A Study of Correlation between CBR Value and Soil Properties for Flexible Pavement in Upgrading Shwebo-Myitkyinar Road

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Abstract: *In flexible pavement design , the determination of the California bearing ratio (CBR) values of the pavement subgrade ,subbase and base course materials are the most important factors.The CBR test method is intended for evaluation of the strength of the materials having maximum particle size 19 mm .The soaked CBR test is time consuming to get the accurate value for uses in pavement design. The related other properties like liquid limit (L.L),plastic limit(P.L),plastic index(PI) ,optimum moisture content (OMC) and maximum dry density (MDD) are also important for CBR value .The CBR is also the determiner of the strength of material used in the pavement design. The other properties are providers in the testing the strength of the materials. In this paper, the correlation between CBR and the properties of soil for subgrade and soil-aggregate mixture for subbase layer are discussed for the upgrading Shwebo-Myitkyinar Road.*

Key Words: *California bearing ratio(CBR), Pavement, Material, Upgradin.*

1. INTRODUCTION:

Most of the Myanmar road are flexible pavements. The pavement carries the distributed load from the axle of the vehicle and transmits it to the wider area below the surface layer called as subgrade. The subgrade layer is the lowest and bears the load by the natural ground. In pavement design, the top soil from the subgrade is removed to the natural road bed soil. The samples also taken from the bed soil and tested in the laboratory. The compaction of the subgrade is important for the required CBR values. The design engineer adopt suitable values for the strength of material in the pavement design. The layer material such as subbase , base material are also tested for CBR values to design layer thickness of the pavement structure.CBR vaule can be directly measured in the laboratory in accordance with ASTM D-1887.Laboratory test results take at least four days to obtain the soaked CBR values of each soil sample.CBR values are also influenced by soil properties. The compaction test also related with CBR test results .The variation of moisture content in the compaction is also different between the natural soil and soil- aggregate mixture. The soil-aggregate mixture is made by the aggregate gradation with sieve size analysis in AASHTO method B. The sieve size analysis is made with trial process to get the accurate ratio of mixture. The compaction test also made with standard and modified compaction test to get the higher CBR value to use in the pavement structure design.

2. METHODOLOGY:

In the present study , soil samples are taken from the existing Shwebo Myitkyinar road .The soil classification is done by USCS soil classification . The tests are done in soil laboratory of Yangon Technological University and Public work laboratory . The river shingles for the subbase layer mixture is also taken from the streams and rivers along the existing Shwebo-Myitkyinar road for the purpose of reducing higher cost in construction of the pavement structure. Economical feasibility is the most important factor for the developing country, Myanmar. The paper is intended to use the available sources by reducing the initial cost. The methodology includes the characteristics are in accordance with ASTM specifications. The testing methods used in the upgrading project are expressed in the table below. Soil shall be classified three types such as coarsed-grained,fine-grained and highly organic soils or miscellaneous soil. There are various common soil types in the existing Shwebo-Myitkyinar road .The materials available for construction of pavement base and subbase are from the upgrading region.

Table 1.Method uses in soil and soil-aggregate mixture

Method for use	Purpose	Specification
Field Moisture Content		AASHTO T265
Specific Gravity	To determine specific gravity of solid	ASTM C127
Grain Size Distribution	To determine the grain size distribution or gradation of solid	ASTM D-42263
Hydrometer Analysis	To determine the grain size distribution of the 200 ɥm material in soil	ASTM D 854-29

Atterberg' Limit	To assist in classifying the soil	ASTM D4318-95
Dry Density and Water Content for Compaction	To determine water % for CBR	AASHTO T-99 and T-180
Compaction Test	To determine soil properties as the effect of varying percentages of water on dry density	ASTM D 1557-91
CBR Test	To determine CBR of material	ASTM D 1883-94

Table 2.Results from laboratory test for soil samples

Sr .No	CBR	PI	OMC	MDD	SOIL TYPE
1	4.83	11.4	10%	1.84	CL
2	10.33	5.51	11.20%	1.9	ML
3	4.22	20.4	14%	1.872	SC
4	5	11.4	13.80%	1.76	SM
5	10	12.27	13%	1.88	SP
6	5	20.4	16%	1.7088	GP
7	3	13.06	10%	1.84	ML
8	8	8.38	11.20%	1.9	SC
9	6	4.475	14%	1.872	SM
10	4.83	11.4	13.80%	1.76	CL
11	10.33	5.51	13%	1.88	GP
12	4.22	20.4	10%	1.84	ML
13	6.67	13.06	11.20%	1.9	SC
14	8.67	14.44	14%	1.872	SM
8	8	8.38	11.20%	1.9	CL

Table 3.Results from laboratory test for subbbase aggregate mixture

Sample Mixture	L.L	PL	PI	OMC	MDD	CBR
CL 60:40	17.79	13.82	3.97	7%	1.38	23.67
ML 70:30	19.65	14.60	5.05	4.8%	1.41	41.33
SM 70:30	17.49	15.16	2.32	4%	1.04	26.12

3. RESULTS AND DISCUSSION:

Table 1 gives a list of results of the laboratory results on fourteen number of samples. Repeated data are also used for the statistical analysis .The calculations are based on simple linear and multiple linear regression analysis. Figure 1 shows the variation of plastic index with CBR values .The value of R^2 found to be 0.446 nearly to 0.45. The R^2 is not much because of the variation of CBR value in larger range in accordance with various soil types. Some soils are mixed with top deposit of clay and sand .The large change of the CBR values cause the particular item R^2 value is small. Figure 2 shows the relation between the MDD and CBR values. It is found that the small range of samples required to use as repeated data.The common soil types such as CL ,ML and SM are mixed with the river shingle to use in subbase layer. Table 2 shows the aggregate mixture ratio and the physical properties of the mixture. The PI of the mixtures are in small number because the river shingle include the sand from the river.

