COMPARATIVE STUDY ON STRENGTHIMPROVEMENT OF SUBGRADE USING PRESS MUD AND GRANITE DUST

Submitted in partial fulfillment of the requirements

of the degree of

MASTER OF TECHNOLOGY

in

CIVIL ENGINEERING

by

SHAIK NAGOORBASHA

(11508922)

Supervisor

Mr. NITIN BHARDWAJ

School of Civil Engineering

LOVELY PROFESSIONAL UNIVERSITY, PHAGWARA

2017

DECLARATION

I, **SHAIK NAGOORBASHA** (11503232), hereby declare that this submission is my own work and that to the best of my insight and conviction, it contains no material beforehand distributed or composed by other individual or office. No material which has been acknowledged for reward of some other degree or certificate of the college or other organization of higher learning with the exception of where due affirmations have been made in the content. It was arranged and displayed under the direction and supervision of **Mr. NITIN BHARDWAJ** (Assistant Professor).

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This is to certify that **SHAIK NAGOORBASHA**has prepare the dissertation-1titled "**COMPARATIVE STUDY ON STRENGTHIMPROVEMENT OF SUBGRADE USING PRESS MUD AND GRANITE DUST**" under my direction. This is a bonafide work of the above competitor and has been submitted to me in fractional satisfaction of the prerequisite for the honor of Masters of Technology in Civil Engineering.

Mr. Nitin Bhardwaj

Supervisor

Assistant Professor

ACKNOWLEDGEMENT

I wish to express our sincere gratitude to our esteemed guide assistant. professor **MR. NITINBHARDWAJ** for his guidance during the course of this Project. We also thank him for the timely advices and suggestions throughout the course work. I am highly obliged to, Head of Department of Civil Engineering for her continuous encouragement and providing all the facilities required for completion of this Project. I would like to thank Mr. PANKAJ, who helped us a lot in carrying out the experiments. I am also thankful to our teaching staff, non-teaching staff and all others involved in this Project.

SHAIK NAGOORBASHA

(11508922)

ABSTRACT

In many conditions sub grade soils are unsatisfactory at their natural state. So the soils which are unsatisfactory can be altered to make satisfactory by adding some additives or materials which helps to get the soil into the good condition as required for the road construction or for any other work. Soil stabilization implies improvement of soil so that it can be used for sub bases, bases and etc. if we are able to improve the soil condition with some of the industrial waste materials which are most abundant and having good strengthening properties we can also save the environment. In this thesis, the work is all about comparative study of sub grade stabilization with press mud and granite dust, which may give the different stabilization properties of a soil and can determine the strength friendly material comparatively. Comparative study of sub grade stabilization includes large number of soil samples to be tested. But it is one of the best ways to carry out work with two or more materials at one time and to evaluate the good soil properties.

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CHAPTER-I

INTRODUCTION

1.1 GENERAL

In transportation engineering department, engineers are allowed to work on pavements, railways, airways and waterways. Study of waterways may also come under the marine engineering department, which deals with the harbors, docks and other water bodies. When we talk about pavement, it comprises of different layers which are sub grade layer, base layer, sub base layer and wearing course. Above all these layers the main layer is sub grade which is prepared with the natural material available underneath the earth. It acts like back bone of roads and railways. Sub Grade is well known as formation level. Formation levels are commonly compacted before constructing a road. Sometimes these sub grade layers are stabilized according to the requirements using additive materials. Sub grade is the foundation of the pavement. All the other layers are laid on the sub grade.

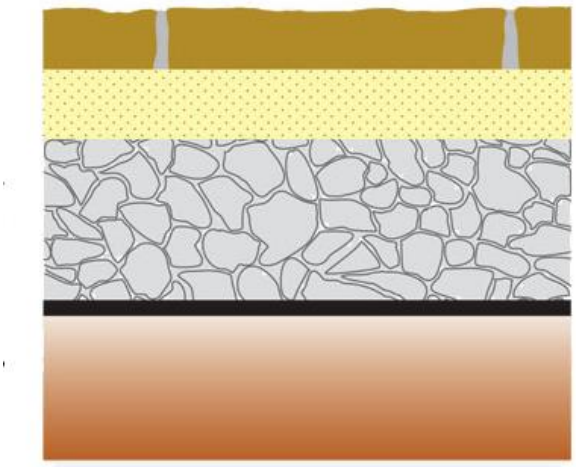


Figure No: 1.1 layers of road

1.2 SUBGRADE PERFORMANCE

Sub grade's performance is generally based on two characteristics which are interrelated to each other:

- Load bearing capacity: The Sub Grade layer must be able to withstand towards the loads transmitted through the other layers of pavement structure. This load bearing capacity is purely based upon the degree of compaction, moisture content, and type of the soil available. A sub grade which is having high load bearing capacity without excessive deformation is considered as good.
- Volume changes. Most of the soils undergo some changes in its volume when they are exposed to the extra moisture or freezing conditions. Some of the clay soils may shrink and swell according to their moisture content, while some of the soils with more fines may be resistible towards the frost actions in the freezing areas. On some big islands may face the problem of volume change due to excess moisture content of the soil present.

1.3 STABILIZATION TECHNIQUES: Almost possibly poor sub grades should be avoided but if in some cases it is necessary to construct over the weak soil there are many techniques to improve the condition of the soil.

