STABILIZING THE CLAY SOIL USING FLYASH, LIME WITH COIR ASH AS ADMIXTURES

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Abstract: Soil is Basic Foundation for any Civil Engineering Structures and Soil Stabilizing can be defined as the modification of soil property Chemical or Physical Means in order to enhance the Engineering quality of soil the property of these clay soil in general is that they very hard when in dry state but they lose all of their strength when in wet state, In light of this property of clay soil these soil pose problem worldwide that serve as challenge to overcome for geotechnical engineers. One of the most important aspects for construction purposes is soil stabilization, which is used widely in foundation and road pavement constructions; this is because such a stabilization regime improves engineering properties of the soil, such as volume stability, strength and durability. In this process, removal or replacing of the problematic soil is done; replacement is done by a better quality material, or the soil is treated with an additive. In the present study using of Fly ash is obtained from Geotechnical Laboratory at NIT Trichy, Clay soil obtained from sindhulipu village in Coimbatore District, Lime is obtained from rasakaplayam lime plant in pollachi and coir fiber is obtained as locally available cheap, eco-friendly Natural material, which can be burned into ash. Hence the cost of stabilization may be economical by replacing good proportion of stabilizing agent using Fly ash, lime and Coir ash, where the result are compared for the two samples likely F.A+ Lime + Soil and F.A+ Lime + C.A + Soil and are observation are made by replacing different proportion to change Maximum Dry Density (MDD) Optimum moisture content (OMC), Unconfined compressive strength (UCS) and unsoaked California Bearing Ratio (CBR) are values Concluded that for various works in civil engineering such as Sub grade for road construction and foundations etc.,

KEY WORDS: Fly Ash, Lime, Coir Ash, Stabilized, Proctor, UCC and CBR

I 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, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve the required properties in a soil needed for the construction work. From the beginning of construction work, the necessity of enhancing soil properties has come to the light. Ancient civilizations of the Chinese, Romans and Incas utilized various methods to improve soil strength etc., some of these methods were so effective that their buildings and roads still exist. In India, the modern era of soil stabilization began in early 1970's, with a general shortage of petroleum and aggregates, it became necessary for the engineers to look at means to improve soil other than replacing the poor soil at the building site. Soil stabilization was used but due to the use of obsolete methods and also due to the absence of proper technique, soil stabilization lost favor. In recent times, with the increase in the demand for infrastructure, raw materials and fuel, soil stabilization has started to take a new shape. With the availability of better research, materials and equipment, it is emerging as a popular and cost-effective method for soil improvement. Here, in this project, soil stabilization has been done with the help of randomly distributed Fly ash is obtained from Geotechnical Laboratory at NIT Trichy shown in Fig 1, Clay soil obtained from sindhulipu village in Coimbatore District shown in Fig 2, Lime is obtained from rasakaplayam lime plant in pollachi shown Fig 3 and coir fiber is obtained as locally available cheap shown Fig 4, eco-friendly Natural material, as which can be burned into ash shown in Fig 5. The improvement and comparative studies have been carried out testing between F.A+L+SOIL and F.A+L+C.A+SOIL replacing in different ratio.


Fig 1.Fly Ash


Fig 2.Clay soil From Site


Fig 3.Lime


Fig 4. Coir


Fig 5. Burnt Coir Ash

II MATERIAL PROPERTIES

2.1 FLY ASH

Fly Ash is also known as Coal Ash, Pulverized Flue Ash, and Pozzolona. Fly ash closely resembles volcanic ashes used in production of the earliest known hydraulic cements about 2,300 years ago. Those cements were made near the small Italian town of Pozzuoli – which later gave its name to the term "pozzolana." A pozzolana is a siliceous or siliceous aluminous material that, when mixed with lime and water, forms a cementatious compound. Fly ash is the best known, and one of the most commonly used, pozzolona in the world. Instead of volcanoes, today's fly ash comes primarily from coal-fired electricity generating power plants. These power plants grind coal to powder fineness before it is burned. Fly ash - the mineral residue produced by burning coal - is captured from the power plant's exhaust gases and collected for use. Fly ash is a fine, glass powder recovered from the gases of burning coal during the production of electricity. These micron-sized earth elements consist primarily of silica, alumina and iron. The difference between fly ash and Portland cement becomes apparent under a microscope. Fly ash particles are almost totally spherical in shape, allowing them to flow and blend freely in mixtures. That capability is one of the properties making fly ash a desirable admixture for concrete. The Properties of fly ash is been tabulated in given below Table 1.

