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Stabilization Of Red Soils With Ordinary Port Land Cement

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Abstract—**In the present study an attempt has made to optimize the percentage of cement by mixing red soil with different proportions by weight of cement. The soil used for the study was collected From Andhra University College of Engineering Grounds, Visakhapatnam District and the type of cement used for stabilization was Ordinary Portland Cement. Tests like UCS, CBR were conducted for different proportions of cement at different curing periods i.e. 1 day, 3 days, 7 days and 28 days. For further improvement in strength, cylindrical cement columns were laid in red soil cement mix of different proportions and were tested for CBR at OMC. The result indicates that the cement has a noticeable influence on the strength characteristics of the red soils. Term soil stabilization means the improvement of the soil and their stability by the use of controlled compaction, proportioning and or the addition of suitable admixture or stabilizers. Soil stabilization deals with physical, physic-chemical and chemical methods to make the stabilized soil serve its purpose as pavement component material. If the stability of the local soil is not adequate for supporting wheel roads, the properties are improved by soil stabilization techniques. Thus the principle of soil stabilized road construction is the effective utilization of local soils and other suitable stabilizing agents. Soil- cement is an intimate mix of soil, cement and water, which is well compacted to form a strong base course. Cement treated or cement modified soil refers to the compacted mix when cement is used in small proportions to impact some strength or to modify the properties of the soil. In granular soil, the mechanism of stabilization is due to the development of bond between the hydrated cement and the compacted soil particles as the points of contact.**

Keywords— **Red Soil,Ordinary Portland cement,UCS test, CBR test.**

INTRODUCTION

In India, as part of infrastructure development, due to the constructions of massive structures and the excessive land utilization, some areas, which are not considered feasible for any safe engineering constructions, become dynamic zones for engineering development to fulfill the needs of growing population in terms of multi-storied buildings for accommodation, commercial and recreational purposes. Construction of buildings and other civil engineering structures on weak soil is highly risky because such a soil is susceptible to excessive settlements due to its poor shear strength and high compressibility. Similarly, constructions of pavements are taken up in a big way. While socio-economic factors govern the alignment, the in-situ ground conditions govern the design and construction of the pavements and hence influence the project cost. Thus, there is constant need for cost effective in-situ ground improvement techniques.

Improving an on-site (in situ) soil's engineering properties is referred to as either "soil modification" or "soil stabilization." The term "modification" implies a minor change in the properties of a soil, while stabilization means that the engineering properties of the soil have been changed enough to allow field construction to take place.

Stabilization in a broad sense incorporates the various methods employed for modifying the properties of a soil to improve its engineering performance. Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and airfield pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of locally available materials.

SCOPE AND OBJECT OF THE STUDY

The main objective of the thesis is to evaluate the effectiveness of the stabilization in enhancing the strength properties of soils.

The following tasks are planned and performed in order to accomplish the objective.

Perform a series of C.B.R and U.C.C tests on the soil-cement mixtures:

1. Based on the test results of the treated soils were analyzed with respect to variables such as, optimum dosage, type of stabilizer, compaction, and moisture content.

2. The optimum curing period will be found for all proportions by UCC values.

SCOPE:

To utilize the stabilized red soils for various geotechnical applications like roads, embankments and fill materials different percentages of cement were added by dry weight of soil mass and tested for various geotechnical properties like

compressive strength, tensile strength and CBR ratio for various curing periods. In this cement stabilized soil samples were compacted at their OMC and cured for their required time periods instant (1 day), 3 days, 7 days, & 28 days are tested for UCS and CBR. Finally these soils are identified, analysed for improvement indices and suggested for various applications in civil engineering as follows:

- Embankments and other structural fills (usually for road construction)
- Waste stabilization and solidification
- Road sub-base construction

METHODOLOGY

the experimental procedures adopted in this investigation and the methodology adopted during the course of the study are briefly presented

MATERIAL USED

The materials used in this investigation are:

- Red soil
- Ordinary Portland Cement

Soil Used

The soil is collected from Andhra University College of Engineering grounds, Visakhapatnam District and Laboratory study was carried out for salient physical characteristics of soil like grading, atterberg limits, IS heavy compaction tests. The properties of soil are presented in table

Port Land Cement

Cement, in the general sense of the word, can be described as a material with adhesive and cohesive properties, which make it capable of bonding mineral fragments into a compact whole.

