EFFECTS OF SAND ON THE CBR BEHAVIOUR OF SOIL

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Abstract : **The present study aims at studying the effect of sand on CBR behavior of fine grained soil when applied in various percentages. For the same purpose the soil from a site near Akhnoor in Jammu District was selected, being water logged, swampy and marshy area. The study aims at improving the CBR and drainage properties of the fine grained soils in water logged by using sand as a stabilizing agent. Sand being a low cost alternative for improvement of much needed hike in CBR values of soils, has been studied. For the same, the source of sand selected was Tarore. Sand being locally available, its use for improvement of fine grained soils is fully justified.**

IndexTerms **–CBR Behaviour, Sandy soil, Stabilization.**

I. INTRODUCTION

Road Network of a country is an indicator of extent of its development. Thus more and more road development projects are being undertaken and executed these days. Therefore, it becomes imperative on our part to ensure the quality of roads being constructed. The flexible pavements are built with a number of layers. In the design process, it is ensured that under the application of load none of the layers is overstressed. This means that at any instance no section of the pavement structure is subjected to excessive deformation to form a localized depression or settlement. In the design of flexible pavements, it has yet not been possible to have a rational design method, where design process and service behavior of the pavement can be expressed or predicted theoretically by mathematical laws. One of the methods of pavement design is California bearing ratio method, which is an empirical one, yet most widely practised.

II. SAMPLING DETAIL

2.1 Undisturbed Samples

These are the samples in which the natural structure of soil and the water content are not disturbed. The undisturbed samples are used to determine the engineering properties of soil. In the present case, core cutters were used to extract the soil samples from the ground. Care has been exercised while ramming the samplers into the ground. The samples obtained were carefully placed in polythene bags and labelled properly.

2.2 Disturbed Samples

These are the samples in which the natural structure of soil gets disturbed during sampling. The disturbed samples can be used to determine index properties of soil. About a gunny bag full of loose soil has been taken from the site. Although the natural structure of the soil gets disturbed during sampling yet these samples represents the composition and mineral content of the soil.

III. TESTING MEHTDOLOGY

For the characterization of soil obtained from the site the general test were conducted and the soil so obtained is characterized by an evaluation of its physical properties and engineering properties.

3.1 Physical properties:

The physical properties of the soil so produced are obtained by the evaluation of
a) Moisture content b) Grain size analysis c) Specific gravity d) Atterberg's limits.

3.1.1 Grain Size Analysis

The grain size analysis is widely used in classification of soils. The data obtained from grain size distribution curves is used in the design of filters for earth dams and to determine suitability of soil for road construction. For determining the grain size distribution of soil sample, usually mechanical analysis i.e. Sieve analysis is carried out and the results are plotted on a semi-log graph. The gradation curve of the given soil sample is as shown in fig 1 below.

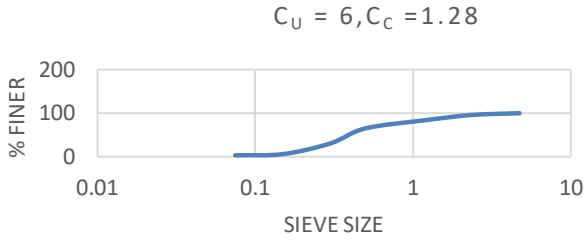

Fig. 1 Particle size Distribution curve

3.1.2 Specific gravity

Specific Gravity of the soil is defined as the ratio of mass of given volume of soil to the mass of equal volume of water at 4^0C. The specific gravity of Natural soil generally falls in the range 2.65 to 2.80 Various methods to determine the specific gravity are available, however in the present case the specific gravity has been determined using density bottle method. The average specific gravity of the given soil sample obtained is 2.69 and the average specific gravity of the sand used is 2.64.

3.1.3 Consistency Limits

The consistency of a fine grained soil is the physical state in which it exists. The water content at which soil changes from one state to the other are known as consistency limits or Atterberg's Limits. The water content at which the soil changes from liquid state to the plastic state is known as Liquid limit and the water content at which the soil becomes semisolid is known as Plastic limit. The numerical difference between the liquid limit and the plastic limit is known as plasticity index. The water content at which the soil changes from semi solid state to the solid state is known as shrinkage limit.
The results on physical properties of the soil used in the present case are summraised in the table 1 below

Tab. 1

S.No	Physical Properties	Result
1	Natural Moisture content	34.5 %
2	Specific Gravity	2.69
3	Liquid limit	35.0%
4	Plastic limit	23.3%
5	Plasticity index	11.7%
6	Shrinkage limit	25%
7	OMC	28 %
8	MDD (g/cm^3)	1.72

Part 2 Study of the effect of sand on CBR behavior of fine grained soils.