Table 1. Geotechnical Property of Fly Ash

Properties	Range
Colour	Grey
Specific Gravity	1.95 – 2.55
Plasticity	Non – plastic
O.M.C (%)	38.0 – 18.0
M.D.D (gm/cc)	0.9 – 1.6

2.2 LIME

Lime has been found to react successfully with medium, moderately fine and fine grained soils causing a decrease in plasticity and swell potential of expansive soils, and an increase in their workability and strength properties (Bulbul, 2013). The effect of lime on soil can be categorized into two groups; immediate and long-term stabilization. Increased workability of soil is the result of immediate improvement which is the main Contributor in early construction stages. Increased strength and durability is considered long-term stabilization that takes place during and after curing. Lime in the form of quicklime (calcium oxide-Ca O), hydrated lime (calcium hydroxide-Ca (OH_2), or lime slurry can be used to treat soils. Quicklime is manufactured by chemically transforming calcium carbonate (limestone-CaCO3) into calcium oxide. Hydrated lime is created when quicklime chemically reacts with water. When hydrated lime reacts with clay particles permanently transforms clay into a strong cementatious matrix. (American Road Builders Association, 2004) and their property lime as given below table 2.

Table 2. Chemical Composition of Lime

Chemical Parameters	Composition Value
Calcium Oxide	90.80
Silica	3.50
Alumina	1.32
Iron Oxide	1.57
Magnesia	1.20 – 0.67

2.3 COIR ASH

Coconut coir is a natural Fiber extracted from the husk of coconut. It is the fibrous material found between the hard, internal shell and outer coat of a coconut. The main advantage of using coconut coir ash in improving the strength of soil sub grade is they are cheap, locally available and eco-friendly. In this study the coconut coir is extracted mainly from green nut. Coir or coconut Fiber belongs to the group of hard structural Fibers. The inclusion of Fibers had a significant influence on the engineering behavior of soil-coir mixtures. Addition of coir ash resulted in decrease in plasticity and increase in hydraulic conductivity. Addition of coir ash in soil improves the overall engineering performance of soil and the properties of coir ash is given below table 3.

Table 3 Geotechnical Property of Coir Ash

Constituents	Percentage Composition
Sio_2	13.78
Al_2o_3	36.24
Fe_2o_3	0.15
Cao	33.37
Mgo	20.06
So_3	0.007
Mno	0.13
K_2o	0.73
P_2o_5	0.021
Na_2o	0.38
LOI	2.14

III RESULT AND DISCUSSION

3.1 MOISTURE CONTENT OF SOIL TEST

Moisture Content is most accurate method of determining the water content,& therefore, used in the Laboratory, the above test is done as per (IS : 2720 Part ii-1973) [refined 2006]The object of this test is to determine the water content of soil sample in the laboratory by oven – drying method and the result is 12.48.

3.2 SPECIFIC GRAVITY OF SOIL TEST

The object of the Specific Gravity test is to be determine the specific gravity of soil fraction passing 4.75 mm sieve by density bottle the average is taken as specific gravity of soil, the above test is done as per (IS : 2720 Part iii-1980) [refined 2006] and the specific gravity of the sample is 2.302.

3.3 PARTICLE SIZE DISTRIBUTION:

The object of this experiment is to determine is to be grain size distribution of coarse grained soil by sieving the test covers both sieve analysis (for gravel fraction) as well as fine sieve analysis (for sand fraction).The test observation and result are recorded as illustrated

3.4 ATTERBERG'SLIMIT

3.4.1 LIQUID LIMIT:

It is the water content of the soil between the liquid state and plastic state of the soil. It can be defined as the minimum water content at which the soil, though in liquid state, shows small shearing strength against flowing. It is measured by the Casagrande apparatus and is denoted by *wL* and result of soil is listed in table 4.

