STABILIZATION OF BLACK COTTON SOIL USING SILICA FUME AND WASTE PET BOTTLES.

A Thesis submitted

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IN

Transportation Engineering

By

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Under the guidance of

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LUCKNOW

JUNE-2020

CERTIFICATE

This is certified thesis entitled **"STABILIZATION OF BLACK COTTON SOIL USING SILICA FUME AND WASTE PET BOTTLES" which has being carried out by Mr. PRASHANT VERMA (1180465006)** for partial fulfillment of requirement for the award of **MARSTER OF TECHNOLOGY** degree in Transportation Civil Engineering of Babu Banarasi Das University, Lucknow, is a record of his work carried out by him under the guidance and supervision. The result embodied in this thesis has not been submitted elsewhere for award of any other degree or diploma.

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DECLARATION

I, hereby declare that the work which is being presented in the M.TECH. Thesis report entitled. "SOIL STABILIZATION OF BLACK COTTON SOIL USING SILICA FUME AND WASTE PET BOTTLES" in fulfillment of the requirement for the award of the MASTER OF TECHNOLOGY in Transportation Engineering (Civil engineering) and submitted to the department of civil engineering of BABU BANARASI DAS university, Lucknow(UP) is an authentic record of our own work carried out during the period from august 2018 to June 2020 under the guidelines of Prof. D.S. Ray, Department of Civil Engineering. The result embodied in this thesis has not been submitted elsewhere for award of any other degree or diploma.

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ABSTRACT

The most important component in the world is soil and it is base of ecosystem and the present day of the soil is more polluted due to disposal of waste plastic by the human being. The rapid growth of industrialization and urbanization to minimization of industrial waste is a serious Problems to present days. So this research paper is mainly focused on recycling based . Black Cotton soil problematic soil for construction purpose and also be problematic to stabilize due to high possibility of swelling and shrinkage as an effecting and change in moisture content. The objective of this thesis to evaluate and effect in stabilization of sub base of soil and using different types of addition so California bearing ratio and other strength properties test are conducted on soil to check whether and the CBR of black cotton soil is increase or not therefore increase of CBR value is used to decreased the thickness of the design pavement and increasing bearing capacity of soil by using of waste material of silica fume and waste PET bottles adding different proportional like:

(i.e. 2&1%.2&2%. 2&3%. 2&4%. 2&5%. 2&6%)
(3&1%. 3&2%. 3&3%. 3&4%. 3&5%. 3&6%)
(4&1%. 4&2%. 4&3%. 4&4%. 4&5%. 4&6%)
(5&1%. 5&2%. 5&3%. 5&4%. 5&5%. 5&6%)

Scrap waste PET bottles is size of 0.5mm.

To improve California bearing ratio. In this project I am tried to evaluate whether on addition of such materials will there be increase in the physical as well as chemical properties of the soil along with it we are expecting certain properties to improve such as CBR value. shear strength. liquidity index. plasticity index. unconfined compressive strength and bearing capacity of soil. Mainly we have focused on increasing the CBR of the soil because on increasing the CBR value it helps in reducing the thickness of the pavement and it is also beneficial to us economically.

ACKNOWLEDGEMENT

First and foremost, I praise God, the almighty for providing me this opportunity and granting me the capability to complete my research work successfully, I would like to express my sincere appreciation and deepest gratitude to my advisor, Prof D.S. Ray, for his support, help and guidance during my graduate study. His guidance has made my learning experience a very special one and I am truly fortunate to have had the opportunity to work with him.

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PRASHANT VERMA

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

The black cotton soil is a notable classification of structural designing test. Exibit's enormous volumetric changes diminish and blow up conduct when dampness content changes. In view of this nature this sort of territory is powerless to harm to structures and walkways dependent on it. In india's extensive soils spread about 0.8X106 km2 of the surface zone. The development of the structure in territories with frail soil wants to improve the attributes of the Soil utilizing blending. These Soil stabilization methods are utilized to improve cutting opposition. CBR. diminished expansionary highlights. and so on. Silica fume is known as smaller scale silica is the aftereffect of a high-immaculateness quartz item with carbon in an electric curve broiler in the creation of silicon amalgam or silicon iron metal. The silica fume rises like a corroded steam. It's Black residue sooner or later like Portland concrete. Silicon fume is the most significant silicon dioxide (over 90%) in a non-crystalline structure. is a line of flying air material has a round shape. It is very slight with a molecule size of under 0.1 microns and a particular surface zone of around 20.000 m2/kg. Silica fume is utilized as a blend of unnatural solid well. With regards to silica fume creation. 100.000 tons of small scale silica are delivered worldwide consistently. Iron likewise has a great deal of smaller scale silica creation. The Steel Authority of India has given the essential offices to deliver in excess of 3000 tons of silica fume every year. Many waste materials are utilized to alter the attributes of delicate soils. Customarily soils are balanced out by lime. concrete. and so forth. In the most recent year the employments of waste materials. for example. fly. plastic. rice shell-debris. slag. and so on.

soil stabilization is picking up significance. This examination tries to discover the impacts of silica fume on the building attributes of Black cotton soil. The soil is put away and occurs in a flighty manner. and they are a boundless assortment of possible development that impacts the nature of the Soil. The test workforce looked to improve the mechanical properties of the Soil to meet the structure needs of the office. Since the new systems are available or constantly go marked down.

Today. one-day locales that have been viewed as unsuitable are being utilized for the improvement of new test offices. Structures that create on strong soils can watch out for the basic settlement of the structure.

To help the heap of the structure. and basic to improve the nature of the shear. as far as possible and the lead of soil and Ground change is known as improving the strength or cutoff of the soil bearing utilizing the extent and development of the blend or stabilizer sensible and controlled compaction. In the course of recent years there has been a great increment in the utilization of plastic items which has caused and inc. proportionality of plastic waste. Regardless. just a limited quantity of such materials are reused and reused and the remainder of them are spared or tossed into removal. Fixed or protected plastic waste defiles grimy mass and prosperity. These plastic materials are utilized in littler amounts for development purposes. Examination has demonstrated that the extension of plastic waste in the Soil will prompt an improvement in soil quality characteristics

1.2 Black cotton soil

Black cotton soil are situated in India's enormous Deccan Trap district. They are also thick. clingy Black material is known as "Black cotton soil". Black cotton soil when reached with water or growing or compression and subsequent minutes to the structure that are not identified with the immediate impact of the heap. Because of its high volumetric changes it isn't reasonable for development. It grows and checks unreasonably because of the introduction of fine mud particles. Another growing and narrowing of the Soil is liable for the differential settlement of the structure with the goal that the Black cotton soil ought to be dealt with utilizing appropriate blends to balance out it. In my exploration work the stabilization of the Black cotton soil is completed utilizing spunky waste containers as a blend. Exploratory work was completed on the substance of silica fume (2%.3%.4%.5%.6%) substance of silica vapor and containers of fumes creatures.

The most well-known sort of stabilization is recorded beneath

Stabilization of lime

Concrete stabilization

Chemical stabilization

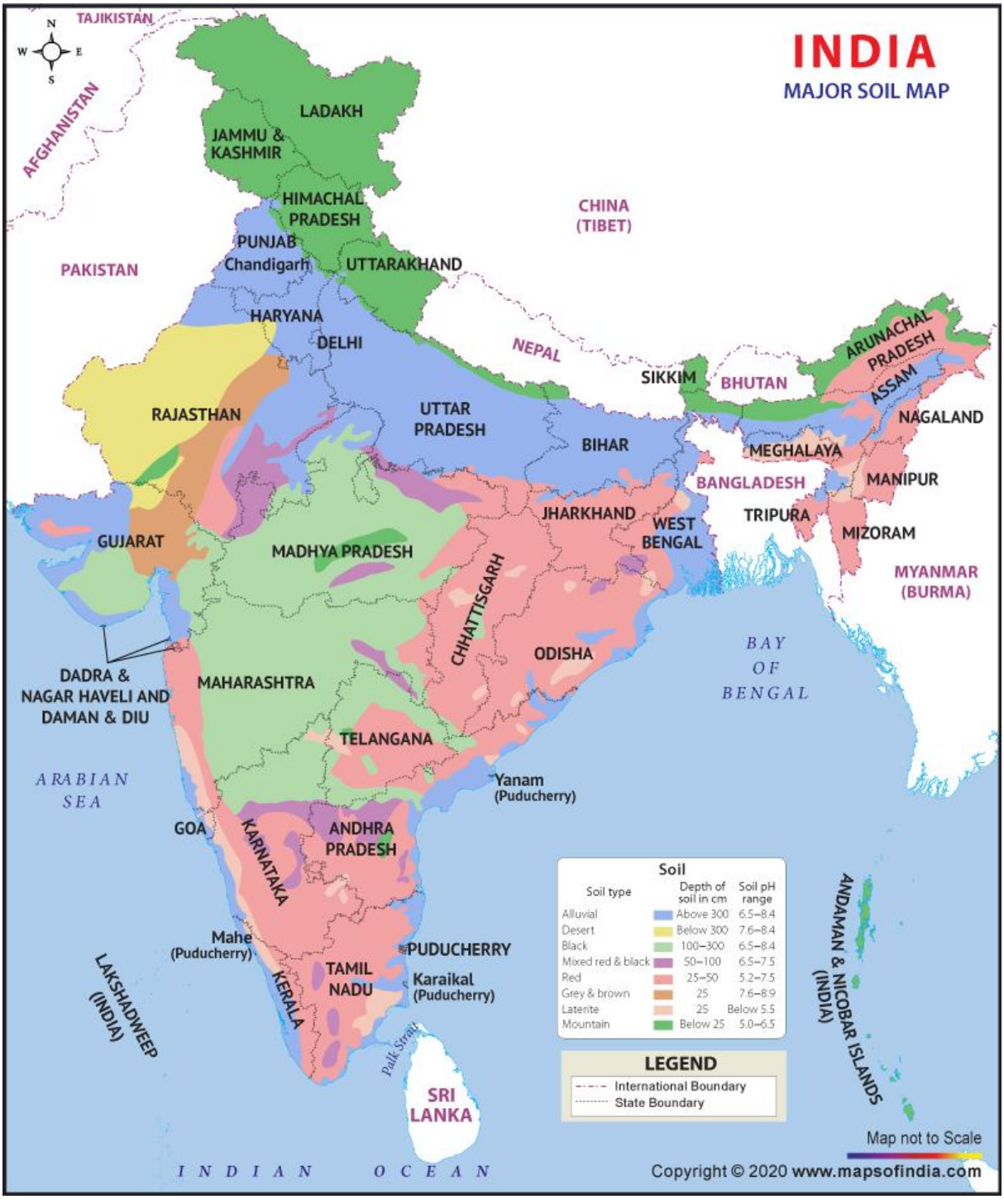
Bitumen stabilization

Salt stabilization

Black cotton soil in India

Practically.25%.of.the.zone.is.involved.by.Black.cotton.soil.in.India..These.Soils.are.generay important.in.the.conditions.of.Andhra.Pradesh..western.Madhya.Pradesh..Gujrat..Maharastra. northern.Karnataka..Tamil.Nadu.and.parts.of.southern.Uttar.Pradesh.(Bundelkhand.zone..The y.are.numerous.mud.soils.and.structure.profound.splits.throughout.the.mid.year.season.".Blac k.cotton.soil".because.of.their.thick.browness.colored.and.cotton.shading.is.developin..They. are.Black.because.of.iron.and.aluminum.mixes..Black.cotton.soils.are.lacking.in.nitrogen..ph osphoric.corrosive.and.natural.issue..yet.wealthy.in.calcium.and.magnesium.potassium.

FIGURE 1.3 INDIA MAJOR SOIL MAP



1.4 ENGINEERING PROPERTIES OF MATERIALS

BLACK COTTON SOIL - THE MUD SOIL WILL HAVE LITTLE AIR COURSE APPEARED DIFFERENTLY IN RELATION TO THE SANDY SOIL. IN ANY CASE. IT CONTAINS A LOT OF FAVORED WATER OVER SAND. IN ANY CASE IT IS EXPOSED TO WATER DEFORESTATION ACHIEVING SETTLEMENT OF THE STRUCTURES.

PET BOTTLES - PET BOTTLES ARE SEMI-FIRM TO SOLIDIFIED AND LIGHT. IT WAS A SENSIBLE HINDRANCE OF MOISTNESS AND GAS AND LIMIT TO ALCOHOL AND SOLVENTS. IT IS INFLUENCE PROTECTED AND STRONG. PET TURNS WHITE WHEN INTRODUCED TO CHLOROFORM AND DISTINCTIVE ENGINEERED MIXTURES. FOR INSTANCE. TOLUENE. PLASTICS ARE FUNDAMENTALLY PARTICULARLY POLYMERISED BLENDS MADE OF CARBON AND HYDROGEN. INCLUDING SUBSTANCES. FOR INSTANCE. OIL AND COMBUSTIBLE GAS. OF THE VARIOUS STRUCTURES. PLASTIC BOTTLES ARE NORMALLY USED WITH BUSINESS MATERIAL PET BOTTLES AFTER USE BECOME A WASTE AND OUGHT TO BE DISPOSED OF SUITABLY. BE THAT AS IT MAY. THERE IS A CHARACTERISTIC ISSUE AS WASTE PET BOTTLES ARE DIFFICULT TO REUSE. REUSE AND START BOTTLES. "POLYETHYLENE TEREPHTHALATE (PET). PET HOLDERS ARE USED TO STORE WATER AND CARBONATED REFRESHMENTS. AFTER USE. PET COMPARTMENTS BECOME A WASTE AND OUGHT TO BE DISPOSED OF IN THE CORRECT MANNER. NEVERTHELESS. THERE IS A CHARACTERISTIC ISSUE. AS WASTE PET BOTTLES ARE DIFFICULT TO REUSE. REUSE AND BIODE

FIGURE 1.4.1WASTE PET BOTTLES

Water - These are the huge components of the Soil. Water. makes the nature of the Soil and should be unblemished and freed from harmful contaminating impacts. for instance. solvent

base. oil. destructive. etc. At the point when everything is said in done. you ought to use water. which is proper for drinking.

Silica Fume - Silica Fume is a ultra-slight powder accumulated as a reaction of the formation of silicon metal composite. It has a roundabout shape and the typical size of silica rage particles is 0.2-0.16 m. It comes in delicate in untidy white tones and in various thing outlines. Solidified silica smolder is essentially silicon dioxide (over 90%) in a non-crystalline structure. The specific zone is about 19.000m2/kg. Silica smolder is used as a fake strong well-and-white mix. To the extent silica smolder creation. practically 90.000 tons of scaled down scale silica are conveyed overall reliably. Iron furthermore has a lot of little scope silica creation..

Figure 1.4.2 silica fume

TABLE 1.4 CHEMICAL PROPERTIES OF SILICA FUME

S.no	Parameters	test value
I	**Chemical test**	
1	silica as SiO_2.% by mass	85.2%
2	Total sulphur content as SO3.%by mass	0.49
3	Lime as CaO.%by mass	6.89
4	Magnesia as MgO.% by mass	4.5
5	Alumina as Al2O3.% by mass	NIL
6	Iron oxide as Fe2O3.%by mass	NIL
II	**Physical test**	
1	Density.g/cc	2.7
2	Particle size distribution(%)	54

1.5Mode of Soil Stabilization

There are a couple of materials being utilized to adjust Black cotton soil. Dependent upon the internal factor that portrays the convergence between the Soil and the stabilizer used. the techniques are widely requested into two sorts:

1. Mechanical adjustment: The rule of pounding. when mixes are added to the ground and the force is compacted as a result of grinding between the Soil and the extra material. Cases of materials that extension resistance with this standard are sand. plastic. geosthests. etc.

2.Chemical adjustment: the compound reaction between the extra material and the minerals in the Soil. Models for this sort of stabilizers are lime. fly flotsam and jetsam. smooth materials. concrete. etc. Plastics are seen as one of the critical manifestations that has immensely helped in different pieces of life. both in the consistent field and in others. The use of plastic has extended an incredible arrangement these days. In any case. by and by. plastic has become the basic defilement in the Bottles on account of the instrument of usage and dispatch and everyone needs to think about this in the current circumstance. The use of plastics must be obliged until further notice. regardless there would be problematic conditions that individuals and the Bottles face in the near future. Since plastic is a non-rotting material. the need to reuse or reuse it in like manner increases. thusly decreasing its waste. The usage

of this plastic waste with a positive explanation helps with diminishing their effect on nature moreover. Adjustment has been created to do anything in a consistent condition which hence is a problematic endeavor. A couple examines are in progress to intertwine waste into the Soil and offset out it with the objective that it might be used for different purposes. Along these lines. the use of plastic as a stabilizer will help in two distinct manners. in keeping an eye on the issue of plastic waste evacuation and besides the usage of the most open Black cotton soil at whatever point possible. This examination suggests the adjustment of Black cotton soil. The right degree in the ground helps with controlling the compaction factor and besides makes it significant. This assessment exhibits that plastic waste can be used for soil adjustment which is shut by different soil tests in various paces of plastic substance.