- **Removal and replacement** (over-excavation): It is one of the most expensive techniques to improve the soil condition. The weak sun grade soil can be excavated and can be filled by the soil having good quality and good strengthening properties
- **Stabilization**: Stabilization can be done by using cementing or asphaltic binders. Addition of these kind of materials in the appropriate proportion may increase the sub grade performance and can reduce the swelling nature.
- **Addition of base layers**. Poor sub grade soils can be made acceptable by adding some base layers to take more load accordingly. These layers are useful spread the loads along the pavement in larger area of sub grade. This method may be taken as exceptional. Because, instead of designing more base layers it is easy to design a base layer with more thickness. This may satisfy the most equations in the design. However these equations are in the empirical part and are majorly avoided in many cases. As to say that the thick pavement structure over the weak sub grade may not make a good pavement.

1.4 OBJECTIVES OF THE STUDY

This investigation of comparative study about the improvement of sub grade performance by utilizing the waste materials like press mud and the granite dust. The only important thing considered in this thesis work is sub grade performance when treated with press mud and granite dust.

- To use granite dust and press mud for the stabilization of sub grade and to study the properties of soil when it is treated.
- Suggesting the material which is economical and good at improving strength of sub grade out of press mud and granite dust.

1.5 SCOPE OF THE STUDY

The determination of engineering properties of selected soil sample is tested in the laboratory.

1. It is necessary for the improvement in the soil properties for any construction purposes like low volume roads or any other pavement structures where the soil available is not good at strengthening properties.

2. While improving the strength properties of soil, the intension of adding waste materials producing by the industries helps environment from the its degradation.

3. Materials used in this investigation are totally waste products in the present era.

4. Comparative study is an easy way to approach, like which material is suitable for the future work or which material is having the properties that we need to increase soil properties or any other purpose.

CHAPTER-II

LITERATURE REVIEW

2.1 PAST STUDIES

Many of researches attempted to improve sub grade strength of soil by using the additives having cohesive materials and agriculture waste as a combination, here below we discuss some of the works done for the improvement of the strength of soil sub grade based on use of press mud and granite dust.

Onyelowe Ken C investigated about the availability of land which is having good natural bearing capacity used for the building is getting decreased day by day. The scarcity of lands leads to the construction of building in lands having poor soil conditions leads to the failure in structural foundations. So it has become very important to increase the quality of soils by adopting appropriate methods. This quarry dust can be used as the replacing material to soil. Many Researches were done from the past years on the improvement of soil condition with the help of waste products evolving in nature. The improvement of engineering properties of soil is happens with the introduction of the quarry dust. Crushed stone industry recommends the quarry dust for the stabilization of soil. Before the use of quarry dust in the soil stabilization process it should be check whether the material can give the good performance over the shrinkage, freeze, moisture and etc.

Mohamed During the process of cutting and polishing of granite products the waste material formed is called granite dust. This research also works on the resistance towards the corrosion when concrete is subjected to the quarry dust. The percentage of quarry dust replaced with the cement is 5, 7.5, 10 and 15. The experiments are done using TGA and X-ray. After the completion of experiments the test results shows that the improvement of compressive strength is at 5% replacement of cement. The tests that are conducted on tensile strength also give the good result. The use of 5% granite dust as a cement replacement also shows the better results towards the corrosion. The 5% use of granite dust also gives the good strength regarding cracks in concrete structure. It is observed that there are many changes took place in the hydration of concrete. These changes took place are very minute. To overcome the problems in hydration of concrete the water-cement ratio is reduced to 0.03%.

A. Arivumangai, **T. Felixkala** River sand is used as the fine aggregate very commonly in the world. Excessive cost of transportation made the river sand very expansive. The cost of transportation of materials from the natural resources is very high due to its more use. The environmental problems rise due to the large scale excavation of natural materials. This made concrete industry to find a material which is being a waste product from the nature. This investigation on M30 concrete states that the sand can be replaced by granite powder which is formed as a byproduct in rock industry by 0, 25 and 50 percentage. Apart from this cement can be partially replaced with silica fume, fly ash and slag. This paper gives a detailed study on compressive strength and tensile strength for 28, 56, 90 days. In this study it is also shows that the effect of durability due to chloride attack and also compared the weight loss with normal concrete. The results of this investigation says that the use of granite dust in concrete improves the performance regarding the strength and also in durability aspect.

Manasseh JOEL This research is conducted to know that whether the crushed granite fines suitable to replace river sand in making concrete pavement. Mainly three types of tests were conducted to check the performance of concrete. Those tests are slump cone, compressive strength and tensile strength test. The concrete blocks are subjected to curing for 28 days. It is the perfect time period to obtain the maximum strength. Tests were conducted after gaining maximum strength and the results are 40.70N/mm2 of compressive strength and 2.30N/mm2 of tensile strength. These results are obtained at the 20% partial replacement of river sand with crushed granite fines. The test results obtained the sample with river sand as fine aggregate are 35N/mm2 of compressive strength and 1.75N/mm2 of tensile strength. The use of 20% granite dust as a replacement to river sand gives good results and economical as well to use in the rigid pavement. It is also environmentally helpful to use the waste product in the making of concrete it is one of the best merits.

J.A. Ayangade (22 January 2004) Using granite dust in floor finish is a current research study. This investigation is done to check the durability aspects of floor finish when it is mixed with the granite dust. Two mix ratios of 1:3 and 1:4 are considered in this study. For the replacement of coarse aggregates marble chips and burnt kernel shells are added to the granite dust in the proportions of 0, 25, 50, 75 and 100 percentages. This investigation also gives the cost

comparative studies according to the percentage of material replaced in coarse aggregate. The compressive strength of kernel shells mixed concrete increases up to 30% when the coarse aggregate is replaced with the granite dust and marble chippings and palm kernel shells of 0-50%. For the replacement of 75-100% the compressive strength increases with the increase of granite dust. The water absorbing capacity also increases with increase of granite dust percentage. The whole coarse aggregate should not be added more than 50% with burnt kernel shells.

