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Potential of Cement Stabilized Moorum as Construction Material

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Abstract: *Soil stabilization is being done to improve the properties of locally available soils to make them suitable for required construction activity. Cement stabilization is one of the oldest methods of stabilization of soils to improve strength and reduce permeability. Most of the research on cement stabilization of soils is done with regards to volume stability, strength improvement interms of Unconfined Compressive Strength, bearing capacity and permeability. In the present work, the mechanism of cement stabilization of soils, factors affecting cement stabilization, previous works related to cement stabilization have been reviewed. Present study, is intended to assess the suitability of locally available moorum soil stabilized by cement for use as alternate to low grade conventional concretes. Cube compressive strengths of cement stabilized moorum has been determined by testing cubes of size 15cm×15cm×15cm after curing periods of 7,14 and 28 days. The percentage cement used for stabilization is varied from 0 to12 in increments of 3 percent. 53 grade OPC cement is used to stabilize the moorum soil. The chemical properties of moorum have been also determined to assess the suitability for use with cement. The cement stabilized moorum with 7 percent and 9 percent stabilizer yielded compressive strengths equivalent to M7.5 and M10 grade concretes. The strengths of cement stabilized moorum has been also assessed in terms of C.B.R. Addition of 3 percent cement by weight to moorum has resulted in C.B.R more than 30 percent and hence indicated its suitability as sub base material for pavement construction.*
Keywords: *Cement stabilization, Mooram, CBR, OMC , MDD.*

I. Introduction

Soil stabilization is referred to as a procedure in which a special soil is proportioned or adding or removed, or a cementing material, or other chemical material is added to a natural soil material to improve one or more of its properties. One of the most common methods of stabilization includes the mixing of natural coarse-grained soil and fine-grained soil to obtain a mixture that develops adequate internal friction and cohesion and there by provides a material that is workable during placement but will remain stable further. All the soils available at the site may not be readily available for required purpose so for improving the engineering properties of available soil, stabilization is required.

Soil stabilization is the process of improving the engineering properties of the soil and thus making more stable. It is required when the soil available for construction is not suitable for the intended purpose .In its broadest senses, stabilization includes compaction, pre consolidation, drainage and many other such process. However, the term stabilization is generally restricted to the processes which alter the soil material itself for improvement of its properties. A cementing material or a chemical is added to a natural soil for the purpose of stabilization. Soil stabilization is used to reduce the permeability and compressibility of the soil mass in earth structures and to increase its shear strength. Soil stabilization is required to increase the bearing capacity of foundation soils. However, the main use of stabilization is to improve the natural soils for the construction of highways and airfields. The principles of soil stabilization are used for controlling the grading of soils and aggregates in the construction of bases and sub bases of the highways and airfields. Soil stabilization is also used to make an area trafficable within a short period of time for military and other emergency purposes. Sometimes, soil stabilization is used for city and suburban streets to make them more noise-absorbing.

II. Aim and objectives of study

The present work is aimed at stabilizing locally available Moorum with cement for assessing its potential as construction material. To achieve the aim, work has been planned with the following objectives.

Objectives:

1. To determine Engineering properties of locally available Moorum
2. To evaluate chemical properties of Moorum to assess its suitability for stabilization with cement.
3. To study the effect of addition of cement on engineering properties of Moorum soil.
4. To assess compressive strength of cement stabilized Moorum by testing cubes cured for 7, 14 and 28 days.
5. To study the improvement in C.B.R of Moorum soil with cement stabilization

III. Material properties

i) Properties of Mooram

Table 1 : Engineering properties of Mooram

S.No	Engineering Properties	Values
1	Specific Gravity	2.67
2	Liquid Limit (%)	25
3	Plastic Limit (%)	NP
4	Grain Size Analysis (a) Gravel (%) (b) Sand (%) (c) Fines (%) (d) Coefficient of Uniformity (e) Coefficient Curvature	 36.3 54.7 9.0 45.45 1.1
5	IS Classification	SW-SM
6	Compaction Characteristics (a) Maximum Dry Density (g/cc) (b) Optimum Moisture Content (%)	 2.03 6.5
7	CBR value (%)	18.9

Table 2 : Chemical Properties of Moorum

S.No	Chemical Properties	Value
1	P^H of soil(1:5)(W/V)	7.69
2	Water Soluble Chlorides (%)	0.008
3	Water Soluble Sulphates (%)	0.002

ii) Properties of Cement

Table 3 : Cement Properties

S.No	Property	Value
1	Specific Gravity	3.1
2	Fineness (%)	96
3	Consistency (a) Normal Consistency (%). (b) Initial Setting Time. (c) Final Setting Time.	 33 1hr 13 minutes 8hr 10minutes
4	Compressive Strength (Mpa) at 3 days at 7 days	 28.2 34.1

