To Enhance the Engineering Properties of Soil by Lime and Fly-Ash for the Structures Foundation

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Abstract- *Soil stabilization is a technique aimed at increasing or maintaining the stability of soil mass and chemical alteration of soils to enhance their engineering properties. Stabilization can be used to treat a wide range of sub-grade materials from expansive clays to granular materials. The durable performance of any construction depends on the soundness of the underlying soils. Unstable or lose soils can create significant problems for pavements or structures. So, soil stabilization techniques are necessary to ensure the better stability of soil that it can successfully sustain the load of the structure, without cutting and replacing of the unstable soil. Conducted laboratory tests to study the shear strength and permeability of sandy soils stabilized with lime and fly ash. Lime and fly ash were added to the soil at ranges 0-5% and 10-30%, respectively. Many Researchers gives out lot of tests have been carried out in order to evaluate the improvement in the properties of soil relevant to building construction obtained when sub-grade soils are stabilized with lime or fly ash. The main objectives of the paper deals with the complete analysis of the improvement of soil properties and its stabilization using lime and fly ash, as increase the shear strength and permeability of the soil.*

Keywords: Lime, Fly Ash, Stabilization, Compaction, Shear Strength

I. INTRODUCTION

Improving an onsite soil's engineering properties is called soil stabilization. Soil stabilization can be explained as the alteration of the soil properties by chemical or physical means in order to enhance the engineering quality of the soil [1]. Soils are highly problematic material of construction because of the susceptibility of soil to undergo large changes in volume due to fluctuations in the moisture content [2]. Soils containing significant levels of silt or clay, have changing geotechnical characteristics in different seasons: In monsoon seasons, they swell and become soft and capacity to bear water is reduced. In drier seasons, shrink when dry or reduce in volume due to evaporation of water and they become harder, and expand when exposed to frost. Site traffic is always a delicate and difficult issue when projects are carried out on such soils. In other words, the re-use of these materials is often difficult, if not impossible [1]. The annual cost of damage to civil engineering structures is estimated as many billions of dollars worldwide [3].Various innovative techniques such as special foundations that include belled piers, drilled piers, friction piers, and moisture barriers have been developed to mitigate the problems posed by soil [4]. But these techniques are highly costly and time taken. Apart from these techniques, stabilization of soil with various additives including fly ash, cement, lime, bagasse ash, wood ash and calcium chloride has also met with considerable. Here, the experiment of soil is done on the combination of fly ash and lime. Lime has been used for several decades as stabilizing agents in deep stabilization of soft soil and it is used to improve the strength parameters (cohesion, angle of internal friction) [5]. Use of lime significantly changes the characteristics of a soil to produce long-term permanent strength and stability, particularly with respect to the action of water and frost [1]. Once the soil has been treated with lime and fly ash, it can be used to create embankments or sub-grade of structures, thus avoiding expensive excavation works and transport. Fly ash is the material extracted from flue gases of a furnace fired with coal. It is non-plastic fine silt. Its composition varies according to the nature of coal burned [6]. There is a lot of fly ash produces in the industries. The quantity of fly ash generated per year worldwide was expected to exceed 100 million tons by the year 2000 [7].

II. BENEFITS OF USING LIME AND FLY ASH MIX IN SOIL STABILIZATION

- Improved resistance to frost,
- Improvement of bearing capacity,
- A reduction in the plasticity index,
- Increase in the soil's compressive strength,
- An improvement in the compaction properties of the soil.

