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STABILIZATION OF LITHOMARGIC SOIL USING FLY ASH AND CONSTRUCTION DEMOLITION WASTE

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Abstract - *Stabilization is one of the most common methods for treating expansive soils to be suitable as a construction material. The abolition of large industrial waste as filler in the landfills near industry requires not only a large space but also causes a major problem with geographic environment. In this study we focus on the new ecological method adopted in soil modification. Investigations were carried out with stabilization of lithomorgic soil using industrial waste by product such as fly ash and demolition waste. Evaluation of unlimited compressive strength (UCS) and California Bearing Ratio (CBR) in lithological soil treated with multiple doses of this activated fly ash with alkaline and demolition waste. The results of the laboratory survey showed that the use of fly ash activated with alkaline and demolition waste in the soil can be effectively stabilized and can be used to improve the efficiency of the weak lithomorgic soil.*

Key Words: soil stabilization, Fly ash Demolition waste

1. INTRODUCTION

An ideal country like India, which has a large geographical area and population, requires a large infrastructure, namely road and buildings network. Everywhere the earth is being used for different structures, from homes to sky scrapers, bridges and highways to rural roads. Almost all civil engineering structures are located in many layers of the earth. The soil can be described as a material that contains rock particles, sand, silt and clay. This natural process has resulted in spreading or stimulation, which involves the demolition of stone caused by the expansion or perspective of temperature change. The weather and disorder of chemical changes occurs when water, oxygen and carbon dioxide gradually connect to the minerals within the rock, so they pass through the sand, silt and clay. Transportation of soil by air, water and ice shapes are available in different soil shapes, such as river deltas, sand monster and glacial reservoirs. Temperature, rainfall and drainage play an important role in the formation of dust in different environmental areas. Under different drainage rays, different soil will form the same form of rock formation.

In India, soil is classified into six groups: alluvial soil, marine soil, laterite and lateritic deposits, expansive soils, sand dunes and boulder deposits. The average area of one million square meter kilometers is covered by subsequent medieval reserves, a 3 million kilometer area covered by black cotton soil, and part of 5 million kilometer is included in the sand dunes. When looking for land with soft soil for construction, attention is made to adapt soil techniques, such as soil stability. Soil stability is the process to improve the physical properties of the earth to improve its strength, stability, etc. When mixed with additives. There are various types of methods used for soil stabilization: soil stabilization with cement, soil stabilization with lime, soil stabilization with bitumen, chemical stabilization.

1.1 LITHOMARGICAL CLAY (SHEDY SOIL)

Lithomargic soil is available in a few meters depth from the earth surface. This local name represents the shedy soil. Interestingly, above the poor layer, lateritic soil, which is relatively high strength. In present There is a very difficult problem for soil engineering activity. Its strength is high in dry conditions, when moisture conditions increase, there is a significant decrease in resistance. Showing this type of soil can be found in almost all parts of the Dakshina kannada district. Due to rapid industrialization, many industries, roads, railways and other structures are emerging. The soil profile is very inevitable in the district of Dakshina kannada. Therefore, road or railway cuttings are very common. Stability of the slopes is mainly dependent on this shedy soil profile.

2. SOIL STABILIZATION

Stabilizatin is a method of mixing and combining material to improve some of the soil properties. The process may include the blending of soils to achieve a desired gradation or mixing of additives that may alter the gradation, texture or plasticity, or act as a binder for cementation of the soil.

2.1 Principles of Soil Stabilization

Various soil stabilization includes:

- Densification of soil by decreasing the air voids.
- Increasing the compaction using well graded soil mass.
- Designing the soil mix for intended stability and durability values.
- Reducing the adsorbed water layer of clay particle to achieve maximum compaction. The process of soil stabilization is useful in the following applications
- Reducing the permeability of soils.
- Increasing the bearing capacity of foundation soils.
- Increasing the shear strength of soils.
- Improving the durability and life span of the structures under adverse moisture and stress conditions.
- Improving the natural ground for the construction of highways and airfields.
- Controlling the grading of soils and aggregates in the construction of bases sub-base courses.

2.2 The Needs and Benefits of Soil Stabilization

Soil properties has a very great deal in construction of structures wich depends a lot on the bearing capacity of the soil, hence, we need to stabilize the soil to improve the load bearing capacity. The gradation of the soil is also a very important property to keep in mind while working with soils. The soils may be well-graded which is desirable as it has less number of voids or uniformly graded which though sounds stable but has more voids.

