Prediction of CBR Value on Gangetic Alluvial Soil

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Abstract- Alluvial soils are very erratic and properties of such soil vary greatly in different locations. The mapping of variation of such soils by Indian standard soil classification system is very helpful for designer and constructors to estimate possible variation of the properties of soils existing at those sites in different districts in West Bengal. Further, plasticity index (PI) is considered to the most important factor for development of the prediction model for CBR. It is also observed that percentage finer is a major contribution for deciding the value of CBR. Now, to evaluate the relationship among CBR value, percentage finer and PI of soil, large number of data on alluvial soils have been collected form either site of Hooghly river for PMGSY schemes. To develop the prediction model, only fine-grained soils data have been used. Some typical alluvial soil have been collected from either side of river Hooghly in West Bengal and different engineering properties have been determined in the laboratories and are used to check the validity of the developed correlations. The results of such searching would be useful for use in the field of design, construction, control and checking for rural roads to be constructed to future on such Gangetic Alluvial soil in West Bengal

Keywords – Alluvial soils, Plasticity Index, CBR, Percentage fiber, Fine-grained soil.

I. INTRODUCTION

Large amount of roads connecting remotest villages in rural India with the existing network of road is being done through different scheme, like Pradhan Mantri Gram Sadak Yojana. For such roads, local soils are used as constructional material for sub-grade construction. Alluvial soils due to their modes of formation are very erratic and properties of such soil vary greatly along different directions. In West Bengal, Ganga enters near Rajmahal, flows to Bangladesh, in the name of Padma, leaving the original river to flow through the district of Murshidabad, from north to sea, remaining as eastern border of the districts, of Hooghly, Howrah and Purba Meidnipur and western border of the districts of Nadia, North and South 24 Parganas. In India, the river is more recognized as Hooghly River. In all these districts, the top soils are alluvial and these soils generally support the rural roads, being constructed. Mapping of the properties of these soils in the above district may be beneficial for further construction and control of the rural road for different authorities. To develop the proposed mapping, large number data generated from soil exploration for design of rural roads in last few years, under PMGSY scheme, may be useful.

Further to conduct a CBR test, representative soil sample has to be collected from location selected, from which a remolded specimen has to be prepared at predetermined optimum moisture content with standard proctor compaction. To obtain soaked CBR value of a soil sample, it takes more time making CBR test expensive, time consuming and laborious. Improper handling and poor quality of testing conditions in hurriedly established field laboratories for temporary purpose in sites may also hamper the accuracy of the test results. Again, only limited number of CBR test could be performed for kilometer length of the proposed road to be constructed. Such limited number of CBR test results may not reveal the variation of CBR values over the length of the road to enable lucid, economic, and safe construction. This is particularly true for road construction on alluvial soils which by nature of their development are extremely erratic in nature, In such cases, only limited number of CBR test values along the alignment of the road, makes difficult for Highway Engineers to incorporate the in-situ variation of soil properties of subgrade along the length of the road properly and also take rational steps to identify and rectify the local weakness present at any location if any, along the length of the road.

Therefore, for cost effectiveness and quick methods to evaluate CBR value, on the basis of low cost, easy, and less time consuming test, becomes important and necessary both design stage and quality checking stage. Development of prediction models might be useful and became a base of judgment on the validation of CBR values.

II. Proposed Investigation

The main aim is to classify the alluvial fine grained near surface soils on the two sides of the Hooghly River for several districts in the state of West Bengal according to their classification based on tested values of PI and liquid limit. Moreover, development of satisfactory prediction model for CBR from the in-situ alluvial soils near the surface, at those districts will be further advantages. It is expected that the results of such searching would be useful for use in the field of design, construction, control and checking for rural roads to be constructed to future on such Gangetic Alluvial soil in West Bengal.

III. Mapping of Gangetic alluvium, Prediction Model for CBR and check for validity

A. Mapping of Gangetic Alluvium for different districts in West Bengal-

Different types of soil are found from various parts of the world have different properties. Therefore, it will be very much useful if one can make a map in Plasticity chart which shows the position of soil of a particular place. As a result if anyone uses the Plasticity Chart, he will find the possible soil characteristics of a particular place and it will be very much helpful for Geotechnical Engineers to find a possible range of CBR value for a particular place without testing the CBR value in the laboratory. Also, the accuracy of the laboratory tested CBR value can be determined if the possible range of CBR value can be predicted from the Plasticity Chart.

For the characterization of Gangetic alluvium soils, a large number of PMGSY data are used and the soil data are plotted in Plasticity Chart. It is observed that all the data are located along a line approximately parallel to A-line. So, for mapping purpose area containing maximum data is read. The suitable range is selected in such a way that majority of all the data lie in that range. To maintain the majority of data, boundaries of the zone containing the data are described by four straight lines. Two line, parallel to A-line while other two line which are parallel to PI axis. These boundaries for the different districts Murshidabad, Nadia, North 24 Pargana, South 24 Pargana, Hooghly, Hawrah and Purba Medinipur are prepared and finally a suitable zoning map for Gangetic alluvium in West Bengal is prepared. The ranges of LL and PI of the soil on either side of river Ganga in Plasticity chart for different districts in West Bengal is given in Table 1. From this table, the position of Gangetic Alluvial soil in West Bengal can be determined and is shown in figure 1 below.

Table 1: District wise ranges of LL and PI of the soil on either side of river Ganga in West Bengal.