1.6 Laboratory model test

The research center test is to improve the limit of the ground bearing utilizing waste PET jugs. At first. starter tests are done distinctly with mud soil so as to decide the properties of the dirt. Trial lab test results incorporate as far as possible. the broiler drying technique. strainer examination. hydrometric investigation. Standard Proctor tests. un bound pressure testing. and California bearing proportion

1.7 OBJECTIVE

> Increase the thickness and extent of California soil proportion (CBR) using silica fume and waste PET holders. for instance. an admixture.

>Provide an elective response for the expulsion of plastic waste.

>Provide a sagacious response for soil adjustment using silica fume and wasting PET holders.

>Determine the perfect substance of plastic waste and silica fume to use.

CHAPTER 2

LITERATURE REVIEW

2.1 Soil Stabilization

2.1.1 Definition

Soil Stabilization is the path to toward modifying and certain Soil properties with different methodologies. mechanical and substance as to make and improved soil material that is all the perfect structuring to properties. Soils iso rdinarily settled to assemble their quality and quality and to hinder breaking down and buildup improvement in soils. The essential goal is the arrangement of a material and soil system that is kept up in the structure conditions of usage and for the arranged presence of the structure adventure. The properties of the Soil move and altogether in better to places or every so often even in a singular recognize; The accomplishment of soil adjustment depends upon soil testing. A couple of methods are used to settle the Soil and the technique must be controlled in the lab with soil material before being applied in the field. Norms of soil adjustment:

- Evaluate the Soil properties of the locale feasible.

Settle on the land property that should be changed to get the structure esteem and pick the successful and financially savvy strategy for adjustment.

Plan the balanced out soil blend test and test it in the research facility for the normal soundness and toughness esteems.

2.1..2 Needs and Advantages

a) Soil properties contrast phenomenally and the advancement of structures depends especially upon the buffering furthest reaches of the ground. thusly. we need to settle the Soil which makes it less difficult to foresee the pile furthest reaches of the ground and moreover improve as far as possible. Soil request is in like manner a noteworthy property to consider while working with soils. Soil can be all around qualified. which is appealing. as it has less vacuum cleaner or similarly requested than when it looks stable anyway has more gaps.

Thusly. it is more astute to join different kinds of soils to improve soil check properties. It is over the top costly to replace the lower soil absolutely the Soil and therefore. soil adjustment is what to look for in these cases.

b) Improves the nature of the Soil. along these lines growing the ability to bearing on the ground.

c) It is more affordable to the extent costs and essentialness to extend as far as possible shorewards than to plunge for profound foundations or barge foundations. It is also used to give more soil adequacy on slants or other practically identical spots.

d) Sometimes soil adjustment is furthermore used to thwart soil crumbling or plan. powder. which is useful especially in dry and completely dry air. Adjustment is similarly performed for the ireoization of soil water; This shields water from entering the ground and as such empowers the Soil to lose its quality. It helps with diminishing the adjustment in soil volume on account of changes in temperature or sogginess content. Adjustment improves soil significance and sturdiness

2.1.3 Methods

Mechanical adjustment methodology

In this methodology. soils of different degrees are mixed to get the perfect property in the ground. This should be conceivable on the spot or somewhere else from where it might be adequately transported. The last mix is compacted using the run of the mill procedures to achieve the fundamental thickness. Included substance strategy for adjustment It implies the alternative of things delivered in the Soil. which in agreeable sums improves the idea of the Soil. Materials. for instance. solid. lime. bitumen. fly flotsam and jetsam. etc are used as substance included substances. Now and again different strands are similarly used as fortresses in the ground. The extension of these strands is finished by two methodologies;

Fiber-arranged fortification

The fibers are engineered in a particular solicitation and all the strands are arranged a comparative way. The fibers are arranged layer by layer such a way. Persevering strands as sheets. strips or bars. etc are methodicallly used in this sort of blueprint.

Irregular fiber support

This arrangement has discrete strands passed on self-assertively in the Soil mass. The mixing is done until the Soil ad the stronghold structure an essentially homogeneous mix. Materials used in such a strong holds are ordinarily gotten from paper. nylon. metals or various materials having changed physical properties. Randomly passed on strands have a couple of central focuses over the effectively dispersed fibers. Somehow thusly of stronghold resembles development of admixtures. for instance. solid. lime. etc. Other than being definitely not hard to incorporate and mix. this method similarly offers quality isotropy. lessens probability of potential feeble planes which occur in the other case and offers flexibility to the Soil.

2.2 LITERATURE REVIEW

The structure properties of clayey subgrade soils may ought to be improved to make them sensible for advancement using a kind of adjustment techniques. Adjustment of black-top subgrade soils has for the most part relied upon treatment with lime. cement. or waste materials. for instance. flyash. slags. Silica Fume.etc. Various researchers are looking for elective materials for soil adjustment. fly garbage is an amazing administrator for compound and mechanical adjustment of soil.

[1]**Saranjeet Rajesh :** contemplated that solid waste evacuation is a productive and ground-breaking way to deal with achieve improvement in building execution of Black cotton soils. The steadfastness of soil using fly flotsam and jetsam and rice husk powder can be extended.

[2]**Abd.El-Aziz(2004):** dissected the effect of lime-silica fume stabilizers on structuring properties of clayey subgrades. They summerised that the flexibility record and swell potential decays and CBR regard augments in a general sense. There is improvement in shear quality limit as well.

[3]**Azzawi (2012)** analyzed effect of silica rage extension on lead of silty clayey soils. they investigated that there is basic huge on growing weight and compressive nature of composite models with silica fume.The vulnerability of soil extended with increase in silica fume content. It is seen that the development of silica rage lessens the improvement of parts outwardly of compacted Soil models diminishing the breaks width by 70%

[4]**Venu Gopal.** the Soil properties with silica seethe as stabilizer and differentiating the equal and various materials. The exploration office assessments show that Soil models having low quality can be treated with fluctuating silica fume of 5.5% to 20.5% by weight of dry soil. The remunerated soil tests showed basic improvement in the quality characteristics.

[5]**Biswa(2012)** mulled over the use of rice husk with lime in subgrade soil for a nation road;they surmised that a basically no proportion of lime (3.2%) added to the clayey soil with RHA. improve the CBR worth and compaction traits by and large.

[6]**Sabat and Nanda (2011)** The effect of marble dust with RHA on clearing soil has been concentrated by it has been represented that the CBR and UCS values increase significantly on account of development of these two materials with ordinary extensive soil.

[7]**Kalkan and Addulut (2004**) dissected the sensibility of silica rage for the improvement of water driven limit in landfill. The assumed that Soil mixed in with silica rage in different degrees. has higher confining strength..low growing weight. and high compressive and shear quality.

[8]**M.Karimi and A.Ghorbani (2011)** pondered effect of lime and microsilica admixtures on silty sand soils. in closeness of sulphates.Results demonstrated that the extension of microsilica to the silty sand soil extends the CBR quality and decreases developing. thusly microsilica waste material can be logically used to update the nature of silty soil.

[9]**Tarun Kumar (05. May 2018)** This examination is done on the improvement of the lanes which is huge and required to be adequately ready to support different weights. To address these troubles plastic wastes are used in the kinds of parts of various sizes for recognizing the fundamental rate proportion of plastic strips and giving the elective strategy to masterminding the plastic wastes. To mull over this reinforcing effect of mixed plastic strips in soil. a movement of standard representative and unsoaked CBR tests have been coordinated and subject to this it is seen that the most outrageous dry thickness of plastic mix soil lessens with augmentation of level of plastic strips. and for CBR increases with addition of level of plastic strips inside a particular limit. Taking into account this end should be drawn is that by growing the proportion of plastic substance. while the estimation of OMC increases. There is augmentation in CBR regard for soil with extending the degree of plastic strips. The most extraordinary CBR regard is obtained when the degree of the plastic strips is 0.9% of dry heap of soil. Therefore 0.9% of strips having length of 2.5cm is considered as required whole.

[10]**KirankumarPatil. (07. July 2017)** amazing system for improving the properties of soil.The essential objective of any adjustment method used for growing the quality and solidness of soil. usefulness and constructability of the Soil. Plastic. for instance. shopping packs is used for strengthening the Soil for improving the various properties of soil. Employments of offsetting of soil are growing the shear nature of soil. bearing restriction of foundations and for improving the ordinary soil subgrade for advancement of roads and runways. In this they are used plastic compartment strips and plastic sack strips for adjustment. From this examination end made is there is augmentation in CBR estimation of a Soil and most noteworthy CBR is practiced when 0.70% proportion of plastic holder strips are added to the Soil after further choice of the strips there is decrease in the CBR regard. In the event that there ought to be an event of plastic sack strips. it has been seen that 2% of the total weigh of the Soil is the perfect degree of the strips. we can in like manner state from this assessment that strips cut out of plastic Bottles are favored option over bits of soil packs. to assemble the CBR estimation of the Soil.

[11]**Sayli D. Madavi.(March-April 2017)** For the improvement of any approachable planning structure the foundation is critical as it supports the structure and to achieve this quality adjustment of soil is required. Soil adjustment is done by extension of sensible admixtures like solid. lime. sand. fly garbage. It is required to combine the new methodologies of soil adjustment which can be feasibly used to address the challenges of society. to diminish the measures of the waste and conveying supportive material from the non-important material which can just with critical exertion reused. This examination reviews the preliminary program coordinated for adjustment of Black cotton soil in the Amravati. a Capital of as of late molded Andhra Pradesh state. They performed course of action of CBR testings to find perfect proportion of plastic substance is required for getting most outrageous CBR regard. It will in general be induced that CBR rate keeps growing up to 4.5% plastic substance in the Soil and accordingly it reduces with extending the plastic substance. In this way. we can say that 4.5% of plastic substance is the perfect substance of plastic waste in the Soil. Subsequently. using plastic as a Soil stabilizer is an effective and beneficial use considering the way that there is nonappearance of worthy quality soil for various turns of events. These systems can be viably decreases sullying and address the challenges of Amaravati . and besides to the whole society. conveying significant material from non-accommodating waste materials.

[12]**Sharan Veer Singh. (Feb 2017)** Infrastructure is a noteworthy fragment that affects when all is said in done improvement of Indian economy. For any Structure foundation has the prime centrality. the strong foundation expect critical occupation. Extensive soils. for instance. Black cotton soil makes issues in foundation and for this adjustment of soil is required. This paper base on the Soil adjustment by using plastic waste things. The plastic fuse can improve the quality thusly extending the Soil bearing constraint of the Soil. Use of plastic waste as help which diminishes the evacuation issue of the waste materials. Investigation has been done in India to choose the suitability of these waste materials for Indian lanes. Considering these the further assessment is required to find the perfect proportion of the degree of plastic waste substance. impacts impact on test and for its more ampleness.

[13]**Kindness Joseph Poweth in 2013** explored on protected and gainful expulsion of quarry dust. tire waste and wastes plastic by using them in the pavements sub level. In their paper a movement of CBR and SPT test were accomplished for finding the perfect paces of waste plastics. and quarry dust in soil test. The results demonstrates simply quarry buildup should be mixed in with the Soil plastic mix. to grow its most outrageous dry thickness and is fitting for black-top sub grade. Tires alone are not sensible for sub grade. They contemplated that Soil plastic mixed in with quarry dust keeps up the CBR regard inside beyond what many would consider possible. Soil tire mixed in with quarry dust gives lesser CBR regard than soil plastic quarry dust mix yet it might be used for black-top sub grade.

[14]**Dr. A.I. Dhatrak in 2015** in the wake of researching execution of plastic waste mixed soil as a geotechnical material. it was seen that for advancement of versatile black-top to improve the sub level soil of black-top using waste plastic holders chips is an elective methodology. In his paper a movement of assessments are done on soil mixed in with different degree of plastic (0.5%. 1%. 1.5%. 2 % and 2.5%) to figure CBR. in view of tests that he shut using plastic waste strips will improve the Soil quality and can be used as sub grade . It is traditionalist and eco-obliging procedure to mastermind waste plastic considering the way that there is lack of satisfactory quality soil for banks and fills.

[15]**Akshat Malhotra and Hadi Ghasemain in 2014** mulled over the effect of HDPE plastic waste on the UCS of soil. In a degree of 2%. 3%. 4% and 6% of the greatness of dry soil. HDPE plastic (42 micron) waste was incorporated. They contemplated that the UCS of Black cotton soil developed extension of plastic waste. Right when 4.6 % plastic waste mixed in with soil quality got was 287KN/m2 which is generally extraordinary in light of the fact that for standard soil it was 71.05KN/m2

[16]**Choudhary. Jha and Gill in 2010** indicated the capacity of HDPE to change over as soil support by improving structuring properties of sub grade soil. From waste plastic HDPE strips are procured and mixed self-assertively with the Soil and by fluctuating degree of HDPE strips length and degrees a movement of CBR tests were done on invigorated soil.

There outcomes of CBR tests shows that thought of strip cut from recuperated HDPE is useful as soil fortress in interstate application.

[17]**Rajkumar Nagle in 2014** performed CBR peruses for improving planning execution of sub grade soil. They mixed Polyethylene. Bottles. Food packaging and shopping sacks. etc as stronghold with Black cotton soil. yellow soil and sandy soil. Their examination demonstrated that MDD and CBR regard increases with increase in plastic waste. Weight bearing breaking point and settlement characteristics of picked soil material are in like manner improved.

[18]**AchmadFauzi in 2016** decided the structure properties by mixing waste plastic High Density Polyethylene (HDPE) and waste crushed glass as fortress for sub grade improvement. The compound segment was investigated by Integrated Electron Microscope and Energy-Dispersive XRay Spectroscopy (SEM-EDS). The structure properties PI. C. OMC values were reduced and ϕ. MDD. CBR regards were extended when substance of waste HDPE and Glass were extended.

[19]**Chebet in 2014** researched office assessments to choose the extension in shear quality and bearing constraint of locally available sand in view of unpredictable mixing of fragments of HDPE (high thickness polyethylene) material from plastic shopping packs. A visual examination of the plastic material after tests and assessment exhibits that the extended quality for the strengthened soil is a direct result of moldable tensions arranged in the fortresses. The factors perceived to affect the adequacy of help material were the plastic properties (center. length. width of the strips) and the Soil properties (degree. atom size. shape)

[20]**HatemNsaif in 2013** wrapped up by mixing plastic waste pieces in with two kinds of soil (clayey soil and sandy soil) at different mixing extents (0.2.4.6.8)% by weight exclusively that. there is basic improvement in the nature of soils because of augmentation in inside contact. The degree of augmentation in the purpose of inside scouring for sandy soil is hardly

more than that in clayey soil. anyway there is no vital addition in connection for the two sorts of soils. Moreover. it was derived that due to low unequivocal gravity of plastic pieces there is decreases in MDD and OMC of the Soil.

[21]**NiloCesarConsoli (2000)** Unconfined weight tests. separating moldable tests. and drenched exhausted triaxial pressure tests with neighborhood strain estimation were done to survey the benefit of utilizing self-assertively appropriated obtained from reusing waste plastic fiber got together with quick setting Portland cement to improve the structuring behavior of a uniform fine sand. The extraordinary and the joint effects of fiber content (up to 0.9 wt. %). fiber length (up to 36 mm). solid substance (from 0 to 7 wt. %). and starting mean convincing weight (20. 60. and 100 KN/m2) on the misshapening and quality characteristics of the Soil were inspected using plan of assessments and diverse backslide examination. The results show that the polyethylene terephthalate fiber stronghold improved the zenith and extraordinary nature of both built up and uncemented soil and somewhat reduced the shortcoming of the cemented sand. Besides. the basic immovability was not on a very basic level changed by the consolidation of fibers.

[22]**AgusSetyoMuntohar(May26.2011**) Albeit abundant plastic waste degrading nature may be utilized as sustaining materials. a potential pozzolanic material (rice husk garbage blended in with lime) has transcendent properties in offsetting soils. Structuring behavior of the fair out clayey/silty soil reinforced with self-assertively appropriated discrete plastic waste fibers is inspected in this paper. The results show that the proposed system is outstandingly feasible to improve the structuring properties of the clayey/buildup soil similar to compressive. pliant. and shear quality. which further overhauled the robustness and strength of the Soil. Taking into account the compressive quality. California bearing extent (CBR). shear quality. and disillusionment characteristics. the perfect proportion of fiber mixed in soil/lime/rice husk trash mixes ranges from 0.**5**–0.**9**% of the dry mass.

[23]**ChaoshengTang(02.11.2006)** In the current examination. 13 gatherings of soil tests were set up at three distinct rates of PP-fiber content (for example 0.06%. 0.16% and 0.26% by weight of soil) and two unique rates of concrete substance (for example 5.5% and 8.5% by

weight of soil). and unconfined pressure and direct shear tests were completed after 7-. 14- and 28-day restoring periods. The test outcomes showed that the consideration of fiber fortification inside uncemented and established soil caused an expansion in the unconfined compressive quality (UCS). shear quality and hub endure disappointment. diminished the solidness and the loss of post-top quality. and changed the solidified soil's fragile conduct to a progressively pliable one. The associations at the interface between fiber surface and soil lattice were broke down by utilizing filtering electron microscopy (SEM). It is discovered that the bond quality and grating at the interface appear to be the prevailing instrument controlling the fortification advantage. The conduct at the interface in fiber-fortified uncemented soil was not quite the same as that in fiber-strengthened established soil. The micromechanical properties of fiber/grid interface were impacted by a few elements. for example restricting materials in soil. ordinary worry around the fiber body. successful contact zone of the interface and fiber surface unpleasantness.

