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Soil Stabilization in Kuttanad Soil using Industrial Waste Blast Furnace Slag

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***Abstract*—Kuttanad clays are silt or clay deposits found in the Kuttanad region of Alappuzha district, Kerala. It has a history of failure of pavements and foundation structures build on top of it. In this paper, stabilization of Kuttanad soil was done by using blast furnace slag, thereby improving the engineering properties of the soil. The result obtained after conducting CBR and consolidation shows that the bearing capacity and coefficient of consolidation has improved, respectively. The optimum moisture content has obtained by adding 6 percentage of slag.**

Keywords—Kuttanad soil; Stabilization; Blast furnace slag

I. INTRODUCTION

Soil stabilization is a process by which a soils physical property is transformed to provide long term permanent strength gains. Stabilization is accomplished by increasing the shear strength and the overall bearing capacity of a soil. Soil stabilization can improve in-situ, or natural state, soils eliminating the need for expensive remove-and-replace operations. Often soils that provide the structural base for roads, building pads or parking lots are chemically treated to control engineering properties of a soil, such as moisture content. Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or combination of the two. Usually, the technology provides an alternative provision structural solution to a practical problem. Soil Stabilization is the alteration of soils to enhance their physical properties.

Stabilization can increase the shear strength of a soil and control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundations. Site feasibility study for geotechnical projects is of far most beneficial before a project can take off. Site survey usually takes place before the design process begins in order to understand the characteristics of subsoil upon which the decision on location of the project can be made. The following geotechnical design criteria have to be considered during site selection:

- Design load and function of the structure.
- Type of foundation to be used.
- Bearing capacity of subsoil

II. SOIL STABILIZATION

A. Components Of Stabilization

Soil stabilization is defined as chemical or physical treatments which increase or maintain the stability of a soil or improve its engineering properties. Soil stabilization is a very common process for almost all the projects. Broadly, all types of soil stabilization can be classified into two groups, that is mechanical stabilization and chemical stabilization. In mechanical stabilization, the grading of a soil is changed by mixing it with other types of soils of different grades. By doing so, a compacted soil mass can be achieved. On the other hand, chemical stabilization is associated with the modification of soil properties by the addition of chemically active materials.

TABLE 1 COMPOSTION OF BLAST FURNACE SLAG

Items	CaO	SiO	Al_2O_3	MgO	Fe_2O_3	K_2O	TiO_2	pH
GGBS	40.13	37.73	5.75	4.26	0.01	0.61	0.65	8.5

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In soil stabilization, it is very important to understand the material properties involved in the mixture and the outcome after mixing. Moreover, it is important to find out how the material is going to perform after stabilization. At the same time the effects of the process on the nearby structures and surrounding conditions need to be evaluated. Accordingly, decisions can be taken on the selection of materials and the corresponding doses. In addition to the selection of materials and the doses there are many other factors governing the effectiveness of this method, e.g., mixing and spreading, selection of roller, compaction layer thickness, compaction effort, sequence of operation, curing, environmental and climatic conditions, etc.

B. Scope

Helps to study the chemical properties of Kuttanad soil stabilized with blast furnace, thus understanding the environmental impacts of the same.

C. Objective

To enhance the physical properties of the sample from Kuttanad. To improve the geotechnical property of low strength Kuttanad soil by mixing with blast furnace. To compare the soil strength and bearing capacity of Kuttanad soil and mixture of Kuttanad soil and blast furnace. To prevent settlement of Kuttanad soil using consolidation method.

Fig. 1 Kuttanad soil

III. METHODOLOGY

The preliminary test on blast furnace slag and Kuttanad soil was done. The preliminary test includes sieve analysis, specific gravity test, moisture content test, Atterberg's consistency test and field density.

Different percentage of blast furnace slag was mixed with Kuttanad soil as 3%, 6%, 9% and 12%. The optimum moisture content was obtained as 26% corresponding to 6% of slag. CBR test, consolidation test and triaxial tests are done on the mixture of soil sample and slag. The engineering properties of the soil are improved.

IV. TESTS ON SOIL

The soil sample is collected from Thalavady, Upper Kuttanad, for the test. The data obtained from the preliminary tests are shown in Table 2.

TABLE 2

Sl No	Preliminary Test	
	Engineering Properties	***Values***
1	Water content%	32
2	Specific gravity	2.61
3	Liquid limit %	47
4	Plastic limit %	32
5	Shrinkage limit %	12.9
6	Field density	1.688 g/cc

A. Compaction

Compaction test is performed to obtain the optimal moisture content at which the soil will become most dense. The percentage of blast furnace slag to be added to the sample soil can be identified using compaction test. A graph is plotted between dry density and water content, the optimum moisture content was obtained as 26% corresponding to 6% of blast furnace slag.

B. CBR

CBR test is conducted to evaluate the strength of the soil. The test is done with mixture of soil sample and 6% of blast furnace slag. A graph is plotted between load and penetration according to the obtained data. From the graph, CBR value without slag was obtained as 21.90% and with slag as 33.33%. This shows, the bearing capacity of Kuttanad soil has improved.

C. Consolidation

Consolidation Test is done to determine the rate and magnitude of settlement in soils. The coefficient of consolidation was obtained as 0.002 and 0.097 without slag and with slag respectively.

CONCLUSION

This study concludes that Kuttanad soil can be stabilized using waste blast furnace slag which is a byproduct from iron industry. Preliminary test of soil and slag shows the engineering properties. Compaction of soil with 3%, 6%, 9% and 12% of slag has done and optimum value is obtained as 6% of slag and optimum moisture content was 26%. In consolidation test we obtained coefficient of consolidation without slag as 0.002 and with slag as 0.097. CBR test was conducted in which CBR value without slag was obtained as 21.90% and with slag as 33.33%. This shows that the stability of the soil has improved by adding blast furnace slag.

REFERENCES

[1] Andres Seco, Sandra Espuelas, Benat Garcia (2021), "Stabilization of a clay soil using cementing material from spent refractories and ground-granulated blast furnace slag" MDPI Sustainability.
[2] Bhanu Prakash Darsi, Kumar Molugaram, Saisantosh Vamshi Harsha Madiraju (2021), "Subgrade Black Cotton Soil Stabilization Using Ground Granulated Blast Furnace Slag (GGBS) and Lime, an Inorganic Mineral" Environment science.
[3] Khaled Ibrahim Azarroug Ehwailat, Mohd Ashraf Mohamad Ismail (2021), "Novel Approach for Suppression of Ettringite Formation in Sulfate-Bearing Soil Using Blends of Nano-Magnesium Oxide, Ground Granulated Blast-Furnace Slag and Rice Husk Ash" MDPI Applied science.
[4] Regi P. Mohan (2020), "Strength characterization of Kuttanad clay soil stabilized with rice husk ash & quarry dust" Proc. Of Fourth Annual Conference Series on Engineering Education for Facing the Future.
[5] S. Durga Prasad, D V S Prasad (2018), "Soft soil stabilization using ground granulated blast furnace slag" ASCE
[6] Ruqayah Alkhafaji, Anmar Dulaimi (2017) "Soft soil stabilization using ground granulated blast furnace slag" Elsevier