Jagmohan Mishra, et al(February 2014) the investigation of this study is about the effect of granite dust on the index properties of lime stabilized black cotton soil. The black cotton soil is stabilized with the 5% of lime. In this study tests were conducted to the samples with composition of 5% lime and 0, 10, 20 and 30% of granite dust. The tests conducted are liquid limit and plastic limit as per the IS code. Test results shows that there is decrease in the expansive behavior of black cotton soil mixed with the granite dust. After the addition of granite dust to the black cotton soil stabilized with 5% of lime decrease its liquid limit and plastic limit from 37% to 28% and 17.45% to 4.80%. So that the expansive behavior of black cotton soil reveals great extent.

V. Saravanan(may 2008)in this investigation bio filtration of xylene polluted air is studied. In the present era it is very important to solve the problems. Tests are conducted on the gas which is indulged with xylene with different flow rates. Those flow rates are 0.03, 0.06, 0.09 and 1.12 m^3 h^-1. These samples are tested with xylene concentration of 0.2 to 1.2 gm^-3. The bio-filter mixed with press mud is recommended to use as a bio-filter for the removal of xylene from the polluted air or gas. After the testing it has found that bio-filter provided cannot remove the high concentration of xylene from the gas. During the period of removing xylene, carbon dioxide has produced. Carbon dioxide produced is of 2.52, the formation of carbon dioxide confirms that there is degradation of xylene and carbon produced helps in the formation of microbial growth.

N. P. S. Yaduvanshi(**01 March 2009)**this research paper indicates that effects of sulphite press mud and nitrogen on the chemical properties of soil. According to this investigation cultivation process is started in spring form of three budded sets. It has found that use of sulphite press mud give good result like, o, 75, 100, 150kg of sulphite press mud is recommended to use as a

fertilizer in cultivation fields. This sulphite press mud is used in cultivation of crops with 80% of moisture in the fields, and by the use of sulphite press mud the chemical properties of soil are not disturbed. This investigation recommends that the use of sulphite press mud will gives good results in clay loamy soils.

H.Venkateswarlu(10, April 2015)the waste material obtained from the aggregate crushing industry is quarry dust. This is the only waste material which is having good strengthening properties. Quarry dust can exhibit good strengthening properties when soil us treated or stabilized with quarry dust. It is also the solid waste material. In the present era there is lots of production of aggregates. Production of aggregates leads to the formation of solid waste material quarry dust. After completion of laboratory tests this paper says that soil varies its engineering properties like liquid limit, plastic limit, plasticity index, compaction characteristics, and California bearing ratio and shear strength when it is treated with quarry dust in different scales. Tests were conducted by adding 0, 5, 10 and 15% of quarry dust. At the addition of 15% quarry dust improves strength of soil. Beyond 15% it is not that much effective as 15%.So from the above experimental analysis it has found that the 10% use of quarry dust for the stabilization and strengthening of expansive soil is recommended.

Ch. Eskioglou In this investigation, to calculate the effectiveness of granite dust as a soil strengthening agent laboratory study has chosen. The study n forest soils reports that there is improvement of soil geotechnical properties by the addition of marble dust. It made removal of PI with treatment especially for high PI soils. Results of this investigation say that strength of soil can be increased by 25% to 50% by the decrease in plasticity index of 15% to 30%. The highest strength of the soil obtained at the mixing of 8% of marble dust for 28 days. Compressive strength of the soil has been increased with the addition of marble dust. Also there in is increase of strength layer coefficient up to 30% and CBR value increases to 50.

