

Stabilization of Soil by Fiber with Fly-Ash

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ABSTRACT: Soil stabilization can be explained as the alteration of the soil properties by chemical or physical means in order to enhance the engineering quality of the soil. The main objectives of the soil stabilization are to increase the bearing capacity of the soil, its resistance to weathering process and soil permeability. The long-term performance of any construction project depends on the soundness of the underlying soils. Unstable soils can create significant problems for pavements or structures, Therefore soil stabilization techniques are necessary to ensure the good stability of soil so that it can successfully sustain the load of the superstructure especially in case of soil which are highly active, also it saves a lot of time and millions of money when compared to the method of cutting out and replacing the unstable soil.

KEYWORDS: Stabilization, Permeability, Sustain, Pavement, Polypropylene Fiber, Fly-Ash.

1. INTRODUCTION

For any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work.

Soil is highly Complex, Heterogeneous and Unpredictable material which has been subjected to vagaries of nature, without any control. The properties of soil change not only from one place to other but also at the place with depth and with a change in the environmental, loading and type, drainage and the conditions under which it exists. In comparison to other construction materials such as concrete or steel, it is not economically feasible to transport the soils from one place to other, because a huge quantity of soil is involved and it is not opened to inspect at greater depth for foundations of different structures.

Sometimes, Civil Engineers are forced to construct structure at site selected for reasons other than soil conditions. Thus, it is increasingly important for the engineer to know the degree to which the engineering properties of the soil may improve or other alternatives that can be thought off for the construction of intended structure at the stipulated site. If unsuitable soil conditions are encountered at the site of a proposed structure, unsuitable soil can be bypassed by means of deep foundation extended to a suitable bearing material, poor material can be removed and replaced by a suitable material, or soil in-place can be treated by using any suitable ground improvement methods to improve its engineering properties. Therefore, to work at the selected site, we need to have proper knowledge about their properties and factors which affect their behavior. Hence, from the beginning of construction work, the necessity of enhancing the soil properties has come to the light and the process of soil stabilization helps us to achieve the required properties in a soil needed for the construction work.

II. STUDIES ON STABILISATION OF SOIL USING WASTE MATERIALS

Prabakar et al. investigated the behavior of soils mixed with fly ash to improve the load bearing capacity of the soil. Three different types of soil and different percentage of fly ash were used. The objectives of this investigation was

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reached to the usefulness of fly ash-soil mixtures, and focused to improve the engineering properties of soil with better load bearing capacity. This study also mentioned the cost effective of fly ash for soil improvement and covered the compaction behavior, settlement, California bearing ratio, shear strength parameters and swelling characteristics. The results showed that addition of fly ash reduced the dry density of the soil and unit weight of soil. The void ratios and porosity changed with increasing content of fly ash in soils. The shear strength of the mixture was improved due to the addition of fly ash and increasing of it was nonlinearly. The value of cohesion increased by the addition of fly ash and this alteration was linear. CBR value of soil improved by the addition of fly ash. The results indicated that the shear strength and the angle of internal friction of soil admixed with fly ash caused a better strength. Using fly ash in soil also reduced swelling in the soil.

Alhozaimy, A.M. (1995) carried out experimental investigations on the effects of adding low volume fractions (<0.3%) of calculated fibrillated polypropylene fibres in soil on compressive flexural and impact strength with different binder compositions. They observed that polypropylene fibres have no significant effect on compressive (or) flexural strength, while flexural toughness and impact resistance showed increased values. They also observed that positive interactions. the addition of polypropylene fibres does not have a significant effect on the direct tensile cracking strength. However, in moderate volume replacements (0.33-0.5%) the addition of macro-synthetic polypropylene fibres showed a 10 to 15% increase in splitting tensile strength. were also detected between fibres and pozzolans.

Rakesh Kumar Dutta (2012) Found that addition of randomly distributed polypropylene fibers enhance the properties of soil studied the effective use of fibers on unconfined compressive strength of clay. The results indicate that the fiber reinforced clay was able to bear higher strains and increase in the unconfined compressive strength was higher with CCl4 treatment. and increase bearing capacity of soil.

III. EXPERIMENTAL RESULTS

The Pycnometer is used for determination of the specific gravity of soil particles of both fine grained and coarse grained soils. The specific gravity of soil is determined using the relation:

$$G = \frac{M_2 - M_1}{(M_2 - M_1) - (M_3 - M_4)}$$

Where M_1 = mass of empty Pycnometer,

M_2 = mass of the Pycnometer with dry soil

M_3 = mass of the Pycnometer and soil and water,

M_4 = mass of Pycnometer filled with water only.

G = Specific gravity of soils.

