Investigation Of Bitumen Emulsion In Gravel Road

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Abstract

The design of the pavement layers to be laid over subgrade soil starts off with the estimation of subgrade strength and the volume of traffic to be carried. Design of the various pavement layers are very much dependent on the strength of the subgrade soil over which they are going to be laid. Weaker subgrade demands thicker layers whereas stronger subgrade goes well along with thinner pavement layers. The Indian Road Congress encodes the exact design strategies of the pavement layers based upon the subgrade strength. Subgrade strength is mostly expressed in terms of CBR, the California Bearing Ratio. Hence, in all, the pavement and the subgrade together must sustain the traffic volume.

The subgrade strength owing to its inconsistency or variable nature poses a challenge for the engineer to come up with a perfect design of pavement. For example, the subgrade is always subjected to change in its moisture content due to precipitation, capillary action, flood or abrupt rise or subsidal of water table. Change in moisture content causes change in the subgrade strength. And it becomes quite essential for an engineer to understand the exact nature of dependence of subgrade strength on moisture content.

The project attempts in understanding the nature of variation of subgrade strength with water content. Thus, various soil samples are put to test for their strengths at different moisture contents by soaking them in waterbath for different days. Required inference can be drawn through the test results.

Introduction

The crust of a pavement, whether flexible or rigid, rests on a soil foundation on an embankment or cutting, normally known as subgrade. Subgrade can be defined as a compacted layer, generally of naturally occurring local soil, assumed to be 500/300 mm in thickness, just beneath the pavement crust, providing a suitable foundation for the pavement. The subgrade in embankment is compacted in two layers, usually to a higher standard than the lower part of the embankment .The soil in subgrade is normally stressed to certain minimum level of stresses due to the traffic loads and the subgrade soil should be of good quality and appropriately compacted so as to utilize its full strength to withstand the stresses due to traffic loads. This leads to economization of the overall pavement thickness. On the other hand the subgrade soil is characterized for its strength for the purpose of analysis and design of pavement.

California Bearing Ratio Test
The California Bearing Ratio Test (CBR Test) is a penetration test developed by California State Highway Department (U.S.A.) for evaluating the bearing capacity of subgrade soil. The CBR test was first introduced or developed by O.J. Porter at California HighwayDepartment in 1920. It is otherwise called as load-deformation test

which is conducted in thelaboratory or in the fields and these results are generally used to find the thickness of pavementlayers, base course and other layers of a given traffic loading by the use of empirical designchart. Initially it practiced for the design of surfaced and un-surfacedairfields which is still based upon CBR today.

The CBR determines the thickness of different elements constituting the pavement. The CBR test is the ratio of force per unit area required to penetrate soil mass by a circular plunger of 50mm at the rate of 1.25mm/min. Observations are carried out between the load resistances (penetration) vs. plunger penetration.. The California bearing ratio, CBR is expressed as the ratio of the load resistance (test load) of a given soil sample to the standard load at 2.5mm or 5mm penetration, expressed in percentage.

Experimental Investigations

The entire study has been conducted on three types of soil, i.e. 1.Clayey Soil, 2.Clayey soil and 3.Red Moorum Soil. Initially experiments were conducted to find out different properties of soil such as index properties, grain size distribution and differential free swell index. Later on heavy compaction tests were conducted to find out the optimum moisture content & corresponding maximum dry density. Then CBR tests were made at different moisture contents including OMC and analysis made to investigate the variation of CBR with respect to different days of soaking, i.e. from unsoaked (day 0) to soaked (day 5). The variations were also made with regard to moisture content at different layers along with different positions (east, west, north, south, centre positions) and also the variations of moisture content with respect to different days of soaking were observed. Direct Shear Test was also conducted on the soil samples.

Index Properties of Soil

Index property	Experimental Value
Liquid Limit	55.29%
Plastic Limit	34.04%
Plasticity Index	21.25%
Specific Gravity	2.65
Differential Swell Index	57%

Grain size distribution of type - 1 soil

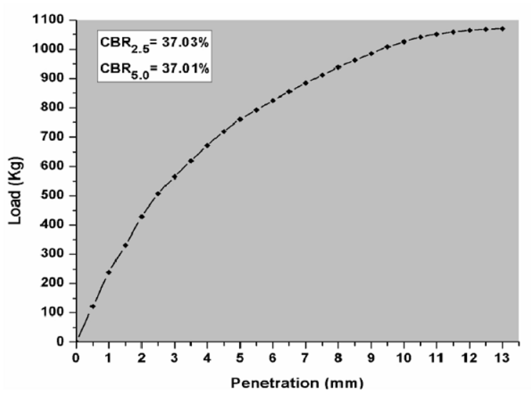
I.S Sieve no.	Weight retained in gm	Percentage Weight retained	Percentage weight passing
4.75mm	4.6	0.46	99.54
2mm	14.5	1.45	98.09
1mm	20.2	2.02	96.07
0.6mm	5	0.5	95.57
0.425mm	9.8	0.98	94.59
0.3mm	5.1	0.51	94.08
.212mm	21.1	2.11	91.17
.015mm	15.6	1.56	90.41
0.075mm	30.49	3.049	87.361

Moisture Variation in Soil Sample

Attempts have been made to take soil samples from various parts of a CBR sample for determination of moisture content, as per the schematic diagram given in Fig 4.8. Middle layer is almost in the middle of the sample (vertical level). The top and bottom layers are about 15 cm from the top and bottom of a sample respectively. The east and west for each layer (horizontal) indicate towards left and right side of the sample respectively, while north and south represent samples away and towards the observer respectively.

CBR values of second type of soil

Compaction Conditions(M.C&D.D)	CBR(%)					
	DAYS OF SOAKING					
	0	1	2	3	4	5
OMC &MDD (14.8,1.85)	35.39	3.57	2.9	2.67	2.5	1.13
98% Density(dry side) (12.46,1.82)	31.77	2.6	1.96	1.87	1.56	0.9
98% Density(wet side) (16.25,1.82)	33.05	2.12	2.08	1.95	1.78	1.12
97% Density(dry side) (10.7,1.794)	32.45	2.02	1.83	1.74	1.67	0.7
97% Density(wet side) (17.8,1.794)	34.33	2.07	1.93	1.88	1.76	0.6



CBR Test Result, Case A (Un-soaked)

Conclusions

An attempt has been made in this project work to explore the effect of saturation, i.e., soaking on the strength properties of subgrade soil, namely CBR which is widely used as a measure of design of all types of pavements. For this three types of soils have been considered .The effect of soaking on degree of saturation on different parts of the soil sample have also been considered in this study. From the results and discussions presented earlier, following conclusions are drawn :

It is observed that the CBR value of the given clayey soil sample with BIS classification "OH" prepared at a particular density decreases rapidly with time of soaking up to 1day after which the rate of decrease is small. While the CBR value reduces by about 20 times compared to the unsoaked conditions, the loss of CBR value in 4 days is about half compared to that after 1 day.It is also observed that there are not much significant variations in CBR values from 3rd day to 4th day of soaking.When soil samples are taken from different points of the CBR sample and tested for its moisture content, it is also observed that there variations in moisture content in a given layer are not significant in unsoaked conditions and 1 day of soaking. However, it is observed that for a longer soaking time, higher moisture contents result at top layer compared to that in the lower layers.

For the 2nd type (Case-B) of soil considered and found to be of "CI" classification, the trend is almost similar to the first type of soil used. 3. For 1st type (Case-A) and 2nd type (Case-B) of soil wet side of Optimum Moisture Content (CBR values) gives better results than that dry side.

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