CHAPTER-III

METHODOLOGY AND EXPERIMENTAL SETUP

3.1 RESEARCH METHODOLOGY

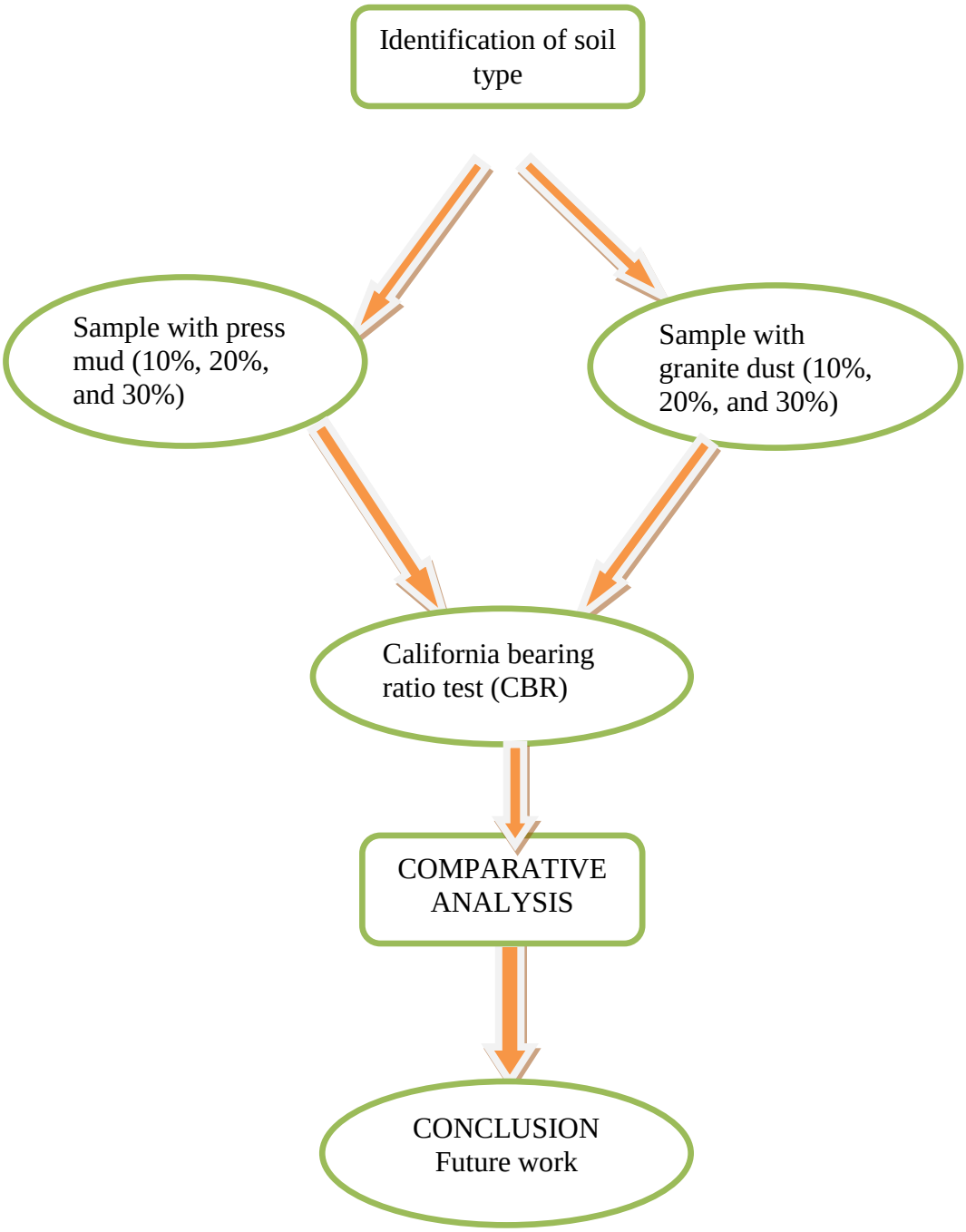


Figure No: 3.1 flow chart for project execution

3.2 MATERIALS USED FOR STABILIZATION

3.2.1 PRESS MUD (Solid Waste from Sugar Industry): After the filtration of sugar cane juice the residue formed is press mud. Sugar cane juice and press mud are purely separated in the clarification process, while the juice is collected at the top which rises and goes for manufacture. Another product is mud that collects at the bottom. To suspend the matter from the collected mud it is filtered. The filtration is done using insoluble salts and fine bagasse. The press filter (used in carbonation factories), mechanical filters and rotary filters are the three types of filters used for the filtration process. After the filtration the press mud is yielded in the form of a cake, which is also called as filter press cake (wet) it can be variable from 1 to 7kg for every 100kg of cane. The total production of press mud is 1700 million tones, only in the year of 2009. It is purely an industrial waste material.

The waste material from the industries is being used as a stabilizing factor and as the soil fertilizer as well as in the production of wax. Other industrial applications apart from the soil are cement industry, pain manufacturing and etc. in the farms it is used as a feeding ingredient to the animals because of its sugar content.

Brazil, India and china are producing the 75% of the world's sugar cane production.

3.2.2 ENVIRONMENTAL IMPACT:

The disposal of the by-products in the sugar industry like press mud is a major issue due to its large quantity of production. Press mud is burnt in the brick kilns in many cases, it results the wastage of large quantity of the nutrients, which leads to effect the environment. It is commonly used as the fertilizer in both the unprocessed and processed form. These are the techniques used to improve the fertility value of press mud. Using press mud as the fertilizer does not affect the environment mostly.

USES OF PRESS MUD

In sugar industry press-mud is one of the by-products. Three thousand kg of press-mud is left in the form of cake as a by-product for every 100 tons of crushed sugar cane in the sugar industry. In our country it has been estimated that 2.8 million tons of press mud is produced every year. Press-mud consists of trace minerals like micronutrients which prevents soil erosion

CHEMICAL COMPOSITION:

No	Elements	Percentage
1	Ca	21.32 - 29.99
2	Si	9.55 - 9.92
3	P	8.41 - 9.58
4	S	3.70 - 7.35
5	K	2.58 - 4.03

Table no: 3.1 chemical composition of soluble press mud.

No	Elements	Percentage
1	Ca	21.7 - 30.64
2	K	1.65 - 3.45
3	S	3.48 - 7.10
4	P	9- 11.31
5	Al	2.40-2.93

Table no: 3.2chemical composition of in-soluble press mud.

3.2.3 GRANITE DUST (Rock Dust):

An igneous rock of light color with the large grains which are enough to visible with the human eye. It is formed under the earth's surface with the slow crystallization of magma. It consists of large amounts or quartz and feldspar and minor amount of mica and other mineral dust also known as the rock powder, rock minerals, rock flour, mineral fines. It is the main formation of the fine crushed rock. The formation of the fine crushed rock is done with manual process or mechanical process. If the amount of rock dust to be produced is of large quantity then should use the mechanical technique if not manual process will be considered for the rock dust production. There will be some of the materials produced as the byproducts which are having Minerals can be used in the organic farming practices. Basalt and the granite which are formed from the magma and are labeled as igneous rock are having elements with good mineral content. Due to the lack of nitrogen, potassium and phosphorous rock dust cannot be used as fertilizer. Rock dust is also a product like limestone; it can be used for spraying inside the walls of the underground coal mines. It reduces the coal dust level. By decreasing the levels of coal dust explosion we can prevent the black lung disease.