2.3 The Advantages Of Soil Stabilization

- If during the construction phase weak soil strata are encountered, the usual practice followed is replacing the weak soil with some other good quality soil. With the application of soil stabilization technique, the properties of the locally available soil (soil available at the site) can be enhanced and can be used effectively as the subgrade material without replacing it.
- The cost of preparing the subgrade by replacing the weak soil with a good quality soil
  is higher than that of preparing the subgrade by stabilizing the locally available soil using different stabilization techniques.
- The strength giving parameters of the soil can be effectively increased to a required amount by stabilization.
- It improves the strength of the soil, thus, increasing the soil bearing capacity.
- It is more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation.
- It is also used to provide more stability to the soil in slopes or other such places.
- Sometimes soil stabilization is also used to prevent soil erosion or formation of dust, which is very useful especially in dry and arid weather.
- Stabilization is also done for soil water-proofing; this prevents water from entering into the soil and hence helps the soil from losing its strength.
- It helps in reducing the soil volume change due to change in temperature or moisture content.

3 PROBLEM DEFINITION:

Soil has air voids, and is less stable and durable compare to other soil. It is permeable, and has less bearing capacity etc. In order to overcome all these problems of soil we are using alkali activated fly ash and demolition waste to increase its characteristics like strength and thereby stability, durability and other characteristics to some extent and making less susceptible to permeability

3.1 Lithomargic soil

Lithomargic soil was taken to a depth of 1-1.50m below the natural ground level near national highway 66, Bhatkal, Karnataka, India. The soil was air dried for 6 days, pulverized and sieved through 425 microns manually before being used for experimental research.

3.2 UPCL Fly Ash

UPCL fly ash was purchased from Udupi Power Corporation Plant Limited, Nandikur Udupi.

3.3 C & D waste used

Construction and demolition concrete waste was collected at various construction and demolition locations in Mangaluru. Construction and demolition concrete waste materials were selected for this study. The collected waste was then crushed with the help of a jaw crusher. The size of the used aggregate varies up to 20 mm. The aggregates were of good quality.

4. SCOPE OF THE STUDY

- Study the basic Engineering properties of Lithomargic soil (Shady Soil).
- To study the behaviour of Shady soil stabilized with using alkali activated fly ash and demolition waste
- Laboratory investigation of shear strength by conducting unconfined compressive strength

(UCS) test the Lithomargic soil treated with different dosages of activated fly ash and demolition waste.

5. METHODOLOGY

- Sieve Analysis.
- Liquid Limit Test.
- Plastic Limit Test.
- Shrinkage Limit Test.
- Compaction Test.
- Unconfined Compression Test.
- California Bearing Ratio (CBR).

6 GEOTECHNICAL PROPERTIES OF LITHOMARGIC SOIL.

Table 6.1: Basic geotechnical properties of lithomorgic soil.

Parameter	Result
Gravel (%)	25
Sand (%)	75
Silt and clay (%)	0
Coefficient of Uniformity (Cu)	6.11
Coefficient of Curvature (Cc)	1.16
Type of soil	Sandy soil (Cu>6 and Cc=1 to 3)
Grade	Well Graded (S shaped curve)
Specific gravity	2.48
OMC (%)	16.0
Dry density(g/cc)	1.84
CBR (%)	3.2
UCC(kg/cm2)	1.17
Liquid limit	49
Plastic limit	18.76