2.3 summary of literature review

An intensive report was done on the writing in regards to the most recent improvements in field of soil stabilization. The need of improving on location soil building properties was stressed on. Studies uncover that California Bearing Ratio (CBR). Liquid breaking point. Plastic cutoff. Swelling and Shrinkage rates were the most significant boundaries remembered while selecting the technique for soil stabilization. The essentials of soil stabilization using various materials Silica fume and waste PET containers were investigated. Generally speaking trustworthiness of the asphalt improves because of stabilization and economy in construction can be gotten with decreased by and large thickness of the asphalt. Further in this task we will balance out the Soil utilizing the previously mentioned materials and look at which stabilizer is most appropriate for stabilization both artificially and monetarily.

CHAPTER 3

STUDY OF BLACK COTTON SOIL

3.1 BLACK COTTON SOIL

black cotton soil is routinely not fitting for advancement in view of its powerlesr structure properties. blackcotton soil covering about 29% of the outside of the field in India. The Black cotton soil is also called rigurto soil. by virtue of its improvement in soil supplements. They are incredibly productive and Black. The grounds of the shopase broad (land that is slanted to noteworthy changes in growing and pressure volume) in nature. The broad soil is commonly known as Black cotton soil in view of its concealing and sufficiency for cotton improvement. In the significant shop parts soil shapes in dry seasons and swells in the wet season. Exactly when the water comes into contact with the expansive soil (maintenance of water from Black cotton soil). its volume increases and when the water disperses from the broad soil. its volume lessens and the ground shrinks. This pressure can get rid of the assistance of structures or various structures and cause a malicious sinking. This results in an example of tightening and extending that puts dreary load on the structures. In like manner. the Black cotton soil holds moistness and becomes stick when wet. This property of holding clamminess and releasing it when during times of drought is amazingly important for crops. Soil adjustment or soil improvement is a technique for improving soil properties. Soil improvement is performed by different methods. for instance. the mechanical system and included substance strategy. Dependent upon the condition of the site and various parts that impact. the sort of system is all around picked. On a very basic level. the mechanical technique is over the top costly. The materials used for adjustment are reused steel materials from various organizations. To overcome these irritates related with Black cotton soil. soil improvement in any case called soil adjustment is performed for Black cotton soil by mixing Black cotton soil with a couple included substances (non-dangerous present day squander)

FIGURE 3.1.1 DRY BLACK COTTON SOIL

Figure 3.1.2 Wet black cotton soil

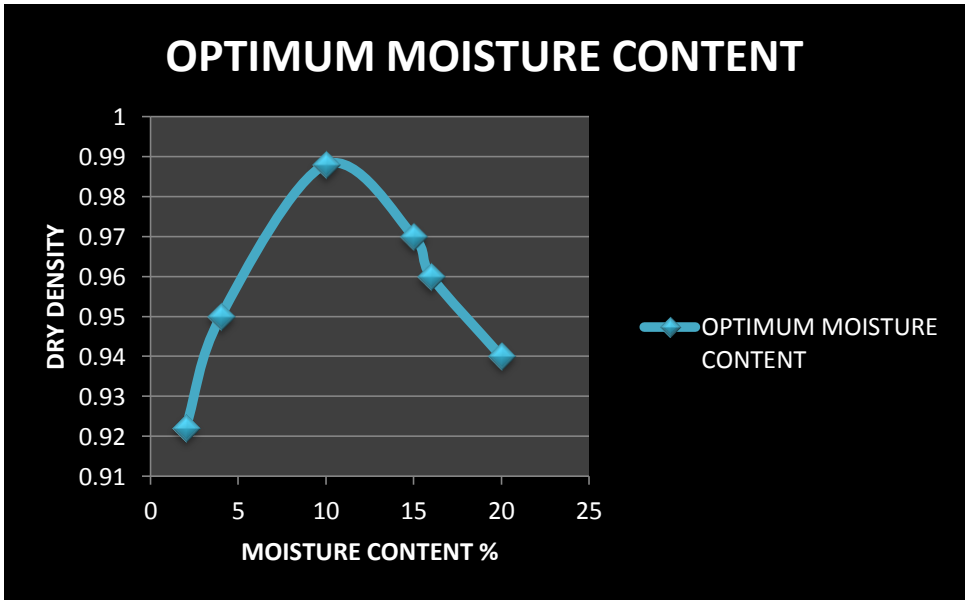
3.2 Laboratory Tests

3.2.1 Optimum moisture content

TABLE 3.2.1 OPTIMUM MOISTURE CONTENT

DRY DENSITY	MOISTURE CONTENT IN %
0.922	2
0.95	4
0.988	10
0.97	15
0.96	16
0.94	20

FIGURE 3.2.1 OPTIMUM MOISTURE CONTENT



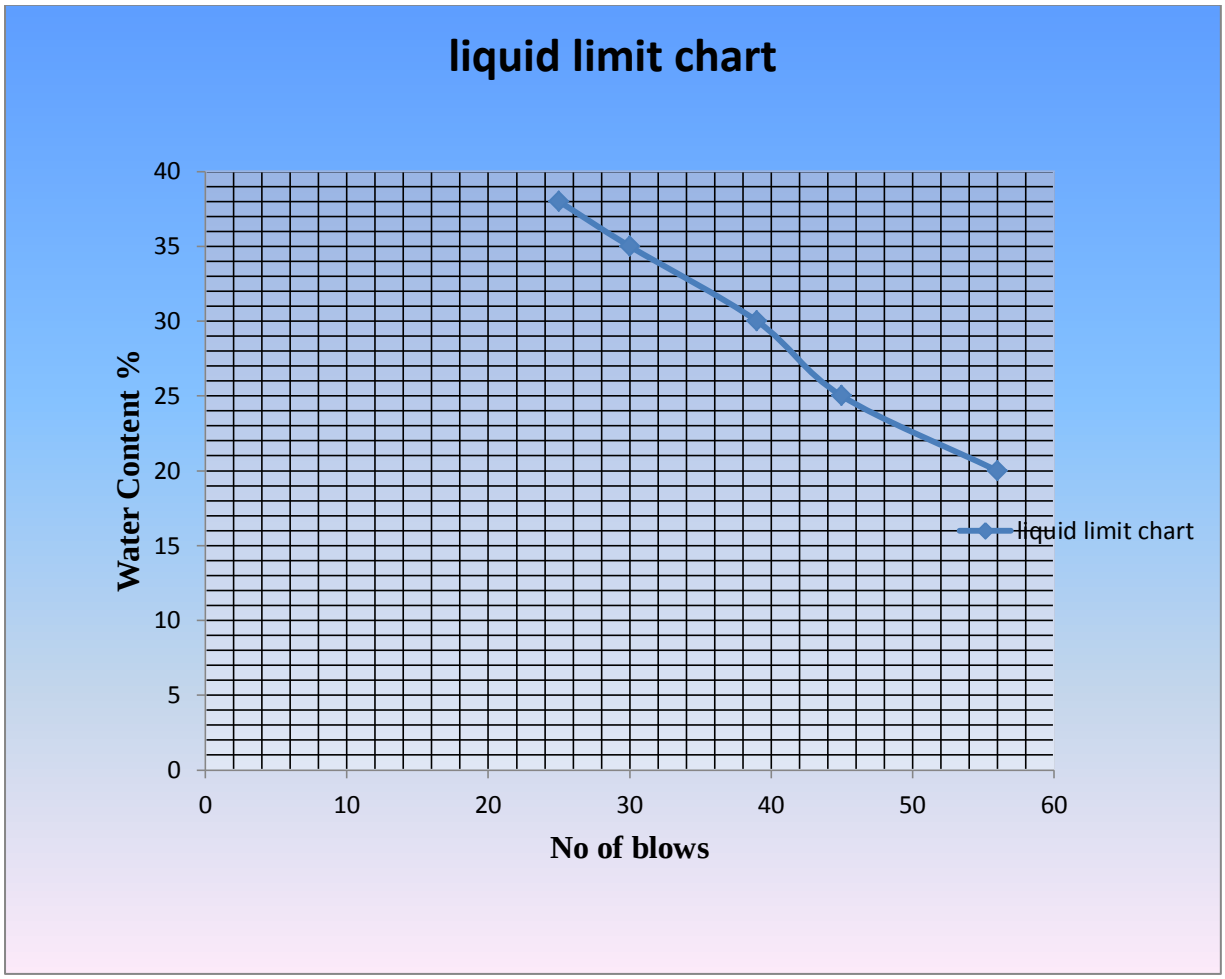
Optimum moisture content =15%

3.2.2 Liquid limit

TABLE 3.2.2 LIQUID LIMIT

Water content %	No of blows
20	56
25	45
30	39
35	30
38	25

FIGURE 3.2.2.1 LIQUID LIMIT CHART



$$\textbf{Plasticity Index} = W_L - W_P$$

$$= 38 - 20$$

$$= 18\%$$

Figure 3.2.2.2 Plastic limit of soil

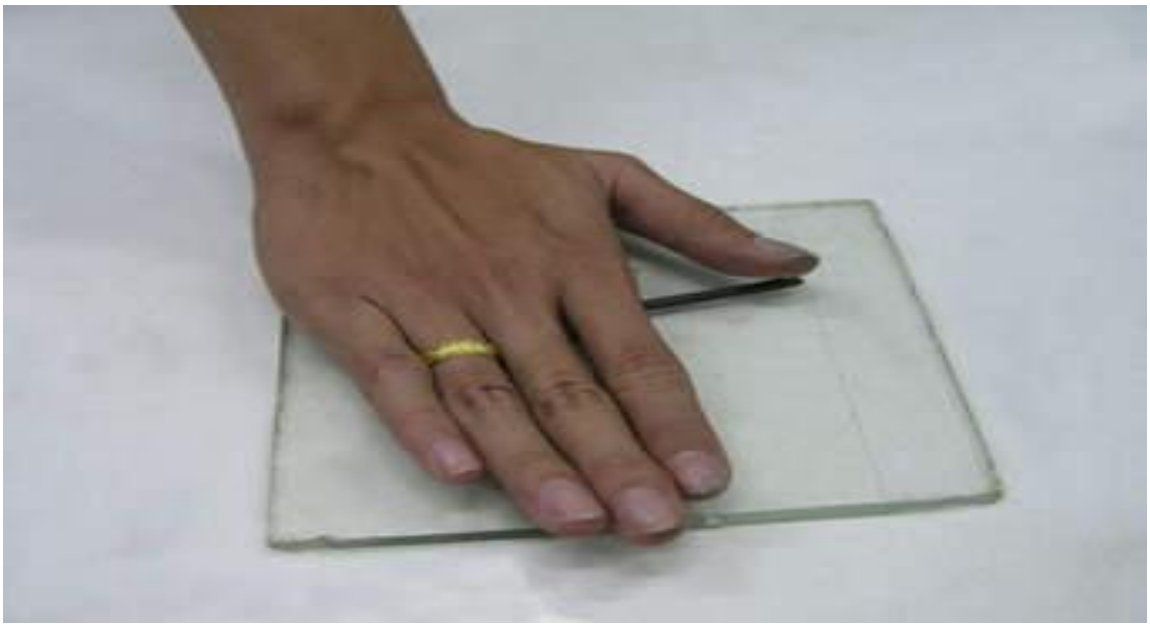
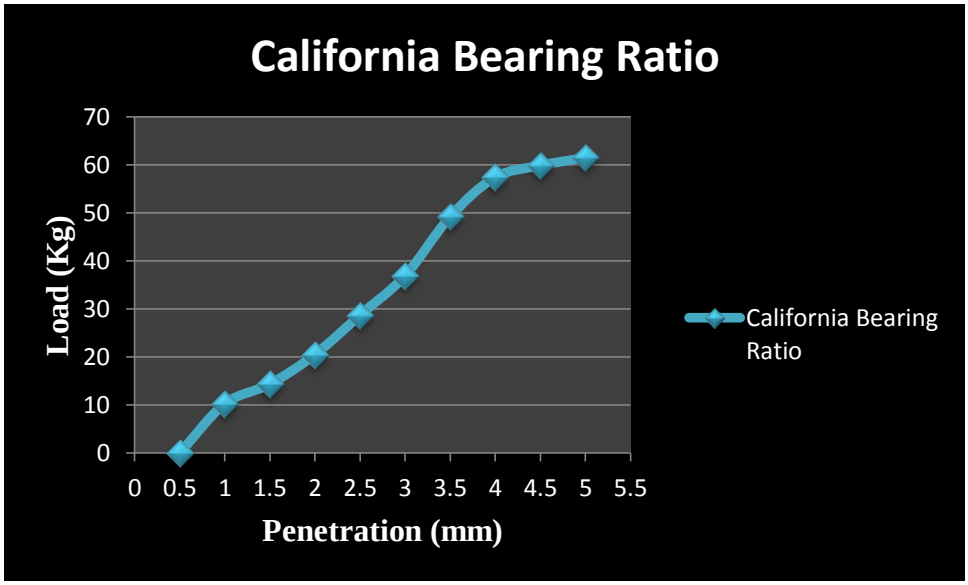


FIGURE 3.2.2.3 CRUMBLE SOIL ROLLED THREAD OF 3.2MM

3.2.3 California Bearing Ratio

Figure 3.2.3 CBR of Black Cotton Soil Without Admixture



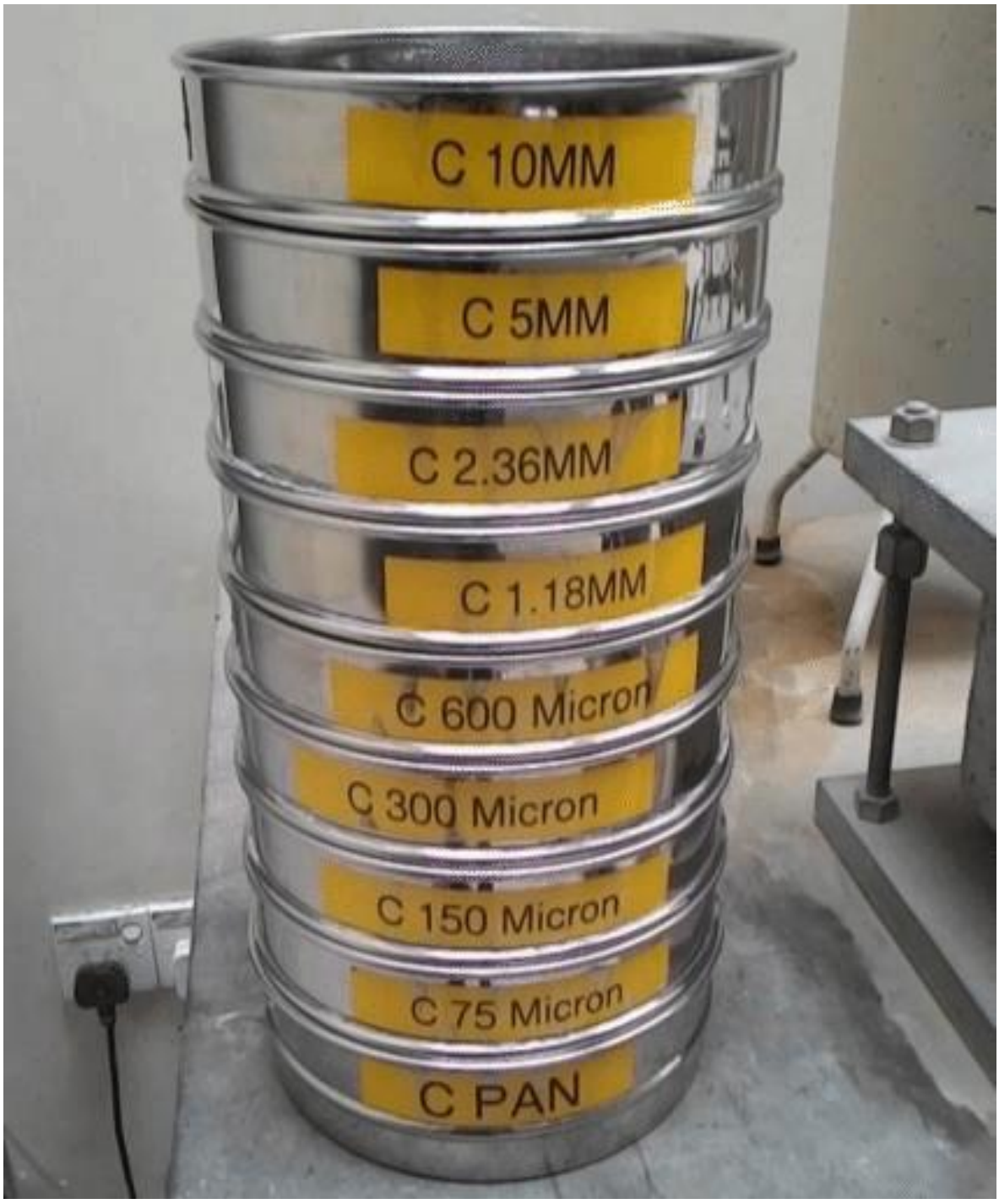
CBR OF BLACK COTTON SOIL WITHOUT ADMIXTURE AT 2.5	**2.094**

3.2.4 Sieve Analysis

TABLE 3.2.4 SIEVE ANALYSIS

S.no	Sieve size (mm)	Soil Retained (gm)	% of Rtained	Cumalative % Retained	% of finer
1	4.75	48	4.8	4.8	95.2
2	2.36	18	1.8	6.6	93.4
3	1.18	50	5.0	11.6	88.4
4	425u	115	11.5	23.1	76.9
5	300u	165	16.5	39.6	60.4
6	150u	166	16.6	56.2	43.8
7	75u	33	3.3	59.5	40.5
8	Pan	405	40.5	100	0

FIGURE3.2.4 SIEVE ANALYSIS



CHAPTER 4

METHODOLOGY

4.1 TEST METHODOLOGY

In this project we focused on increasing the CBR of the soil by using Silica fume and waste PET bottles.