USES OF GRANITE DUST

- Granite dust is used in the making of base layer of the pavement, and can be used for the forming of walkways as well as to improve the mineral content in the crop land.
- Stone dust can be used as an alternative material to sand while creating a walkway or pavement. Stone dust forms a water proof barrier under the pavement due to its very fine particles when compacted properly. It is also useful when constructing a low volume road.
- Sometimes gravel may be replaced by the stone dust by landscapers. Stone dust can be compacted by the landscaper to form a good walkway or drive way without using concrete. Landscapers sometimes use stone dust alone as a replacement for gravel. Stone dust is the multipurpose user material.
- In the fields of organic gardens stone dust may be used. Because of its lack of nitrogen, potassium and phosphorous. But it provides trace minerals to the organic fields. Some organic gardeners use stone dust on their fields. The best thing about the stone dust is that it can improve the surface area that the water can dissolves the minerals and provides to the plants. The amount of Trace minerals is more in stone dust when compared with the limestone.

3.3 EXPERIMENTS: Following are different type of experiments conducted in this project:

1. Sieve analysis.
2. Liquid limit.
3. Plastic limit.
4. Standard proctor test
5. California bearing ration (CBR).

3.3.1 SIEVE ANALYSIS

Take the is sieves and place them in increasing order from bottom to top i.e.0.75, 0.009, 0.212, 0.425, 1, 2, and4.75.the point to be remember while performing the test is that the percentage loss should not be exceeding 2%.after that the soil that has to be tested should bring from the site to the lab for experimentation. Take soil of 1kg place it on the top pan and start the process of sieving for 15-18 minutes. Note the values of the soil that is passing from the each sieve and the

soil that has retained on the each sieve. From the noted valves calculate the percentage of passing and percentage of retained on the each sieve.

Figure no: 3.2 Sieves

After calculating the percentages of total loss will be obtained. For this the percentage of loss is0.8 the valve less than the 2.so we can continue to the further process that is soil classification.

- First look the .075 in which passing is less than 50% so it is coarse grain soil.
- Percentage of passing through the sieve size 4.75 mm is greater than 50% so it is sand.
- In third step looks the sieve size .075mm in which fines is greater < 5% so it is having
- Calculate the C_u and C_c values from the below log graph.
- Log is used because sizes of particles are accurately denoted.
- From the graph D_{10}=0.1, D_{30}=0.16, D_{60}=0.33 are known.

$C_u = D_{60}/D_{10}$

$=0.33/0.1 \quad = 3.3$ mm

$C_c = (D_{30})^2 / (D_{10} * D_{60})$

$= 0.78$ mm

- This satisfied the both the conditions of poorly graded sand
    - C_u<6 and/or 1>

3.3.2 LIQUID LIMIT

First check the device to ensure that it was clean and working order. A soil sample of is prepared by sieving the soil in 0.425mm sieve take 120gm of it in dish. Add some distilled

water The sample and mix it thoroughly to from a uniform paste with the help of spatula. Then soil become clay and left it for 20min to ensure uniform master distribution. Now place a portion of paste in the cup of liquid limit device and squeeze down and spread the paste in the cup with spatula. Trim the soil at the top so that the maximum depth of soil in the cup is 1cm.Now use the casagrandes tool to groove the soil if it is clay and if it is sandy use ASTM type grooving tool. Now lift and drop the cup by rotating handle at the rate of two revolutions per second ill the two half's of the soil cake come in contact by flowing not by sliding with the bottom of the group along the distance about 12mm.count the number of blows required for the process and note in table. Ensure that the number of blows should be 15to 34. From the float portion take a representative of the soil using spatula in sample container of known weight. Ensure that spatula cuts the soil across the right angle to the group. Repent the experiment with different water contents that is dryer to water conditions of the soil and record the various observations.

After taking various samples place these samples in the oven for drying tov24hours. After on day weight the samples and note the values in the table. Then calculate the moisture content of the soil in particular number of blows. Plot the graph between moisture content and number of blows on a semi log graph. The moisture content corresponding to the 25 blows from the flow curve is the liquid limit of the soil.

Calculation:

$$\text{Water content} = [(W_1 - W_2 / W_2 - W_0) * 100\%].$$

W_0 = Weight of container

W_1 = Weight of container+ wet soil

W_2 = Weight of container+ oven dry soil

$W_1 - W_2$ = Weight of water

$W_2 - W_0$ = Weight of oven- dry soil.

Result: The obtained liquid limit of the normal soil is 24 %

Fig 3.3 liquid limit test

3.3.3 PLASTIC LIMIT

Plastic limit is the water content at which the soil just begins to crumble when rolled into a thread approximately 3mm in diameter. The 50gm soil sample is taken which is sieved in 0.425mm sieve. Now add distill water to the soil sample mix it thoroughly so that the soil mass is plastic enough to be easily molded. Now prepare a ball from the soil mass of 8 gm and place it on the glass plate and roll it with the figures so that a thread of uniform diameter is formed. The rate of rolling should be 80to90 stalks per minute and continue the rolling until thread reaches to 3mm by taking the reference of the metallic rod. Then collect crumble pieces of soil thread in a container and weight them and determine the moisture content. Repeat the process two more times and record the values.

After this take the sample and put in the oven and calculate the moisture content

Fig: 3.4 rolled soil sample

3.3.4 STANDARD PROCTOR TEST (SPT)

This test is conducted to determine the optimum moisture content of the soil. The standard proctor test is based on the compaction done to obtain the maximum dry density of the soil sample. present in soil sample and increase the dry density of the soil. The compaction process can be accomplished by tamping and vibrating depending upon the type of soil. In this process we can find out the dry density and optimum moisture content of soil using light compaction as per IS:2720 part 7.