3.4.2 PLASTIC LIMIT:

This limit lies between the plastic and semi-solid state of the soil. It is determined by rolling out a thread of the soil on a flat surface which is non-porous. It is the minimum water content at which the soil just begins to crumble while rolling into a thread of approximately 3mm diameter. Plastic limit is denoted by *wP*. Result of soil is listed in table.4.

Table 4 Liquid limit, Plasticity& IS Classification Soil Test Result

S.NO	DESCRIPTION	RESULT	REMARK
1	Liquid Limit	38.5	-
2	Plastic Limit	20	-
3	Plasticity Index	13.505	Low plasticity
4	Consistency index	1.96	-
5	IS classification	CL.ML	Inorganic low plasticity

3.4 Proctor Compaction Test

The Optimum Water Content (OMC) and Maximum Dry Density (MDD) is obtained by conducting Proctor's Test as per IS: 2720 (Part 7) – 1980. The relation Between Moisture content and dry density is obtained from compaction test. The optimum moisture content and maximum dry density obtained from compaction test on soil are resulted and Modified Proctor Compaction Test Result obtained in the optimum value in 6% of fly ash and 2% lime as constant where added with clay soil the result in Chart given below and The Test Result obtained in the optimum value in 3% Coir ash, 3% of fly ash and 2% lime as constant where added with clay soil the result in Fig 6, 7 and 8 given below.