4.1 PRACTICALS TEST

4.1.1 Atterbergs limit

4.1.2 Liquid limit

Table 4.1.2 Liquid Limit for soil.

S.NO	WEIGHT OF DRY SOIL(g)	QUANTITY OF WATER ADDED (ml)	PERCENTAGE OF WATER ADDED(%)	NO.OF BLOWS
1	100	25	25	34
2	100	38	38	26
4	100	42	42	22
5	100	44	44	16

- Liquid limit = 38%

Figure 4.1.2 Casa grande apparatus for liquid limittest

4.1.4 Plastic limit

Plastic limit test

$$Plastic\ limit = \frac{(w_2 - w_3)}{(w_2 - w_1)} * 100$$

TABLE 4.1.4: SHOWS PLASTIC LIMIT FOR SOIL

Wt of empty bottle	(W_1) = 21g
Wt of bottle + Sample before drying	(W_2) = 48g
Wt of bottle + Sample before drying	(W_3) = 42g

$$\text{Plastic limit} = \frac{48-42}{48-21} \times 100$$

Plastic limit =21.4%

Plasticity Index = Liquid limit – Plastic limit

= 38 – 21.4

= 16.6%

FIGURE4.1.4.1 PLASTIC LIMIT OF SOIL

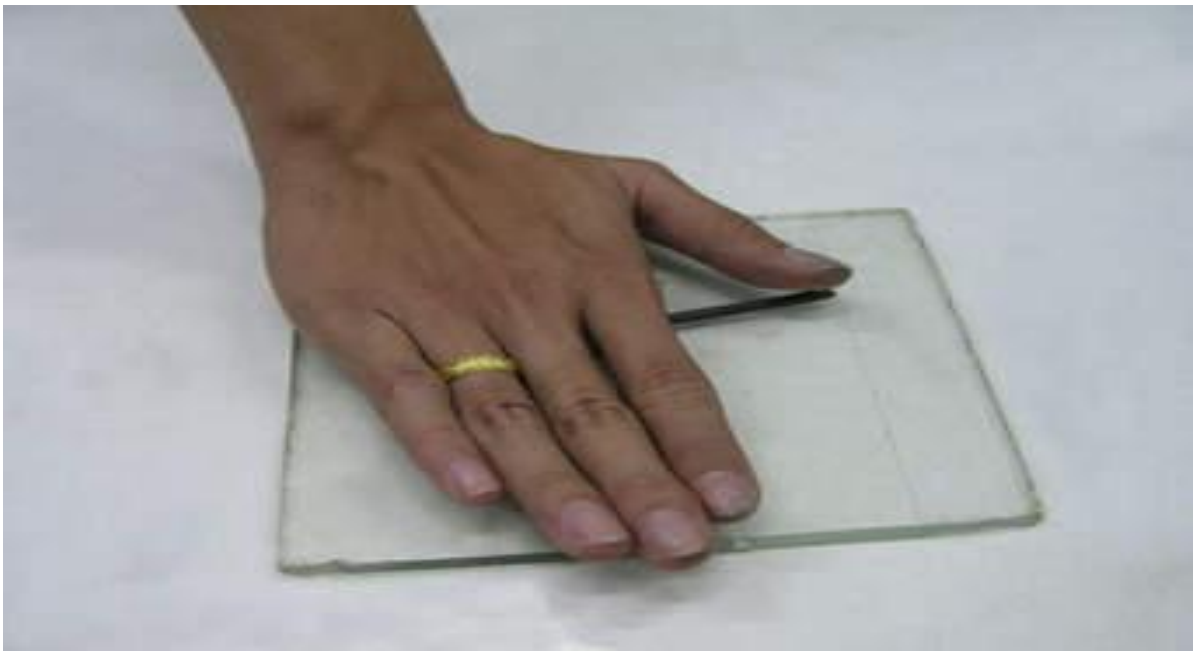


FIGURE 4.1.4.2 CRUMBLE

SOIL ROLLED OF 3.25MM

CHAPTER 5

EXPERIMENTAL TESTS

5.1 CBR OF WASTE PET BOTTLES

Steps to step for making soil sample with Waste PET Bottles added in it is as follows:

- Firstly. we prepare five soil samples each of 4.5 kg. In first sample we mix (2&1%) Silica Fume And Waste PET Bottles of the total weight of the soil sample i.e. 4.5kg. and same procedure is followed for the remaining samples and adds both silica fume and waste pet bottles in different percentages
  (i.e. 2&1%, 2&2%, 2&3%, 2&4%,2&5%, 2&6%)
  (3&1%,3&2%, 3&3%, 3&4%, 3&5%, 3&6%)
  (4&1%, 4&2%, 4&3%, 4&4%, 4&5%, 4&6%)
  (5&1%, 5&2%, 5&3%, 5&4%, 5&5%, 5&6%)
- Then each sample is placed in a mould along with a base plate and displacer disc.
- Then each soil sample was compacted in 3 equal layers. each layer given 56 blows by 2.6 kg hammer.
- Remove the collar and trim off soil.
- Turn the mould upside down and remove the base plate and the displacer disc.
- Base plate along with mould under loading system is fixed.
- Now each sample is tested for CBR at different Penetration levels (i.e. 0.5. 1. 1.5. 2.2.5.3.3.5.4.4.5). And on this basis graphs for each sample is plotted and with the help of it we calculate CBR
- 1 Division is Equal to 4.1kg force.
- Calculate the CBR value Following Formula.