The equipment required for the test is compaction mould, collar, and detachable plate, weighing machine, oven and metal rammer of 2.6kg.Find the volume of the mould. Take the soil sample about 2.5 kg and the water content of 4% in the soil if it is sandy soil and about 8% if it is clay. Clean the mould and apply grease or oil to avoid the stickiness of soil to the mould. Take the weight of the mould without attaching the collar to it. Place the soil in the mould in to three layers and compact each layer by the rammer about 25 blows having a free fall from 36cm height. Now remove the collar and trim of the excess soil projecting the mould using the straight edge. Take the weight of the mould with the compacted soil and record the values. Remove soil from the mould using the tool and take the soil sample from the middle portion of the soil in to container for the water quantity determination.

Dry density of the soil can be determined by using the formula is shown below

$$\gamma_d = \gamma_b / (1 + w)$$

$$\gamma_d = Dry\ density$$

$$\gamma_b = Bulk\ density$$

$$w = water\ content$$

Fig.3.5 Formula of dry density

Fig 3.6 tamping soil sample

fig 3.7 observation of mould weight

3.3.5 CALIFORNIA BARING RATIO

The highway department of California State has developed the CBR method to find the strength of soil sub grade of the pavement. The bearing valve of soil can be obtained by the CBR test. The CBR can be performed in the site and in the lab too with the help of plunger on the both remolded samples and original samples. The loading is 1.25mm/minute and the plunger having a diameter of 50mm. the loads required to penetrate 2.5 mm and 5mm are recorded is expressed with respective to the standard load in percentages. Standard load at 2.5, 5, 7.5, 10 and 12.5mm. CBR valve is defines as the ratio of load per unit area required to penetrate the soil mass by its standard plunger at the specified rate to that corresponding required for penetration of standard material.

OPERATION OF CBR

To perform the test, the apparatus as per IS: 2720 comprises of mold with internal diameter150mm and height of 175mm with the detachable collar and detachable base plate having perforations at the bottom. A spacer disc of 148mm diameter and a height of 47.7mm.the surcharge weights having central hole of 2.5kg and a plunger with 15mm diameter and 100mm height.

A loading machine of 5000 kg which is capable of penetrating vertically of1.25mm per minute. The test consists of two parts there are

- Preparing test specimen.

- Penetration test.

The specimen can be prepared by dynamic compaction and static compaction. In static compaction, the load applied gradually and in dynamic compaction the load is applied by hammering. The dynamic compaction can be prepared by the hammer used is 2.6kg with a free fall of 31cm with 56 blows to each layer. Various in the heavy compaction the specimen prepared in five layers. The hammer used is 4.89kg with a free fall of 45cm with 75 blows to each layer. Let us see how dynamically compacted specimen is prepared to assemble the mold. the spacer disc with threaded hole side at the bottom of base plate and filter paper top on it and apply lubricating liquid at inner side of the mold to prevent the sticking of the soil also fix the color and tight the clamps. Now take the 5kg of soil passing from the20mm sieve and mix with the predetermined quantity of the water such that the water content of the soil is equal to OMC or equal to the field moisture content.

Mix water and soil thoroughly so has to prepare the uniform consistency. Transfer the soil in to the mold and fill such that after compaction the layer is about 1/3rd. or$1/5^{th}$ of the total thickness case may be. now compact soil with suitable number of blows as stated above. After compaction of the soil scratch on the top surface of the layer and add more soil and compact in similar manner for second layer. Repeat the same process for top layer also and remove the color and trim the top of the surface also remove the base plate and filter paper. Remove the spacer disc and place the filter paper at the bottom place the mold such that the compacted surface at the bottom. Place the assembly on the pedestal of the loading machine to fix the plunger and bring the plunger in contact with the soil sample and apply seating load of 4kg this is to establish the good contact between soil and plunger.

Now add other 2.5kg weight at the top and set dial readings zero allow the plunger to penetrate at rate of 1.25mm per minute Note down the readings on proving ring corresponding to a penetration of 0.5, 1.0, 1.5, 1.5, 2.0, 4.0, 5.0 7.5, 10.0, and12.5. sometimes the CBR curve may exhibit a concavity in the beginning in which case the correction is to be applied. From the curve determine the load corresponding to 2.5mm and 5.0mm penetration and compute CBR valve based of below formula

$$\text{CBR, \%} = \frac{\text{Load or pressure sustained by specimen at 2.5 or 5.0mm penetration} \times 100}{\text{Load or pressure sustained by standard aggregates at the corresponding penetration}}$$

Fig 3.8 preparation of sample

fig 3.9 CBR testing

CHAPTER-IV
RESULT AND DISCUSSION

The obtained results till now are as follows

- By performing the sieve analysis, it is known that the soil sample taken is poorly graded sand.
- By performing the liquid limit analysis, it is known that the soil sample contains 24% of the moisture content.
- By performing the plastic limit analysis, it is known that the plastic for the sandy soils are not able to prove because the sample breaks when it is rolled. so the soil ha non-plastic properties.