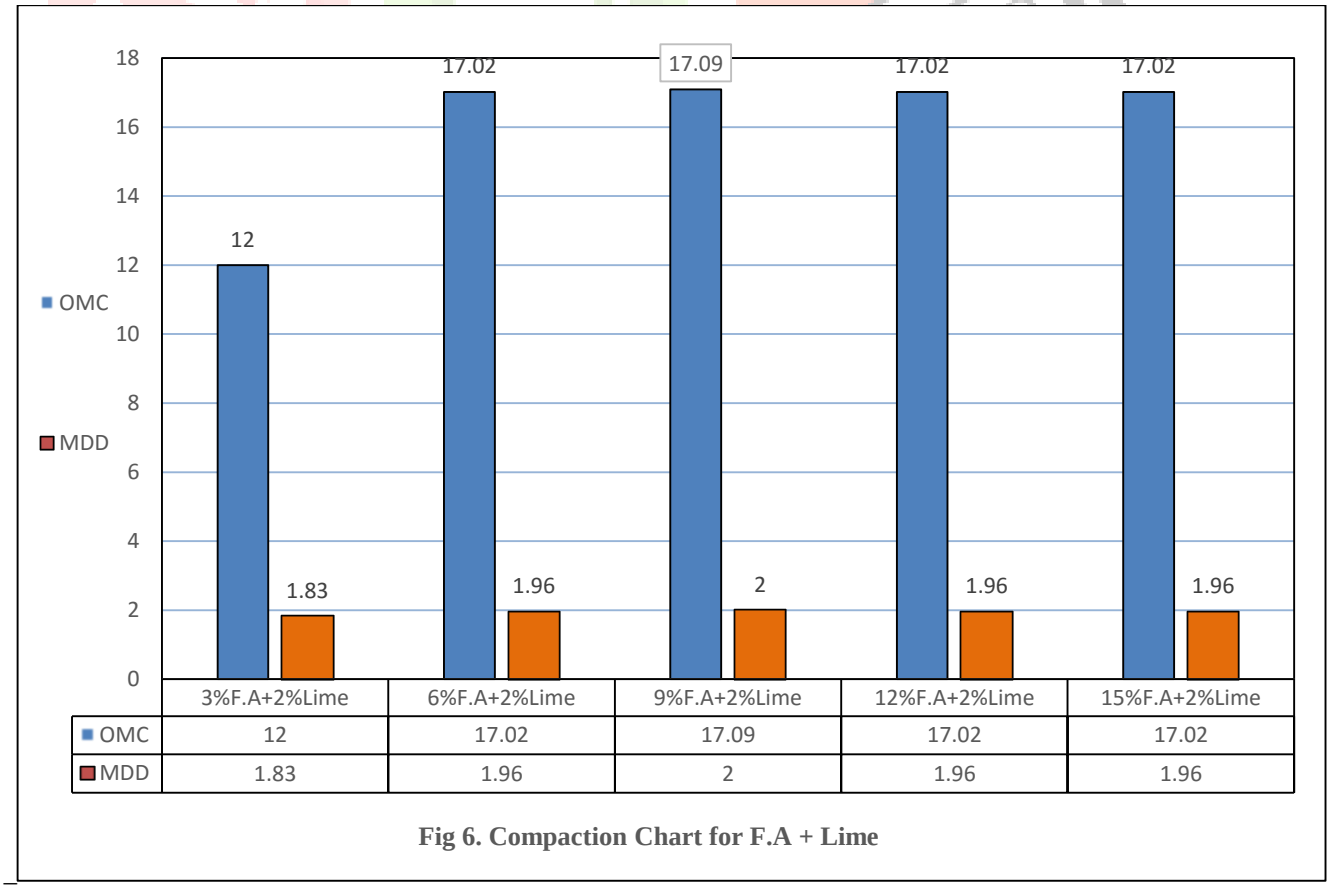


Fig 6. Compaction Chart for F.A + Lime

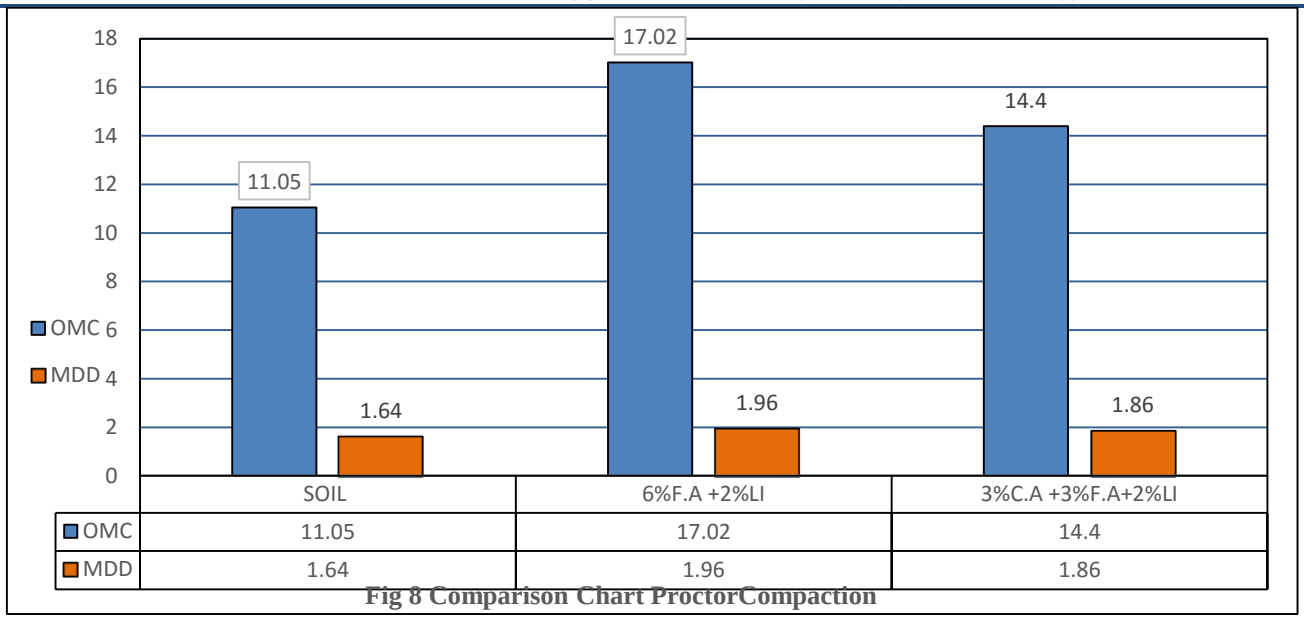


Fig 8 Comparison Chart ProctorCompaction

3.5 UCC TEST RESULT

The Unconfined Compressive strength and cohesive is obtained by conducting unconfined compressive strength test. The test was conducted as per IS 2720 (part 10):1991.The test were conducted on soil samples prepared under light energy of compaction. The relation between stress and strain and result of unconfined Compressive strength test on sample prepared under light compaction. The Unconfined Compressive strength and cohesion obtained as a result of Unconfined Compressive strength conducted on soil samples prepared under light compaction is shown below chart, Unconfined Compressive Strength Test Result obtained in the optimum value in 6% of fly ash and 2% lime as constant where added with clay soil and the test resulted in table 6.3.1, 6.3.3 and graph 6.3.2 is given below and The Test Result obtained in the optimum value in 3% Coir ash, 3% of fly ash and 2% lime as constant where added with clay soil and the resulted in Fig 9, 10 and 11