Name of the District	Range of LL	Range of PI
Murshidabad	30% to 50%	PI=0.73(LL-20) to PI=0.73(LL-8.22)
Nadia	33% to 48%	PI=0.73(LL-23.3) to PI=0.73(LL-8.22)
North 24 Pargana	40% to 50%	PI=0.73(LL-24.2) to PI=0.73(LL-13.4)
South 24 Pargana	30% to 45%	PI=0.73(LL-24.4) to PI=0.73(LL-10.3)
Hooghly	32% to 58%	PI=0.73(LL-22.9) to PI=0.73(LL-6.99)
Hawrah	29% to 55%	PI=0.73(LL-25.2) to PI=0.73(LL-9.27)
Purba Medinipur	30% to 55%	PI=0.73(LL-20) to PI=0.73(LL-9.27)

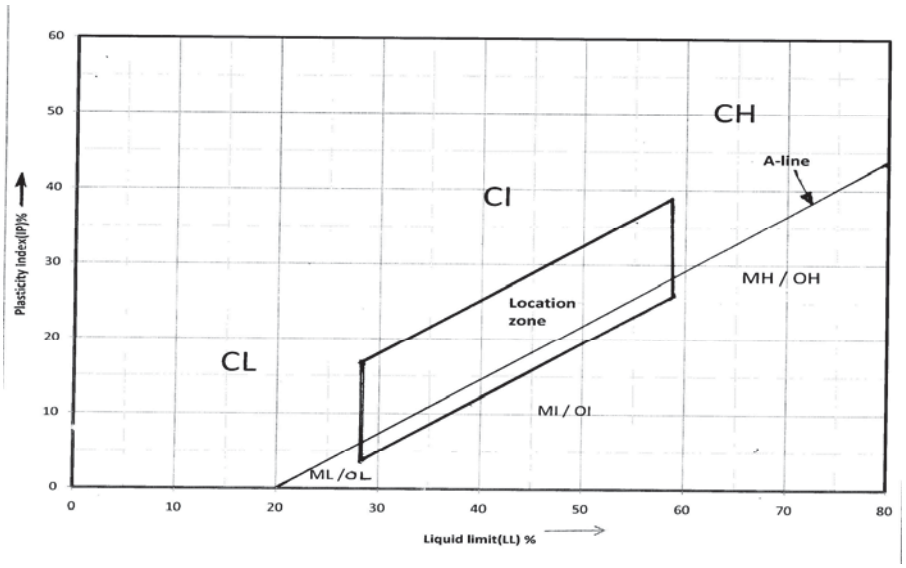

Fig.1 Position of Gangetic Alluvial soil in West Bengal in Plasticity Chart

B. *Prediction Model for CBR value on Gangetic Alluvial Soil –*

For construction of road on Gangetic alluvial in West Bengal where soil is extremely erratic due to their depositional history, the development of satisfactory prediction model for CBR from the in-situ alluvial soils near the surface, at those areas is required. Many researchers indicated that PI followed by the liquid limit and percentage finer have major contribution for deciding the CBR value. Now, to evaluate the relationship among CBR value, percentage finer and PI of soil, large number of data on alluvial soils near surface form either site of river Hooghly have been collected from PMGSY schemes. To develop the prediction model, data for only fine-grained soils have been used. Finally, some typical alluvial soil have been collected from different districts on either side of river Hooghly in West Bengal and different engineering properties like LL, PL, percentage finer, and soaked CBR at OMC have been determined in the laboratories and are used to check the validity of the developed correlations.

For each group of soils the observed values of CBR are plotted against (w*PI) of the soil. Where, w is percentage of soil passing 75μ and PI is plasticity index of soil. From the relationship, the trend of variation of CBR value with the change of (w*PI) value was noted. Now, efforts have been made to establish a best fit curve that can fit the point as closely as possible. The equation of best fit curve is developed for necessary correlation. After detailed data processing with LL, PI and soaked CBR collected from large field data from near surface soil in Gangetic West Bengal, general correlation between them has been established as,

$$\text{Soaked } CBR = \left(\frac{m}{w \times PI} \right)$$

Where, 'w' is the percentage finer than through 75 micron, and 'PI' is the plasticity index.

The different values of 'm' for different types of soil are given below in Table 2.

Table 2: Value of 'm'

Plasticity Index	Group	Value of 'm'
7-17	CL	4650
7-17	CI	4680
17-28	CL	6500
17-28	CI	6550
17-28	CH	6774
>28	CH	9500

C. *Check for the Validity of the Proposed Correlation –*

Some typical alluvial soil have been collected from different districts on either side of river Hooghly in West Bengal and different engineering properties like LL, PL, percentage finer, and soaked CBR at OMC have been determined in the laboratories and are used to check the validity of the developed correlations as given in Table 3.

Table 3: Check for the Validity of the Proposed Correlation

% Finer	PI	Measured CBR	Predicted CBR	Error	Group
93.58	20.90	3.3	3.35	1.484	CI
94.33	21.01	3.2	3.30	3.28	CI
94.30	20.88	3.2	3.33	3.956	CI
93.82	20.90	3.1	3.34	7.755	CI
93.82	20.90	3.1	3.34	7.755	CI
93.00	20.97	3.1	3.36	8.342	CI
94.10	21.18	3.0	3.29	9.548	CI
87.14	14.32	3.47	3.70	7.4	CL
87.75	14.26	3.42	3.70	8.7	CL
87.34	14.03	3.45	3.80	10.0	CL

IV.CONCLUSIONS

Mapping of Gangetic Alluvial soil in plasticity chart is very much beneficial to find the possible soil characteristics of a particular site and it will also very helpful for Geotechnical Engineers to predict promptly a possible range of CBR value for that site without testing time consume and costly 4 days soaked CBR in the laboratory. From the experimental study reported above, it may be concluded that the experimental soaked CBR values when compared with predicted value of soaked CBR on the basis of presented correlation, gives very excellent results and the variation between predicted and observed values are less than 10%.

V.ACKNOWLEDGEMENT

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