$$CBR = \frac{(Corrected\ Load\ value)}{(Standard\ load)} \times 100$$

FIGURE 5.1.1 CBR AT 2%SILICA AND 1%WASTE PET BOTTLES

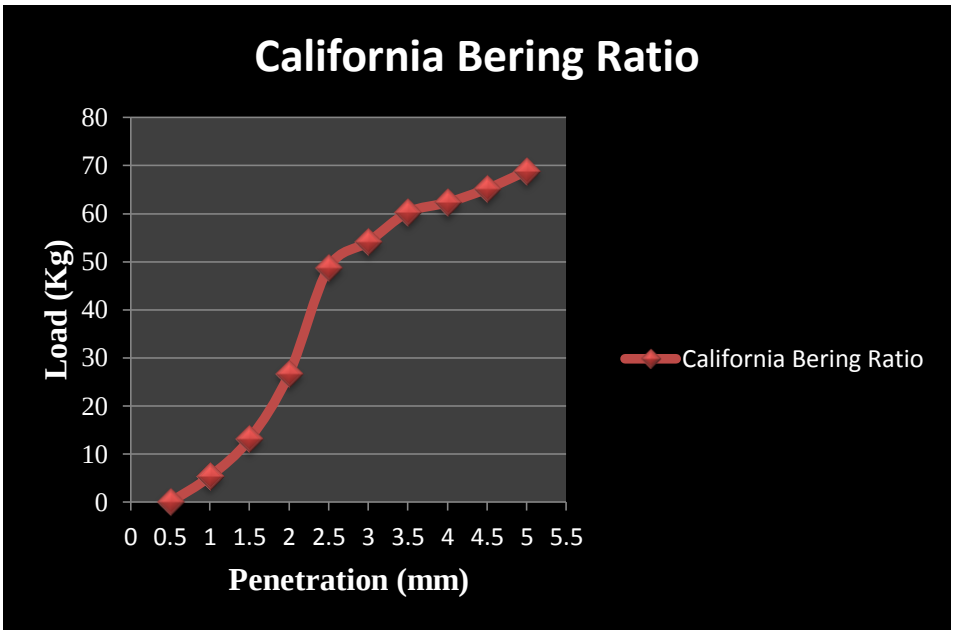


FIGURE 5.1.2 CBR AT 2% SILICA FUME AND 2% WASTE PET BOTTLES

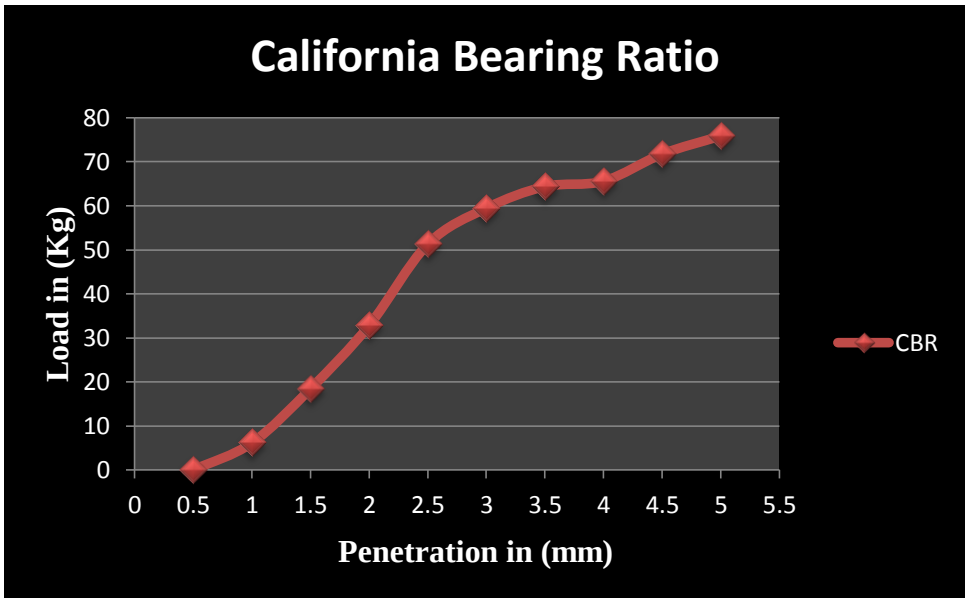


FIGURE 5.1.3 CBR AT 2%SILICA FUME AND 3%WASTE PET BOTTLES

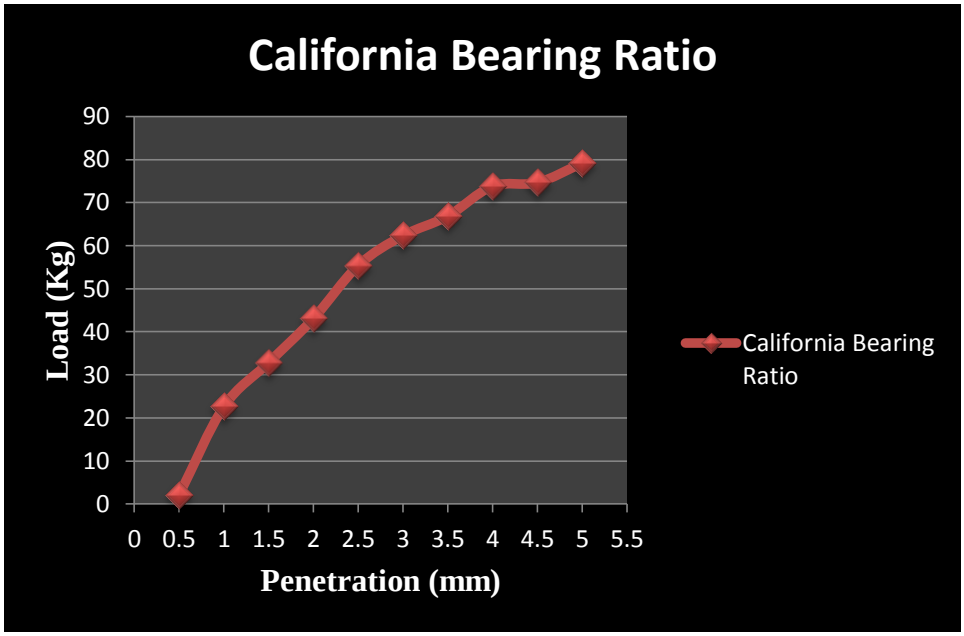


Figure 5.1.4 CBR at 2%silica and 4%waste pet bottles

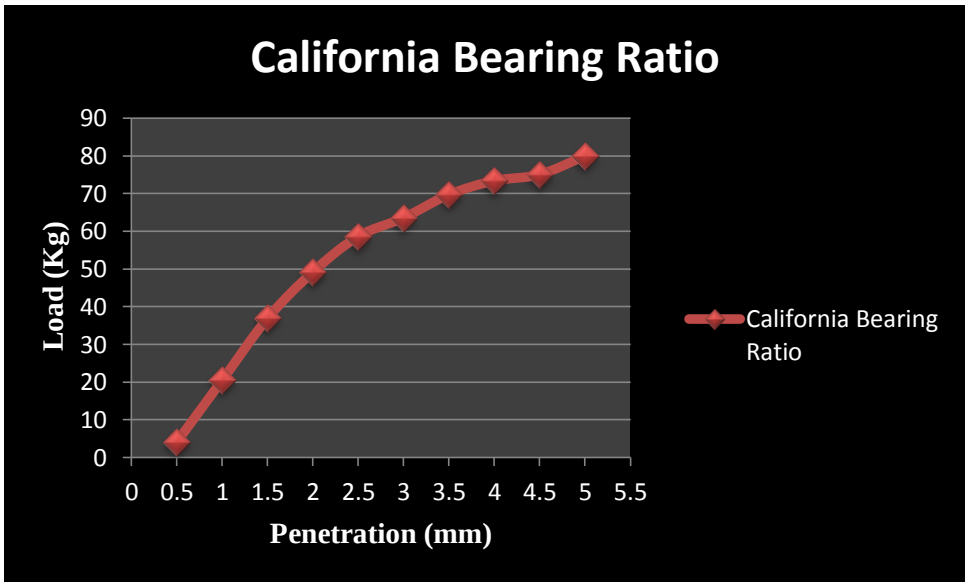


FIGURE 5.1.5 CBR AT 2%SILICA AND 5%WASTE PET BOTTLES

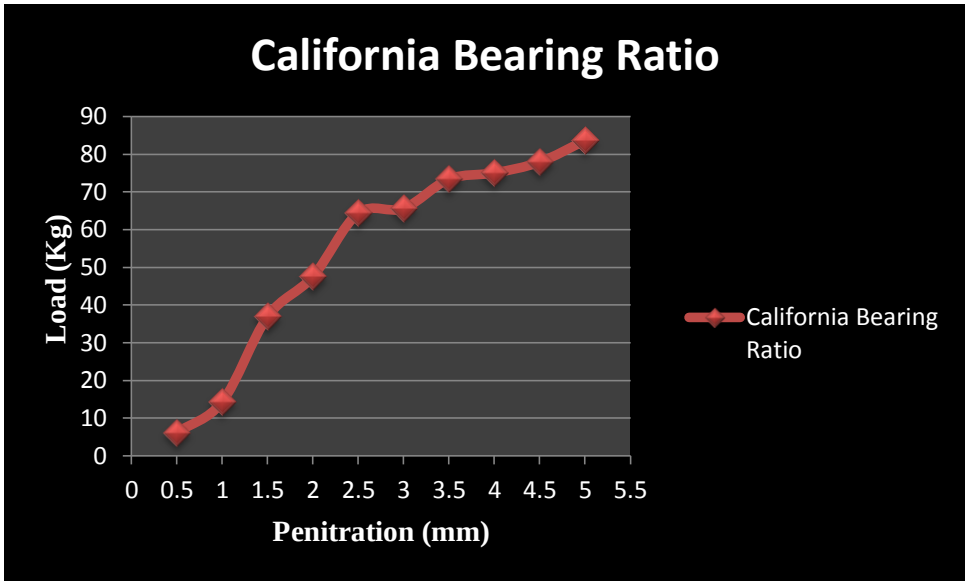


FIGURE 5.1.6 CBR AT 2%SILICA AND 6%WASTE PET BOTTLES

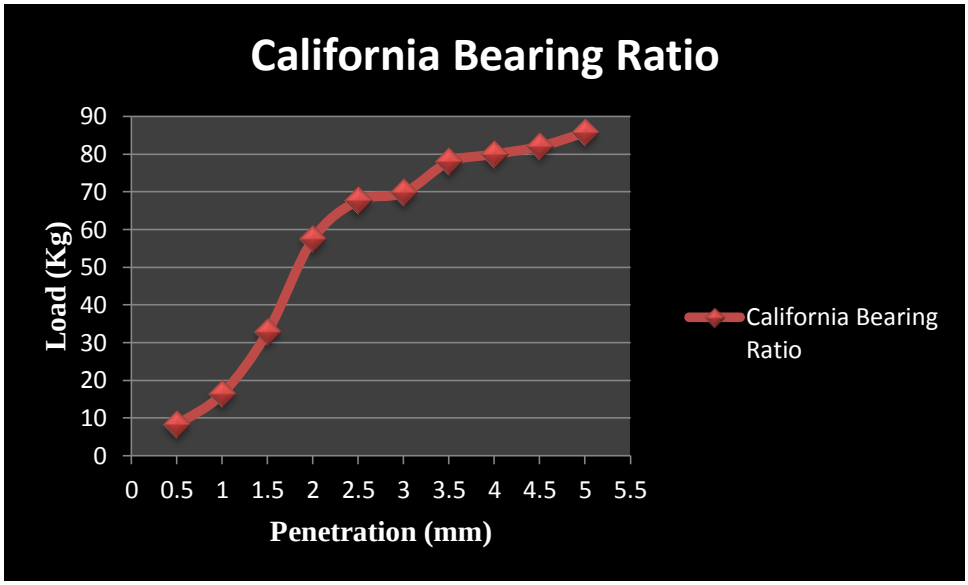


FIGURE 5.1.7 CBR AT 3%SILICA AND 1%WASTE PET BOTTLES

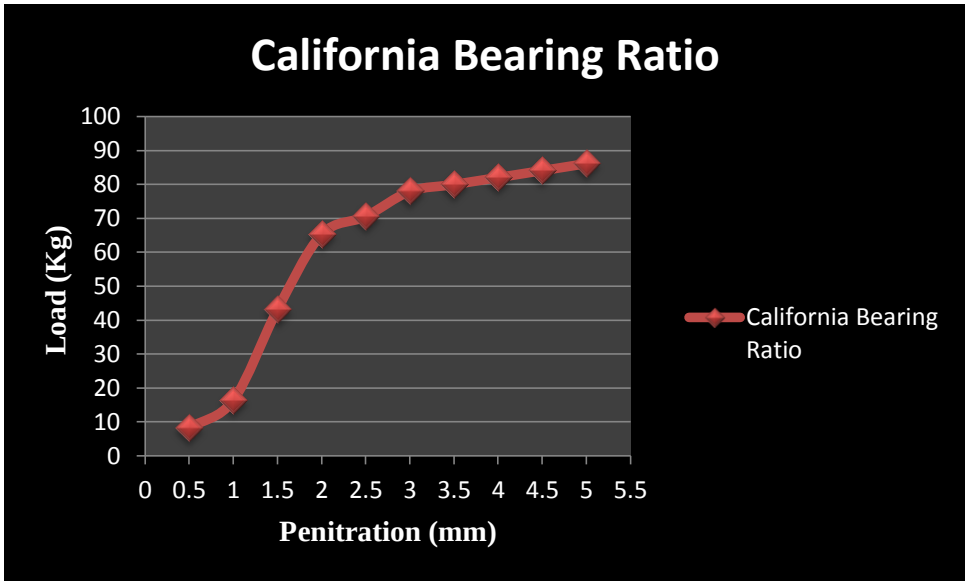


FIGURE 5.1.8 CBR AT 3%SILICA AND 2%WASTE PET BOTTLES

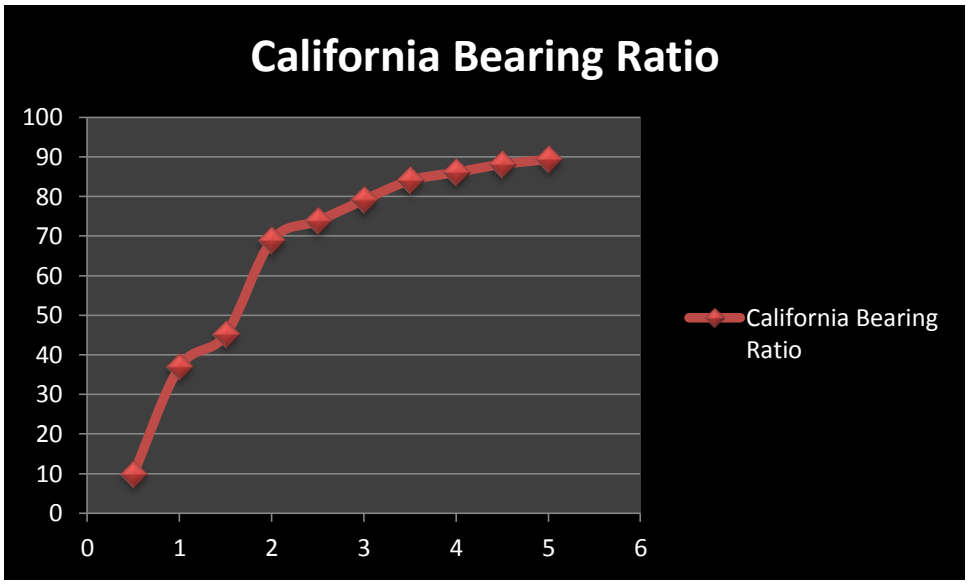


FIGURE 5.1.9 CBR AT 3%SILICA AND 3%WASTE PET BOTTLES

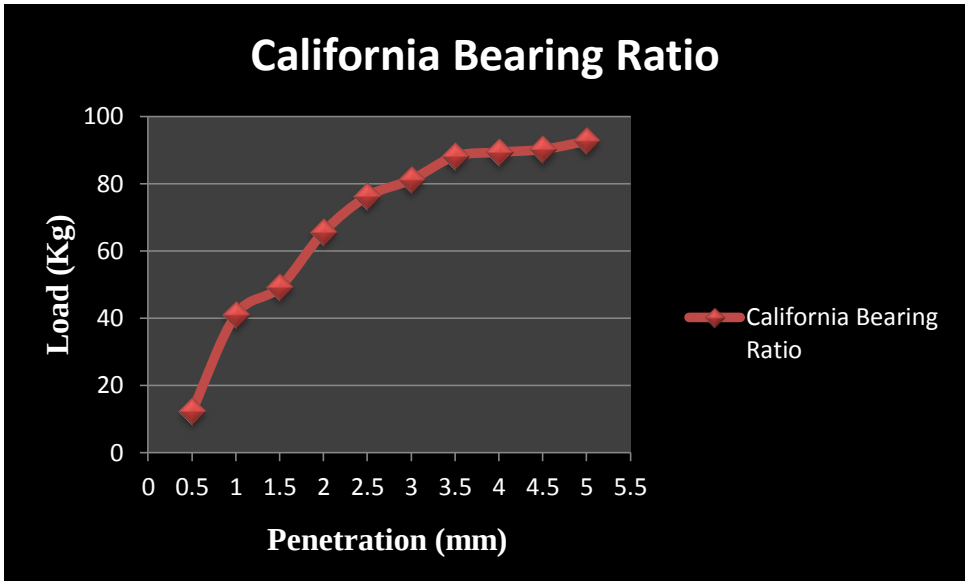


FIGURE 5.1.10 CBR AT 3%SILICA AND 4%WASTE PET BOTTLES

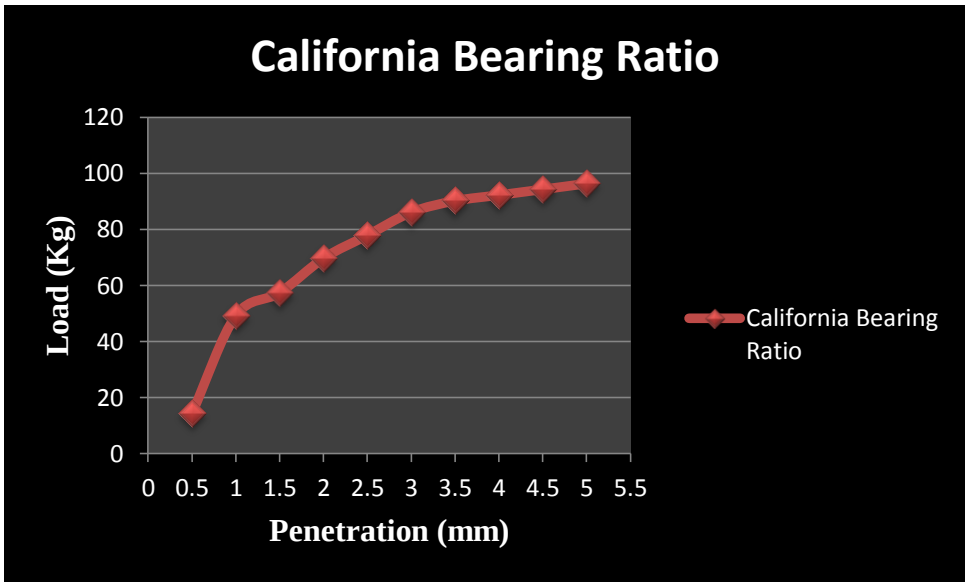


FIGURE 5.1.11 CBR AT 3%SILICA AND 5%WASTE PET BOTTLES

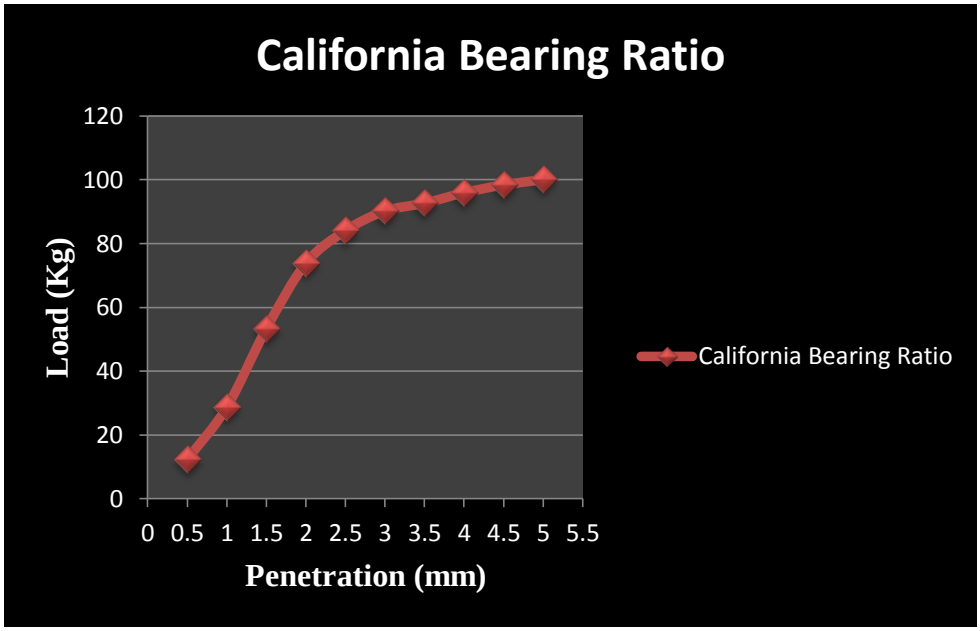


FIGURE 5.1.12 CBR AT 3%SILICA AND 6%WASTE PET BOTTLES

