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Before and After a Detailed Study of the Stability of the Specific Quality than Earth

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ABSTRACT:

The long-term performance of any construction project depends on the soundness of the underlying soils. Unstable soils can create significant problems for pavements or structures. With proper design and construction techniques, lime treatment chemically transforms unstable soils into usable materials. Indeed, the structural strength of lime-stabilized soils can be factored into pavement designs. Swelling soils are soils that increase in volume as they get wet and shrink as they dry out. Theses soils are commonly known as Bentonite, Expansive, or Montmorillinitic soils. Swelling soils contain a high percentage of certain kind of clays particles that are capable of absorbing large quantity of water. Soil expands upon 10 percent by its volume when water is added to the soil that contains clay particles.Lime in the form of quicklime (calcium oxide – CaO), 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. It is hydrated lime that reacts with clay particles and permanently transforms them into a strong cementitious matrix. Lime can be used to treat soils to varying degrees, depending upon the objective. The least amount of treatment is used to dry and temporarily modify soils. Such treatment produces a working platform for construction or temporary roads. A greater degree of treatment supported by testing, design, and proper construction techniques--produces permanent structural stabilization of soils.

I.INTRODUCTION:

This project prescribes the appropriate type or types of additives to be used with different soils types, procedure for determining a design treatment level for each type of additive, and recommended construction practice for incorporating the additives into soils.

The long-term performance of any construction project depends on the soundness of the underlying soils. Unstable soils are always a trencher and can create significant problems for pavements or structures. With proper design and construction techniques, lime and cement treatment chemically transforms unstable soils into usable materials. Indeed, the structural strength of stabilized soils can be factored into pavement designs. Stabilizers can be used to treat soils to varying degrees, depending upon the objective. The least amount of treatment is used to dry and temporarily modify soils. Such treatment produces a working platform for construction or temporary roads. A greater degree of treatment supported by testing, design, and proper construction techniques produces permanent structural stabilization of soils.Before beginning any construction project, project plans and specifications must be developed. For highway pavements, the design must accommodate expected traffic volumes along with environmental, site, and material conditions. All structural designs should be based upon laboratory tests and mix designs that fit the demands of the particular project and provide the most economical alternative for the planned use.

A highway is a public road, especially a major road connecting two or more destinations. Any interconnected set of highways can be variously referred to as a “highway system”, a “highway network”, or a “highway transportation system”. The history of highway engineering gives us an idea about the roads of ancient times. Roads in Rome were constructed in a large scale and it radiated in many directions helping them in military operations. Thus they are considered to be pioneers in road construction. The modern roads by and large follow Macadam’s construction method, use of bituminous concrete and cement concrete are the most important developments. Various advanced and cost-effective construction technologies are used. Developments of new equipments help in the faster construction of roads. Many easily and locally available materials are tested in the laboratories and then implemented on roads for making economical and durable pavements.Scope of transportation system has developed very largely. Population of the country is increasing day by day.The need for travel to various places at faster speeds also increased. This increasing demand led to the emergence of other modes of transportation like railways and travel by air. While the above development in public transport sector was taking place, the development in private transport was at a much faster rate mainly because of its advantages like accessibility, privacy, flexibility, convenience and comfort. This led to the increase in vehicular traffic especially in private transport network. Thus road space available was becoming insufficient to meet the growing demand of traffic and congestion started. In addition, chances for accidents also increased. This has led to the increased attention towards control of vehicles so that the transport infrastructure was optimally used. Various control measures like traffic signals, providing Roundabouts and medians, limiting the speed of vehicle at specific zones etc. were implemented.

II.RELATED WORK:
A.Advanced Soil Stabilization Techniques

The stabilization of naturally-occurring or native soil has been performed by millennia. The Mesopotamians and Romans separately discovered that it was possible to improve the ability of pathways to carry traffic by mixing the weak soils with a stabilizing agent like pulverized lime stone or calcium. This was the first chemical stabilization of weak soils to improve their load-carrying ability. Successful modern soil stabilization techniques are necessary to assure adequate subgrade stability, especially for weaker and wetter soils. It is widely recognized that selection between cementitious stabilizing agents cement and lime is based on the Plasticity Index (P I) of the primary soil type being improved.

B.Current Stabilizing Technology:

The currently employed technologies for soil stabilization include multiple alternatives. One choice involves the pulverization and homogenization of existing materials in place without the addition of an additive to change or improve the characteristics of the material. This technology is typically performed when the in-situ material is suitable and when FDR (Full Depth Reclamation) can create a new stabilized base of sufficient thickness and strength for the intended traffic loads. Of course, a surface of some type must be placed over the stabilized base to protect it.

