International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 3.45 (SJIF-2015), e-ISSN: 2455-2584
Volume 3, Issue 3, March-2017

# Literature review on a laboratory study of thickness design of flexible pavement by the CONSOLID system in black cotton soil

Chotliya Gaurang[1] , Bhatt Khushbu[2], N.B.Parmar[3]

[1]*Civil Department, Parul University Limda, Vadodara,*
[2]*Civil Department, Parul University, Limda, Vadodara.*
[3] *Civil Department, Parul University, Limda, Vadodara*

***Abstract— With rapid growth of population, fast urbanization and more construction of buildings and other structures has resulted in reduction of good quality available land. There is no choice for People except to use soft and weak soils around for construction activities. Such soil possesses poor shear strength and high swelling & shrinkage. The South Gujarat region in India have majority of top soil as black cotton soil. The black cotton soil has characteristics of shrinking on drying and heaving on wetting. This soil being expansive creates several types of damages to pavement structures, and in some cases the pavement may even become unserviceable. A laboratory investigation is carried out to study the effect of COSOLID SYSTEM on index and engineering properties of the Black Cotton Soils. The properties of stabilized soil such as compaction characteristics and California bearing ratio were evaluated and their variations with content of consolid 444 and solidry are evaluated and also to evaluate the improvement in properties by the addition of consolid 444 and solidry to be used in pavement design for economy. A consolid system also reduces thickness of the pavement and save resources and construction time. A comparative study of pavement thickness design by IRC METHOD is also done.***

***Keywords— black cotton soil , soil stabilization , consolid 444 , solidry , increase CBR , IRC pavement design***

## I. INTRODUCTION

Several types of advanced materials are tried to establish the efficiency of new materials in road construction. However, the use of new materials and technologies is not becoming popular owing to certain procedural constraints as well as lack of awareness and therefore appropriate steps may have to be taken for popularizing the new technologies for building better roads with less cost. Adoption of such technique may also result in the conservation of natural resources, energy and environment. Roads are having different layers which provide strength for sustaining the heavy loads due to vehicle movement. If sub grade soil has poor properties, it needs modification or stabilization with stabilizers to improve its properties. Along with improvement in engineering properties of soil, stabilization is also used to achieve economy in terms of cost by reducing thickness of layers of pavement. The consolid treatment proves to be one of the best available stabilizers for various soils. Black cotton soil is highly plastic soil and bearing strength is very less compared to other soil. By adopting consolid – 444 and solidry in required doses, bearing strength can be improved.

## II. LITERATURE REVIEW

R.Vinod Kumar, Pavithra.M.(Jan 2016) reported ; As per IRC recommendation, California Bearing Ratio (CBR) value of sub grade is used for design of flexible pavements. California Bearing Ratio (CBR) value is an important soil parameter for design of flexible pavements. CBR value of soil may depend on many factors like maximum dry density (MDD), Optimum moisture content (OMC), Liquid limit (LL), Plastic limit (PL), Plasticity index (PI), Type of soil, etc..And also CBR value of the soil is affected by the soaked and unsoaked condition of the soil, the results obtained by these tests are used with the empirical curves determined the thickness of pavement and it's component layers. Sub grade soil is an essential component for design of both flexible and rigid pavement structure, laboratory investigation of sub grade strength parameter as CBR beneficial for design of flexible pavement. This study considers the use of CBR, Unconfined compressive strength (UCS).

Ravin M.Tailor,Dr. Navin C. Shah (March 2015) reported ; The expansive soils are one of the most problematic materials. The black cotton soil has characteristics of shrinking on drying and heaving on wetting. This soil being expansive creates several types of damages to pavement structures, and in some cases the pavement may even become unserviceable. The IRC: 37 – 2001, Annexure – 4 suggest 0.6 to 1.0 m thick non-cohesive soil cushion on the expansive soil for road construction which led to higher cost for road construction. Also for new urban areas it is difficult to raise the embankment or to excavate the subgrade upto such a depth due to existing structures and under laying service lines. To provide economical solution along with feasible application two innovative materials were used namely, CONSOLID and Geotextile for flexible

pavement. The CONSOLID application shows the great improvement of CBR values helping the overall stability of the pavement. The Geotextile provided below the pavement components to act against the heaving of the swelling soil at the same time it helps as drainage layer also. Field study is undertaken to observe the effect of Geotextile in flexible pavement performance and 2 specific boundary conditions are created for observations. The Observations shows about 50 % reduction in shrinkage effect for paved road reinforced with Geotextile subjected to drying and wetting cycles. Both the materials are having its unique advantage in the performance improvement of flexible pavement over expansive subgrade.