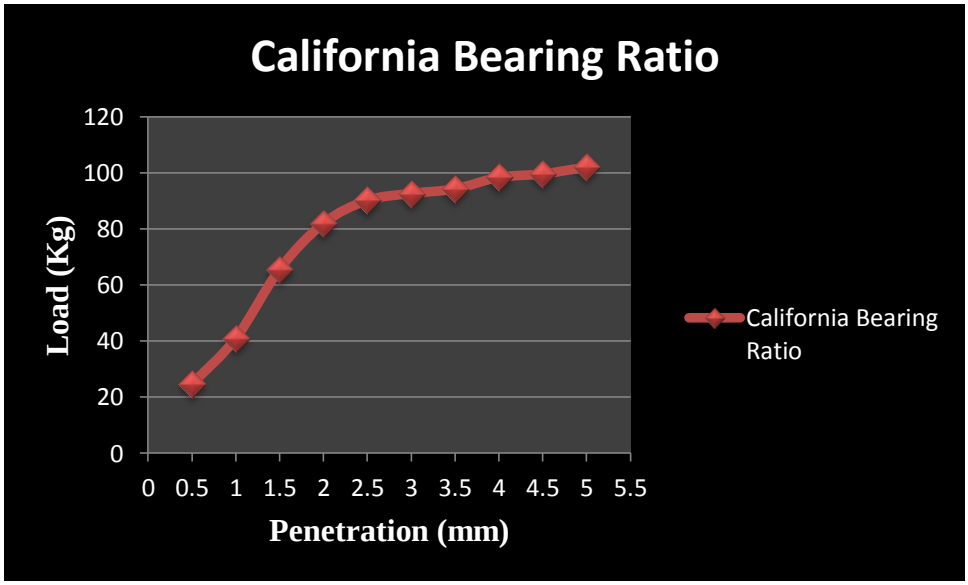


FIGURE 5.1.13 CBR AT 4%SILICA AND 1%WASTE PET BOTTLES

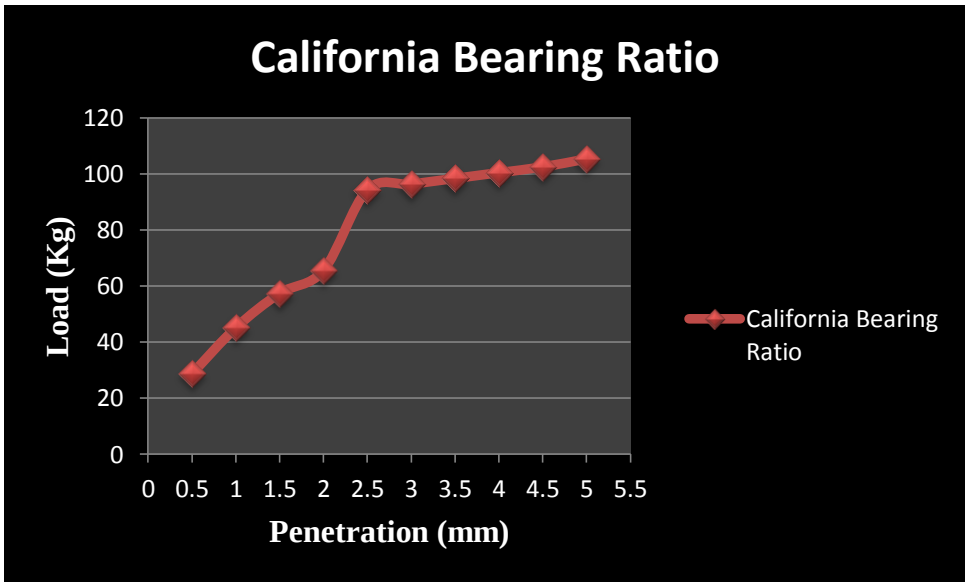


FIGURE 5.1.14 CBR AT 4%SILICA AND 2%WASTE PET BOTTLES

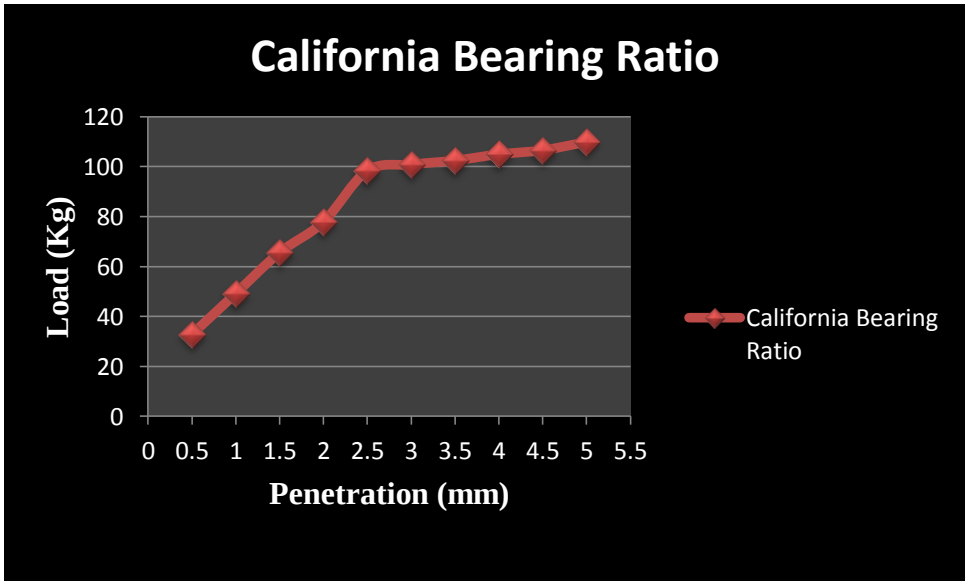


FIGURE 5.1.15 CBR AT 4%SILICA AND 3%WASTE PET BOTTLES

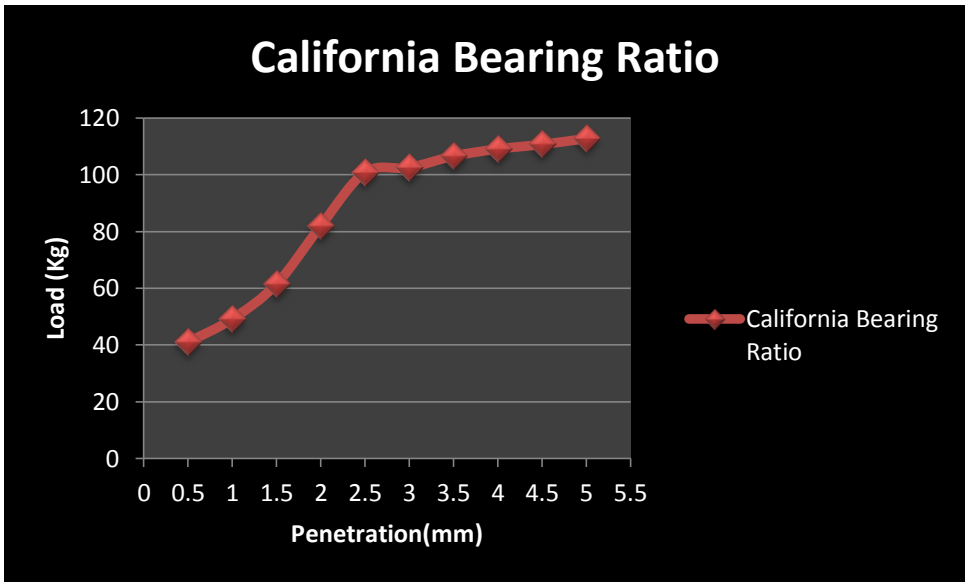


FIGURE 5.1.16 CBR AT 4%SILICA AND 4%WASTE PET BOTTLES

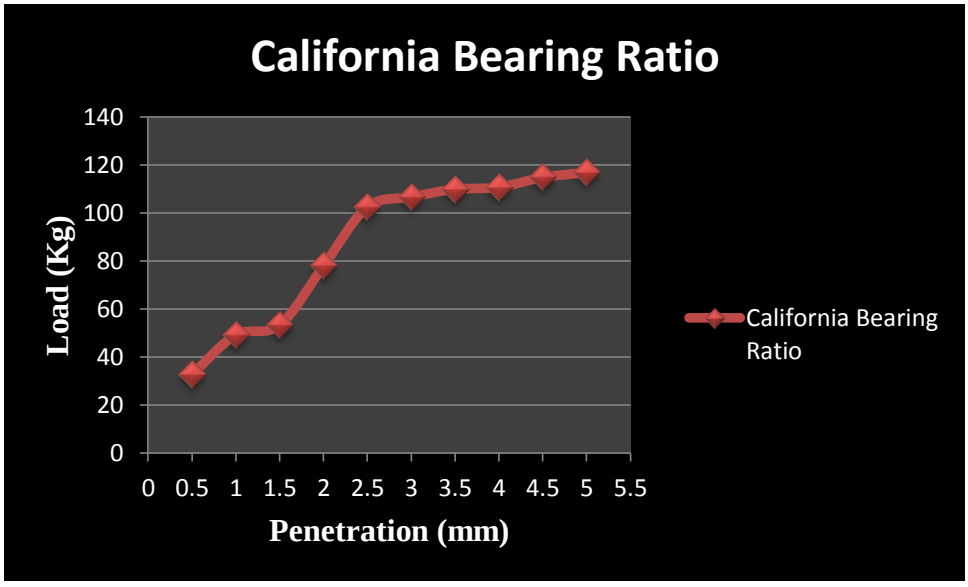


FIGURE 5.1.17 CBR AT 4%SILICA AND 5%WASTE PET BOTTLES

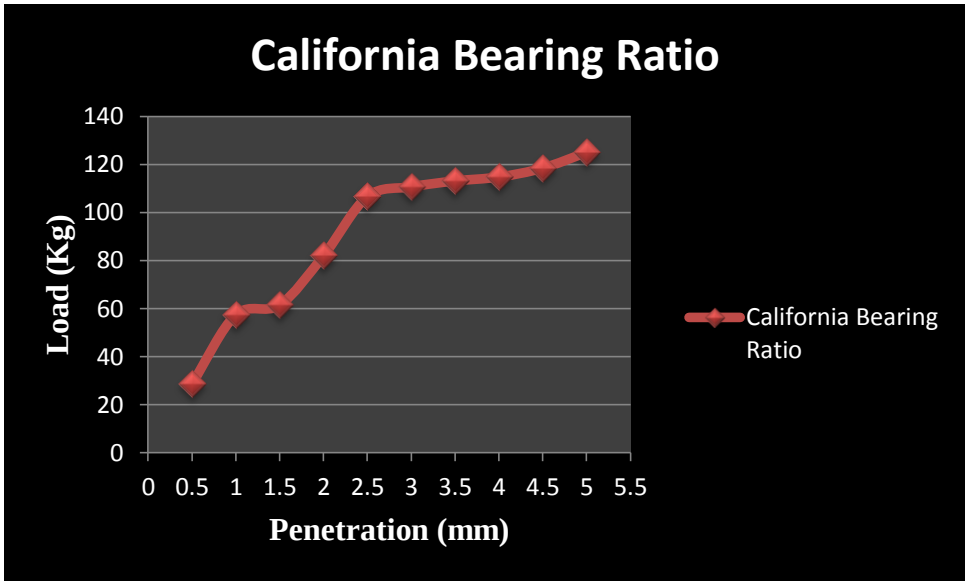


FIGURE 5.1.18 CBR AT 4%SILICA AND 6%WASTE PET BOTTLES

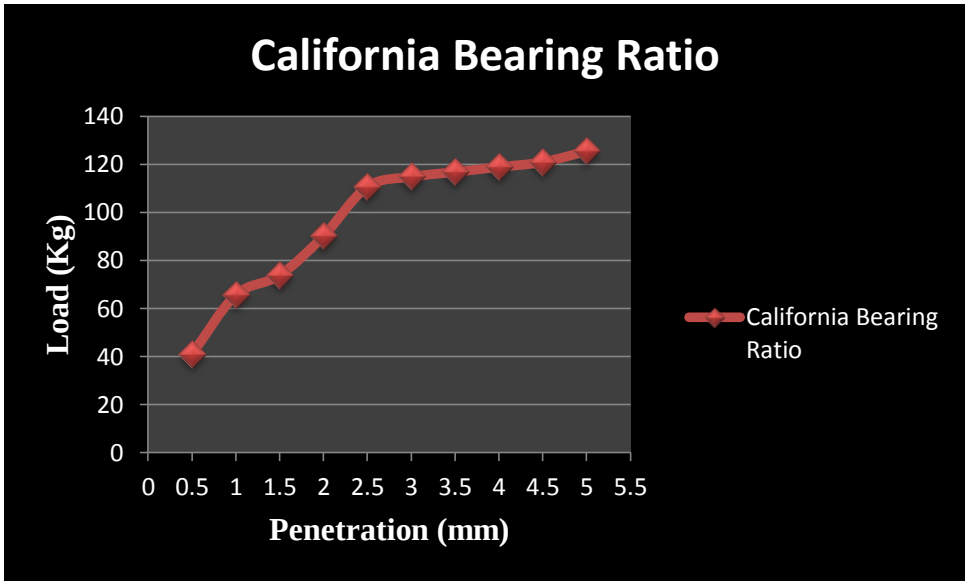


FIGURE 5.1.19 CBR AT 5%SILICA AND 1%WASTE PET BOTTLES

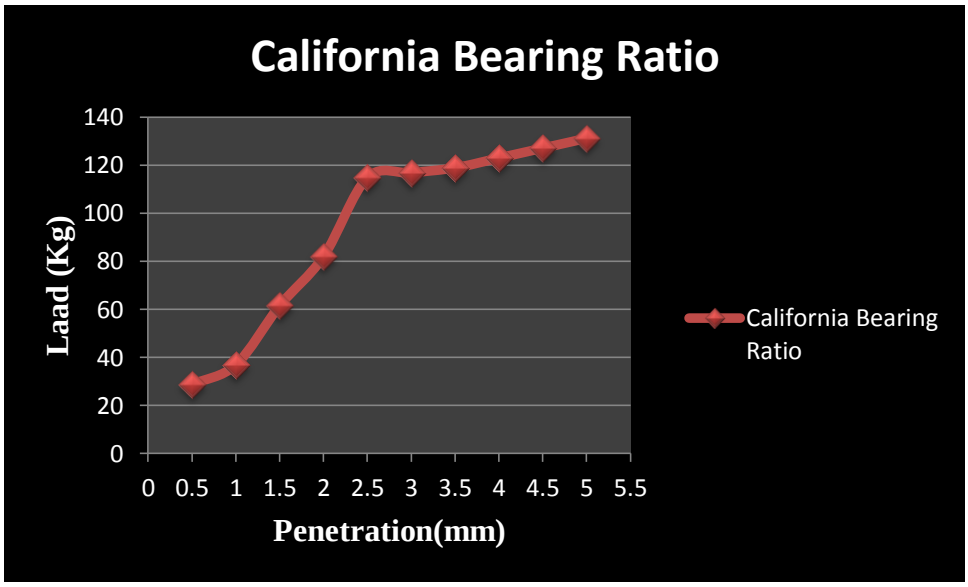


FIGURE 5.1.20 CBR AT 5%SILICA AND 2%WASTE PET BOTTLES

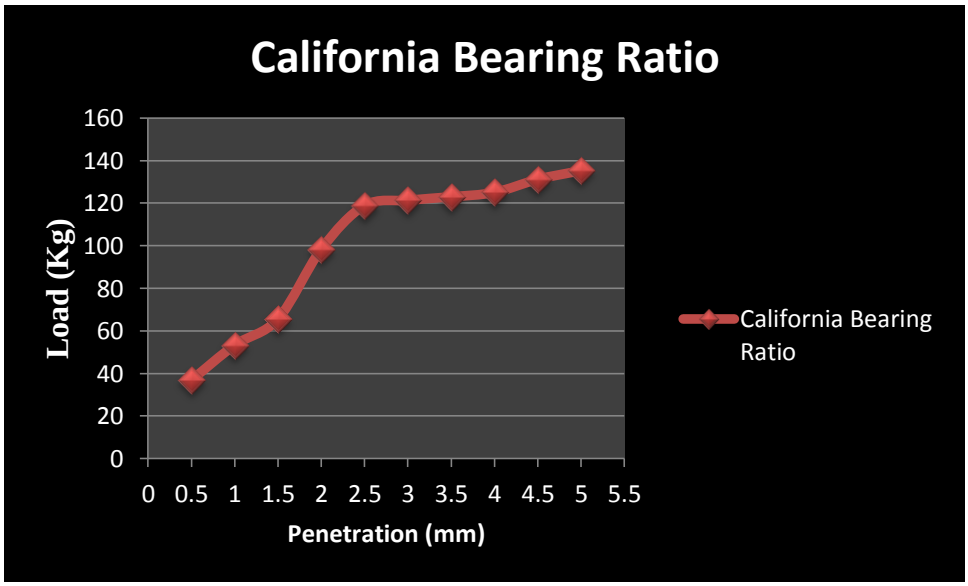


FIGURE 5.1.21 CBR AT 5%SILICA AND 3%WASTE PET BOTTLES

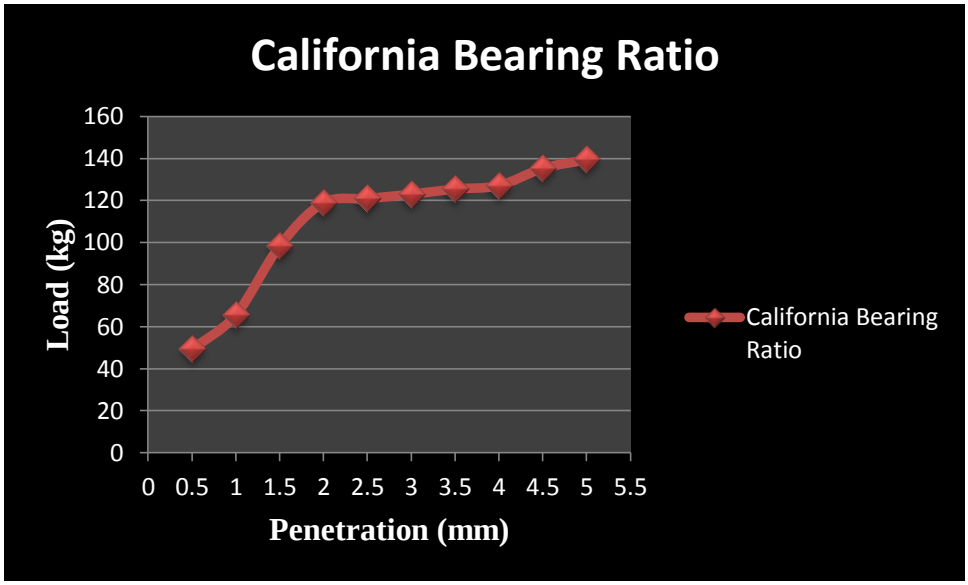


Figure 5.1.22 CBR at 5%silica and 4%waste pet bottles

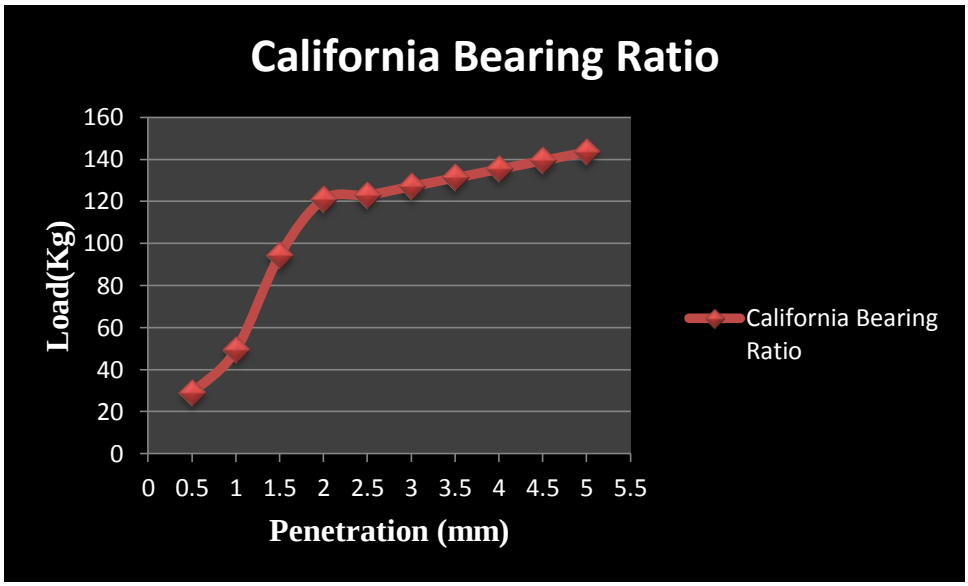


Figure 5.1.23 CBR at 5%silica and 5%waste pet bottles

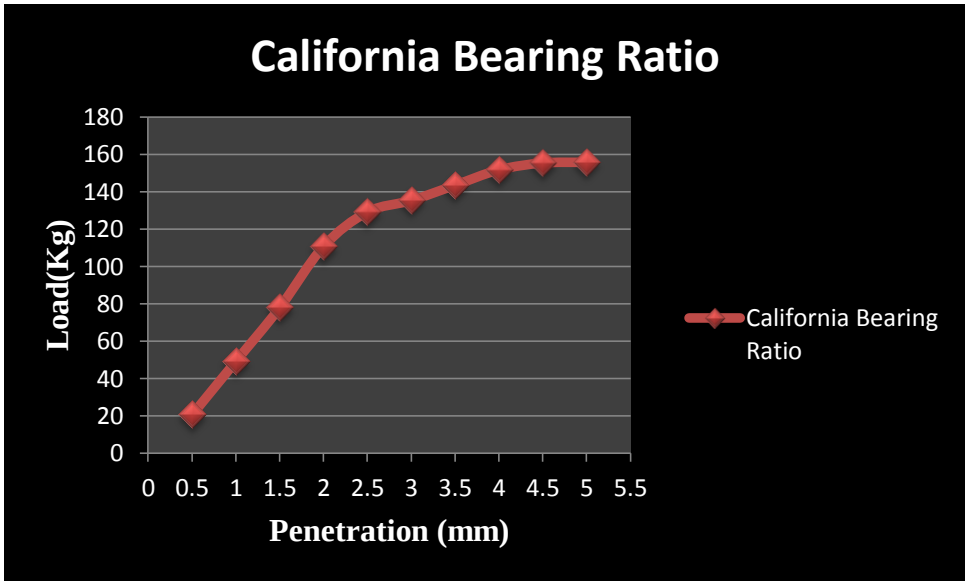
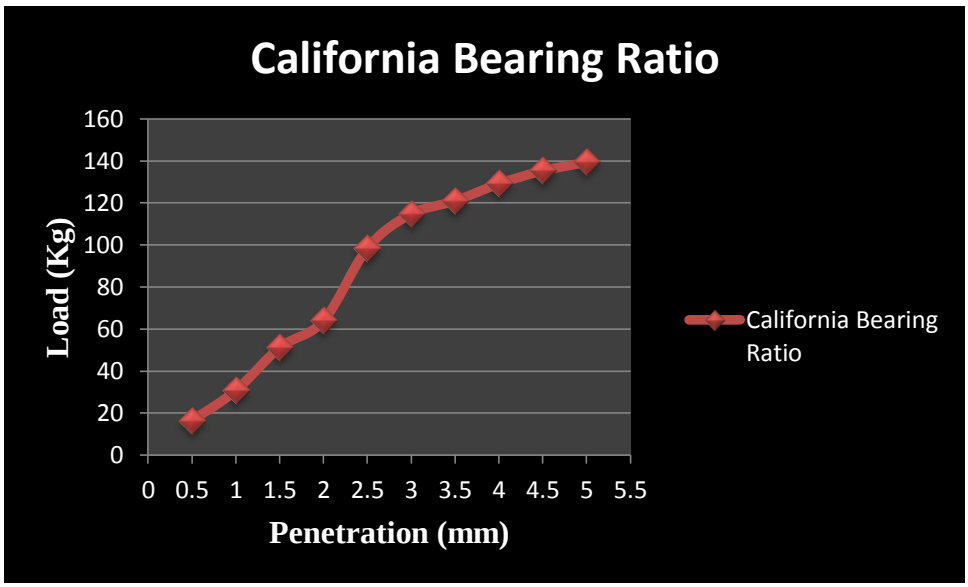