A second technique for the stabilization includes the addition of a single additive such as lime, cement or bitumen. Less common additives include flyash and mineral fillers. Addition of this stabilizing agent was historically done dry. In recent years, the environmental considerations have led to more frequent utilization of liquid slurry additives. The dry stabilizing agent is premixed with water to form slurry which has water content at or slightly below the optimum moisture content for the material being stabilized. The wet slurry applied doesn't form any dust. When the stabilizing agent is able to be added during the pulverization pass of the stabilizer, a corresponding reduction in production costs and time can also be realized.

Another more expensive, but effective, stabilization technique involves use of multiple additives to achieve superior results. In these instances, it may be necessary to spread one of the additives onto the surface to be stabilized and to add another in slurry form through the stabilizer's on-board additive system. In some instances, multiple stabilization passes will be needed to thoroughly blend the combined additives into the in-situ material. Each project must be operated with 'best practices' for its unique site conditions and desired end results.

III.IMPLEMENTATION:
A.STABILIZATION WITH LIME

The use of lime to dry, modify or stabilize soils has been specifications or procedures for lime stabilization of fine – grained and/or mixed soils when the United States interstate highway system was being constructed in 1960's.In 1999, National Lime Association commissioned Dr. Dallas Little to evaluate the structural properties of lime and to develop practical lime stabilization MDTP (Mixture Design and Testing Procedure). His work outlined seven steps may be necessary for mixture design and testing of lime stabilized soils.

B.STABILIZATION WITH CEMENT:

According to the PCA (Portland Cement Association), CTB (Cement – Treated Base) has provided economical, long lasting pavement foundations for over 70 years. The advantages of cement stabilization are several:

1.Cement stabilization increases base material strength and stiffness, which reduces deflections due to traffic loads. This delays surface distress such as fatigue cracking and extends pavement structure life.

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2.Cement stabilization provides uniform, strong support, which results in reduced stresses to the sub-grade. Testing indicates a thinner cement-stabilized layer can reduce stresses more effectively than a thicker un-stabilized layer of aggregate. This reduces sub-grade failure, pothole formation and rough pavement surfaces.
3.Cement stabilized bases have greater moisture resistance to keep water out; this maintains higher strength for the surface.
4.Cement stabilization reduces the potential for pumping of sub-grade fines.
5.Cement stabilization base spreads loads and reduces sub-grade stress.

CTB is a cemented, rigid material that distributes load over a larger area due to its slab – like characteristics and high beam strength. CTB is practically impervious; it resists freezing/thawing cycles, rain or high ground water tables and spring – weather damage. CTB continues to gain strength with age, even under traffic loading.

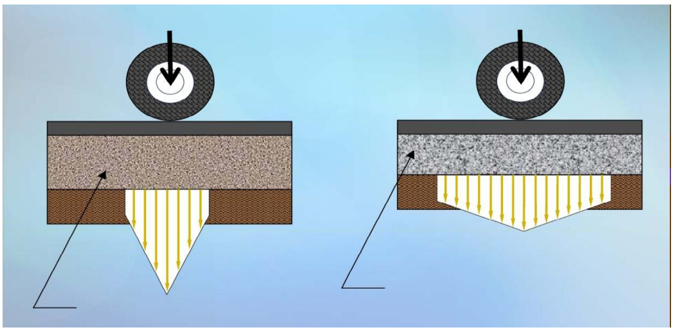

Figure 1: Load distribution

C.STABILIZATION OF BLACK COTTON SOIL AND MARINE CLAY SOIL:

Modification of black cotton soils by chemical admixtures is a common method for stabilizing the swell-shrink tendency of expansive soils. Advantages of chemical stabilization are that they reduce the swell-shrink tendency of the expansive soils and also render the soils less plastic. Among the chemical stabilization methods for expansive soils, lime stabilization is most widely adopted method for improving the swell-shrink characteristics of expansive soils. Lime stabilization of clays in field is achieved by shallow mixing of lime and soil or by deep stabilization technique. Shallow stabilization involves scarifying the soil to the required depth and lime in powder or slurry form is spread and mixed with the soil using a rotovator. The use of lime as deep stabilizer has been mainly restricted to improve the engineering behaviour of soft clays Deep stabilization using lime can be divided in three main groups: lime columns, lime piles and lime slurry injection. Lime columns refer to creation of deep vertical columns of lime stabilized material. Lime piles are usually holes in the ground filled with lime. Lime slurry pressure injection, as the name suggests, involves the introduction of lime slurry into the ground under pressure. Literature review brings out that lime stabilization of expansive clays in field is mainly performed by mixing of lime and soil up to shallow depths. The use of lime as deep stabilizer has been mainly restricted to improve the engineering behaviour of soft clays. Use of lime in deep stabilization of expansive soils however has not been given due attention. There exists a definite need to examine methods for deep stabilization of expansive soils to prevent the deeper soil layers from causing distress to the structures in response to the seasonal climatic variations.