Devendr Choudhary, Dr. Y. P Joshi(June 2014) reported ; As per IRC recommendation, California Bearing Ratio (CBR) value of subgrade is used for design of flexible pavements. California Bearing Ratio (CBR) value is an important soil parameter for design of flexible pavements and runway of air fields. It can also be used for determination of sub grade reaction of soil by using correlation. It is one of the most important engineering properties of soil for design of sub grade of roads. CBR value of soil may depends on many factors like maximum dry density (MDD), optimum moisture content (OMC), liquid limit (LL), plastic limit (PL), plasticity index (PI), type of soil, permeability of soil etc. Besides, soaked or unsoaked condition of soil also affects the value. These tests can easily be performed in the laboratory. the estimation of the CBR could be done on the basis of these tests which are quick to perform, less time consuming and cheap, then it will be easy to get the information about the strength of subgrade over the length of roads, By considering this aspect, a number of investigators in the past made their investigations in this field and designed different pavements by determining the CBR value on the basis of results of low cost, less time consuming and easy to perform tests. In this study, attempts have been made to seek the values of CBR of different soil samples and correlate their CBR values for the design purpose of flexible pavement as per guidelines of IRC: SP: 37-2001.

Ervin M.(August 2012) reported ; The consolid soil stabilization process allows soil or otherwise inferior pavement materials to be improved to base or sub base quality by the in situ addition of the CONSOLID products. Only very small percentages of product are required and minimizing transport costs by using locally available soil. Furthermore, the process does not bind the treated material but modifies the surface chemistry of the soil fines. As such, the treatment is permanent, and is not time dependent as far as construction is concerned. Potential savings of up to 50 per cent of normal construction costs can be achieved.

Ujjaval J. Solanki , Dr. N.C.SHAH , R.G.Dhamsaniya , M.D.Barasara (March 2012) reported ; It has been found that the use of consolid system in highway construction offers technical, economic, and environmental benefits.It show significant increase in CBR and UCS value and also decrease the capillary rise of water. It also reduces the thickness of pavement compared to convention method of construction and also consolid system reduces the demand for heavy wearing course save resources and construction time.

Seco ,F. Ramírez , L. Miqueleiz , B. García (2011) investigated modification of expansive clay soils using consolid system and compare with waste materials of industrial origin. This article presents an experimental study in the stabilization of an expansive soil, consisting of the reduction of its swelling capacity and the improvement of its mechanical capacities by the addition of by-products and waste materials of industrial origin.

Willbard N. J Kassian (2009) investigated the soil stabilization with Consolid soil stabiliser has been used with success at a number of sites in Tanzania. The various possible areas of application of this stabiliser together with the preferred application rates are discussed. The report dwells on the soil evaluation test criteria starting from the field typical representative soil sample selection, the various soil tests carried in the Laboratory of the University of Dares Salaam and the results obtained. Evaluation and discussion of these results for the different soils tested is done. Attention is drawn to the parallel for the practical application on the field and reasons are given for the recommendations reached on the strength of the laboratory results. They finally discusses the critical theoretical aspects of the consolid stabilisation system and points out the practical and theoretical parallels as obtained in the two case discussed earlier on.

S. Eren,M. Filiz (2009) reported ; it has been found that the use of consolid system was an alternative of the conventional soil stabilization method i.e. Lime and cement stabilization.They also reported that consolid system show the higher improvement in soil than conventional method.also.the consoled system use for road construction as well as in water proofing , dam constructions, filling works, etc.

Dr. Eduardo Tejeda Piusseaut , Dr. Luis Emilio Serrano, Pedro Morales (May 2003) investigated modification in soil using consolid system and reported that soil treated with consolid system was used for road construction. Also, reported that it show that the great improvement of the water resistance in the treated soil with CONSOLID system.

