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STABILIZATION OF RED SOIL USING GLASS FIBER AND QUARRY DUST

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Abstract - Red soil covers a large portion of land in India. This soil is found in areas with low rainfall and is not capable of retaining moisture. Red soil possesses lower strength compared to other soils due to its porous and friable structure. To improve the engineering and strength properties of this red soil, soil stabilization can be carried out by adding some admixtures to this soil. Soil stabilization is one of the promising techniques used to improve the geotechnical properties of soil and has become major practice in construction engineering. This project aims to conduct a study to check the improvements in properties of red soil by adding glass fiber and quarry dust. By varying percentages of quarry dust and glass fiber, the soil parameters, such as grain size, compaction, shear strength, liquid limit, plastic limit, maximum dry density and free swell index may be studied.

Key words: Soil stabilization, admixtures, quarry dust, glass fiber.

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, work with soils, proper knowledge about their properties and factors which affect their behavior is necessary. Soil stability is one of the most important topics in geotechnical engineering practices. With frequent failures of soil mass, whether it is on a slope or level ground, have proved to be costly in terms of both life and property. Soil stabilization is generally the modification of the soil properties to improve the behaviour of the soil. The main purpose of the soil stabilization is to improve the bearing capacity of the soil. Here, in this study, soil stabilization has been done with the help of glass fiber and quarry dust obtained as waste material. The improvement in the shear strength parameters has been stressed upon and comparative studies have been carried out using different methods. Here Glass fiber and Quarry dust are used as admixtures. Quarry dust is added to the soil sample at the following percentages (10%, 20%, 30%, 40% & 50%) and glass fiber is added to the soil sample at the following percentages (0.25%, 0.50%, 0.75%, 1.00% & 1.25%) in the length of 10mm.

2. LITERATURE SURVEY

[1] A study was conducted by **Gbenga Matthew Ayininuola (2018)** revealed that addition of glass fiber into the two lateritic soils led to increase in soil California bearing ratio and maximum dry density.

[2] **Samer Rabab'ah (2020)** The data and results obtained in this research work show that the addition of glass fiber to expansive soils has a considerable effect on their UCS (Unconfined Compressive Strength), indirect tensile strength, and free swell. This increase in the strength of the soil and the reduction in the swelling tendency was proportionally dependent on the percent of used fiber. By improving the strength and stiffness of subgrade soil, the use of glass fiber in expansive subgrade reinforcement can result in a significant reduction in the design thickness of pavement.

[3] **M. Sai Nandan, K. Venkata Sai, P. Rakesh, N. Sandeep Kumar, K. Shyam Chamberlin, 2020:** The focus of this report is to study the feasibility of stabilizing the soil by using rice husk ash and coconut coir fibre, thus re-using the waste materials and providing an economical and eco-friendly method of soil stabilization. Soil stabilization is a system to treat the soil to improve the performance of the soil. The capacity, rice husk ash as stabilizing additive to expansive soil is evaluated for the enhancing engineering properties of expansive soil. The Assessment includes the dedication of the swelling capacity, plastic limit, liquid limit, plasticity index, cohesion & compaction characteristics of the expansive soil. For the soil which lacks enough stability, various stabilization techniques can be adopted. Various percentage of rice husk ash and coconut coir fiber (5% to 25%). the practices were executed on 5 proportions 5% ,10%,15%, 20% and 25% with the sample. The optimum value of the assessment is found at the proportion of 15% in table 3i.e.the value of unconfined compressive strength is 142kN/m2. The adding of RHA and coconut coir fibre increases soil strength and we got optimum value at 15%. Keep on increasing the percentage of RHA, after 15% the strength of soil decreases.

3. OBJECTIVES OF THE PRESENT STUDY

- To study the stabilization of red soil by using ad-mixtures like glass fiber and quarry dust.
- To determine the optimum use of these stabilizing materials and give us the result of increasing the shear stresses, bearing capacity and other strength properties.
- Comparing the properties of soil with and without the use of quarry dust and glass fiber.

4. MATERIALS REQUIRED

The materials used for conducting the experiments in the present study are shown below

4.1 Red soil

The red soil required for the experiments is collected from local ground of Lingayas Institute of Management and Technology. The following figure shows red soil.

Fig-1: Red soil

4.2 Glass fiber

Glass is a non-metallic fiber, widely used as industrial material. It is material made from extremely fine fibers of glass. Glass fiber for this study was collected from a store at Auto Nagar, Vijayawada, Krishna district. The following figure shows Glass fiber.