IV.Reporting of results:

The specific gravity G of the soil = (M2 – M1) / [(M2-M1)-(M3-M4)]
Where,

M1 – mass of empty bottle;
M2 – mass of the bottle and dry soil;
M3 – mass of bottle, soil and water;
M4 – mass of bottle filled with water only.

The specific gravity should be calculated at a temperature of 27oC and reported to the nearest 0.01. If the room temperature is different from 27oC, the following correction should be done:

G =Corrected specific gravity at 270C;
k = [Relative density of water at room temperature]/ Relative density of water at 27oC.
A sample proforma for the record of the test results is given below. Relative density of water at various temperatures is taken from table here. Relative Density Water
Specific gravity (G) = (M2 – M1)/((M2-M1) – (M3-M4))
Where

M1 - Mass of the empty bottle;
M2 - Mass of the bottle and dry soil;
M3 - Mass of the bottle, soil and water;
M4 - Mass of the bottle filled with water only.

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4.1.EXPERIMENTS ON SPECIFIC GRAVITY FOR BLACK COTTON SOIL:

4.2.SOIL STABILIZATION USING LIME AS STABILIZER:

Table 1: Specific Gravity of Black Cotton soil using 0% of Stabilizer
0% of Stabilizer

S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	26.100	26.540	25.410
02	M_2	33.040	33.710	32.090
03	M_3	80.990	81.900	79.930
04	M_4	76.840	77.670	75.920
05	$G = (M_2 – M_1)/((M_2-M_1) – (M_3-M_4))$	2.480	2.430	2.500

Thus the Specific Gravity of the Black Cotton Soil is 2.470
Table 2: Specific Gravity of Black Cotton soil using 1% of Lime
1% of Lime

S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	26.700	25.710	26.660
02	M_2	33.220	32.520	33.710
03	M_3	81.000	80.150	81.800
04	M_4	77.710	75.880	77.160
05	$G = (M_2 – M_1)/((M_2-M_1) – (M_3-M_4))$	2.010	2.610	2.920

Thus the Specific Gravity of the Black Cotton Soil is 2.513
Table 3: Specific Gravity of Black Cotton soil using 2% of Lime
2% of Lime

S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	25.640	26.760	26.330
02	M_2	32.180	33.720	33.180
03	M_3	80.230	81.900	80.910
04	M_4	75.930	77.860	76.760
05	$G = (M_2 – M_1)/((M_2-M_1) – (M_3-M_4))$	2.910	2.420	2.530

Thus the Specific Gravity of the Black Cotton Soil is 2.620
Table 4: Specific Gravity of Black Cotton soil using 3% of lime
3% of Lime

S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	26.650	25.660	26.390
02	M_2	33.650	32.590	32.890
03	M_3	82.050	80.260	81.000
04	M_4	77.700	76.010	77.060
05	$G = (M_2 – M_1)/((M_2-M_1) – (M_3-M_4))$	2.640	2.580	2.530

Thus the Specific Gravity of the Black Cotton Soil is 2.583

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Table 5: Specific Gravity of Black Cotton soil using 4% of Lime

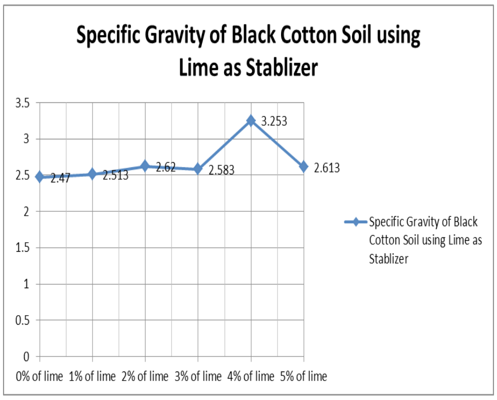
S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	26.240	26.680	25.730
02	M_2	33.260	33.540	32.620
03	M_3	80.960	81.420	80.270
04	M_4	76.700	76.100	75.860
05	$G = (M_2 – M_1)/((M_2-M_1) – (M_3-M_4))$	2.540	4.450	2.770

Thus the Specific Gravity of the Black Cotton Soil is 3.253

Table 6: Specific Gravity of Black Cotton soil using 5% of Lime

S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	26.640	26.130	25.500
02	M_2	33.660	32.980	32.600
03	M_3	82.070	81.110	80.150
04	M_4	77.520	76.990	75.890
05	$G = (M_2 – M_1)/((M_2-M_1) – (M_3-M_4))$	2.840	2.500	2.500

Thus the Specific Gravity of the Black Cotton Soil is 2.613



Graph 1: Specific Gravity of Black Cotton Soil using Lime as Stabilizer.