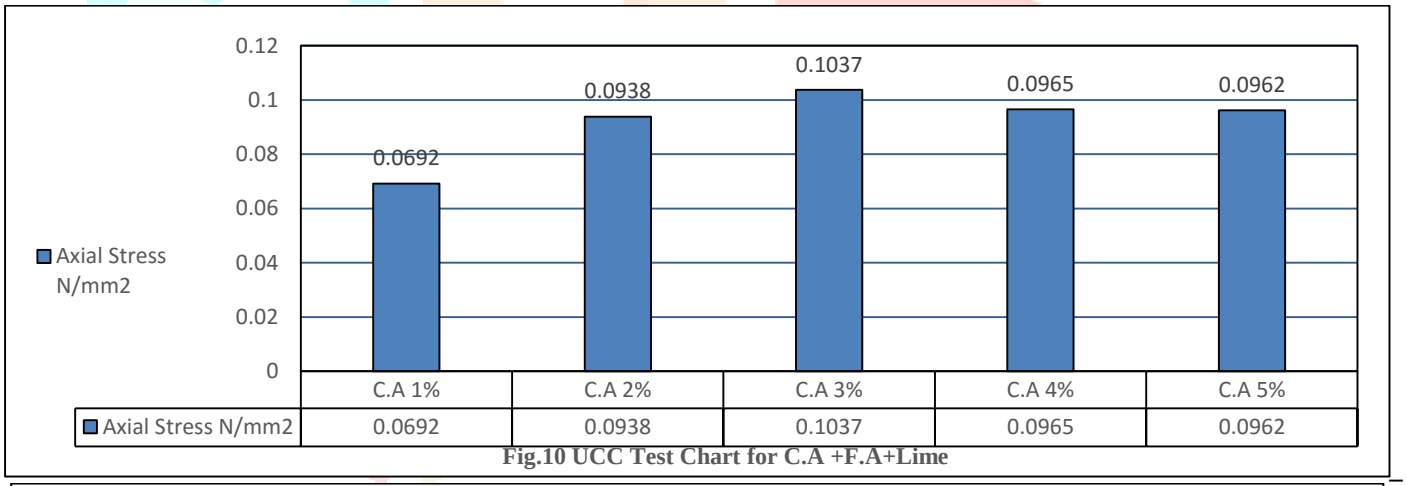


Fig.10 UCC Test Chart for C.A +F.A+Lime

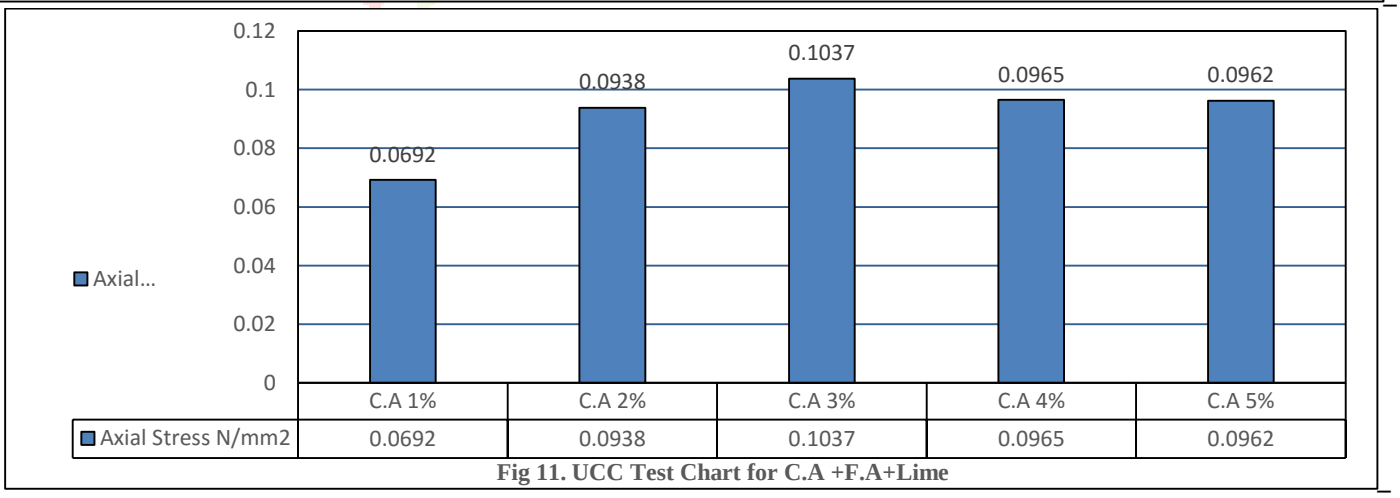
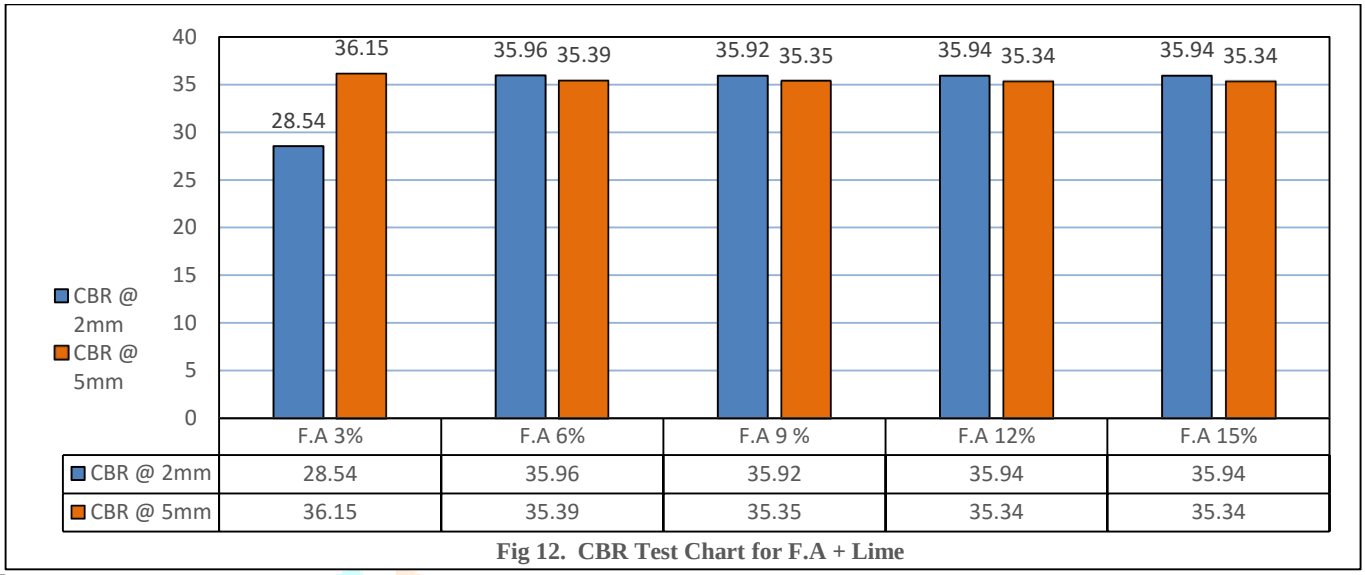