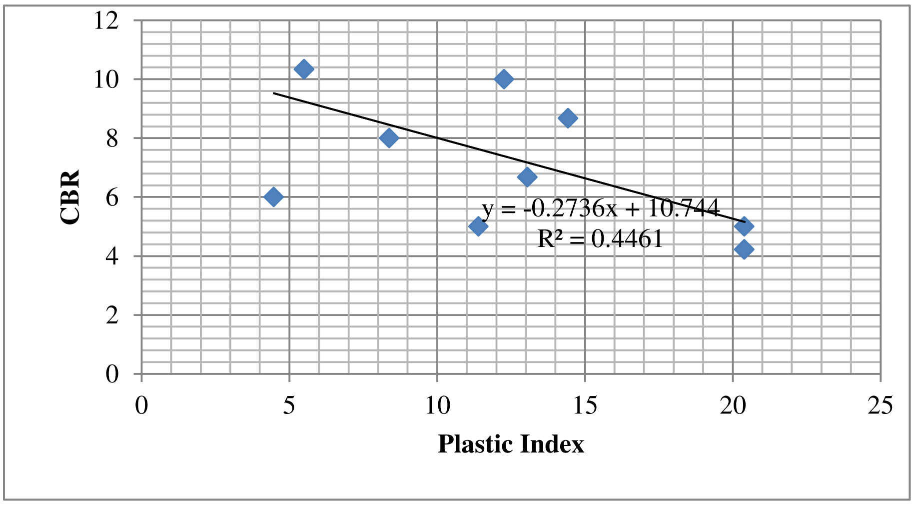

Figure 1. Relation between CBR and Plastic Index

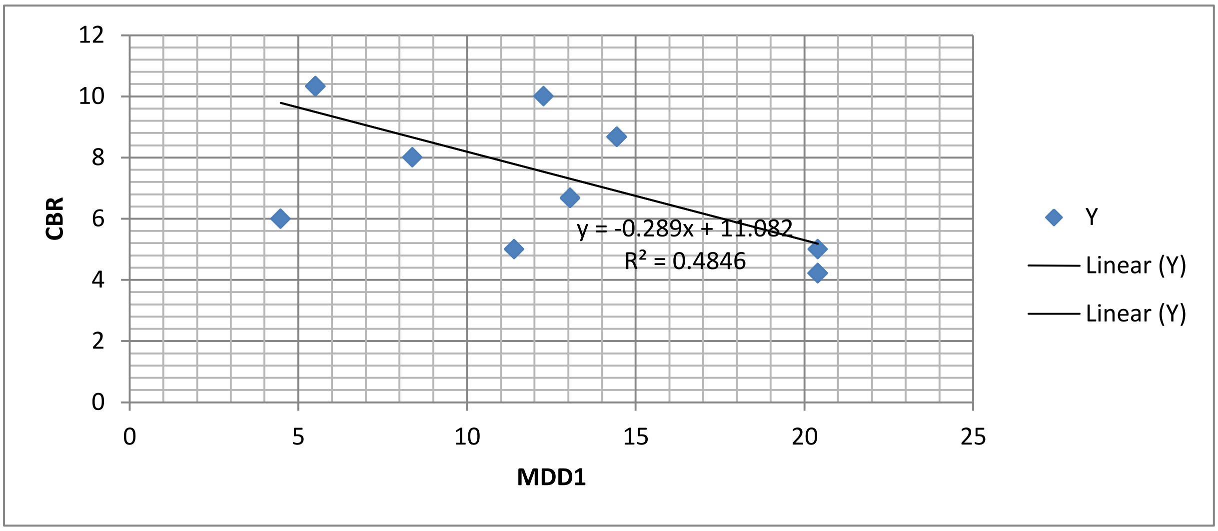

Figure 2. Relation between CBR and Maximum Dry Density

The study was to develop correlation between the CBR value of the soil and soil properties for the upgrading Shwebo-Myitkyinar road.

For correlation of CBR ,MDD and PI are

$$CBR = -0.31314\ PI + 25.71882\ MDD$$

The coefficient of the correlation (R2) for the above equation is found to be 0.6725.The equations holds good in correlation the CBR valued with PI and MDD. Among soil properties , PI and MDD are found to be good relation but the other soil properties are.

Table 3. Comparison between actual data and predicted data from equation

TEST RESULTS	PREDICTED VALUE
5	5.531321
10	7.783051
5	5.088997
3	3.952858
8	9.383724
6	6.434417
4.83	5.531321
10.33	10.30429
4.22	5.088997
6.67	3.952858
8.67	7.123562
4.83	5.531321
10.33	10.30429
4.22	5.088997

4. CONCLUSION:

PI and CBR are negatively correlated and it means that CBR decrease while PI increase so PI can be explained the variation of CBR.The estimated regression coefficient of PI is – 0.31 and in a statistical point of view, the significant level of PI is less than 1% because P-value is 0.0028.For MDD, it can be said that there is a positive correlation between MDD and CBR. It means that 25 units of MDD increase while CBR 1 unit increase.The estimated regression coefficient of MDD is + 25 and in a statistical point of view , the significant level of MDD is less than 1% because P-value is 0.004926.

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