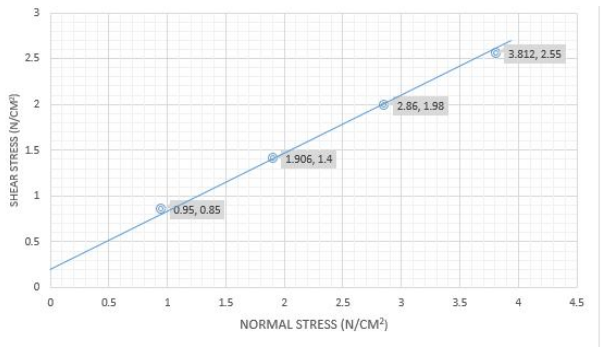
III. METHODOLOGY

The study of soil is particularly relevant to Gomti River Bank Lucknow (U.P) as it is reported through test, that the soil has low shear strength. In the study it has been planned to mix the Fly Ash and Lime at certain amount replacing the normal soil by weight and study the changes in engineering properties of soil. Five soil samples is to becollected from five locations within, Gomti river

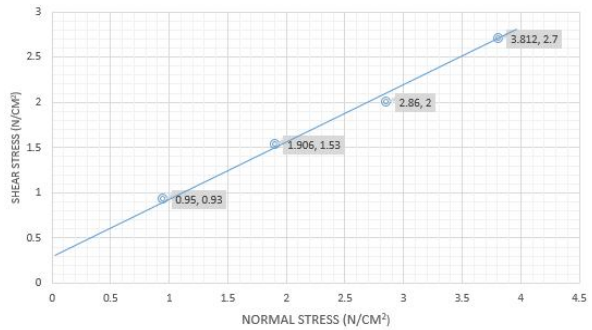
bankLucknow. Fetching of sample is at different depth at each sampling point. The locations is to be selected as case-studies to establish the basic effect that Lime and Fly Ash would have on the properties of soil. At each of the five sites, a burrow pit is dug to collect soil samples. The soil samples is to be air-dried and stockpiled in separate sacks. The sacks were labeled A, B, C, D, E. In order to classify the soils using USCS (unified soil classification system) soil samples grain sizes is to be analyzed and atterberg limit is to be measured in accordance with BS 1377(1998). It has been planned to mix the Lime and Fly ash at certain amount replacing the normal soil by weight and study the changes in engineering properties of soil .Lime and Fly ash is mixed in a different proportion Lime (1%, 2%, 3%, 4%, 5%) Fly ash (10%, 15%, 20%, 25%, 30%) and then take the samples, index and as well as engineering properties will be observed. For the purpose of determining the shear strength of the soil required for geotechnical design and assessing the behavior of soil properties as affected by lime and fly ash. The following laboratory tests is to be conducted on the samples particle size analysis, Atterberg limits test, compaction test Permeability test and Direct shear test.

IV. DIRECT SHEAR TEST

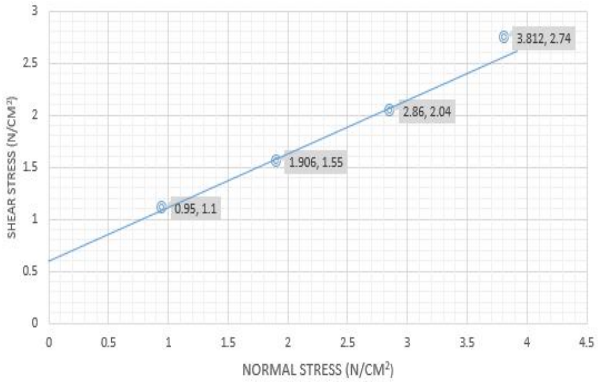
Standard Direct shear **(IS-2720-PART-13-1986)** is simple and mostly recommended for sandy soils, sometimes on soils containing some cohesive soil content.



