A Study on Black Cotton Soil Stabilized By Using Dry Grass

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Abstract

India is a populated country. Shelter is the basic need for every human being, but the available space for construction is decreasing day by day, so everyone are interested to construct multistory buildings which offer more space and better facilities for the growing population. But, the soil available is week many areas whole over india in order to improve the bearing capacity of soil stabilization is being done. As there are many types of stabilization are under practice, but those are costly. In order to reduce the stabilization we used dry grass as a stabilizing material. Dry grass is easily available, economical, eco friendly material which is available in all places. In this present it is proved that dry grass improves the bearing capacity of soil. In this study a series of compaction, unconfined compression test are conducted for both basic soil and test soil at 0, 3, 7, 14, 28 days and California bearing ratio test is conducted for basic soil. The percentages of dry grass added to soil is 2%, 4%, 6%, 8%, 10%. The optimum moisture content increses from 2% to 8% of the grass added soil (test soil) and it shows its decrease at 10% of grass added to the soil. The maximum dry density also shows its decrease from 2% to 8% of grass added and it shows a sudden increase for 10% of grass added. And the UCC test also goes on increasing upto 8% of grass added to soil and it shows a decrease for 10% of grass added.

Keywords: *UCC test, compaction, maximum dry density, California bearing ratio, optimum moisture content, stabilization, bearing capacity.*

1. Introduction

This present study is carried on black cotton soil which is collected from Palathodu a village in Mandapeta mandal of EastGodavari district of Andhra Pradesh in India. Why we select black cotton soil instead of red and laterite soils is because of the availability of black cotton soil in East Goadavari district is very high. And we collected the soil sample from a cultivation field of Putta Annaurna at a depth of 1.5meters. Black soil has many disadvantages it hs high swelling properties, and it becomes mussy for even a small rainfall. So, construction of buildings on this soil leads to collapse of buildings. And the dry grass used in this study is collected from paddy field, and the dry grass is cut into pieces of size of 5cm length. And different tests are conducted on soil, starting with differential free swell and continued with a series of Proctor Heavy Compaction, California Bearing Ratio, Unconfined Compression tests on soil.

2. Literature Review

Stabilization of soil is important in order to densify the soil and thereby increasing the bearing capacity of soil. Soil stabilization can be done by many methods. One is lime soil stabilization, cement soil stabilization, bituminous stabilization and mechanical stabilization. Mechanical stabilization is done by using rollers and by doing heavy compaction. The mechanical stabilization densifies the soil and reduces the porosity and void ratio. But this process increases the stabilization cost of sub soil. And in recent times there are many new technologies arrived but those are also not economical. In order to reduce the stabilization costs we introduced dry grass as a stabilizing material.

3. METHODOLOGY

This present study highly focuses on the impact of dry grass on black soil. There are many tests conducted on soil they are Differential Free Swell, Atterbergs Limits, Specific Gravity, Sieve Analysis, CBR, UCC and Compaction. The bearing capacity of soil increases by the addition of dry grass to soil.

In the below table the results for basic soil are depicted:

S.No		Name of the test	Result
1		Differential free swell (%)	123
2		Liquid limit (%)	83.7
3		Plastic limit (%)	46.4
4		Gravel content (%)	7
5		Fines content (%)	71
6		Sand content	22
7		Specific gravity	2.89
8		Compaction (IS heavy compaction) Optimum moisture content (%) Maximum dry density (%)	 16.2 1.528
9		Unconfined compression test (KPa)	56.8
10		California bearing ratio At 2.5mm penetration At 5mm penetration At 7.5mm penetration	 4.164 3.248 2.286

The differential free swell for the soil taken is very high so that stabilization is required for it. And the tests for test soil is also conducted by following the IS code provisions for all the tests.