CHEMICAL COMPOSITION OF PORT LAND CEMENT:

The raw material in the manufacture of port land cement consist mainly of lime, silica, alumina and iron oxide. In addition to the main compounds. There exists minor compunds, such as Mgo, TiO_2, Mn_2O_3, K_2O and Na_2O; they usually amount to not more than a few percent of the weight of cemen

Name of compound	**Oxide composition**	**Abbreviation**
Tricalcium silicate	$3Cao.Sio_2$	C_3S
Dicalcium silicate	$2Cao.Sio_2$	C_2S
Tricalcium aluminate	$3Cao.Al_2O_3$	C_3A
Tetra calcium alumina	$4Cao.Al_2O_3$	C_4A
Ferrite	Fe_2O_3	F

Table.1: Main compounds of port land cement

Chemical Composition of OPC

Lime (Cao)	-	61.8%
Soluble Silica	-	20.4%
Alumina(Al_2O_3)	-	4.8%
Iron oxide(Fe_2O_3)	-	3.6%
Magnesia(Mgo)	-	0.8%
Sulphur(So_3)	-	1.3%
Loss of Ignition	-	1.68%
Insoluble residue	-	0.6%
Standard consistency	-	28%
Initial setting time Minutes	-	110
Final setting time Minutes	-	228
Specific Gravity	-	3.12
Fineness (Retained IS 9µ Sieve)	-	4%

LABORATORY TESTING

Properties of soil

The following tests were conducted on the soil. The index and engineering properties of soil were determined.

- Grain size analysis
- Atterberg limits
- Specific gravity
- Proctor's compaction test
- Unconfined compressive strength test
- California bearing ratio test

UNCONFINED COMPRESSIVE TEST:

Unconfined compressive test at OMC is conducted as per I.S:2720 (part - x). Specimen after preparation were moist cured in closed desiccators at room temperature for 1, 3,7,28

days and at end of each curing period, specimens of a correspond mix were taken out and tested for their unconfined compressive strength**.**

SPECIMEN PREPARATION:

The samples were prepared by static compaction method to achieve maximum dry density at optimum water content. The mould consists of steel device with an internal diameter of 38 mm and height of 76 mm. The volume of steel tube was calculated as equal to the volume of the sample knowing the volume and the density required, the weight of the sample of trial mixes whose combination percentages were chosen are determined and the water content corresponding to the optimum moisture content was added. This was transferred to the steel-tubing device. It was then compressed by rotating or pushing the pistons simultaneously from both the ends, which resulted in a sample of 38-mm diameter and 76 mm height. These samples were extracted with the help of a sample extruder. The ends of each specimen were trimmed flat perpendicular to its axes of specimen.

CURING:

Three identical samples were prepared for their maximum density at optimum water content based on compaction curves obtained. The sample for various curing periods of testing that is immediate (1 day), 3 days, 7 days and 28 days testing. All the samples prepared were labeled according to the trial combination chosen. Samples were cured in desiccators' and covered with moist cloth to maintain 100 % humidity and prevent loss of any moisture from the samples. All the samples intended for immediate testing were tested immediately.

TEST PROCEDURE:

The test was conducted using unconfined compression test apparatus at a strain rate of 1.2 mm/min. The specimen to be tested was placed centrally in between the lower and upper platform of the testing machine. The proving ring readings were noted for each 50 divisions on a deformation dial gauge. The loading was continued until three or more consecutive reading of the load dial showed a decreasing or a constant load or a strain of 20 % had been reached.

CALIFORNIA BEARING RATIO:

The samples are prepared at OMC is conducted as per I.S:2720 (part-xvi). Specimen after preparation were moist cured in closed desicators at room temperature for 1, 3, 7, 28 days and at end of each curing period, specimens of a correspond mix were taken out and tested for their california bearing ratio test.

SOIL-CEMENT MIXTURES

The soil-cement mixtures were taken in different proportions as 2%, 4%, 6%, 8% and 10% soil by weight.