IV. Stabilization of Mooram with Cement

i) Effect of cement addition on compaction characteristics

Table 4: Compaction Characteristics of Cement Stabilized Moorum

S.No	Cement Content (%)	Optimum Moisture Content (%)	Maximum Dry Density(g/cc)
1	3	6.5	2.16
2	6	8.6	2.19
3	9	9.2	2.26
4	12	10.3	2.31

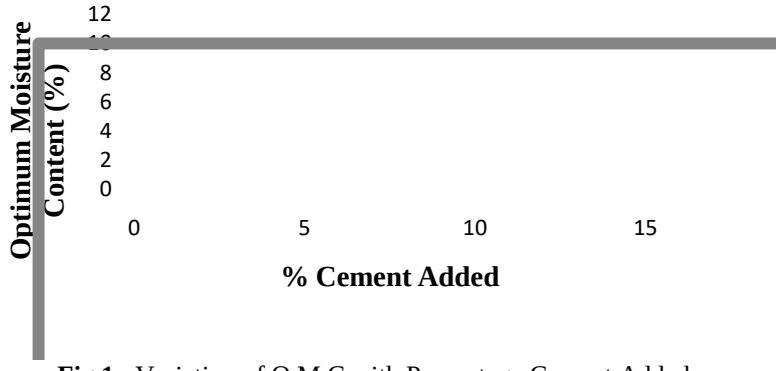

Fig.1 : Variation of O.M.C with Percentage Cement Added

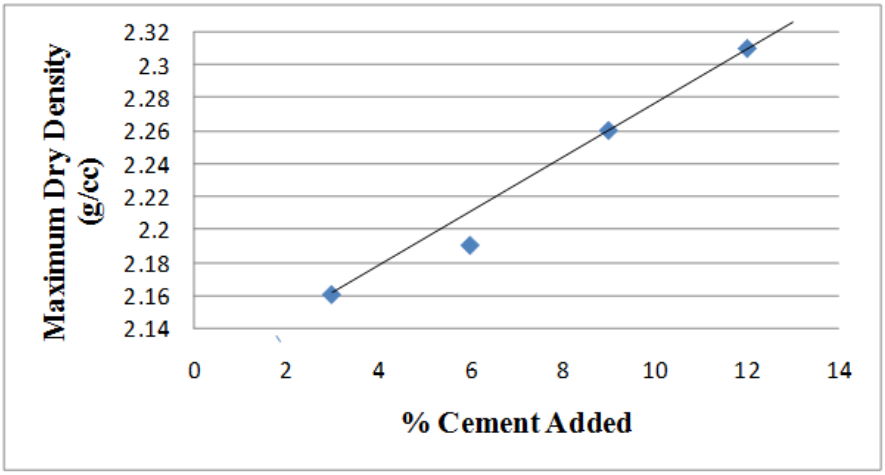

Fig. 2: Variation of M.D.D with Percentage Cement Added

ii) Effect of cement addition on compaction characteristics

Table 5 : Plasticity Characteristics of Moorum Stabilized by Cement

S.No	(%) Cement content added	Plasticity Characteristics		
		LL (%)	PL (%)	PI
1	3	23	NP	NP
2	6	21	NP	NP
3	9	20	NP	NP
4	12	18	NP	NP

iii) Effect of Cement addition on strength characteristics

Table 6: Effect of Cement addition on strength characteristics

S.No	Cement Content (%)	Compressive Strength of Cubes (N/mm^2)		
		7 days	14days	28 days
1	3	0.6	1.11	2.07
2	6	3.92	5.03	6.96
3	9	7.77	9.185	12.59
4	12	10.8	12.74	16.29