About grass:

Grass is a fiber which is mainly composed of water and cellulose. There is about 70% of water and 30% of cellulose in it. The dry grass has less water content than in fresh green grass. In this study the grass used has the following properties:

S.No	Name of The Property	Value
1	Width of one grass folicle	0.7 cms
2	Length of grass taken	5 cms
3	Specific gravity of grass	1.78

4. Results and Discussions

The behavior of soil at different percentages of the addition of grass

S.No	Percentage Addition of Grass (%)	Optimum Moisture Content (%)	Maximum Dry Density
1	2	16.8	1.536
2	4	18.3	1.612
3	6	21.7	1.723
4	8	24.2	1.786
5	10	20.6	1.689

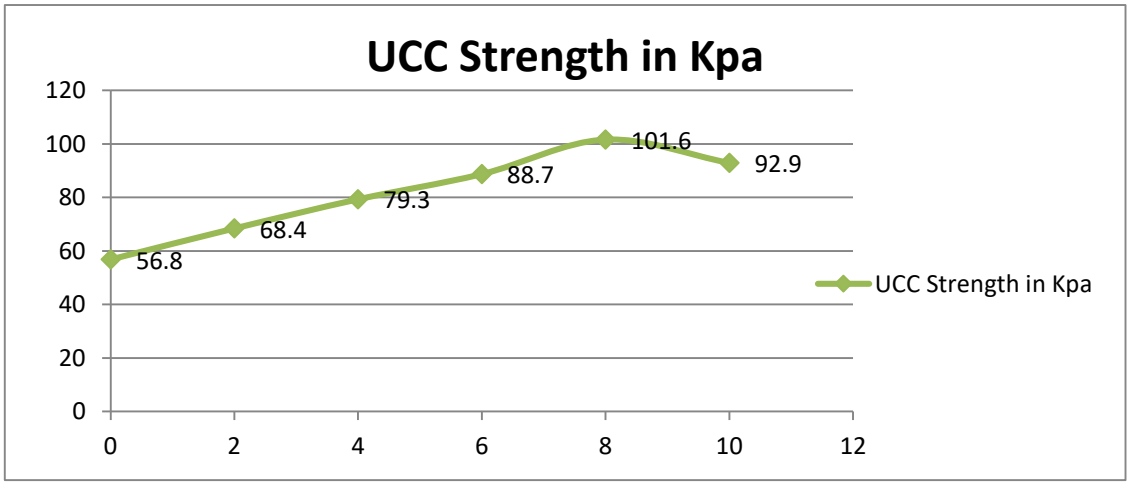
Unconfined compression test data for the percentage addition of grass to the soil for 0, 3, 7, 14, 28 days:

UCC strength in KPa

S.No	Percentage Addition of Grass (%)	0 days	3 days	7 days	14 days	28 days
1	Basic soil	56.8	62.7	70.6	77.3	83.6
2	2	68.4	76.1	89.8	102.6	114.7
3	4	79.3	91.2	98.6	108.4	123.6
4	6	88.7	110.6	115.7	127.3	133.6
5	8	101.6	126.3	138.4	151.2	173.6
6	10	92.9	114.9	125.3	136.3	149.4

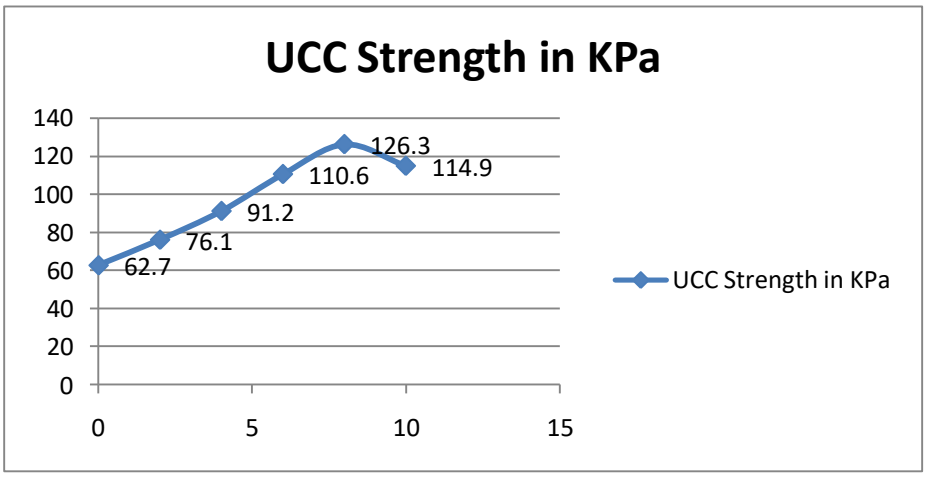
Graphs:

At zero days:



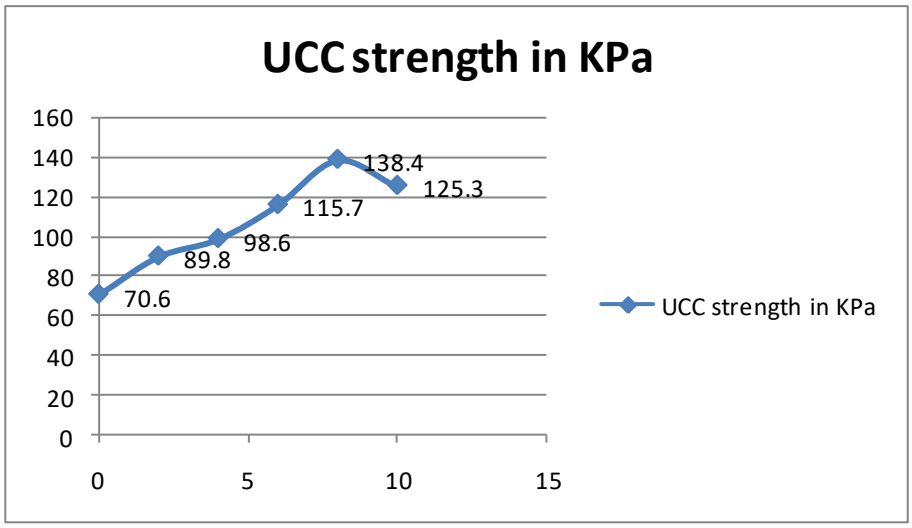
This graph shows that the unconfined compressive test result for 8% of addition of grass is high when compared with other percentage addition of grass.

At three days:



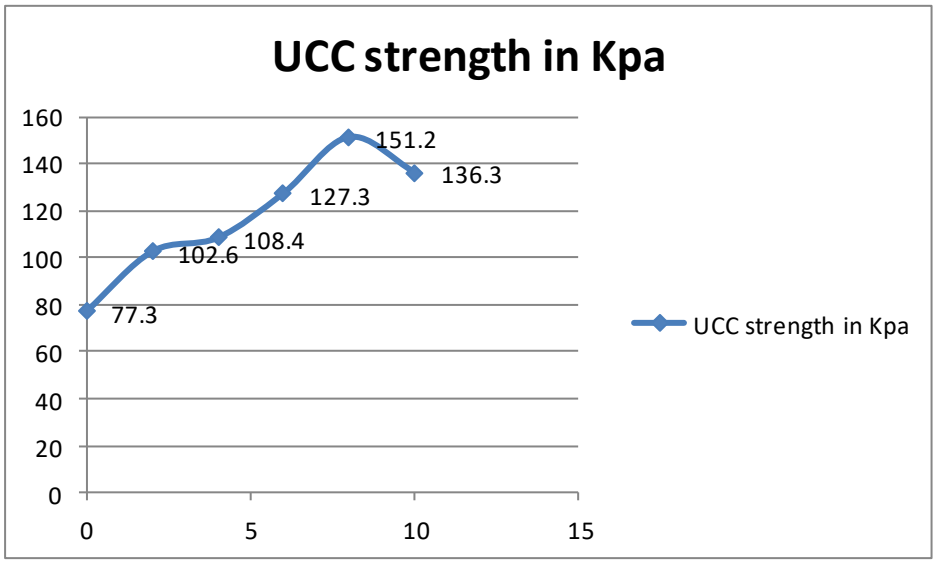
This graph shows that the unconfined compressive test result for 8% of addition of grass is high when compared with other percentage addition of grass.

At 7 days:



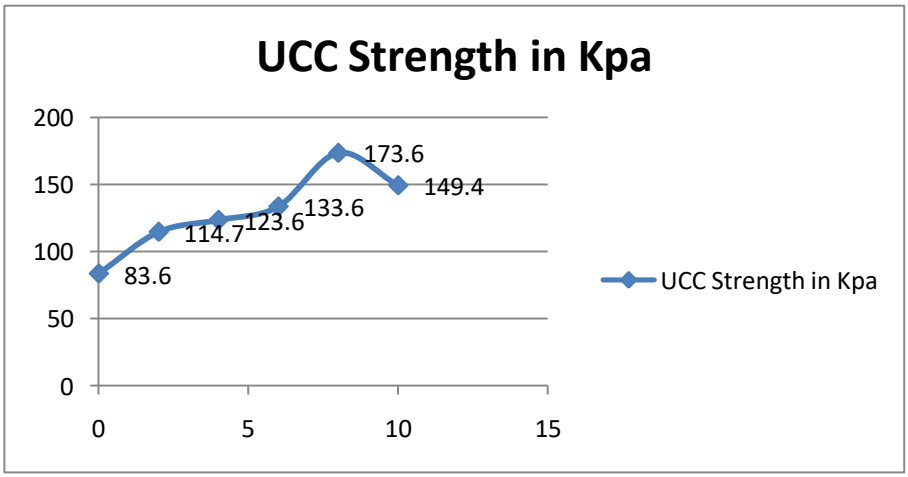
This graph shows that the unconfined compressive test result for 8% of addition of grass is high when compared with other percentage addition of grass.