Fig-2: Glass fiber

4.3 Quarry dust

It is a byproduct of the crushing process which is a concentrated material used as aggregates for concreting purpose, especially as fine aggregates. Quarry dust for this study was collected from Vijayawada, Krishna district of Andhra Pradesh. The following figure shows Quarry dust material.

Fig-3: Quarry dust

5. METHODOLOGY

The experimental investigation has been carried out on the red soil sample to study the strength properties as a result of adding Glass fiber and Quarry dust in various percentages namely 0.25%, 0.5%, 0.75%, 1%, 1.25% and 10%, 20%, 30%, 40%, 50% respectively. Tests like sieve analysis, liquid limit, plastic limit, compaction, and free swell index were conducted on soil sample with and without adding admixtures.

6. RESULTS

6.1 SIEVE ANALYSIS

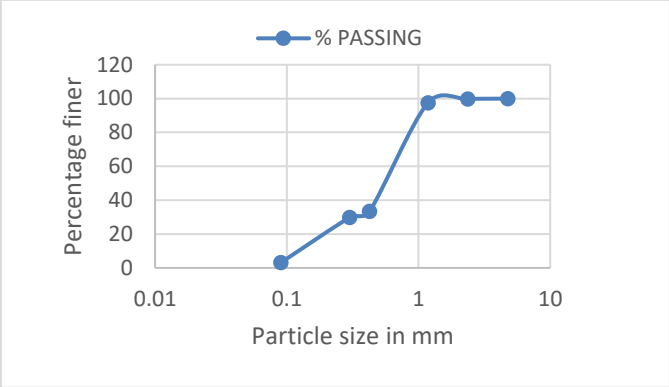

Fig-4: Particle size distribution using sieve analysis for red soil

6.2 LIQUID LIMIT TEST

Table-1: Liquid limit test results for red soil

Sample	Liquid limit
Red soil	23.76%
Red soil+0.25% Glass fiber+10% Quarry dust	26.85%
Red soil+0.5% Glass fiber+20% Quarry dust	12.79%
Red soil+0.75% Glass fiber+30% Quarry dust	24.52%
Red soil+1% Glass fiber+40% Quarry dust	29.39%
Red soil+1.25% Glass fiber+50% Quarry dust	29.70%

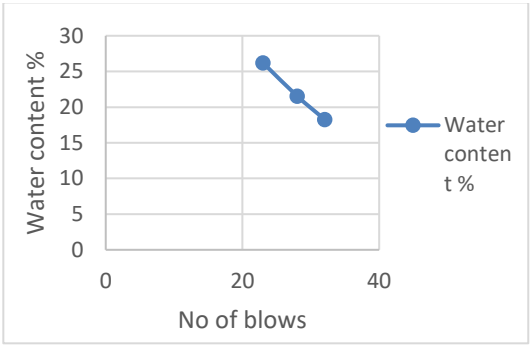

Fig-5: Liquid limit curve for red soil

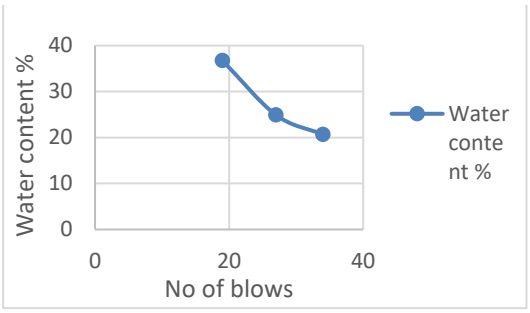

Fig-6: Liquid limit curve for red soil with 0.25% glass fiber and 10% quarry dust

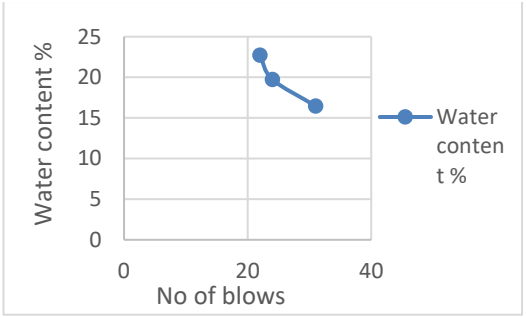

Fig-7: Liquid limit curve for red soil with 0.5% glass fiber and 20% quarry dust

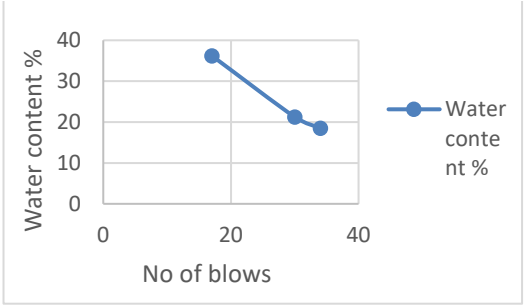

Fig-8: Liquid limit curve for red soil with 0.75% glass fiber and 30% quarry dust

