STRENGTH IMPROVEMENT OF SILTY SOIL WITH COCONUT FIBER AND FLY ASH

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Abstract - *Soil is an unconsolidated material, composed of solid particles produced by the disintegration of rocks. Sometimes soil needs to be stabilized so that its strength increases and it is more durable. Coconut fiber is used for improving the property of soil and is also very advantageous as it is very cheap and locally available. Coconut fibre is extracted from coconut shell and is available in abundant quantity at coastal regions of India. Coconut fibers has good tensile strength and are highly durable. Fly ash is the combustion product of coal in thermal power plants. Fly ash is one of the materials used as the binding admixture which improves the engineering properties of the soil. They are cheap, locally available and it is also eco-friendly.*

Key words :- Fly-ash, Coconut fibre , Tensile strength , strength of soil etc .

1. INTRODUCTION.

Soil is the uppermost unconsolidated material of the earth present naturally in the universe. It is formed by the decomposition of rocks under the influence of naturally occurring conditions such as wind, rain, snow, heat, etc. It is abundantly available and is the cheapest construction material. It is a complex material because of its highly variable composition and characteristics. The characteristics of soil change according to topography and its location. For safer construction the properties of soil should match with the design requirements of an engineering structure. Geotechnical engineer plays an important role in this work for checking whether the requirements of the structure are fulfilled by the soil or not. Construction of engineering structures on poor soil involves a great risk. These soils show settlements, low shear strength and high compressibility. The method of alteration or improvement of the engineering properties of soil to stabilize it is known as soil stabilization. The main effect of stabilization is decrease the compressibility and permeability of soil and to improve its load bearing capacity. Now many new methods have been founded to be used to improve the engineering properties of the unstable soil to increase its stability for designing the structure. Improvement of soil mainly deals with three methods, i.e., removing the unwanted materials, controlling the groundwater conditions and stabilizing the soil.

2. METHODOLOGY

A. Liquid Limit Test

The liquid limit of soil was determined in the laboratory by using Casagrande's apparatus . First of all the cup was adjusted to give a drop of exactly 1cm on the base. Then about 120 gm. of dry soil sample passing through 425 micron IS sieve was taken. It was mixed thoroughly with a known percentage of tap water. After that the paste of soil was placed in the cup and smoothened properly. Then the grooving tool was placed and moved through the sample to give a depth of 1 cm by holding it perpendicular to the face of cup. The handle of Casagrande's apparatus was turned with hand @ 2 revolutions per second. The no. of blows required to close the groove along 10mm length were counted. The water content was changed in such a manner that no. of blows needed to close the groove fall between 10 to 40 blows. Liquid limit was taken as amount of water at 25 blows.

B. Plastic Limit Test

The dry soil about 30 g weights passing through 425 micron sieve was taken for this test. Then it was mixed thoroughly with 20% water. Then 6 g of soil mass was taken and a ball was made and rolled on the glass plate with fingers to form a thread of uniform diameter. This rolling and remolding process was done with increment in water content until the thread just started crumbling at a diameter of 3 mm. Care was taken that rolling was done with fingers not palm of hand The water content of this part of the thread was determined. The test was repeated two times by taking fresh samples of soil. The plastic limit was taken as the average of three water contents. After determining liquid and plastic limits, Plasticity index was found out. Plasticity Index (P.I.) = L.L. - P.L, where L.L is liquid limit and P.L. is plastic limit

C. Standard Proctor Test

The apparatus used for the standard proctor test comprised of a cylindrical mould having an internal diameter of 100 mm, height 127.5 mm and volume 1000 mm; the removable collar of 60 mm height and a removable base. The rammer used was 2.6 kg weight with a drop of 310 mm .About 2.5 kg of oven dried soil sample passing through 4.75 mm sieve was taken and was mixed with about 10% of water by weight in a container. The mould was cleaned. Oiling of the mould was done. The collar was attached on the mould and mould was filled with soil in such a way that after compacting it with 25 evenly distributed blows of rammer, it is 1/3 rd of its previous height . Scratching of top of first layer was done with knife before placing and compacting the second layer. The second and third layers were compacted in a similar manner. The collar was removed from the mould and a straight edge was used to trim off the excess soil