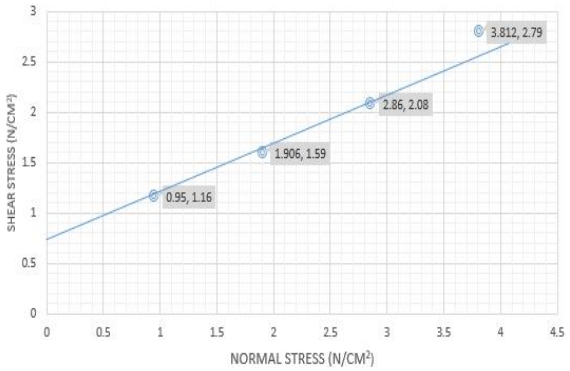
Graph 1: Without Treatment



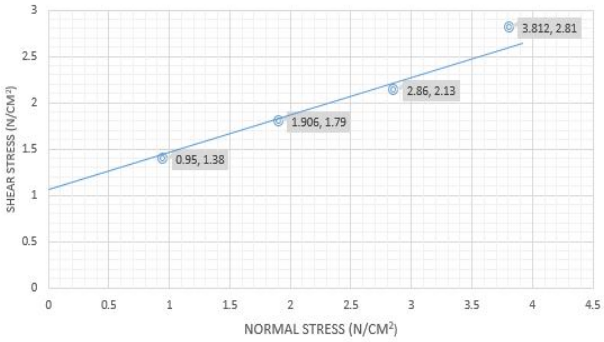
Graph 2: 1% Lime and 10% Fly Ash



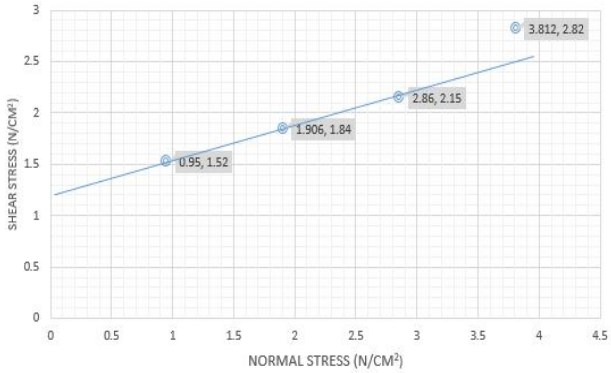
Graph 3: 2% Lime and 15% Fly Ash



Graph 4: 3% Lime and 20% Fly Ash



Graph 5: 4% Lime and 25% Fly Ash



Graph 6: 5% Lime and 30% Fly Ash

Table 1: Different Percentages of Lime and Fly Ash Mixed

Lime %	Fly ash %	Cohesion of soil (c) N/cm^2	Angle of shearing resistance (ϕ)
1	10	0.3642	23
2	15	0.59	22
3	20	0.750	19
4	25	1.1	18.5
5	30	1.19	16.5

V. PERMEABILITY TEST

The permeability test is a measure of the rate of the flow of water through soil. Falling Head Permeability Test is performed on sands as the pore openings are large and hence high permeability (k $>10^{-3}$ cm/s). Concluded after test, by mixing of lime and fly ash, the permeability of soil is reduces. The permeability of normal soil (without treatment), 1.12x 10^{-3} cm/s.

Table 2: Different Percentages of Lime and Fly Ash Mixed

Lime %	Fly Ash %	Permeability (cm/s)
1	10	1.031 x 10^{-3}
2	15	0.912 x 10^{-3}
3	20	0.735 x 10^{-3}
4	25	0.565 x 10^{-3}
5	30	0.351 x 10^{-3}

VI. CONCLUSION

There is a positive effect of different percentages of additives on the resilient properties of sandy soil. An extensive laboratory testing program was carried out to investigate the influence of using lime-fly ash admixtures on the characteristics of sandy soil. The observations and conclusions can be summarized as follows:

- Addition of lime significantly improved consistency, strength properties of the soil. However, the presence of fly ash fundamental to further improves the soil behavior. Moreover it is always encouraged to use fly ash for stabilization where easily and economically available.
- The results show that lime and fly ash played an important role in improving the shear strength characteristics and reduces permeability of sandy soil.
- Based on the tests results, it can be stated that, as the different percentage of lime-fly ash increases the shear strength and the optimum lime-fly ash content at 5% lime with 30% fly ash.
- Based on the tests results, it can be stated that, as the different percentage of lime-fly ash decreases the permeability and gives the best result on the mix of lime-fly ash content at 5% lime with 30% fly ash.

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