Figure 5.1.24 CBR at 5%silica and 6%waste pet bottles



5.2 PERCENTAGE OF ADMIXTURE

TABLE 5.2 PERCENTAGE OF ADMIXTURE

S.NO	PERCENTAGE OFR ADMIXTURE SILICA FUME AND WASTE PET BOTTLES	CBR AT 2.5
1	2%Silica Fume And 1%Waste PET Bottles	3.56
2	2%Silica Fume And 2%Waste PET Bottles	3.74
3	2%Silica Fume And 3%Waste PET Bottles	4.04
4	2%Silica Fume And 4%Waste PET Bottles	4.27
5	2%Silica Fume And 5%Waste PET Bottles	4.69
6	2%Silica Fume And 6%Waste PET Bottles	4.93
7	3%Silica Fume And 1%Waste PET Bottles	5.15
8	3%Silica Fume And 2%Waste PET Bottles	5.39
9	3%Silica Fume And 3%Waste PET Bottles	5.57
10	3%Silica Fume And 4%Waste PET Bottles	5.69
11	3%Silica Fume And 5%Waste PET Bottles	6.13
12	3%Silica Fume And 6%Waste PET Bottles	6.60
13	4%Silica Fume And 1%Waste PET Bottles	6.89
14	4%Silica Fume And 2%Waste PET Bottles	7.18
15	4%Silica Fume And 3%Waste PET Bottles	7.36
16	4%Silica Fume And 4%Waste PET Bottles	7.48
17	4%Silica Fume And 5%Waste PET Bottles	7.78
18	4%Silica Fume And 6%Waste PET Bottles	8.10
19	5%Silica Fume And 1%Waste PET Bottles	8.38
20	5%Silica Fume And 2%Waste PET Bottles	8.68
21	5%Silica Fume And 3%Waste PET Bottles	8.83
22	5%Silica Fume And 4%Waste PET Bottles	8.98
23	5%Silica Fume And 5%Waste PET Bottles	9.43
24	5%Silica Fume And 6%Waste PET Bottles	7.18

Optimum CBR of admixture Silica Fume And Waste PET Bottles is (5&5%) After calculation the CBR we observed that CBR of the soil sample taken has increased and after Adding (5&5%) Silica Fume And Waste PET Bottles. The CBR is maximum i.e..**CBR=9.43**

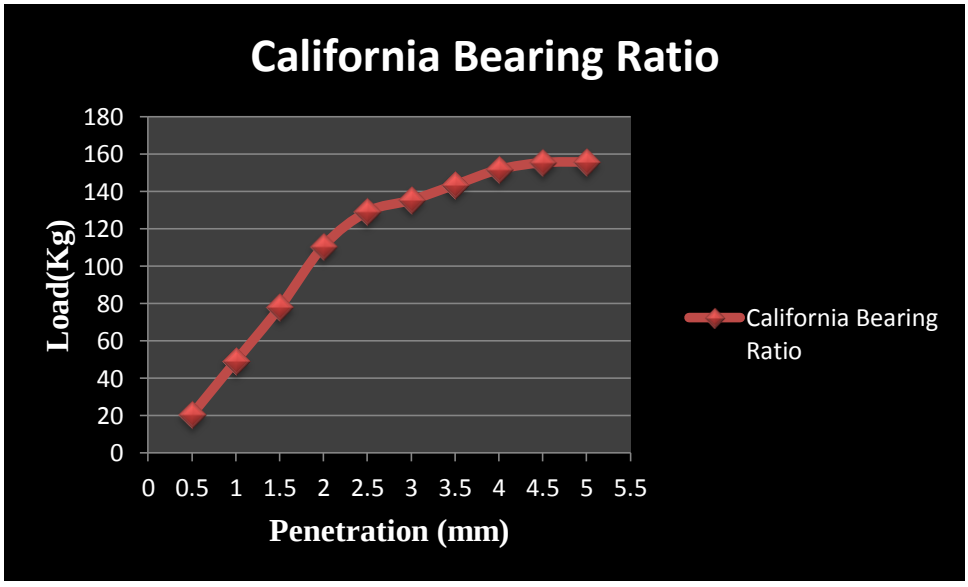
CHAPTER 6

RESULT ANALYSIS AND DISCUSSION

6.1DISCUSSION :

From this study it is clear that there is a considerable improvement in California Bearing Ratio (CBR) of sub-grade due to use of following materials like Waste PET bottles and Silica Fume mixing both (5&5%) the Optimum CBR given **9.43** Therefore study was carried out with Waste PET bottles and Silica Fume to combined graph of all the values of the CBR are obtained from the above mentioned stabilizers. Graph is shown in

FIGURE 6.1.1 OPTIMUM CBR VALUE AT (5&5%) SILICA FUME AND WASTE PET BOTTLES.



6.2Crust thickness :

Calculation of crust thickness: All the calculations are done as per the guidelines of IRC:37:2012

Design Data Required

$$N = \frac{365 \times [(1+r)^n - 1}{r} \times A \times F \times D$$

Where.

N= The cumulative no. of standard axles (8160kg) to be carried by the pavement during the design life in term of msa.

A= Initial traffic in the year of completion of construction.

$$A = P(1+r)^2$$

P= No commercial vehicle as per last count.

D= Lane distribution factor.

F= Vehical damage factor.

N= Design life in year.

r = Annual growth rate of commercial vehicle.

X = no.of year of construction.

CBR Value of Soil Subgrade=9.43

Table 6.2.1 Survey data

Date	1 Axle	2 Axle	MultiAxleTrailer/Tanker	LCV
DAY 1	**372**	**254**	**148**	**1138**
DAY 2	**406**	**267**	**167**	**1265**
DAY 3	**395**	**247**	**195**	**1039**
TOTAL	**1173**	**768**	**510**	**3442**
AVERAGE DAILY	**391**	**256**	**170**	**1147**

TOTAL COMMERCIAL VEHICLE PER DAY=1964

DESIGN PERIOD = 15 YEAR

Total Commercial VehiclePer Day As Per Last Count(P)=1964

Data takes IRC:37-2012

1-Annual growth rate of commercial vehicles (r)=0.5

2-Vehicle damage factor (for plain terrain & CVD 150-1500) as per table 1(F)=4.5

3-Lane distribution factor (D)=0.4 four lane

4-Initial traffic in the year of completion of construction in terms of commercial vehicle per day (A)

$$A = P(1 + r)^2$$

$$A=1964(1+0.075)^2 \approx 2270\text{cvpd}$$

Cumulative Number of Standard axle (csa) :

$$N = \frac{365 \times [(1+r)^n - 1}{r} \times A \times F \times D$$

$$N = \frac{365 \times [(1+0.075)^{15} - 1}{0.075} \times 2270 \times 4.5 \times 0.4$$

$$N = 38952667.94$$

$\approx$ 38.95 msa

TABLE 6.2.2 Crust Thickness

S.NO	ADMIXTURE	CBR VALUE	CRUST THICKNESS				
			TOTAL CRUST IN mm	CRUST COMPOSITION			
				SUB BASE	BASE NON BITUMINOUS	BASE BITUMINOUS	SURFACE COURSE
				GSB IN mm	WBM IN mm	DBM IN mm	BC IN mm
1	NON ADMIXTURE	2.09	915	475	250	150	40
2	WASTE PET BOTTLES AND SLICA FUME	9.43	595	210	250	95	40

6.3 Method of Measurement.

TABLE 6.3.1 Quantity of Bottlest to be Stabilized for 1km length of road and 7m wide.

S.NO	Non Admixture	Quantity	Rates in (Rupees)	Amount
1	**Sub Base (GSB)** =1000 × 7.00 × 0.475 =3325cum	3325cum	3687	12.259.275rs
2	**Base Non Bituminous(WBM)** =1000 × 7.00 × 0.250 =1750cum	1750cum	4124	72.170.00rs
3	**Base Bituminous(DBM)** =1000 × 7.00 × 0.095 =665cum	665cum	8805	5.855.325rs
4	**Surface Course(BC)** =1000 × 7.00 × 0.040 =315Cum	315cum	9664	3.044.160rs
			TOTAL	28.375.760rs

TABLE 6.3.2 Quantity of Bottlest to be Stabilized for 1km length of road and 7m wide.

S.NO	Admixture	Quantity	Rates	Amount
1	Sub Base (GSM) = 1000 × 7.00 × 0.210 =1470cum	1470cum	3687	5.419.890rs
2	Base Non Bituminous(WBM) =1000 × 7.00 × 0.250 =1750cum	1750cum	4124	7.217.000rs
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4	Surface Course(BC) =1000 × 7.00 × 0.040 =315Cum	315cum	9664	3.044.160rs
			TOTAL	21.536.375rs

CHAPTER 7

CONCLUSION

7.1 COST CONCLUSION

TABLE 7.1 COMPARISON COST OF FLEXIBLEPAVEMENT

Cost of Design Pavement Non Admixture	**Cost of Design Pavement Non Admixture**
28.375.760rs	21.536.375rs

Total Saving of cost = 28.375.760 – 21.536.375

= 6.839.385rs

7.2 CONCLUSION

The critical study of the admixture for stabilization indicates that stabilization with admixture is ahead more popularity over other methods of stabilization. However present state or knowledge does not lead to any normal design for such stabilization. therefore the present study was carried out with practical approach of admixture to be added for stabilization. at the present time the cost of construction of a flexible pavement highway are much superior. at last affect the construction of infrastructure of the country. The bitumen and stone ballast and gravel are main constituents of flexible pavement in highway industry. Our country needs massive financial resources to meet out international standard based road infrastructure. To meet out these financial resources. it is now our duty to advance technological innovation to decrease quantity of material resources and improve construction quality to make sure this objective with different type of admixtures i.e. Waste PET Bottles and Silica Fume as admixture were added with changeable percentage in the standard soil passing through

2.36mm. A very important parameter. CBR. California Bearing Ratio. is used as tool for formative the improvement of strength of soil in Highway Construction CBR determined with the help of CBR apparatus by adding admixture (Silica Fume and Waste PET Bottles) with difference from (2&1)% to (5&6)%. The actions of normal soil has changed after adding admixture. The total work was comprised with Zero percentage of admixture in same quality of soil. Each type of admixture with changeable percentage show different development of CBR values. A relative study was carried out with different % of admixture and data were collected or generated. To achieve ultimate objective of study. the crust thickness was evaluate with the help of IRC code "Design of flexible pavement: IRC 37-2018" and traffic (MSA) Million Standard Axles. It was investigated further construction cost difference of each admixture with respect to soil with no admixture with Data Book of Standard Highway – MORTH. Because. admixture were added in whole process. the cost involved in procure different admixture and construction were also considered while comparing the cost of different admixture. It was observed that mixing admixture of (5&5)% was found good quality as admixture to improve CBR. Admixture for soil stabilization to save cost of construction of flexible pavement.

CHAPTER 7

FUTURE SCOPE AND INVESTIGATIONS

Based on the present study findings. it is felt that further work should be pursued in the following area:

- Evaluation could be done with other admixtures like Ligin. Crumb Rubber. Geosynthetics materials etc.
- Assessment should be carried out with nearby available soil which will be more useful for practical purpose.
- Mixture of admixture used for stabilization should be carry out better result.
- Findings of this investigation should be carry tested in field for actual result.
- Environmental condition should also considered in evaluation of the findings for further actual results.

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A Review of Literature on Stabilization of Black Cotton Soil using Silica fume and Waste Pet Bottles

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Abstract:
The most important component in the world is soil and it is base of ecosystem and the present day of the soil is more polluted due to disposal of waste plastic by the human being. The rapid growth of industrialization and urbanization to minimization of industrial waste is a serious Problems to present days. So this research paper is mainly focused on recycling based . Black Cotton soil problematic soil for construction purpose and also be problematic to stabilize due to high possibility of swelling and shrinkage as an effecting and change in moisture content. The objective of this thesis to evaluate and effect in stabilization of sub base of soil and using different types of addition so California bearing ratio and other strength properties test are conducted on soil to check whether and the CBR of black cotton soil is increase or not therefore increase of CBR value is used to decreased the thickness of the design pavement and increasing bearing capacity of soil by using of waste material of silica fume and waste PET bottles adding different proportional like:
(i.e. 2&1%, 2&2%, 2&3%, 2&4%,2&5%, 2&6%)
(3&1%,3&2%, 3&3%, 3&4%, 3&5%, 3&6%)
(4&1%, 4&2%, 4&3%, 4&4%, 4&5%, 4&6%)
(5&1%, 5&2%, 5&3%, 5&4%, 5&5%, 5&6%)
Scrap waste PET bottles is size of 0.5mm.
To improve California bearing ratio. In this project I am tried to evaluate whether on addition of such materials will there be increase in the physical as well as chemical properties of the soil along with it we are expecting certain properties to improve such as CBR value. shear strength. liquidity index. plasticity index. unconfined compressive strength and bearing capacity of soil. Mainly we have focused on increasing the CBR of the soil because on increasing the CBR value it helps in reducing the thickness of the pavement and it is also beneficial to us economically.

I. INTRODUCTION

In nature, soil will deposit and occur in an erratic manner, thus turn out an infinite variety of possible combination which will affect the strength of the soil. For years' research personnel have tried to improve the mechanical properties of soil to suit the requirements of engineering structures. Since new techniques are either available or constantly emerging. Now a day's sites which have been deemed unsuitable, are being put to use for the construction of new challenging structures.

The buildings which are constructed in cohesive soils may tend to easy settlement of the structure. In order to withstand the load of the structure, it is essential to improve the shear strength, bearing capacity and behavior of the soil. Soil stabilization means the improvement of stability or bearing power of the soil by the use of proportioning and the addition of suitable admixture or stabilizer's and controlled compaction. Over the last few years there has been a considerable rise in the use of plastic products which caused a proportionate increase in the plastic waste. But only a lesser quantity of such materials are recycled and reused and rest of them are stored or thrown to the disposal. The disposed or stored plastic waste pollutes the soil mass and causes health problems. These plastic materials are used in lesser quantity for engineering purpose. Several studies have shown that the addition of plastic waste in soil will cause a development in the strength characteristics of soil.

II. LITERATURE REVIEW

[1]**Saranjeet Rajesh:** contemplated that solid waste evacuation is a productive and ground-breaking way to deal with achieve improvement in building execution of Black cotton soils. The steadfastness of soil using fly flotsam and jetsam and rice husk powder can be extended.

[2]**Abd.El-Aziz(2004):** dissected the effect of lime-silica fume stabilizers on structuring properties of clayey subgrades. They summerised that the flexibility record and swell potential decays and CBR regard augments in a general sense. There is improvement in shear quality limit as well.

[3]**Azzawi (2012)** analyzed effect of silica rage extension on lead of silty clayey soils. they investigated that there is basic huge on growing weight and compressive nature of composite models with silica fume. The vulnerability of soil extended with increase in silica fume content. It is seen that the development of silica rage lessens the improvement of parts outwardly of compacted Soil models diminishing the breaks width by 70%

[4]**Venu Gopal.** the Soil properties with silica seethe as stabilizer and differentiating the equal and various materials. The

exploration office assessments show that Soil models having low quality can be treated with fluctuating silica smoke of 5.5% to 20.5% by weight of dry soil. The remunerated soil tests showed basic improvement in the quality characteristics.

[5]**Biswa(2012)** mulled over the use of rice husk with lime in subgrade soil for a nation road;they surmised that a basically no proportion of lime (3.2%) added to the clayey soil with RHA. improve the CBR worth and compaction traits by and large.

[6]**Sabat and Nanda (2011)** The effect of marble dust with RHA on clearing soil has been concentrated by it has been represented that the CBR and UCS values increase significantly on account of development of these two materials with ordinary extensive soil.

[7]**Kalkan and Addulut (2004**) dissected the sensibility of silica rage for the improvement of water driven limit in landfill. The assumed that Soil mixed in with silica rage in different degrees. has higher confining strength..low growing weight. and high compressive and shear quality.

[8]**HatemNsaif in 2013** wrapped up by mixing plastic waste pieces in with two kinds of soil (clayey soil and sandy soil) at different mixing extents (0.2.4.6.8)% by weight exclusively that. there is basic improvement in the nature of soils because of augmentation in inside contact.