The soil sample procured has been blended with sand. The sand has been added in soil sample in various percentages such as 25%, 50%, 62.5%, 75% and 87.5% and following tests have been conducted on the blended mixture so obtained.

3.2 Engineering properties

The geotechnical properties are used to determine

(a) Compaction characteristics
(b) Strength characteristics

3.2.1 Compaction characteristics

Density of soil is an important parameter since it controls its strength, compressibility and permeability. The compacted unit weight depends upon the amount and method of energy application and material properties such as grain size, gradation, Particle shape, plasticity and the moisture content at compaction. The test aids in determining the percent compaction and water content necessary to obtain the desired properties for construction. Modified Proctor (Heavy) Compaction on the blended soil mixture at all the percentages has been carried out in order to determine OMC and MDD.
The compaction characteristics viz. optimum moisture content (OMC) and maximum dry density (MDD) of the Blended mixture of soil so obtained have been plotted as shown in figure 2.

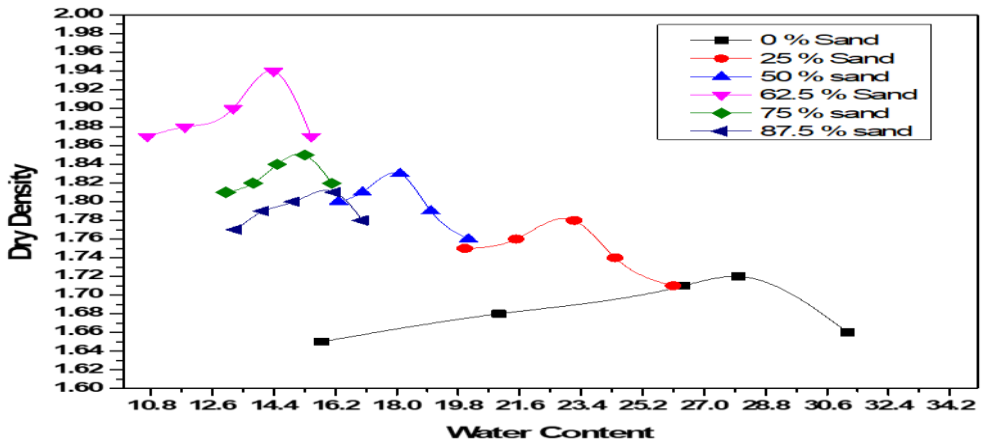

Fig. 2 Plot of Density vs Water Content

3.2.2 CBR Values

The CBR samples have been prepared at OMC values of respective soil mixtures and CBR values have been determined for soaked as well as un-soaked samples. The soaking of samples has been for the period of 4 days only.

Compilation of results of laboratory investigations carried out on the soil procured from the Akhnoor site. The material has been subjected to tests for establishing their physical and geotechnical properties. The detailed results of the mechanical stabilization carried out on the above soil using sand as the stabilization agent. The influence of sand on the various properties including the CBR behavior of the soil has been studied.

The CBR behavior of the Blended mixture of soil so obtained have been plotted as shown in figure.

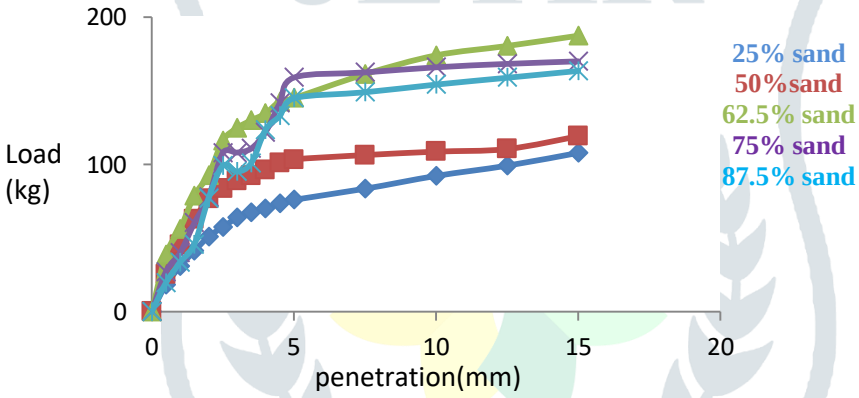

Fig.3 Load vs. Penetration graph (Un soaked)