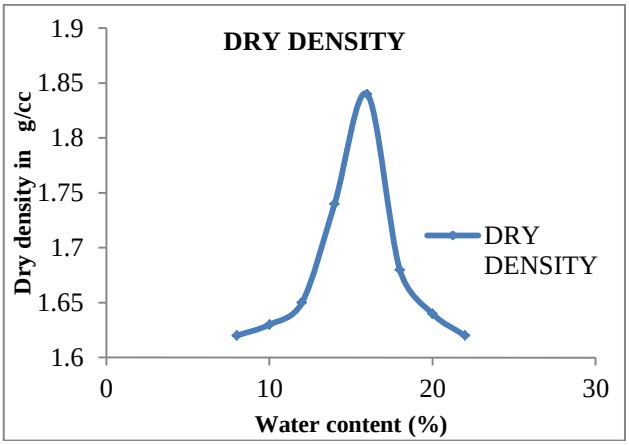

Fig.6.1: Dry density of lithomorgic soil

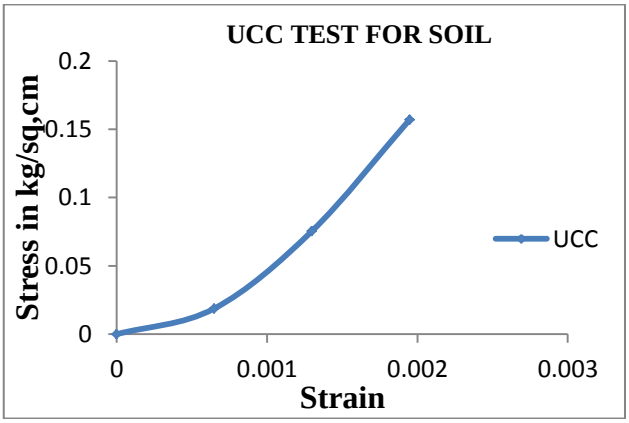

Fig.6.2:UCC Test for lithomorgic soil

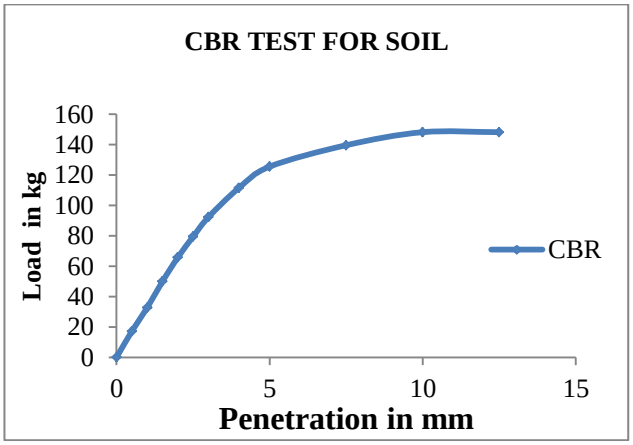

Fig.6.3: CBR Test for Lithomargic soil

The soil is stabilized by mixing with different percentage of fly ash and then it was tested to get various geotechnical properties. The results on various proportions are produced in the Table 5.2 to Table 5.5. Various geo technical properties like compaction characteristics, shear strength characteristics, shear strength characteristics, CBR etc. are tabulated.

Table 6.2: Basic geotechnical properties of lithomargic soil blended with 30% fly ash (OPT)

Parameter	Result
OMC (%)	18.75
Dry Density(g/cc)	1.73
UCC(kg/cm2)	1.60
CBR (%) (Unsoaked)	3.92

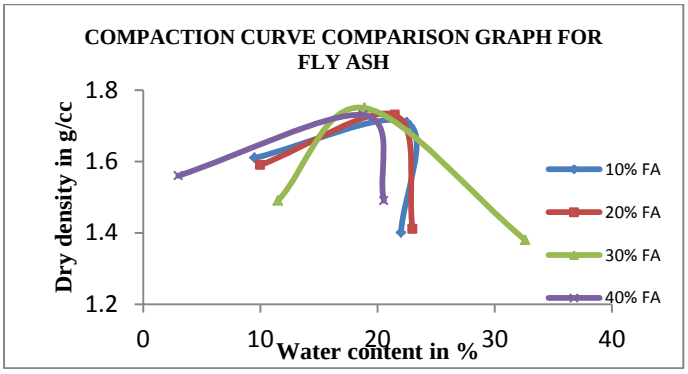

Fig.6.4: Compaction curve comparison graph for fly ash

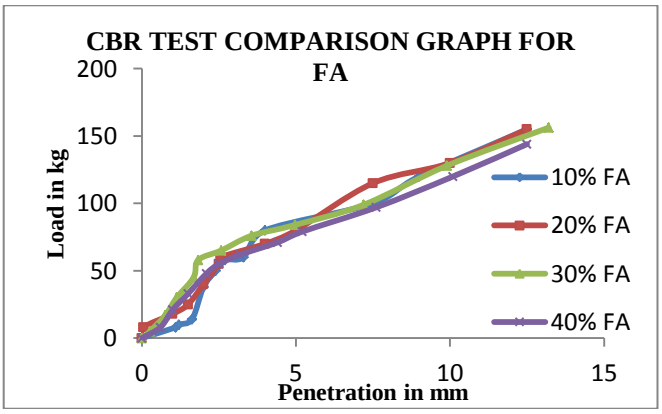

Fig.6.5: CBR Test Comparison Graph For Fly Ash

7. OBSERVATIONS FOR STABILISED SOIL USING FLY ASH AND DEMOLITION WASTE

The soil is stabilized by mixing with optimum percentage of fly ash and varying demolition waste and then it was tested to get various geotechnical properties. The results are produced in the Table 5.6 to Table 5.9. Various geo technical properties like compaction characteristics, shear strength characteristics, shear strength characteristics, CBR etc. are tabulated.

