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Experimental Research on LooseSoil Soil Stabilization Using Compacting and Grouting

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ABSTRACT- Soil stabilization is a very common process in all construction projects. By using Compaction and Grouting method is to increase the Strength and Bearing Capacity of loose soil. This techniques are done for soil stabilization on loose soil based on experimental studies. This techniques are conducted on Aalapakam in Cuddalore. The Soil Stabilization is to increase the strength , stability of soil and to reduce the construction cost by making best use of locally available materials. To improve the characteristic at site and it also able to capable of carrying load and to increase the shear strength by decrease the compressibility of the soil. Soil stabilization materials help in increasing the load bearing capability, tensile strength & overall performance of soil.

KEYWORDS- Stabilization, Tensile Strength, Bearing Capacity, Shear Strength

I. INTRODUCTION

Soil stabilization a general term for any physical, chemical, mechanical, biological or combined method of changing a natural soil to meet an engineering purpose. Improvements include increasing the weight bearing capabilities, tensile strength, and overall performance of in situ sub soils, sands, and waste materials in order to strengthen of ground improvement.

Some of these new stabilizing techniques create hydrophobic surfaces and mass that prevent road failure from water penetration or heavy frosts by inhibiting the ingress of water into the treated layer. However, recent technology has increased the number of traditional additives used for soil stabilization purposes. Stabilization is achieved confinement of particle movement to improve the strength of the entire layer. This method is ideal for recompaction and consolidation of weak soil strata, increasing and improving load bearing capacity under structures and the remediation of shallow and deep sinkhole problems. There is no problems are occur by usinf grouting and compaction method.

A. Introduction of Grouting

This is particular efficient when there is a need to support deficient public and private infrastructure. The primary purpose of compaction grouting is to increase the density of soft, loose or disturbed soil, typically for settlement control, structural re-leveling, increasing the soil's bearing capacity, and mitigation of liquefaction potential. Ground improvement and ground modification refer to the improvement in or modification to the engineering properties of soil that are carried out at a site where the soil in its natural state does not possess properties that are adequate to withstand the load of the structure.

B. Introduction of Compaction

Compaction is the best-known soil stabilisation technique used to improve strength and reduce porosity. Here, the soil in its loose state is brought to a dense state by supplying compaction energy. Soil compaction is used for support of structural entities such as building foundations, roadways, walkways, and earth retaining structures to name a few. For a given soil type certain properties may deem it more or less desirable to perform adequately for a particular circumstance.

II. OBJECTIVES

1. Identifying the type of soil.
2. Analyzing the properties of soil at the area.
3. Finding Optimum moisture content.
4. Increased shear strength.
5. Reducing Permeability and Shrinkage cracks.
6. California Bearing Ratio(CBR) of the loose soil.
7. It can significantly enhance the properties of the soil used in the construction of infrastructure.
8. Soil stabilization is to improve on site materials to create a solid and strong sub base and base course.

III. MATERIAL COLLECTION

A. Soil Sample

Soil test may refer to one or more of a wide variety of soil analysis conducted for one of several possible reasons.

- Soil type: loose soil
- Soil zone: Aalapakkam, Cuddalore (Dt)
- ***The Following Tests are Done***
- **Specific Gravity Test:** Specific gravity also called relative density, is the ratio of the density of a substance to the density of a reference substance; equivalently, it is the ratio of the mass of a substance to the mass of a reference substance for the same given volume. Apparent specific gravity is the ratio of the weight of a volume of the substance to the weight of an equal volume of the reference substance.
- **California Bearing Ratio Test:** The California Bearing Ratio Test (CBR test) is a penetration test that can be performed in the laboratory or in-situ. They

can be considered as small scale bearing tests in which the ratio of penetration to the size of the loaded area is much greater than in bearing tests. California Bearing Ratio (CBR) test is used to calculate the stability of soil sub-grade and other flexible pavement materials.

- **Tri-Axial Compression Test:** Very loose sand is defined as sand whose state is significantly looser than its critical state. The detailed stress-strain behaviour of very loose sand in triaxial compression is described for the first time within the framework of critical state soil mechanics. Strain contours in normalized stress space are presented for several sands and are shown to be remarkably consistent. The observed normalized behaviour is used to develop a simple constitutive model for the behaviour of very loose sands, based on plasticity theory.
- **Direct Shear Test:** A direct shear test is a laboratory or field test used by geotechnical engineers to measure the shear strength properties of soil or rock materials of discontinuous in soil.

IV. EXPERIMENTAL STUDIES AND RESULT

A. Excremental Studies for Normal Loose Soil

- **Specific Gravity Test**

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

S. NO	DESCRIPTION	TRIAL 1	TRIAL 2	TRIAL 3
1.	Mass of empty bottle	0.652	0.653	0.652
2.	Mass of bottle and dry soil	o.853	0.858	0.859
3.	Mass of bottle soil and water	1.629	1.628	1.629
4.	Mass of bottle filled with water	1.498	1.498	1.498
Specific gravity		2.87	2.73	2.72
Specific gravity G		2.78		

Result:
Thus the specific gravity of Normal Loose Soil is 2.78.