D. California Bearing Ratio Test

The apparatus used for California Bearing Ratio test consisted of cylindrical mould having an internal diameter 150 mm, height 127.3 mm and volume 3000 cc. The rammer used was of diameter 50 mm, mass 4.89 kg and free drop of 450 mm. About 5.5 kg of oven dried sample was taken after sieving through 4.75 mm IS sieve. It was mixed thoroughly with 14% water by weight. This sample was kept in air tight container for 24 hours. After that the displacement disc was inserted at the bottom of mould. The mould was filled with soil in such a way that after compacting it with 56 evenly distributed blows of rammer, it is about1/5 th of its previous height. Scratching of top of first layer was done with knife before placing and compacting the second layer. The other layers were compacted in a similar manner. Fourth and the fifth layers were compacted by placing collar on the mould. The collar was removed from the mould and a straight edge was used to trim off the excess soil. The sample with mould and base plate was weighed. The mould was kept in water for curing for a period of 4 days. Then the mould was taken out of water and base plate was unscrewed from the mould and displacement disc was removed. Then the graph was plotted between the penetration and load values. Then the CBR values were calculated at 2.5mm and 5.0 mm penetration by taking 1370 kg and 2055 kg as standards loads respectively.

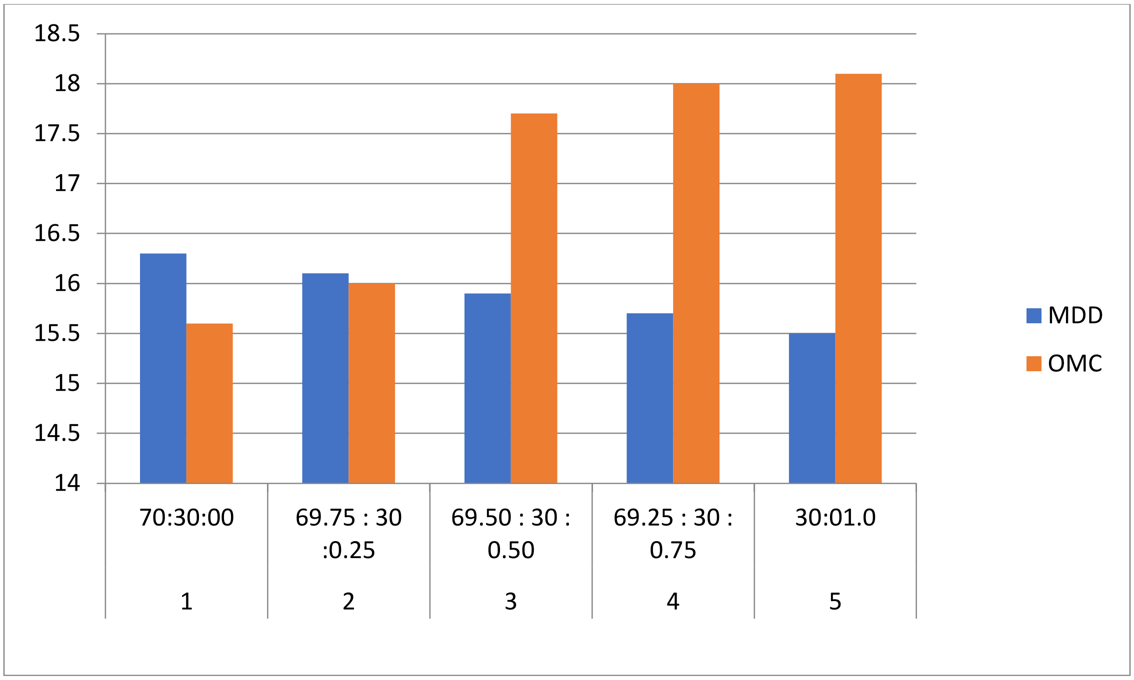