SPECIFIC GRAVITY OF SOIL

No.	DETERMINATION NO	NOTATION	1	2
01	Pycnometer no		01	22
02	Mass of pycnometer	M1 kg	0.643	0.645
03	Mass of pyc.+soil	M2 kg	0.844	0.844
04	Mass of pyc.+soil+water	M3 kg	1.781	1.789
05	Mass of pyc+water	M4 kg	1.657	1.668
06	Specific gravity	$G = \frac{M_2 - M_1}{(M_2 - M_1) - (M_3 - M_4)}$	2.610	2.531

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$$\text{AVERAGE SPECIFIC GRAVITY} = \frac{(2.610)+(2.531)}{2}$$

$$= 2.557$$

SPECIFIC GRAVITY OF FLY-ASH

No.	DETERMINATION NO	NOTATION	1	2
01	Pycnometer no		01	22
02	Mass of pycnometer	M1 kg	0.644	0.644
03	Mass of pyc.+fly-ash	M2 kg	0.844	0.844
04	Mass of pyc.+ fly-ash +water	M3 kg	1.770	1.769
05	Mass of pyc+water	M4 kg	1.661	1.663
06	Specific gravity	$G = \frac{M2-M1}{(M2-M1)-(M3-M4)}$	2.19	2.12

$$\text{AVERAGE SPECIFIC GRAVITY OF FLY-ASH} = \frac{(2.19)+(2.12)}{2}$$

$$= 2.15$$

STANDARD PROCTOR TEST OF SOIL SAMPLE WITH 2% FLY-ASH:

The test consists in compacting soil at various water contents in the mould, in three equal layers, each layer being given 25 blows of the 2.5 kg rammer dropped from a height of 30.5cm. The dry density obtained in each test is determined by knowing the mass of the compacted soil and its water content. The compactive energy used for this test is 6065 kg cm per 100 ml of soil.

We get 3kg of oven dried soil passing through 4.75 mm sieve is then taken and thoroughly mixed with water. The quantity of water to be added initially depends upon the probable optimum water content for the soil. The initial water content is taken about 4% for the used samples of fly ash. The empty mould attached with the base plate is weighted without collar. The collar is then attached to the mould. The mixed and matured soil is placed into eh mould and compacted by giving 25 blows of the rammer uniformly distributed over the surface, such that the compacted height of the soil is about 1/3 the height of the mould. The second and the third layers are similarly compacted, each layer being given 25 blows. The last layer should not project more than into the collar. The collar is removed and the top layer is trimmed off to make t level with the top of mould.

The weight of the mould, base plate and the compacted soil is taken. A representative sample is taken from three different layers of the mould, one from the top layer, other from the middle section and the third from the bottom section of the mould, and kept for water content determination. The bulk density and the corresponding dry density for the compacted soil are calculated from the following table and graph.

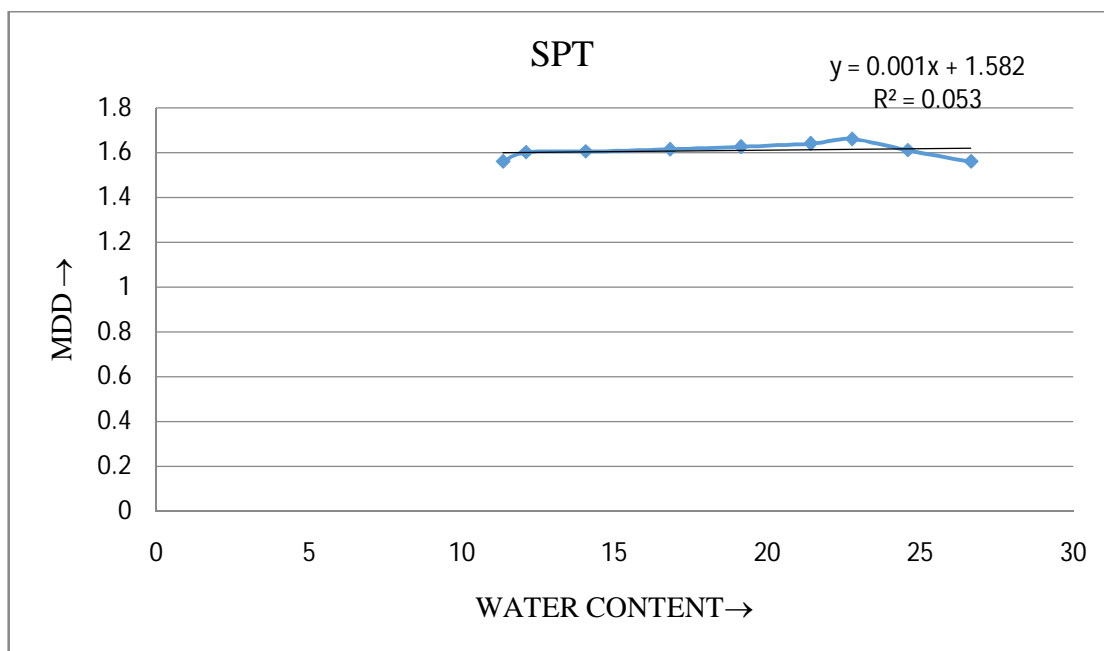
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No	Observation	1	2	3	4	5	6	7	8	9
1	Weight of empty mould	3.674	3.674	3.674	3.674	3.674	3.674	3.674	3.674	3.674
2	Weight of empty mould+compacted soil	5.415	5.469	5.505	5.560	5.612	5.676	5.712	5.691	5.650
3	Mass of compacted soil	1.741	1.795	1.831	1.886	1.938	2.002	2.038	2.017	1.976
4	Bulk density	1.741	1.795	1.831	1.886	1.938	2.002	2.038	2.017	1.976
5	Container no.	17	15	14	16	13	18	1	2	3
6	Mass of empty container	11.84	12.14	12.09	12.29	11.88	12.23	11.81	11.81	12.21
7	Mass o container +wet soil	18.60	16.86	18.01	23.61	18.85	17.84	20.92	21.79	22.85
8	Mass of container +dry	17.91	16.35	17.28	21.98	17.73	16.85	19.23	19.82	20.61
9	Water content	11.36 %	12.11 %	14.06 %	16.82 %	19.14 %	21.42 %	22.77%	24.59 %	26.66 %
10	Dry density	1.56	1.601	1.605	1.614	1.626	1.640	1.660	1.610	1.560