RESULTS AND DISCUSSIONS

These collapisble red soils are also come under suddenly decreases in volume when it becomes saturated. These soils are generally wind & water borne deposited soils which have low water content and high void ratio in natural state. Such soils usually have a honey-comb structure in which porius structure is maintained by a water-soluble interparticle bond. When the watercontent of the soil is increased, the interparticle bond is broken and the soil mass suddenlydecreases in volume causing its collapse. Buildings and other structures constructed on a collapisble soil have large settlements causing damage. Roads, highways, pipelines and other utilities constructed on such soils have maintenance problems

S.NO	Description of the Property	Values
1	Gravel content (%)	0
2	Sand content (%)	72
3	Fines (%)	28
4	Liquid Limit (%)	24.8
5	Plastic Limit (%)	18.5
6	Specific gravity	2.63
7	OMC (IS heavy Compaction) Optimum moisture content (%) Maximum dry density (g/cc)	 12 1.86
8	California bearing ratio	2

Table.2: Soil Properties

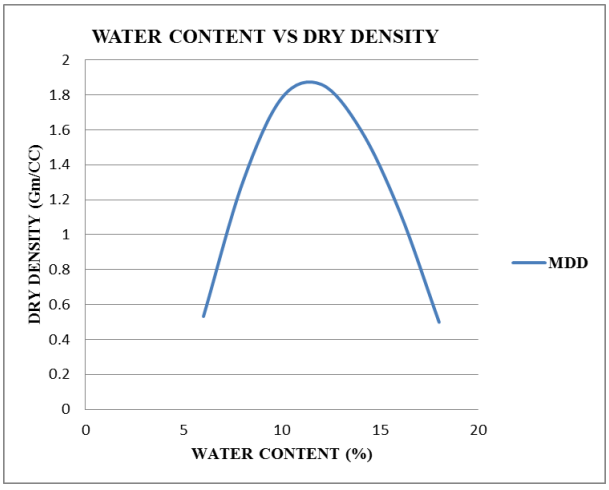

Fig.1: Water content vs Dry density

% of Cement	OMC	MDD
0% Cement	12%	1.83 g/cm^3
2% Cement	12.36%	1.88 g/cm^3
4% Cement	12.66%	1.94 g/cm^3
6% Cement	12.99%	1.99 g/cm^3
8% Cement	13.43%	2.07 g/cm^3
10% Cement	14%	2.13/cm^3

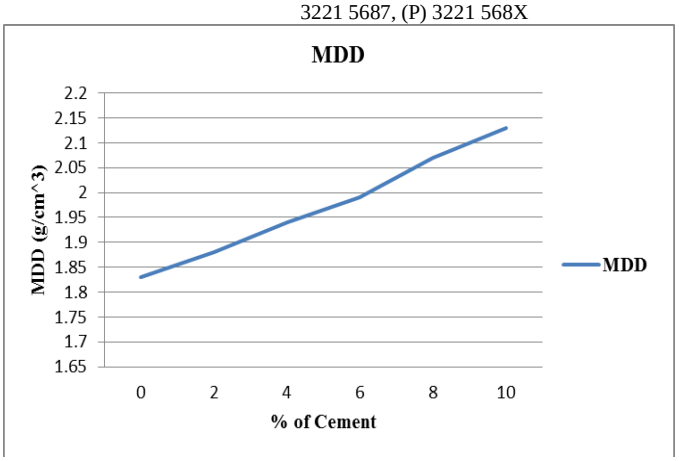

Fig.3: MDD Percentage

UNCONFINED COMPRESSIVE STRENGTH (Kg/Cm^2):

Specimen Preparation:

Cylindrical samples of sizes 38 mm diameter and 76 mm were prepared by static compaction method at their maximum dry density and optimum moisture contents. All the prepared samples were cured for 1 day, 3 days, 7 days and 28 days by maintaining 100% humidity. Unconfined compressive strength test were conducted after completion of their curing period.

COMPACTION CHARACTERISTICS FOR DIFFERENT PERCENTAGES OF CEMENT:

Table.3: Compaction characteristics for different percentage of cement

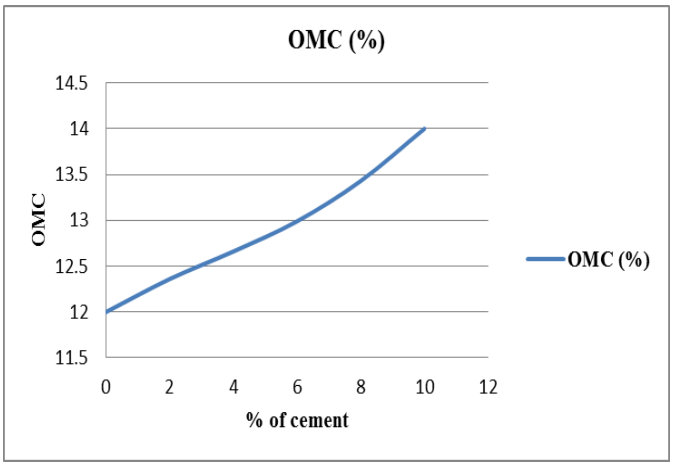

Fig..2: OMC Percentage

Unconfined Compressive Strength of Red Soil with different percentages OPC atOMC:

	% OPC at OMC				
DAYS	2	4	6	8	10
1	4.2	5	5.95	6.5	7.3
3	6.42	8.32	11.42	12.85	16.85
7	13.5	15.33	19.16	28.6	39.35
28	13.8	18.46	25.35	36.2	47.42

Table.4Different %OPC at OMC

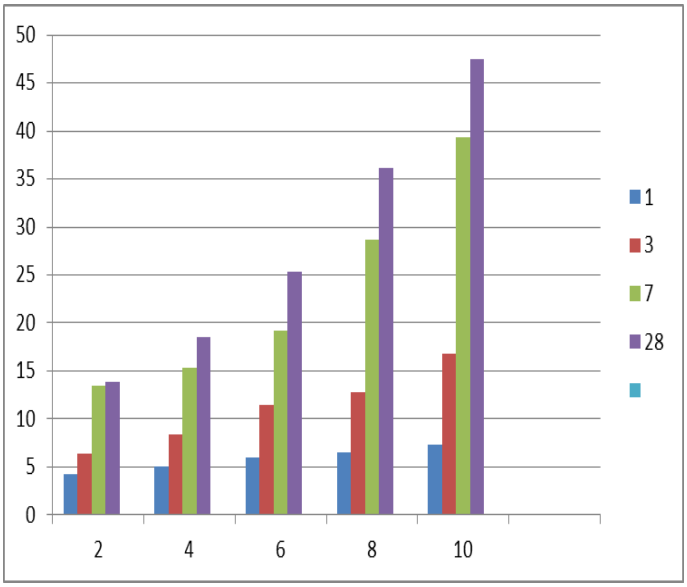

FIG.4: MDD PERCENTAGE

CBR Values Of Red Soil With Different OPC At OMC

Table.5: different OPC at OMC

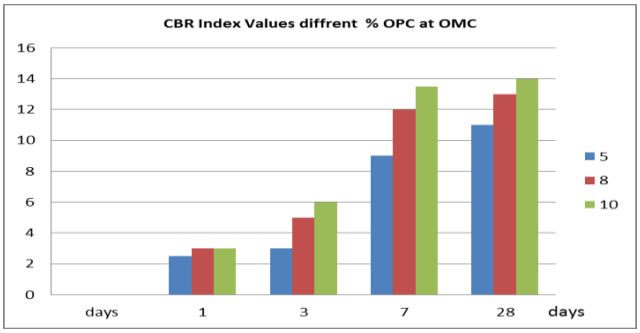

Fig.5: different OPC at OMC based in days

CONCLUSION

From the study of red soil stabilized with OPC at compacted condition in the following conclusions are derivedAdiition of OPC to red soil increases UCS and CBR values in compacted condition for all curing periods.Increase in curing period increases the strength values. Maximum increase was observed for 7 days and 28 days. Maximum values are obtained because of effective agglomeration among the particles of red soil and cement mixes.On observing the higher values of CBR, this stabilized soil can be used as base, sub base coarse in the construction of flexible pavement and as filling material in foundations.The addtion of OPC converts the soil structure into flocculated structure, because of this structure the chain formation among the particles of cement and redsoil plays a vital role in obtaining the maximum values during the process of stabilization

SCOPE

There is a lot of scope to continue the work for further research based on the conclusions of the project.Red soil can be stabilized with combination of admixtures like lime and bitumen. Addition of lime influence the mechanical strength and bitumen make a increase in the soil plasticity.Admixtures can be added such as fibers like coir fiber and jute fibers to study the change in improvement of strength characteristics.Red soil can be stabilized with betonies and lime to increase soil plasticity.The other parameters like C, Ø (shear parameters), permeability, Consolidation, can be studied to check its feasibility in the construction of embankments.The use of Geo grids and Geo nets with this stabilized mix will increase the tensile strength and interface friction, so that this combination mix can be used in the construction of flexible pavements

	CBR Index Values diffrent % OPC at OMC		
	5	8	10
DAYS			
1	2.5	3	3
3	3	5	6
7	9	12	13.5
28	11	13	14

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