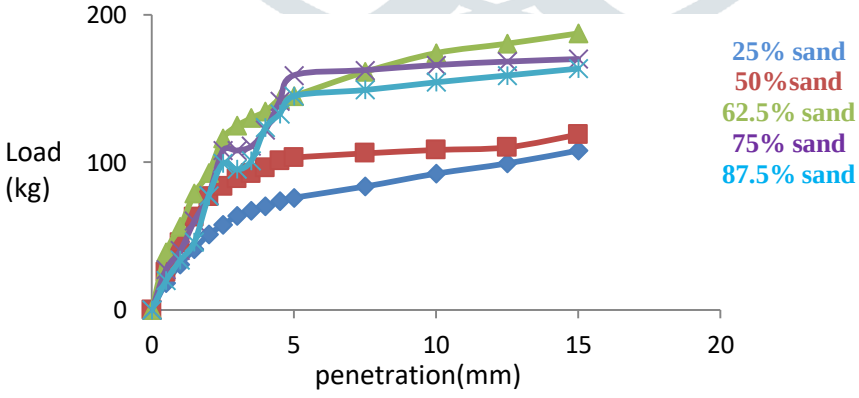

Fig.4 Load vs. Penetration graph (Ssoaked)

IV. SUMMARY OF RESULTS

The results of the above conducted tests are summarized in tabular form in table 2.

Tab. 2

PROPERTY	100% NATURAL SOIL	100% SAND	NATURAL SOIL TREATED WITH				
			25% SAND	50% SAND	62.5% SAND	75% SAND	87.5% SAND
OMC(%)	28	--	23	18.1	14.4	15.3	16.2
MDD(g/cc)	1.72	--	1.78	1.83	1.91	1.85	1.81
Unsoaked	2.5	7.75	4.2	6.1	8.5	7.9	7.2
Soaked	1.9	6.6	3.5	5.3	7.1	6.9	6.3

Further, the CBR values against the percentage of sand blended with the natural soil have been plotted as shown in figure 5.

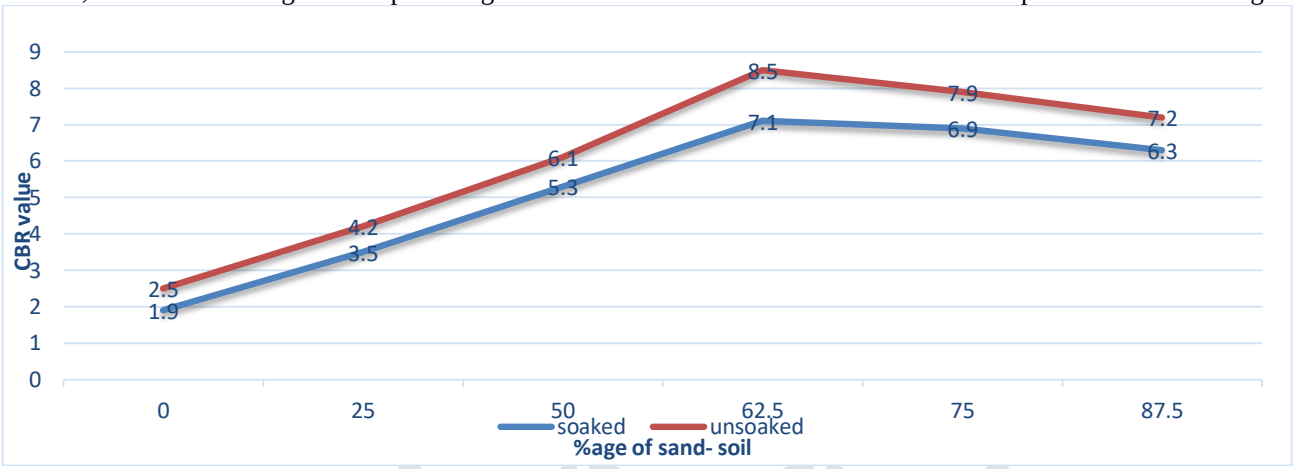

Fig.5 CBR value vs. %age of Sand

V. CONCLUSION

On investigating the characteristic properties of soil it has been found that it was silt dominated soil, due to which the CBR value was quite low. When sand as admixture was used in the natural soil, the properties especially the CBR value has improved significantly. It has been observed that maximum value of CBR of 8.5% in case of unsoaked sample and 7.1% in case of Soaked samples were obtained at (62.5% sand + 37.5% natural soil).

Further, it has been observed that the optimum moisture content has reduced significantly from 28 % (natural soil) to 14.4% (62.5% sand + 37.5% natural soil).

Sand being a low cost alternative for improvement in the CBR values of soil and locally available, so its use for the improvement of properties of fine grained soil is justified.

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