Fig 11. UCC Test Chart for C.A +F.A+Lime

3.6 CBR TEST RESULT

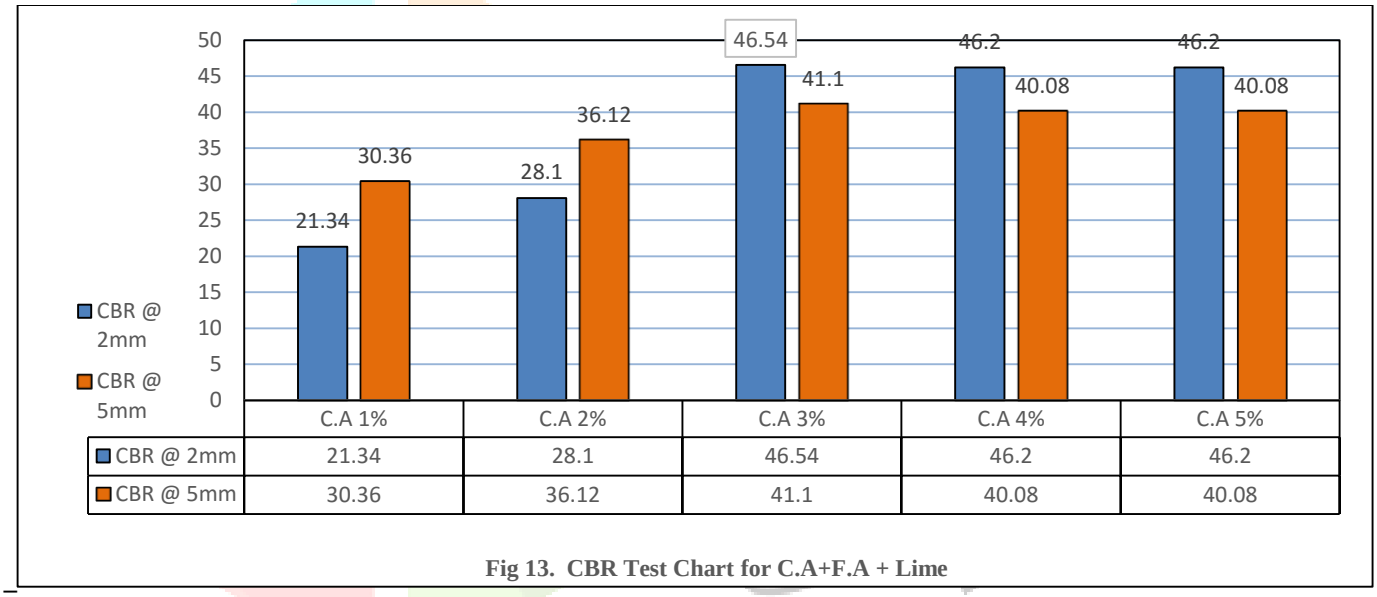
The object of the experiment is to determine the California Bearing Ratio (C.B.R) of a compacted Soil Sample in the laboratory, in unsoaked state. The method also covers the determination of CBR of undisturbed soil Sample, Unsoaked CBR Result obtained in the optimum value in 6% of fly ash and 2% lime as constant where added with clay soil the result in Fig 12, 13 and 13 is given below and The Test Result obtained in the optimum value in 3% Coir ash, 3% of fly ash and 2% lime as constant where added with clay soil and the resulted. Unsoaked CBR

Result obtained in the optimum value in 6% of fly ash and 2% lime as constant where added with clay soil, The Test Result obtained in the optimum value in 3% Coir ash, 3% of fly ash and 2% lime as constant where added with clay soil and the resulted in Fig12,13and 14 is given below.



