^[8] developed Critical appraisal of correlations between CBR and subgrade modulus. So in this paper, it is found that on reviewing the various correlation between E and CBR, these equations must be used with caution, since the thickness of the pavement layers is determined based on the estimated E values, using these E-CBR relation without considering the soil properties may lead to providing inadequate pavement layer above the subgrade. So absence of experimental data the triaxial testing facility being expensive and not widely available, the resilient modulus can be determined using CBR value.

Simo Tosovic et al. (2010)^[9] developed C.B.R. Testing with Dynamic conical penetrometer in the process of road rehabilitation. The paper is Content of basic principles of operation with dynamic cone penetrometer, so by means of the device whereby one obtains in-situ data on bearing capacity of road and subgrade along with a definition of thickness and limits among the layers. The paper is concluding a test results obtained in the field for fine grained materials, all along with the relationship with CBR laboratory test results.

Saied Enayatapour et al. (2006) [10] have carried out work on Unconfined compressive strength by using dynamic cone penetrometer for stabilized soil. The DPI values for cement treated soils were lower than the DPI values for lime treated soils. Also excellent correlation models (R^2 of 0.97 and 0.91) were obtained between UCS and DPI, treatment method, and curing time. This indicates that the DCP method can be a valuable tool for predicting unconfined compressive strength of shallow subgrade treatment.

Deepika Chukka et al. (2012) [11] have carried out work on estimation of different properties of soil Sub grade using Dynamic Cone Penetration. So here by various testing a DCPI value decreases with increasing CBR value also relation can be define as a $\text{Log (CBR)} = 0.441 - 0.296 \text{Log (DCPI)}$ and DCPI value decreased with increasing value of UCS. The DCP value can be used to determine the average value of UCS of subgrade and the relation can be define as $\text{Log (UCS)} = 18.51 - 13.66 \text{Log (DCPI)}$. DCPI increases with moisture.

Dr. R. Srinivasa Kumar et al. (2015) [12] have carried out work on Comparative study on model develop by the CBR, DCPT, FWD test results. Towards this objective, the DCP as a low cost and alternative tool used for evaluating unbound granular and subgrade soil of low volume and roads in developing and under-developed countries where routine evaluation of FWD is not feasible. So the differences among the different relationships developed for different countries may be due to variations in prevailing soil type, drainage condition and layers confinement and depth of testing and variations in test procedures adopted.

III. CONCLUSION

This Paper presents a literature review on Correlation between different engineering properties of subgrade soil. So in most of the paper content with correlation of CBR (California bearing ratio) and DCPT (Dynamic cone penetration) and UCS (Unconfined compressive strength). So based on different correlation it's easy to identify a different subgrade soil. So this model equation is very helpful for finding Different properties of subgrade soil.

IV. REFERENCE

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