- **Direct Shear Test**

$$\tau = c' + \sigma' \tan \phi'$$

The test is carried out on either undisturbed samples or remoulded samples. To facilitate the remoulding purpose, a soil sample may be compacted at optimum moisture content in a compaction mould. Then specimen for the direct shear test could be obtained using the correct cutter provided. Alternatively, sand sample can be placed in a dry state at a required density, in the assembled shear box. Assemble the shear box. Compact the soil sample in mould after bringing it to optimum moisture condition. Carefully transfer the sample into shear box. Place the loading plate on top of the upper porous plate.

Result:
Thus the Shear Stress of Normal Loose Soil is 0.0076 KN/mm².

- **Tri-Axial Compression Test:**

Cell Pressure Kg/cm²	Strain Dial	Proving Ring Reading
0.50	0	0
	50	0
	100	5
	150	0
	200	6
	250	0
	300	0
	350	7
	400	0
	450	8

Result:
Thus the Cell Pressure of Normal Loose Soil is 0.04 KN/mm².

- **Califonia Bearing Ratio Test**

Penetration of Plunger in mm	Standard Load in Kg
2.5	1370
5	2055

S. No	Penetration Dial	Load Dial	
	Penetration in mm	Readings	Load In Kg
1.	0.5	0	0
2.	1	3	34.5
3.	1.5	0	0
4.	2.0	5	57.5
5.	2.5	7	80.5
6.	3	8	92
7.	3.5	10	115
8.	4	12	138
9.	4.5	15	172.5
10.	5	17	195.5
11.	5.5	18	207
12.	6	20	230
13.	6.5	22	253
14.	7	0	0
15.	7.5	25	287.5
16.	8	28	322
17.	8.5	30	345
18.	9	34	391

Formula:
C.B.R. = (Pt/Ps) X 100

Result:
Thus the California Bearing Ratio of Normal Loose Soil are,
1. C.B.R. of specimen at 2.5 mm penetration = 5.875
1. C.B.R. of specimen at 5 mm penetration = 9.513.

B. Sea Sand after Compaction and Grouting

- **Specific Gravity Test**

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

S.NO	DESCRIPTION	TRIAL 1	TRIAL 2	TRIAL 3
1.	Mass of empty bottle	0.653	0.655	0.656
2.	Mass of bottle and dry soil	o.853	0.855	0.856
3.	Mass of bottle, soil and water	1.622	1.624	1.625
4.	Mass of bottle filled with water	1.508	1.508	1.508
Specific gravity		2.33	2.35	2.35
Specific gravity G		2.34		

Result:
Thus the Specific gravity of Compacted and Grouted Loose Soil is 2.34.

- **Direct Shear Test**

$$\tau = c' + \sigma' \tan \phi'$$

The test is carried out on either undisturbed samples or remoulded samples. To facilitate the remoulding purpose, a soil sample may be compacted at optimum moisture content in a compaction mould. Then specimen for the direct shear test could be obtained using the correct cutter provided. Alternatively, sand sample can be placed in a dry state at a required density, in the assembled shear box.
Assemble the shear box. Compact the soil sample in mould after bringing it to optimum moisture condition.
Carefully transfer the sample into shear box. Place the loading plate on top of the upper porous plate.

Result:

Thus the Shear Stress of Compacted and Grouted Loose Soil is 0.017KN/mm².

- **Tri-Axial Compression Test**

Cell Pressure Kg/cm²	Strain Dial	Proving Ring Reading
0.50	0	0
	50	0
	100	5
	150	0
	200	6
	250	0
	300	0
	350	7
	400	0
	450	8

Result:
Thus the Cell Pressure of Compacted and Grouted Loose Soil is 0.04 KN/mm².

- **Califonia Bearing Ratio Test**

Penetration of Plunger in mm	Standard Load in Kg
2.5	1370
5	2055

S. No	Penetration Dial	Load Dial	
	Penetration in mm	Readings	Load in Kg
1.	0.5	0	0
2.	1	3	34.5
3.	1.5	0	0
4.	2.0	5	57.5
5.	2.5	7	80.5
6.	3	8	92
7.	3.5	10	115
8.	4	12	138
9.	4.5	15	172.5
10.	5	17	195.5
11.	5.5	18	207
12.	6	20	230
13.	6.5	22	253
14.	7	0	0
15.	7.5	25	287.5
16.	8	28	322
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Formula:
C.B.R. = (Pt/Ps) X 100

Result:
Thus the California Bearing Ratio of Compacted and Grouted Loose Soil are,
1. C.B.R. of specimen at 2.5 mm penetration =5.875.
2. C.B.R. of specimen at 5 mm penetration =9.513.

V. CONCLUSION

The Strength, Stability and Overall Performance of the Loose Soil had improved by using Compaction and Grouting Methods. The Specific Gravity, Shear Stress, Cell Pressure and California Bearing Ration of the Loose Soil had discovered.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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