At 14 days



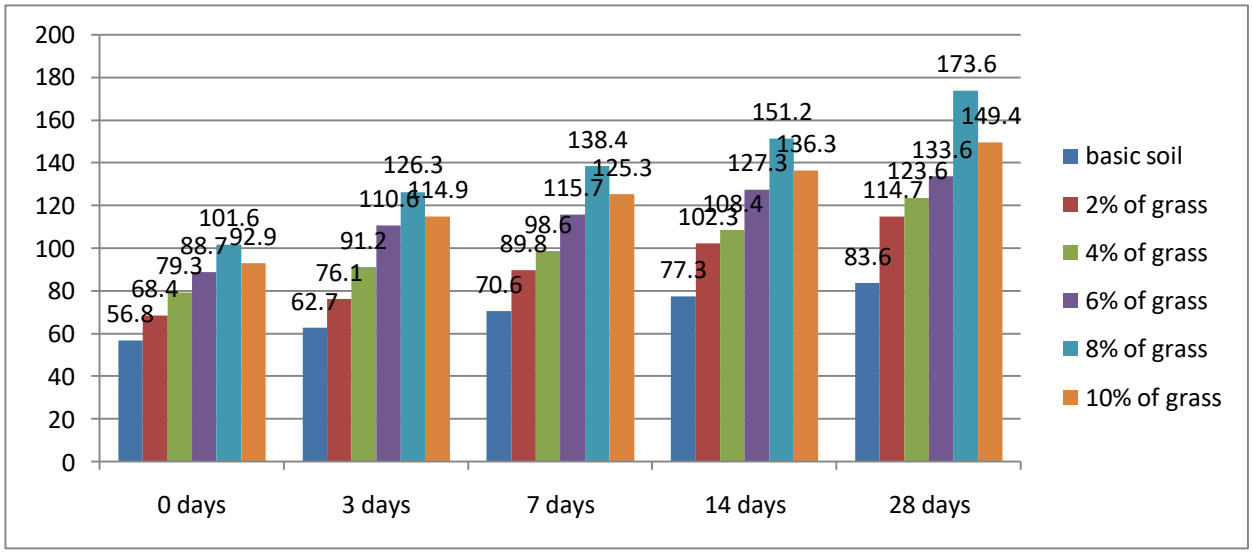
This graph shows that the unconfined compressive test result for 8% of addition of grass is high when compared with other percentage addition of grass.

At 28 days



This graph shows that the unconfined compressive test result for 8% of addition of grass is high when compared with other percentage addition of grass.

This graphs represent the increase in strength of test soil from basic soil at various percentages at 0, 3, 7, 14, 28 days:



Unconfined Compression Test Results

This graph shows that the unconfined compression test of soil increases upto 8% addition of grass to the soil and it decreased for 10% of addition of grass.

5. Conclusions:

1. The optimum moisture content of soil increases from 2% to 8% addition of grass and it decreases for 10% addition of grass to basic soil.
2. The maximum dry density also increases from 2% to 8% addition of grass and it decreases for 10% addition of grass to basic soil.
3. The unconfined compressive strength of soil increased drastically shows its peak value at 8% of grass added to the soil at 28 days, and it again falls at 10% addition of grass.
4. The entire study shows that the unconfined compressive strength of soil is increased by the addition of dry grass to it.
5. Dry grass is cheap and available in all places of India.

6. References:

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- *I.S:2720 (part - viii)1983 for compaction test*
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- *I.S:2720 (part - v),1985.for palstic limit*
- *I.S:2720 (part - v),1985 for liquid limit*
- *IS: 2720 (Part XL)-1977.for differential free swell.*