The degree of augmentation in the purpose of inside scouring for sandy soil is hardly more than that in clayey soil.anyway there is no vital addition in connection for the two sorts of soils. Moreover. it was derived that due to low unequivocal gravity of plastic pieces there is decreases in MDD and OMC of the Soil.

[9]**NiloCesarConsoli (2000)** Unconfined weight tests. separating moldable tests. and drenched exhausted triaxial pressure tests with neighborhood strain estimation were done to survey the benefit of utilizing self-assertively appropriated obtained from reusing waste plastic fiber got together with quick setting Portland cement to improve the structuring behavior of a uniform fine sand. The extraordinary and the joint effects of fiber content (up to 0.9 wt. %). fiber length (up to 36 mm).

solid substance (from 0 to 7 wt. %). and starting mean convincing weight (20. 60. and 100 KN/m2) on the misshapening and quality characteristics of the Soil were inspected using plan of assessments and diverse backslide examination. The results show that the polyethylene terephthalate fiber stronghold improved the zenith and extraordinary nature of both built up and uncemented soil and somewhat reduced the shortcoming of the cemented sand. Besides. the basic immovability was not on a very basic level changed by the consolidation of fibers.

[10]**AgusSetyoMuntohar(May26.2011**) Albeit abundant plastic waste degrading nature may be utilized as sustaining materials. a potential pozzolanic material (rice husk garbage blended in with lime) has transcendent properties in offsetting soils. Structuring behavior of the fair out clayey/silty soil reinforced with self-assertively appropriated discrete plastic waste fibers is inspected in this paper.

The results show that the proposed system is outstandingly feasible to improve the structuring properties of the clayey/buildup soil similar to compressive.

pliant. and shear quality. which further overhauled the robustness and strength of the Soil. Taking into account the compressive quality. California bearing extent (CBR). shear quality. and disillusionment characteristics. the perfect proportion of fiber mixed in soil/lime/rice husk trash mixes ranges from 0.**5**–0.**9**% of the dry mass.

III. METHOD OF CBR CALCULATION

Steps followed for making soil sample with Waste PET Bottles added in it is as follows:

• Firstly, we prepare five soil samples each of 4.5 kg. In first sample we mix (2&1%)Silica Fume And Waste PET Bottles of the total weight of the soil sample i.e. 4.5kg, and same procedure is followed for the remaining samples and adds waste pet bottles in different percentages

(i.e. 2&1%, 2&2%, 2&3%, 2&4%, 2&5%, 2&6%)
(3&1%, 3&2%, 3&3%, 3&4%, 3&5%, 3&6%)
(4&1%, 4&2%, 4&3%, 4&4%, 4&5%, 4&6%)
(5&1%, 5&2%, 5&3%, 5&4%, 5&5%, 5&6%)

• Then each sample is placed in a mould along with a base plate and displacer disc.

• Then each soil sample was compacted in 3 equal layers, each layer given 56 blows by 2.6 kg hammer.

• Remove the collar and trim off soil.

• Turn the mould upside down and remove the base plate and the displacer disc.

• Base plate along with mould under loading system is fixed.

• Now each sample is tested for CBR at different Penetration levels (i.e. 0.5, 1, 1.5, 2,2.5,3,3.5,4,4.5). And on this basis graphs for each sample is plotted and with the help of it we calculate CBR

• 1 Division is Equal to 4.1kg force.

• Calculate the CBR value Following Formula.

$$CBR = \frac{(CorrectedLoadvalue)}{(Standardload)} \times 100$$

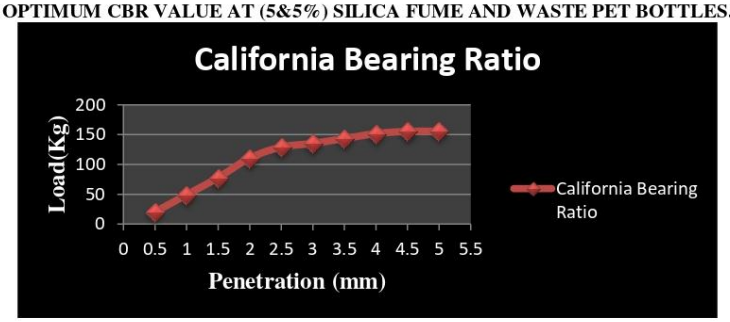
IV. RESULT ANALYSIS AND DISCUSSION

DISCUSSION:

From this study it is clear that there is a considerable improvement in California Bearing Ratio (CBR) of sub-grade due to use of following materials like Waste PET bottles and Silica Fume mixing both (5&5%) the Optimum CBR given **9.43**

Therefore study was carried out with Waste PET bottles and Silica Fume to combined graph of all the values of the CBR are obtained from the above mentioned stabilizers. Graph is shown in

OPTIMUM CBR VALUE AT (5&5%) SILICA FUME AND WASTE PET BOTTLES.



V. DATA COLLECTION FOR CALCULATE CRUST THICKNESS

Calculation of crust thickness: All the calculations are done as per the guidelines of IRC:37:2018

Date	1 Axle	2 Axle	Multi Axle Trailer/Tanker	LCV
DAY 1	372	254	148	1138
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Design Data Required

$$N = \frac{365 \times [(1+r)^n - 1}{r} \times A \times F \times D$$

Where.
N= The cumulative no. of standard axles (8160kg) to be carried by the pavement during the design life in term of msa.
A= Initial traffic in the year of completion of construction.

$$A = P(1+r)^2$$

P= No commercial vehicle as per last count.
D= Lane distribution factor.
F= Vehical damage factor.
N= Design life in year.
r = Annual growth rate of commercial vehicle.
X = no.of year of construction.
CBR Value of Soil Subgrade=9.43

TOTAL COMMERCIAL VEHICLE PER DAY=1964

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DESIGN PERIOD = 15 YEAR
Total Commercial VehiclePer Day As Per Last Count(P)=1964
Data takes IRC:37-2012
1-Annual growth rate of commercial vehicles (r)=0.5
2-Vehicle damage factor (for plain terrain & CVD 150-1500) as per table 1(F)=4.5
3-Lane distribution factor (D)=0.4 four lane
4-Initial traffic in the year of completion of construction in terms of commercial vehicle per day (A)

$$A = P(1+r)^2$$

A=1964(1+0.075)^2 ≈ 2270cvpd

Cumulative Number of Standard axle (csa) :

$$N = \frac{365 \times [(1+r)^n - 1}{r} \times A \times F \times D$$

$$N = \frac{365 \times [(1+0.075)^{15} - 1}{0.075} \times 2270 \times 4.5 \times 0.4$$

$$N = 38952667.94$$

≈ 38.95 msa

Crust Thickness

S.NO	ADMIXTURE	CBR VALUE	CRUST THICKNESS				
			TOTAL CRUST IN mm	CRUST COMPOSITION			
				SUB BASE	BASE NON BITUMINOUS	BASE BITUMINOUS	SURFACE COURSE
				GSB IN mm	WBM IN mm	DBM IN mm	BC IN mm
1	NON ADMIXTURE	2.09	915	475	250	150	40
2	WASTE PET BOTTLES AND SLICA FUME	9.43	595	210	250	95	40

VI. METHOD OF MEASUREMENT:

Quantity of Bottlest to be Stabilized for 1km length of road and 7m wide.

S.NO	Non Admixture	Quantity	Rates in (Rupees)	Amount
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4	**Surface Course(BC)** =1000 × 7.00 × 0.040 =315Cum	315cum	9664	3.044.160rs
			TOTAL	28.375.760rs

Quantity of Bottles to be Stabilized for 1km length of road and 7m wide.

S.NO	Admixture	Quantity	Rates	Amount
1	Sub Base (GSM) = 1000 × 7.00 × 0.210 =1470cum	1470cum	3687	5.419.890rs
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3	Base Bituminous(DBM) =1000 × 7.00 × 0.095 =665cum	665cum	8805	5.855.325rs
4	Surface Course(BC) =1000 × 7.00 × 0.040 =315Cum	315cum	9664	3.044.160rs
			TOTAL	21.536.375rs

VI. 1. COST CONCLUSION

Table.6.1. Comparison Cost Of Flexible pavement

Cost of Design Pavement Non Admixture	Cost of Design Pavement Non Admixture
28.375.760rs	21.536.375rs

Total Saving of cost = 28.375.760 – 21.536.375
= 6.839.385rs

VII. CONCLUSION

The critical study of the admixture for stabilization indicates that stabilization with admixture is ahead more popularity over other methods of stabilization. However present state or knowledge does not lead to any normal design for such stabilization, therefore the present study was carried out with practical approach of admixture to be added for stabilization. at the present time the cost of construction of a flexible pavement highway are much superior, at last affect the construction of infrastructure of the country. The bitumen and stone ballast and gravel are main constituents of flexible pavement in highway industry. Our country needs massive financial resources to meet out international standard based road infrastructure. To meet out these financial resources, it is now our duty to advance technological innovation to decrease quantity of material resources and improve construction quality to make sure this objective with different type of admixtures i.e. Waste PET Bottles and Silica Fume as admixture were added with changeable percentage in the standard soil passing through 2.36mm. A very important parameter, CBR, California Bearing Ratio, is used as tool for formative the improvement of strength of soil in Highway Construction CBR determined with the help of CBR apparatus by adding admixture (Silica Fume and Waste PET Bottles) with difference from (2&1)% to (5&6)%. The actions of normal soil has changed after adding admixture. The total work was comprised with Zero percentage of admixture in same quality of soil. Each type of admixture with changeable percentage show different development of CBR values. A relative study was carried out with different % of admixture and data were collected or generated. To achieve ultimate objective of study, the crust thickness was evaluate with the help of IRC code “Design of flexible pavement: IRC 37-2018” and traffic (MSA) Million Standard Axles. It was investigated further construction cost difference of each admixture with respect to soil with no admixture with Data Book of Standard Highway – MORTH. Because, admixture were added in whole process, the cost involved in procure different admixture and construction were also considered while comparing the cost of different admixture. It was observed that mixing admixture of (5&5)% was found good quality as admixture to improve CBR. Admixture for soil stabilization to save cost of construction of flexible pavement.

VIII. FUTURE SCOPE AND INVESTIGATIONS

Based on the present study findings. it is felt that further work should be pursued in the following area:

• Evaluation could be done with other admixtures like Ligin. Crumb Rubber. Geosynthetics materials etc.

• Assessment should be carried out with nearby available soil which will be more useful for practical purpose.

• Mixture of admixture used for stabilization should be carry out better result.

• Findings of this investigation should be carry tested in field for actual result.

• Environmental condition should also considered in evaluation of the findings for further actual results.

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A Review of Literature on Stabilization of Black Cotton Soil Using Waste Pet Bottles

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Abstract:
Soil is a most essential component of the earth's ecosystem. But now a day's the soil is getting polluted due to disposal of waste plastic materials by human beings. For engineering consideration's, black cotton soil is one of the challenging material for construction purpose, which will not easily get stabilized due to its high potential of shrinking and swelling as an effect of change in moisture content. It will minimize the stability and shear strength of black cotton soil when compared to other types of soil. This paper explains stabilization of black cotton soil through application of PET (Polyethylene Terephthalate) bottles which is efficiently used to come across the challenges of society, to reduce the quantities of plastic wastes, to improve the physical properties of soil, such as shear strength, bearing capacity through controlled compaction. PET (Polyethylene Terephthalate) bottles are used in different proportion (3%, 5%, and 7%) in size is less than 0.5 mm. Then index Properties test, Standard Proctor, Unconfined Compressive, Moisture Content and California Bearing Ratio are conducted to find the properties of soil which will increases the bearing capacity of soil.

Keywords: Soil stabilization, black cotton soil, plastic wastes, PET bottles.

I. INTRODUCTION

In nature, soil will deposit and occur in an erratic manner, thus turn out an infinite variety of possible combination which will affect the strength of the soil. For years' research personnel have tried to improve the mechanical properties of soil to suit the requirements of engineering structures. Since new techniques are either available or constantly emerging. Now a day's sites which have been deemed unsuitable are being put to use for the construction of new challenging structures. The buildings which are constructed in cohesive soils may tend to easy settlement of the structure. In order to withstand the load of the structure, it is essential to improve the shear strength, bearing capacity and behavior of the soil. Soil stabilization means the improvement of stability or bearing power of the soil by the use of proportioning and the addition of suitable admixture or stabilizer's and controlled compaction. Over the last few years there has been a considerable rise in the use of plastic products which caused a proportionate increase in the plastic waste. But only a lesser quantity of such materials are recycled and reused and rest of them are stored or thrown to the disposal. The disposed or stored plastic waste pollutes the soil mass and causes health problems. These plastic materials are used in lesser quantity for engineering purpose. Several studies have shown that the addition of plastic waste in soil will cause a development in the strength characteristics of soil.

Tarun Kumar (05, May 2018) This study is carried out on the development of the roadways which is very important and required to be strong enough to support different loads. To meet these challenges plastic wastes are used in the forms of strips of various sizes for identifying the required percentage amount of plastic strips and providing the alternative way for disposing the plastic wastes. To study this reinforcing effect of mixed plastic strips in soil, a series of standard proctor and unsoaked CBR tests have been conducted and based on this it is observed that the maximum dry density of plastic mix soil decreases with increase of percentage of plastic strips, and for CBR increases with increase of percentage of plastic strips within a certain limit. Based on this conclusion should be drawn is that by increasing the amount of plastic contents, the value of the MDD decreases whereas the value of OMC increases. There is increase in CBR value for soil with increasing the percentage of plastic strips. The maximum CBR value is obtained when the percentage of the plastic strips is 0.8% of dry weight of soil. Hence 0.8% of strips having length of 2cm is considered as required amount.

Kiran kumar Patil, (07, July 2017) Stabilization of soils is an effective method for improving the properties of soil. The main objective of any stabilization technique used for increasing the strength and stiffness of soil, workability and constructability of the soil. Plastic such as shopping bags is used for reinforcing the soil for improving the various properties of soil. Applications of stabilizing of soil are increasing the shear strength of soil, bearing capacity of foundations and for improving the natural soil subgrade for construction of highways and airfields. In this they are used plastic bottle strips and plastic bag strips for stabilization. From this study conclusion made is there is increase in CBR value of a soil and maximum CBR is achieved when 0.75% amount of plastic bottle strips are added to the soil after further addition of the strips there is decrease in the CBR value. In case of plastic bag strips, it has been observed that 2% of the total weigh of the soil is the optimum proportion of the strips, we can also state from this study that strips cut out of plastic bottles are

better option than strips of soil bags, to increase the CBR value of the soil.

Sayli D. Madavi,(March-April 2017) For the construction of any civil engineering structure the foundation is very important as it supports the structure and to achieve this strength stabilization of soil is required. Soil stabilization is done by addition of suitable admixtures like cement, lime, sand, fly ash. It is required to incorporate the new techniques of soil stabilization which can be effectively used to meet the challenges of society, to reduce the quantities of the waste and producing useful material from the non-useful material which cannot easily recycled. This study reviews the experimental program conducted for stabilization of black cotton soil in the Amravati, a Capital of newly formed Andhra Pradesh state. They performed series of CBR testings to find out optimum amount of plastic content is required for obtaining maximum CBR value. It can be concluded that CBR percentage goes on increasing up to 4% plastic content in the soil and thereon it decreases with increasing the plastic content. Hence, we can say that 4% of plastic content is the optimum content of plastic waste in the soil. Thus, using plastic as a soil stabilizer is an economical and gainful usage because there is lack of good quality soil for various constructions. These techniques can be serves the purpose of reducing pollution and meet the challenges of Amravati, and also to the whole society, producing useful material from non-useful waste materials.

Sharan Veer Singh, (February 2017) Infrastructure is a major sector that propels overall development of Indian economy. For any Structure foundation has the prime importance, the strong foundation plays very important role. Expansive soils such as black cotton soil creates problems in foundation and for this stabilization of soil is required. This paper focus on the soil stabilization by using plastic waste products. The plastic inclusion can improve the strength thus increasing the soil bearing capacity of the soil. Use of plastic waste as reinforcement which reduces the disposal problem of the waste materials. Research has been done in India to determine the suitability of these waste materials for Indian roads. Based on these the further study is required to find out the optimum amount of the percentage of plastic waste content.

II. CONCLUSION

Based on the review of the various research paper we can conclude that plastic strips in optimum amount with suitable dimension is feasible for improving the engineering properties of soil. Plastic can be utilized as one of the materials that can be used as soil stabilizing agent in proper proportion of plastic must be there, which helps in increasing the CBR of the soil. Thus, using plastic as a soil stabilizer is economical and gainful use in construction as there is lack of good quality soil for various construction. Reducing the amount of plastic waste and producing useful product from non useful waste materials for sustainable foundation and subgrade improvement. This new technique of soil stabilization can be effectively used to meet the challenges of society and it can significantly enhance the properties of soil used in construction of road infrastructure, foundation, stabilization of embankment, pavement sub grade and other different fields as per the needs and flexibility. Further large-scale research is advisable to determine the boundary effects influence on test and for its more effectiveness.

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