The maximum dry density of soil is 1.665 at 22.60 % of water content.

CALIFORNIA BEARING RATIO TEST

SOIL SAMPLE WITH 0.1% FIBER AND 2% FLY-ASH AT 22.60% WATER CONTENT

This is a penetration test developed by the California division of highways as method for evaluating the stability of soil sub Grade and other flexible pavement materials. The CBR test may be conducted in laboratory on a prepared specimen in a mould or in situ in the field. The laboratory CBR apparatus consists of a mould 150 mm diameter with a base plate and a collar, a loading frame with a cylindrical plunger of 50mm diameter and a dial gauge for measuring the expansion on soaking and penetration values.

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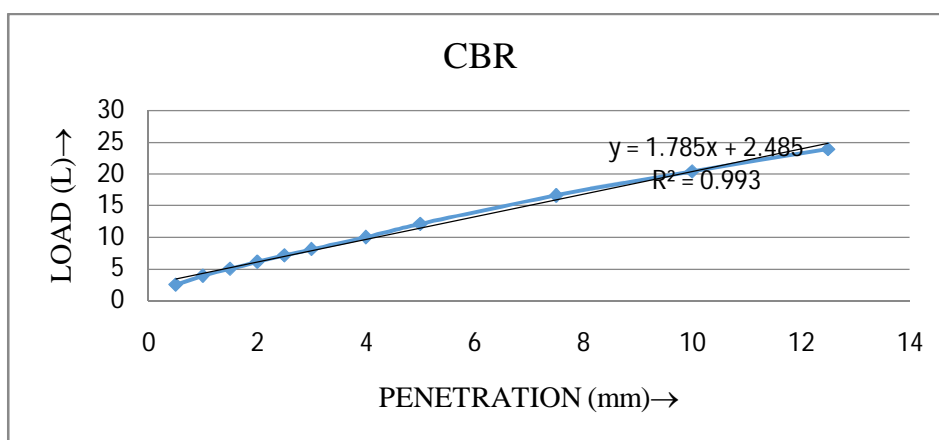
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The load values to cause 2.5mm and 5mm penetration are recorded .These loads are expressed as percentage of standard load values at respective deformation levels to obtain CBR value. For obtain CBR value we used soil sample with 0.1% fiber and 2% fly-ash and the CBR value at 2.5mm and 5mm is given by below table and graph.

Sr. No	PENETRATION(mm)	DIAL READING	LOAD (kg)
01	0.5	0.8	3.4
02	1.0	1.1	5.0
03	1.5	1.8	5.8
04	2.0	2.1	6.4
05	2.5	2.5	7.0
06	3.0	3.1	7.4
07	4.0	4.0	8.0
08	5.0	4.9	9.0
09	7.5	7.1	11
10	10	10.0	12.9
11	12.5	12.5	22.2



- 1. THE CBR VALUE AT 2.5 MM = 0.518%**
- 2. THE CBR VALUE AT 5 MM = 0.43 %**
- THE CBR VALUE OF SOIL IS = 0.518%**

IV. CONCLUSION

1. Fly-Ash and Fiber additive may be successfully used to enhance the engineering properties of soil particularly CBR.
2. It has been observed that CBR value increases with Fly-Ash and Fiber content 1%, 1.5%, 2% for soil.
3. It is observed that value increases significantly after addition of 1.5% Fly-Ash and Fiber content

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