Table 7.1 Basic geotechnical properties of lithomargic soil blended with 30% fly ash (OPT) and 10% demolition waste.

Parameter	Result
OMC (%)	16.8
Dry Density(g/cc)	1.66
UCC(kg/cm2)	2.24
CBR (%) (Unsoaked)	2.72

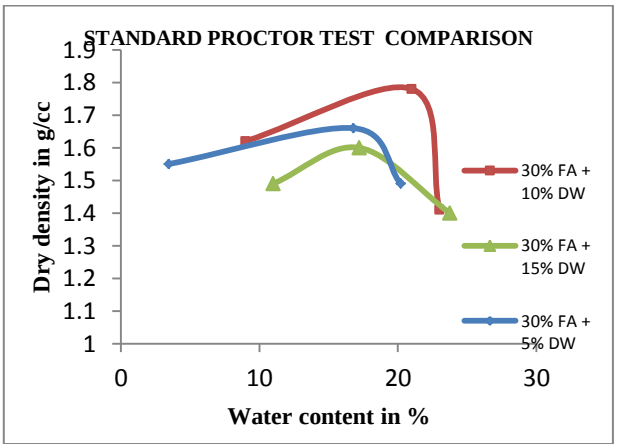

Fig.6.6: Standard Proctor Test Comparison

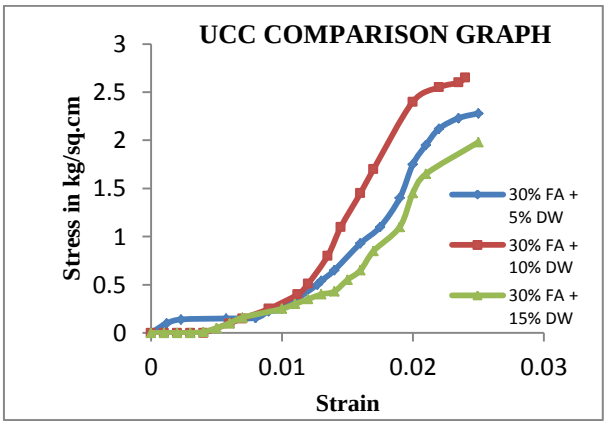

Fig 6.7: UCC Comparison Graph

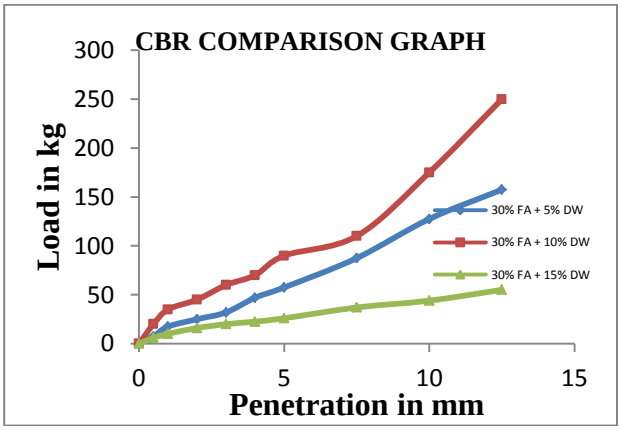

Fig 6.8: CBR Comparison Graph

CONCLUSION

From this study we concluded that, The shady soils are locally available soil in Dakshina Kannada district. Lithomargic soil or shady soil is a name given to the locally available whitish, pinkish or yellowish silty sand. Shady soils are also known as lithomargic clay. Strength of the soil reduces when it comes in contact with the water and they are very sensitive to water. Hence to use the soil is construction it is very important to stabilize it. In our project stabilization is carried out by replacement of fly ash with demolition waste. The soil for the study was collected from Haleyangadi near Surathkal of Dakshina Kannada district in India. The basic geotechnical properties of soil are obtained. Later part of the work was continued by stabilization were the soil is mixed with different percentage of fly ash and demolition waste. Effects of stabilization of various properties of soil for different percentage of additives were studied.

The following are the important conclusion drawn from the investigation:

- It was studied that compressive properties of demolition waste and binding nature of fly ash helps in improving the strength of the soil.
- By conducting various geotechnical properties on the soil blended with fly ash and demolition waste, it was found that strength of the soil with 30% of fly ash and 10% of demolition waste will give maximum compressive strength (which is about 45% more than lithomargic soil) and CBR properties (about 75.29.% more than lithomargic soil)
- This can be used for stabilizing lithomargic soil of embankment, pavement subgrade, and other different field as per the needs and flexibility.

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