E. Unconfined Compressive Strength Test

The apparatus used for Unconfined Compressive strength test consisted of split mould of internal diameter 5.2 cm and height 7.8 cm, Proving ring having 1 kN capacity, dial gauge and sampling tube. An oven dried sample weighing equal to the product of maximum dry density and the volume of mould, passing through 600 micron sieve was thoroughly mixed with quantity of water equal to optimum moisture content. The split mould and the sampling tube was greased with oil and the screws were tightened. The mixed soil mass was placed in the mould in three layers and each layer was compacted with 30 blows using a small hammer. Then the sample was extracted carefully and height of the sample was noted. The sample was placed on the bottom plate of the compression machine and the plates were adjusted so that these touch the sample both at upper and lower portion. Dial gauges for length shortening were installed .For determining the compressive strength loading frame was used. Loading was done at rate of 1.0 mm / min. The loading was continued till the failure surface was clearly developed or until the axial strain of 20% was obtained. The load was recorded at failure and the compressive strength was determined for stress strain behaviour.

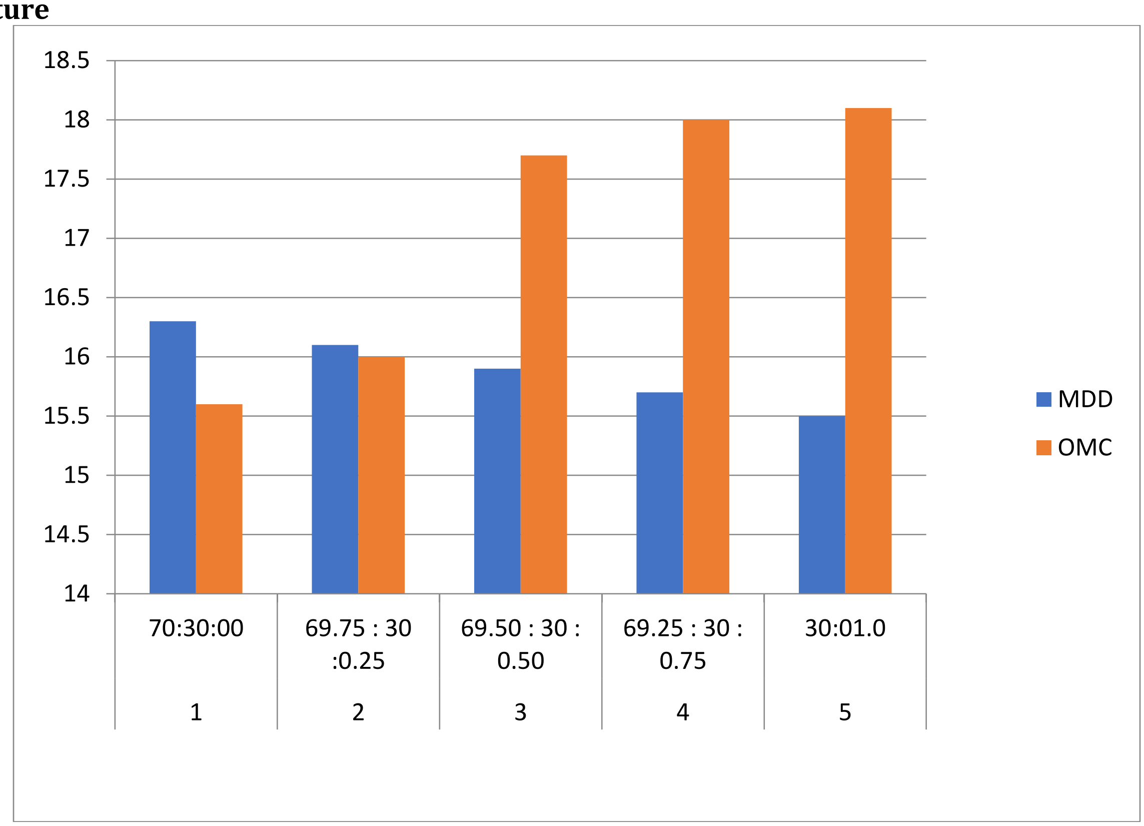
Therefore,Q_u= P / A_c, where, Q_u = Unconfined Compressive Stress P = Axial Load at Failure
A_c = Corected Area = A_o / 1 – C, Where , A_o = Initial area of spec. C= Change in length