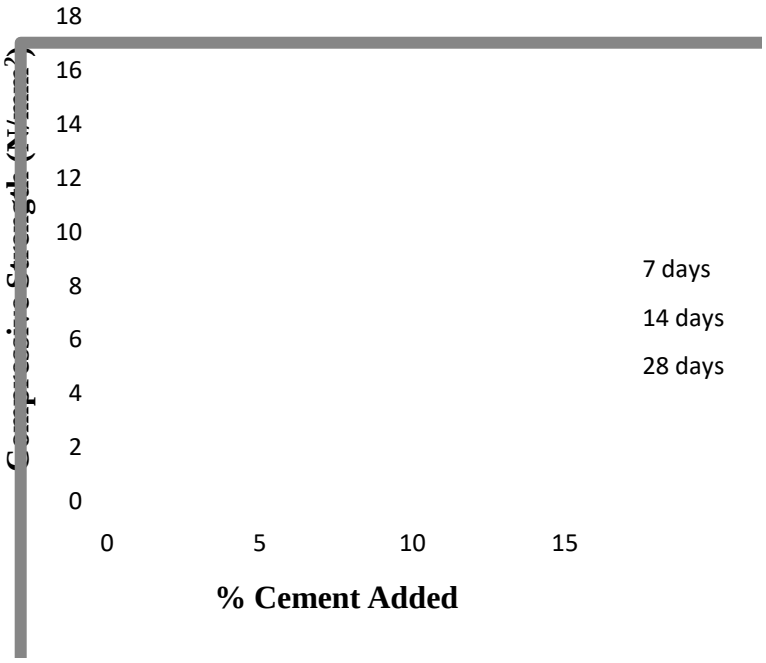

Table 7 : California Bearing Ratio Values of Cement Stabilized Moorum

S.No	Cement content (%)	Optimum Moisture Content (%)	Days	CBR value (%)
1	0	6.3	7	18.9
2	3	6.5	7	34.79
3	6	8.6	7	93.43

V. Summary

i) **Pproperties of mooram soil**

Engineering properties of Moorum soil presented in Table indicate that the soil sample is coarse grained with predominant percentage of sand. Based on the gradation and plasticity characteristics it classified as well graded silty sand (SW – SM) as per ISSCS (Indian Standard Soil Classification System). From plasticity characteristics, it can be noted that soil is Non plastic (NP). The Moorum has C.B.R value of 18.9% and hence it cannot be used in sub base courses of flexible pavements. The sub base layers demand use of Moorum soil with soaked C.B.R 20% and 30% for normal and heavy trafficked roads respectively. Chemical properties of Moorum presented in Table 3.2, reveal that durability of cement is not effected by its environment (P^H = 7.19, Chlorides = 0.08%, sulphates = 0.02%).

ii) **Properties of cement**

The properties of cement presented in Table confirm the grade of cement (53grade) and its quality.

iii) Stabilization of mooram with cement

a) Compaction Characteristics

Compaction characteristics of cement stabilized Moorum presented in Table indicate that O.M.C values increased with increase in percentage cement added to Moorum. The increase in O.M.C values can be attributed to increased specific surface of mix, with increased percentage of cement (cement being fine grained). It can be further seen from Table that the M.D.D values also increased with increase in percentage of cement addition to Moorum. The increased M.D.D values are due to introduction of cement in to the voids of soil.

b) Plasticity characteristics

From Table, it can be observed that liquid limit of Moorum stabilization with cement decreases with increased percentage of cement added. The reduction in values of liquid limit is due to cation exchange processes involved in cement stabilization of soil. As the Moorum is non plastic, it remained non plastic at all percentages of cement addition.

c) Strength Characteristics

Above Fig. reveals that compressive strength of cement stabilized cubes increased linearly with increase in percentage of cement added. The compressive strength of cubes increased with increase in curing period. It can be noticed from Fig. that cement stabilized Moorum cubes yielded compressive strength equivalent to M7.5 and M10 grade concrete. Hence, cement stabilized Moorum may be used as alternative to conventional concrete in mass cement concrete applications such as construction of gravity retaining walls, forming sub base for cement concrete roads etc.

From Table, it can be seen that addition of 3% of cement to Moorum has yielded C.B.R value above 30%, hence cement stabilized Moorum can be used in sub base of pavements.

VI. Conclusions

Based on experimental study carried out on cement stabilized locally available Moorum following conclusions have been made.

- The locally available Moorum selected for the study is a well graded coarse grained soil with little amount of non plastic fines. As the Moorum does not contain excess percentage of sulphates and chlorides, it may be considered for stabilization with cement.
- The compressibility of Moorum decreases with increase in percentage of cement addition.
- The compaction characteristics both O.M.C and M.D.D increase with increase in percentage of cement added to the Moorum.
- The compressive strength of cement stabilized Moorum increases linearly with increase in percentage of cement used for stabilization.
- The strength of cement stabilized Moorum increases with curing period.
- The compressive strength of cement stabilized Moorum cubes with 7% and 9% cement have strengths equals to strengths of M7.5 and M10 grade concrete cubes.
- The C.B.R values of Moorum treated with cement increase significantly.
- The amount of cement required for modifying the Moorum as sub base material is only 3%.

Hence locally available Moorum under study can be effectively stabilized by cement and can be used as replacement for M7.5 and M10 grades of concrete in mass concrete applications, bed concreting and also in sub base layers of pavements.

Limitations

- The results are applicable for Moorum under study with 53grade OPC as stabilizer.
- The results may vary if PPC is used as stabilizer and with grade of cement.
- The study did not cover durability accepts of cement stabilized Moorum.

Scope of further study

- Similar studies may be carried out on gravelly soils.
- The effect of grade of concrete on strength of stabilized soil may also be studied.
- The split tensile strength and flexural strength of cement stabilized Moorum may also be studied for extended scope of application.

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