4.2.1.SOIL STABILIZATION USING CEMENT AS STABILIZER:

Table 7: Specific Gravity of Black Cotton soil using 0% of Stabilizer

S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	26.100	26.540	25.410
02	M_2	33.040	33.710	32.090
03	M_3	80.990	81.900	79.930
04	M_4	76.840	77.670	75.920
05	$G = (M_2 – M_1)/((M_2-M_1) – (M_3-M_4))$	2.480	2.430	2.500

Thus the Specific Gravity of the Black Cotton Soil is 2.470

EXPERIMENTS ON PLASTIC LIMIT FOR BLACK COTTON SOIL

15.7.1. SOIL STABILIZATION USING LIME AS STABILIZER

Table 37: Plastic Limit of Black Cotton soil using 0% of Stabilizer

S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	19.890	20.670	19.960
02	M_2	27.920	28.740	27.990
03	M_3	24.980	26.000	25.290
04	$(w_p) = [(M_2 – M_3) / (M_3 – M_1)] * 100$	57.760	51.407	50.456

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Thus the Plastic Limit of the Black Cotton Soil is 53.274

Table 38: Plastic Limit of Black Cotton soil using 1% of Lime

S.No	Observations and Calculations	Trail 1	Trail 2	Trail 3
01	M_1	21.190	20.960	20.500
02	M_2	29.250	29.000	28.600
03	M_3	26.340	26.250	25.550
04	$(w_p) = [(M_2 - M_3) / (M_3 - M_1)] * 100$	56.504	51.984	60.396

Thus the Plastic Limit of the Black Cotton Soil is 56.294

V.CONCLUSION:

As a result of soil stabilization, the bearing capacity of the foundation of the structure is increased and its strength, water tightness, resistance to washout, and other properties are improved. Soil stabilization is widely used in the construction on sagging soils of industrial and civil buildings The experiments conducted and the graphs generated there by conclude that BLACK COTTON SOIL

Specific Gravity

i.The addition of lime, increases specific gravity consistently from 2.47 to 2.613, the maximum specific gravity value is obtained at 4% is high with a value as 3.253.
ii.The addition of cement, increases specific gravity consistently from 2.47 to 2.486, but a variable decrease in specific gravity is observed at 4% of cement addition.
iii.On addition of lime and cement to the black cotton soil, the specific gravity increased consistently, where the graph obtained resembles both the graphs of lime and cement stabilization.

Plastic Limit
i.The plastic limit value has increased from 53.274 to 58.829 from 0% to 3% of lime beyond 3% of addition of the lime decreases the plastic limit. Thus the plastic limit at 3% of black cotton is considered as the optimum at 3%.
ii.The plastic limit value has increased from 53.274 to 58.3 from 0% to 3% of cement beyond 3% of cement the value has decreased to 51.749. Thus the plastic limit of soil sample at 3% of stabilizer is considered beyond which the plastic limit is bad.
iii.The addition of lime and cement increased plastic limit increased at 3% (63.796) and there by the value decreased to 52.445.

Liquid Limit
i.The value of the liquid limit for the black cotton soil has decreased to 50 at 4% of lime and then the value has increased to 63 at 5%.
ii.On addition of cement to the black cotton soil the liquid limit value has decreased to the 60.5 at 3% and the value has increased its value at 4% and then the value has decreased to 61.5 at 5%.
iii.The liquid limit vale has decreased consistently at 0% to 3% and then the value has increased consistently from 3% to 5%.

Plastic Index
i.The value of plastic limit has decreased from 18.726 (0% of lime) to 2.351 (2% of lime) and the value has increased to 4.329 (3% of lime) then the value has decreased to 3.042 (4% of lime) and the value has increased to 17.428 (5% of lime).
ii.On addition of cement, the value has decreased consistently at 3% and the value increased at 4% and then the value has decreased at 5% of cement.
iii.The value of plastic index has decreased consistently at 2% and then the value has increased consistently at 5%.

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4 Photo courtesy of Mt. Carmel Sand & Gravel.
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