3. RESULT

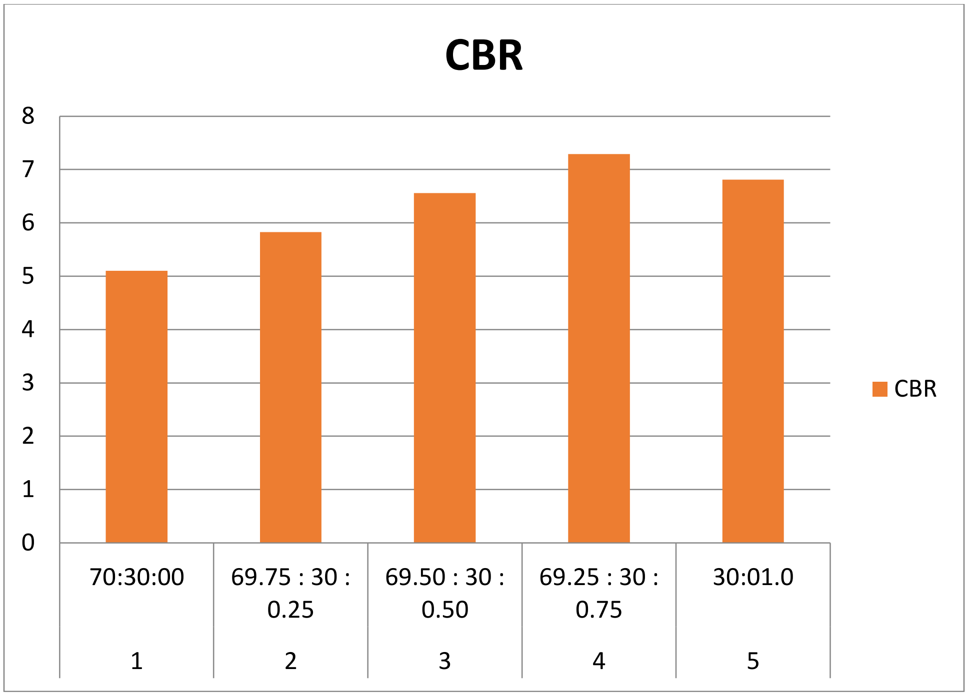
i. Graph representing the curves that are obtained from standard proctor test for soil – fly ash mixture



ii. Graphs representing the curves that are obtained from standard proctor test for soil – fly ash – coconut fiber mixture



iii. Graphs representing the curves that are obtained from California bearing ratio test for soil – fly ash mixture



4. CONCLUSIONS

- When percentage fly ash increases in soil there is increase in O.M.C. and decrease in M.D.D.
- With the increase in quantity of coconut fiber the value of O.M.C. increases and M.D.D. decreases.
- The optimum value of fly ash to be used for further work was 30%.
- The best ratio obtained was 69.25% soil: 30% fly ash: 0.75% coconut fiber.
- Soaked CBR value increases from 2.67% for virgin soil to 7.29% for the best ratio of the mix.
- Unconfined compressive strength of soil- fly ash mixtures increase with increase in coconut fiber up to 0.75 % by weight.

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