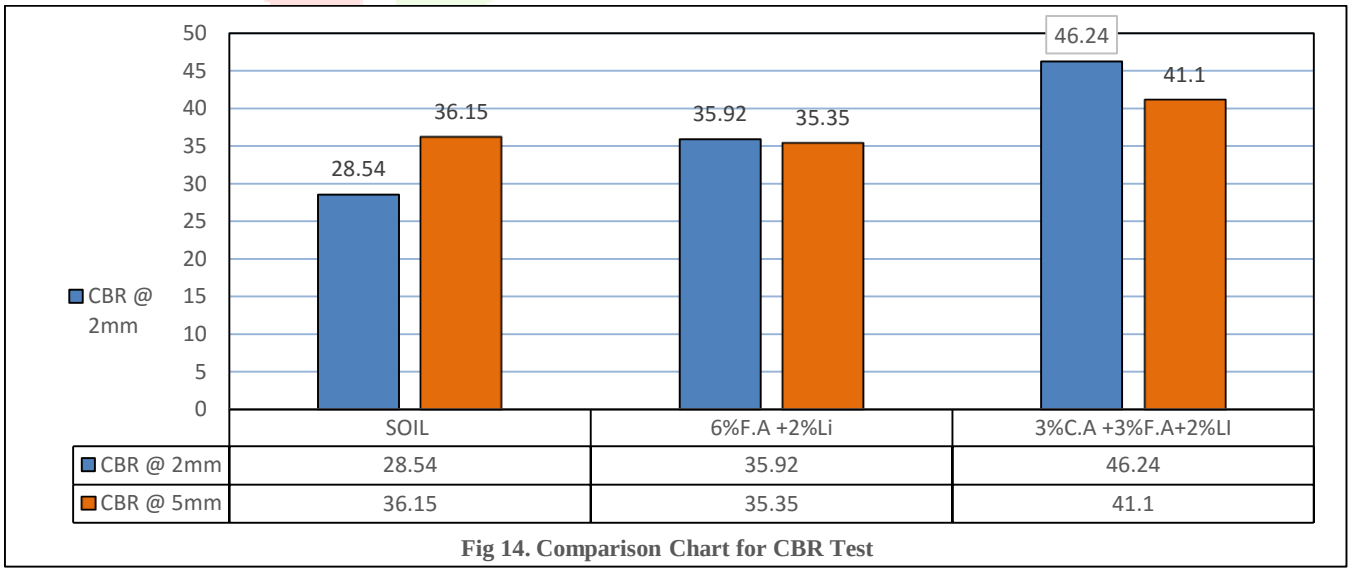
	F.A 3%	F.A 6%	F.A 9 %	F.A 12%	F.A 15%
CBR @ 2mm	28.54	35.96	35.92	35.94	35.94
CBR @ 5mm	36.15	35.39	35.35	35.34	35.34

Fig 12. CBR Test Chart for F.A + Lime



	C.A 1%	C.A 2%	C.A 3%	C.A 4%	C.A 5%
CBR @ 2mm	21.34	28.1	46.54	46.2	46.2
CBR @ 5mm	30.36	36.12	41.1	40.08	40.08

Fig 13. CBR Test Chart for C.A+F.A + Lime



	SOIL	6%F.A +2%Li	3%C.A +3%F.A+2%LI
CBR @ 2mm	28.54	35.92	46.24
CBR @ 5mm	36.15	35.35	41.1

Fig 14. Comparison Chart for CBR Test

V CONCLUSION

Based on the project, we concluded the experiment study, the effect of fly ash and coir ash on geotechnical properties on the clay soil are investigated and analyzed from the result obtained, it can be concluded there is little improvement is usage coir ash stabilized soil. The conclusion to the study is summarized as follows. The maximum dry density of soil increases with of addition of fly ash in soil. Where

the coir ash decreases in maximum dry density the optimum moisture content of soil decreases on stabilizing with fly ash due to chemical reaction in between of fly ash and lime. In which the optimum moisture content of soil increases with addition of coir ash, fly ash and lime the UCC and CBR value get increased to high limit at an optimum value of 6% fly ash content and 2% of lime as constant, For Coir ash of UCC and CBR value gets increased to high limit at an optimum value of 3% of coir ash, 3% of fly ash and 2 % lime as constant it also concluded that for the improvement in strength using stabilization in practical purposes, these optimum percentage values of coir ash , fly ash and lime can be recommended for the construction. Where coir ash is alone added to soil is carried out for future studies it may be improve the soil strength while comparing, But the addition of coir ash, fly ash and lime is beyond this limit to the soil is not beneficial and workable.

VI FUTURE WORK

Where coir ash is alone added to soil is carried out for future studies it may be improve the soil strength while comparing and we precidited that it design load we practically applied likewise it can be improved in future studies.

VII ACKNOWNLEDGEMENT

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