International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 3 Issue 8, July 2016

ISSN: 2394-4404

Effect Of Saturation On Strength Properties Of Subgrade Soil

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Abstract: The design of the pavement layers to be laid over sub grade soil starts off with the estimation of sub grade strength and the volume of traffic to be carried. Design of the various pavement layers are very much dependent on the strength of the sub grade soil over which they are going to be laid. Sub grade strength is mostly expressed in terms of CBR (California Bearing Ratio). Weaker sub grade essentially requires thicker layers whereas stronger sub grade goes well with thinner pavement layers. The sub grade is always subjected to change in saturation level due to precipitation, capillary action, flood or abrupt rise of water table. Change in moisture level in sub grade causes change in the sub grade strength. And it becomes quite essential for an engineer to understand the exact nature of dependence of sub grade strength on moisture variation. An understanding of the dependence of the CBR strength of local soils on water content will contribute towards better design and maintenance practices. Normally CBR test is an easy and well adopted method conducted on soil samples to measure the strength of sub grade. However, many other tests are also considered for assessing the sub grade strength.

Keyword: Subgrade soil, Subgrade strength, Moisture variation, CBR test.

I. INTRODUCTION

As per MORD Specifications, subgrade can be defined as a compacted layer, generally of naturally occurring local soil, assumed to be 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. In cuttings, the cut formation, which serves as the subgrade, is treated similarly to provide a suitable foundation for the pavement. Where the naturally occurring local subgrade soils have poor engineering properties and low strength in terms of CBR, for example in Black Cotton soil areas, improved subgrades are provided by way of lime/cement treatment or by mechanical stabilization and other similar techniques. The subgrade, whether in cutting or in embankment, should be well compacted to utilize its full strength and to economize on the overall pavement thickness. The current MORD Specifications require that the subgrade should be compacted to 100% Maximum Dry Density achieved by the Modified Proctor Test (IS 2720-Part 7). The material used for subgrade construction should have a dry unit weight of not less than 16.5kN/m^3.

A subgrade's performance generally depends on three of the basic characteristics, which are briefly described below:

- ✓ Load bearing capacity: The subgrade must be able to support loads transmitted from the pavement structure. This load bearing capacity is often affected by degree of compaction, moisture content, and soil type. A subgrade that can support a high amount of loading without excessive deformation is considered good.
- ✓ Moisture content: Moisture tends to affect a number of subgrade properties including load bearing capacity, shrinkage and swelling. Moisture content can be influenced by a number of things such as drainage, groundwater table elevation, infiltration, or pavement porosity (which can be assisted by cracks in the pavement). Generally, excessively wet subgrades will deform excessively under load.
- ✓ Shrinkage and/or swelling: Some soils shrink or swell depending upon their moisture content. Additionally, soils with excessive fines content may be susceptible to frost

heave in northern climates. Shrinkage, swelling and frost heave will tend to deform and crack any pavement type constructed over them.

II. EXPERIMENTAL WORK

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.

III. RESULTS

✓ INDEX PROPERTIES OF SOIL

Index property	Experimental Value
Liquid Limits	55.45%
Plastic limit	33.60%
Plasticity Index	21.25%
Specific gravity	2.63%
Differential Swell Index	57%

Table 1

✓ GRAIN SIZE DISTRIBUTION OF TYPE SOIL

I.S Sieve no.	Weight retained in gm	Percentage Weight retained	Percentage weight Passing
4.75	4.6	0.46	99.54
2	14.5	1.45	98.09
1	20.2	2.02	96.07
.6	5	.5	95.57
.425	9.8	.98	94.59
.300	5.1	.51	94.08
.212	21.1	2.11	91.17
.015	15.6	1.56	90.41
.075	30.49	3.049	87.361

Table 2

Based on the above properties the IS Soil Classification for the soil is ‘OH’

✓ CALIFORNIA BEARING RATIO TEST RESULTS

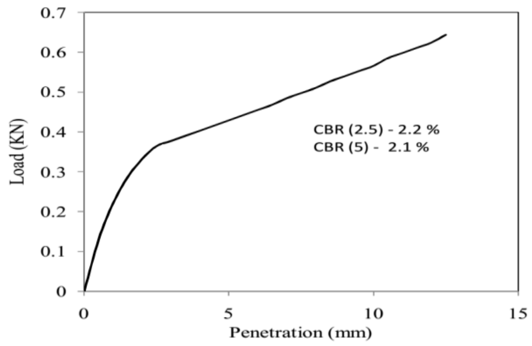

Figure 1

✓ DIRECT SHEAR TEST RESULTS

Direct shear test was carried out at different dry densities and moisture contents.

Results of direct shear test are:

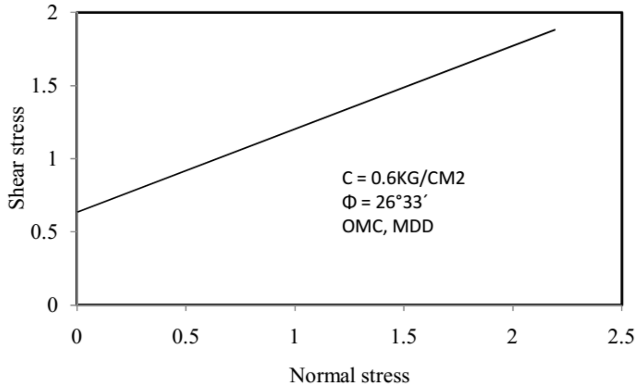

Figure 2

IV. 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. It has been observed that as usual with decrease in degree of compaction (either on wet or dry side) cohesion and angle of friction decreases.

REFERENCES

[1] Khanna .S.K & Justo C.E, Highway Engineering
[2] Dr. K.R. Arora, Soil mechanics and foundation engineering
[3] IRC-SP 72-2007, Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads, IRC, New Delhi
[4] IRC-SP 37-2007