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Improvement of Bearing Capacity of Sandy Soil by using Grouting

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ABSTRACT

The constructional activities in the coastal areas require deep foundations because of the poor engineering properties of weak soil at shallow depths. The very low bearing capacity of the foundation bed causes shear failure. Further, the high water table and limited depth of the top sandy layer in these areas restrict the depth of foundation thereby further reducing the safe bearing capacity. Grouting, which has several applications in the field of civil engineering, was once considered as a mysterious operation. Permeation grouting is a process of filling the pores in the soil with the cement slurry and improves the engineering properties of the possible solutions to the foundation problems by improving the properties of soil at shallow depths by using sodium silicate.

Keywords: Bearing Capacity, Permeation Grouting, Sodium Silicate, Cement

I. INTRODUCTION

The ground improvement of the soil is a technique of improving the engineering properties of the soil that can be carried out at a site. Permeation grouting is a process of low pressure grouting which helps to effluent the cement slurry in the soil with less pressure. Low pressure grouting is a process of injecting the cement slurry into the voids, cavity of the soil. It is improve the properties of the soil, especially reduces the permeability in the sample and the permeability of formations under the water retaining structures, control the erosion of soil, increase the strength of materials below foundation. It is also reduce the deformability of the material in the foundation. The setting of cement grout in the pore space increases both the strength and stiffness.

Soil stabilization, with cement grouts injected under pressure, has come into broad use in construction. At present method of grouting is highly prevalent in a number of branches of structural engineering; and in foundation engineering for the reinforcement of foundations below buildings and structures. Pressure grouting alters strength, failure stain, modulus and mode of failure of sand. It would be both practical and useful to estimate the properties of the grouted sand from the constituent properties. The compressive behaviour of grouted sand will depend on the cohesive behaviour of the grout, bonding and the properties of

the sand. The physical or chemical interaction of two materials at their interface is known as adhesion or bonding. The strength and type of this bond plays an important role in the mechanical behaviour of chemically grouted materials. Grouting is mainly responsible for the gain in cohesion by the material and only affects the friction angle. The cohesion varies with cement content, the magnitude of the cohesion and also the friction angle is a slightly increasing function of cement content. The increase in angle of friction is negligible with respect to cohesion. The Mohr Coulomb cohesion varies between 0.1 and 0.5 MPa depending on the cement content of the grout and the relative density of the soil and increases in proportion with the cement to water ratio.

Objectives

1. Study the different properties of soil.
2. Increasing depth of soil foundation.
3. Compacting and confining the soil.
4. Replacing the poor soil.
5. Stabilizing the soil with chemicals (sodium silicate).
6. Reducing the settlement of soil.
7. Improving bearing capacity and shear strength of soil.

II. LITERATURE REVIEW

1. Gopalsamy.p1, Sakthivel.m2, Arun.k (2017)

the very low bearing capacity of the foundation bed causes shear failure and excessive settlements. Further, the high water table and limited depth of the top sandy layer in these areas restrict the depth of foundation thereby further reducing the safe bearing capacity. Based on this experimental investigation made on sandy and grouted soil was concluded as, it can be seen that grouted soil has good liquid limit, plastic limit, compaction and bearing ratio are high when compared to ordinary sandy soil.

2. Santhosh Kumar. T. (2016) The constructional activities in the coastal areas often demand deep foundations because of the poor engineering properties and the related problems arising from weak soil at shallow depths. the very low bearing capacity of the foundation bed causes shear failure and excessive settlements. The shear strength of the loose sandy soil steadily increases with increase in cement content and also with curing period. The rate of increase in shear strength is very high at higher percentages of cement than at lower percentage.

3. K.VenkatRaman1, P.Dayakar1, K.V.B. Raju(2016)

Permeation grouting is a simple method of ground improvisation technique which helps to stabilize the loose soil stratum. Permeation grouting is a process of filling the pores in the soil with the cement slurry and improves the engineering properties of the soil. The shear strength parameters in the loose and medium dense

state of the soil are investigated by plate load test on the grouted soil sample by determining the correlation between load and displacement on the grouted medium.

III. METHODS AND MATERIAL

The following are some of the materials used in this experiment for analyzing are

1. Sandy soil

Sand is fairly coarse and loose so water is able to drain through it easily. While this is good for drainage, it is not good for growing plants because sandy soil will not hold water or nutrients.

2. Tap Water

Ordinary drinking water available in the construction laboratory was used for casting all specimens of this investigation. Water helps in dispersing the cement even, so that every particle of the aggregate is coated with it and brought into ultimate contact with the ingredients. It reads chemically with cement and brings about setting and hardening of cement. It lubricates the mix and compact property. Potable water, free from impurities such as oil, alkalis, acids, salts, sugar and organic materials were used.

3. Sodium Silicate

Sodium silicate is stable in neutral and alkaline solutions. In acidic solutions, the silicate ion reacts with hydrogen ions to form silica acid, which when heated and roasted forms silica gel, a hard, glassy substance.

4. Grouting Injection

Grouting is made to soil by using injection model, which will be applied pressurized by hand pressure only.

METHODOLOGY

1. Collect the soil (sand soil).
2. Wash it with water free from salts and dry in the oven to ensure it is free from moisture.
3. Perform CBR, compaction, liquid limit, plastic limit, on the sand (usually the result is zero for plastic and liquid limit).
4. Improve the properties of sandy soil by performing grouting.
5. Perform all test on the improved soil.
6. Report the result between both sample.

IV. RESULTS AND DISCUSSION

Test Performed

1. Liquid Limit Test

2. Plastic Limit Test
3. Shrinkage Limit Test
4. Specific Gravity
5. Direct Shear Test
6. California Bearing Ratio test
7. Unconfined compression test

Test Results

Sr. No.	Name of Test	Result
1	Plastic limit test	38.31%
2	Liquid limit test	57.68%
3	Shrinkage limit test	10.95%
4	Specific gravity test	2.19
5	Direct shear test	1.22 kg/cm^2
6	California bearing ratio test	2.01%
7	Unconfined compression test	0.0188 kg/cm^2

V. CONCLUSION

Based on this experimental investigation made on sandy and grouted soil was concluded as, it can be seen that grouted soil has good liquid limit, plastic limit, compaction and bearing ratio are high when compared to ordinary sandy soil. The cost of sodium silicate is low when compared to other grouting materials; it has property to rise the normal properties of soil in effective manner.

VI. REFERENCES

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