Jones, Kevin (May 1987) reported ; Any soil found anywhere, to be upgraded to achieve better characteristics necessary in improving road life and quality". Consolid was evaluated along with mixes of cement-fly ash and hydrated lime on two soils.

The soils were an A-2-4(0) with zero plasticity index and an A-7-8(18) with a 31 plasticity index. American Consolid Inc. recommended an application rate of 0.10% Consolid 444 and 1.00% Conservex by dry soil weight. The application rate chosen for cement-fly ash was 5% cement and 15% fly ash and for hydrated lime it was 6.5%. Testing involved triaxial testing of specimens after water soaking, unconfined compressive strength of specimens before and after water soaking, and freeze and thaw testing of specimens after water soaking. All specimens were compacted to standard proctor at optimum moisture. The cement-fly ash treated mixes had the highest strength and durability followed by the hydrated lime treated mixes.

## III. CONCLUSSION

By the use of the consoled system Any soil found anywhere, to be upgraded to achieve better characteristics necessary in improving road life and quality. As we know pavement based design and thickness of sub- base depends upon CBR value so increment in CBR value results in reduction of thickness of sub-base, which means materials require for pavements are having less quantity and it also save the construction time

Conventional method of pavement construction is having less initial cost but it requires the high maintenance costs because of the water enter in the sub-grade. Water is one the worst enemy of the soil sub-grade that affect the road pavement direct or indirectly. The consolid system improve the water resistance of the soil sub-grade. Consolid system may have high initial cost but it has nearly no maintenance costs which improve the life period of the road pavement.

Durability As we know the conventionally made roads are not very long lasting, they hardly remain in good conditions for 10 to 15 years. But having consoled system as all problems due to water are eliminated, the roads life for good conditions increases up to 20-25 years.

## REFERENCES

1. Dr. Eduardo Tejeda Piusseaut , Dr. Luis Emilio Serrano , Ing. Pedro Morales, “Use of the CONSOLID product in the improvement of soils report on the results obtained in the laboratory” (May 2003).
2. Devendra Kumar Choudhary , Dr. Y. P Josh ,‘‘A Detailed Study of Cbr Method for Flexible Pavement Design” (www.ijera.com, ISSN : 2248-9622, Vol. 4, Issue 6( Version 5), June 2014, pp.239-253)
3. Ervin, M, “Low Cost Road Construction Using CONSOLID Stabilization Technology” (https://trid.trb.org / view.aspx%3Frid%3D1196972 / Aug 24 2012).
4. Jones, Kevin , ‘‘Evaluation of the Consolid System of Soil Stabilization’’(May 1987)
5. Ravin M. Tailor And Dr.Navin C.Shah,‘‘Applications Of Innovative Materials For Performance Improvement Of Flexible Pavement Over Expansive Subgrade.” March, 2015, Vol. 8, Issn:2186-2982(P), 2186-2990(O)
6. R.Vinod Kumar, Pavithra. M,‘‘ Experimental Study on Design of Flexible Pavement Using CBR Method” (International Journal of Engineering Research, ISSN:2319-6890 Volume No.5, Issue Special 1 pp : 63-68, 8 & 9 Jan 2016)
7. S. Eren , M. Filiz, “Comparing the Conventional Soil Stabilization Methods to the CONSOLID SYSTEM used as an alternative admixture matter in ISPARTA DARIDERE Material” (www.elsevier.com/locate/conbuildmat 23 (2009) 2473-2480).
8. Seco , F. Ramírez , L. Miqueleiz , B. García, “Stabilization of Expansive Soils for use in Construction” (www.elsevier.com/locate/conbuildmat 51 (2011) 348-352).
9. Ujjaval J. Solanki , Dr. N.C.SHAH , R.G.Dhamsaniya , M.D.Barasara, “A Study on Soil Stabilization through Innovative Material for Construction of Rural Roads – A Case Study of East Gujarat”(www.nbmcw.com › articles › case-studies, March-2012).
10. Willbard N. J Kassian, “Typical Field Application Of Consolid In Tanzania” , (2009)pp.391-405