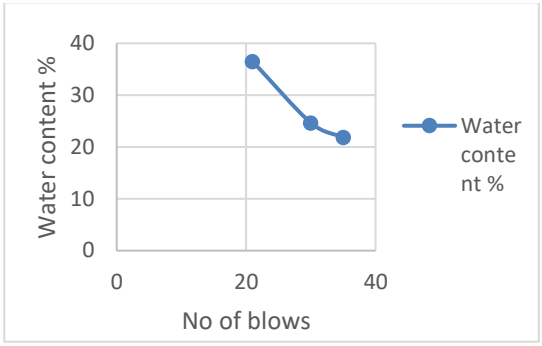

Fig-9: Liquid limit curve for red soil with 1% glass fiber and 40% quarry dust

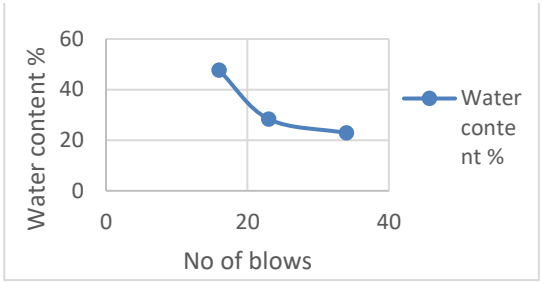

Fig-10: Liquid limit curve for red soil with 1.25% glass fiber and 50% quarry dust

6.3 PLASTIC LIMIT TEST RESULTS

Table-2: Plastic limit test results for red soil

Percentage of admixtures	Water content %
0%	16.02
0.25%/10%	50.8
0.5%/20%	20.8
0.75%/30%	14.68
1%/40%	15.5
1.25%/50%	16.02

6.4 COMPACTION TEST RESULTS

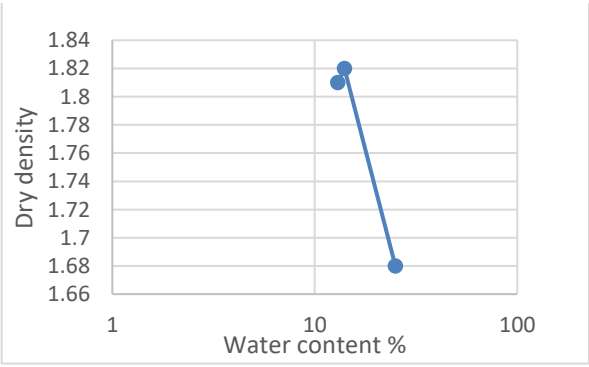

Fig-11: Compaction curve for red soil

Table-3: Compaction test results for red soil

Percentage	MDD (g/cm^3)	OMC (%)
0	1.77	18
0.25%/10%	1.66	30
0.5%/20%	1.56	25
0.75%/30%	1.75	19
1%/40%	1.94	14
1.25%/50%	2.03	15

6.5 FREE SWELL INDEX

Table-4: Free swell index of red soil

Percentage	Swell index %
0	42.8
0.25%/10%	50
0.5%/20%	28.5
0.75%/30%	33.3
1%/40%	14.2
1.25%/50%	20

7 CONCLUSION

From the results obtained, the following were observed

- The liquid limit value of the soil is increasing with the increase of quarry dust and glass fiber proportions to the soil.
- We got the maximum plastic limit value of the soil at 0.25%/10% of glass fiber and quarry dust respectively and it decreased for further proportions.
- We got the maximum dry density of soil at 1.25%/50% and optimum moisture content 0.25%/10%.
- The value of free swell index increased first and then decreased with the addition of quarry dust and glass fiber.

Finally in this study we concluded that addition of quarry dust and glass fiber has increased the values of the properties like Optimum Moisture Content, Dry Density, Liquid limit, Plastic limit, and Free swell index.

8 FUTURE SCOPE

Improving properties of soil become a matter of paramount importance today. Here an effort has been made to study the effect of glass fiber and quarry dust. In this study I have limited my work to maximum of 1.25% glass fiber and 50% quarry dust. Research can be done on soil stabilization with more than 1.25% glass fiber.

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