4.1 Result of sieve analysis

Sieve sizes (mm)	mass retained in each sieve(grams)	% retained	% passing
4.75	77	7.854985	92.14502
2	82	8.056395	84.08862
1	81	8.257805	75.83082
0.425	84	8.459215	67.3716
0.212	214	21.55086	45.82075
0.09	405	40.7855	5.035247
0.075	1	0.100705	4.934542

Table 4.1 Sieve Analysis

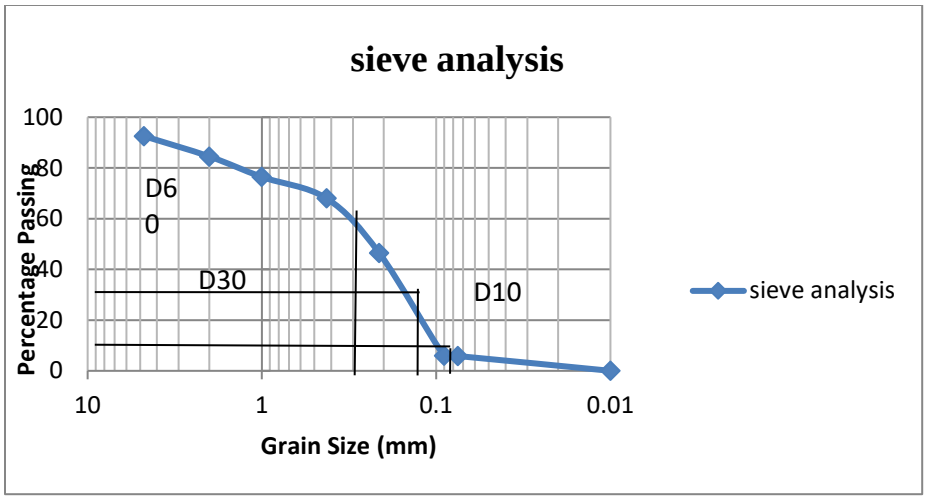


Fig 4.1 Graph For Sieve Analysis

Finally, it has concluded that the soil is poorly graded sand.

4.2 Results for the liquid limit

Wet weight of soil(w1)	Dry weight of soil(w2)	Wet weight of soil-dry weight of soil(w1-w2)	weight of water/dry weight of soil	Moisture content(%)	Blows count
26	22	4	0.18	18.18	36
96	78	18	0.23	23.07	29
30	24	6	0.25	25	19

Table 4.2 Liquid Limit for Normal soil

Liquid limit of normal is 24 %

4.3 Standard proctor test: MDD AND OMC OF STANDRAD PROCTOR TEST:

The optimum moisture content and maximum dry density for the normal soil and to the soil with stabilizers has been calculated from the results which are plotted in the graphs for dry density to moisture content.

Press Mud	OMC	MDD
0	15.2	1.719
5	14.1	1.69
10	13.7	1.60
15	15.4	1.83

Table4.3 OMC and MDD values of soil with various percentages of press mud

Granite dust	OMC	MDD
0	15.2	1.719
10	14.8	1.56
20	12.5	1.73
30	15.6	1.74
40	16.8	1.85
50	14.2	1.60

Table4.4 OMC and MDD valves of soil with various percentages of granite dust

4.3.1 Graphical representation of standard proctor test

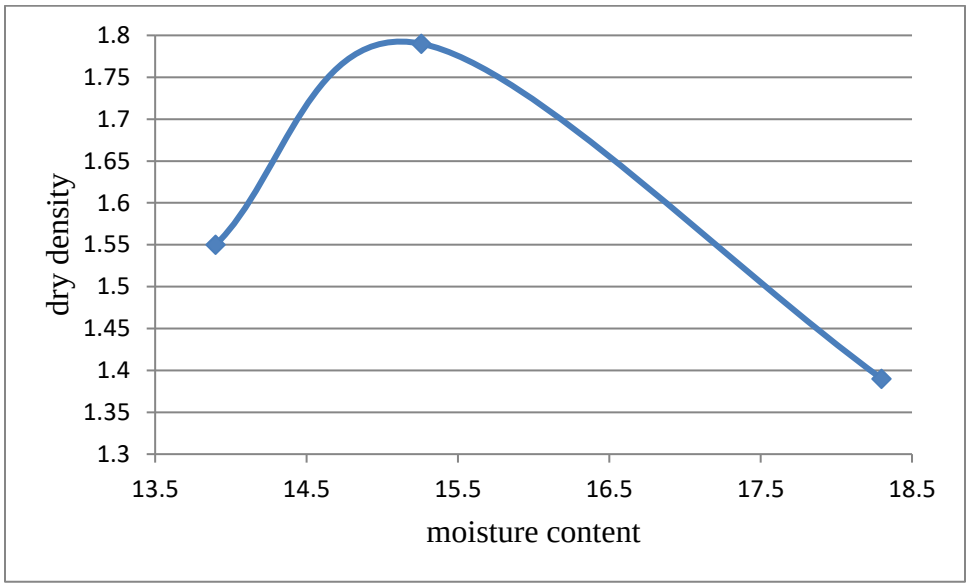


Fig.4.2 Graph dry density to OMC for normal soil

The above graph is drawn between dry density and moisture content for the normal soil through the standard proctor test. The maximum dry density is 1.719 at the optimum moisture content of 15.2%

:

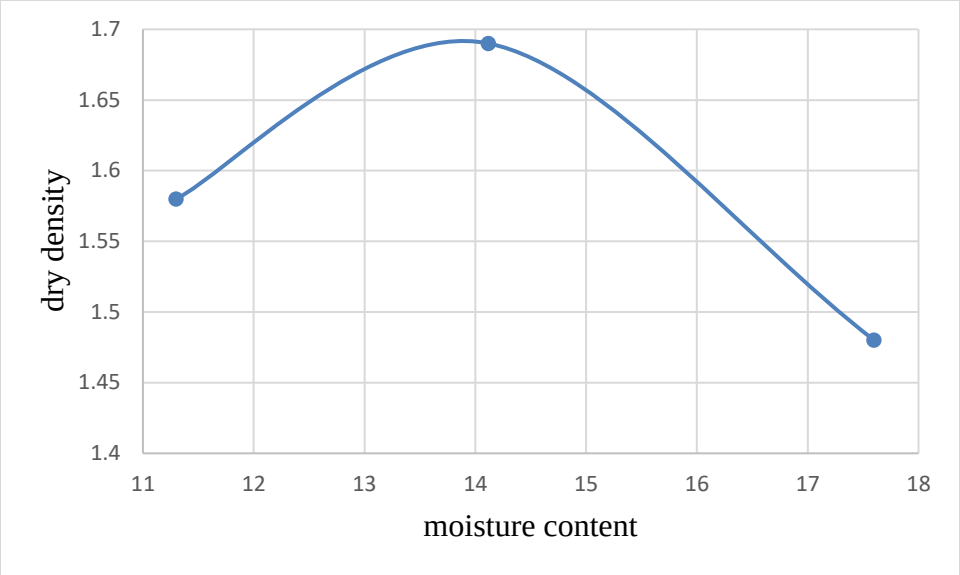


Fig 4.3 Graph for soil replaced with 5% press mud

The above graph is drawn between dry density and moisture content through standard proctor test for the soil treated with 5% press mud. The dry density and moisture content obtained from the above graph are 1.69 and 14.1%

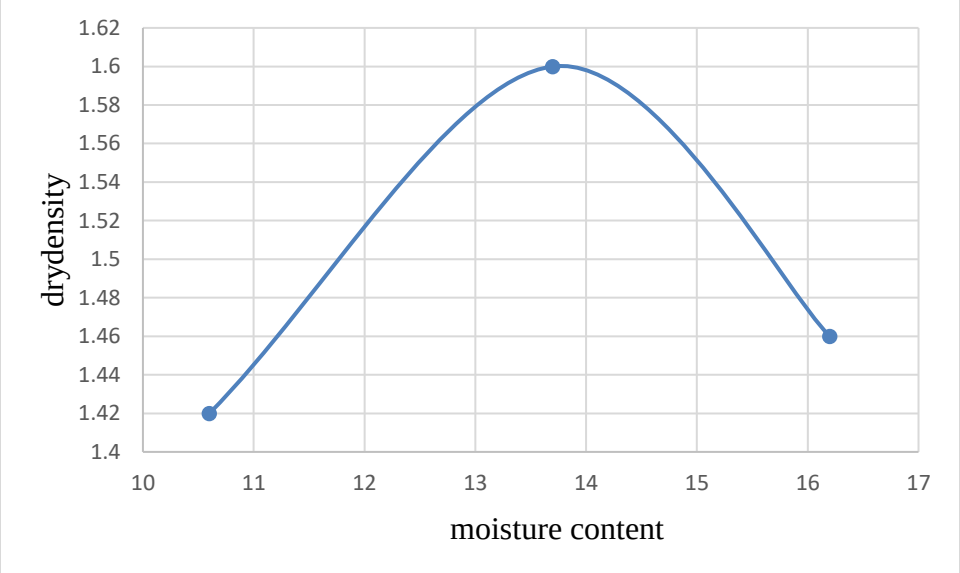


Fig 4.4 Graph for soil replaced with 10% press mud

The above graph is drawn between dry density and moisture content through standard proctor test for the soil treated with 10% press mud. The dry density and moisture content obtained from the above graph are 1.60 and 13.7%

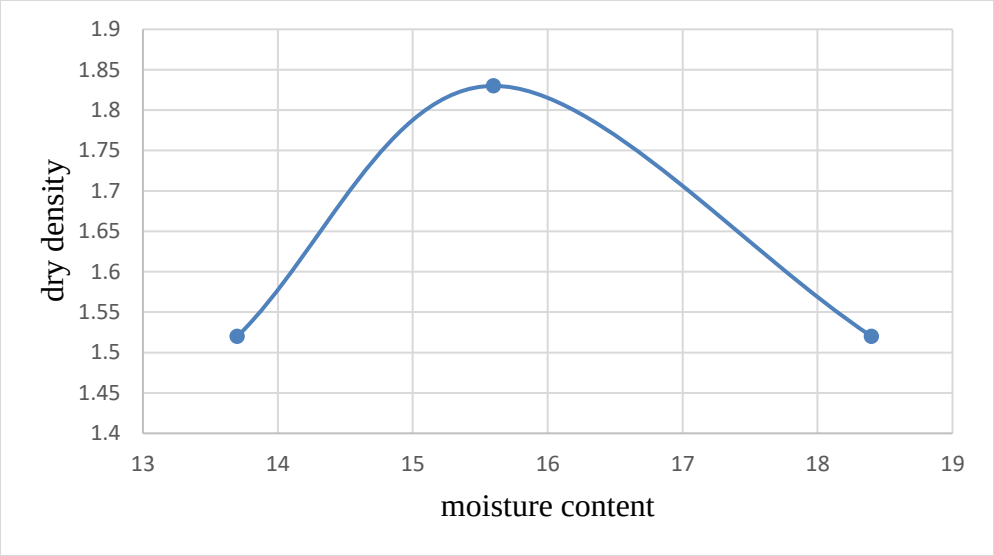


Fig 4.5 Graph for soil replaced with 15% press mud

The above graph is drawn between dry density and moisture content through standard proctor test for the soil treated with 15% press mud. The dry density and the moisture content obtained from the above graph are 1.83 and 15.4%

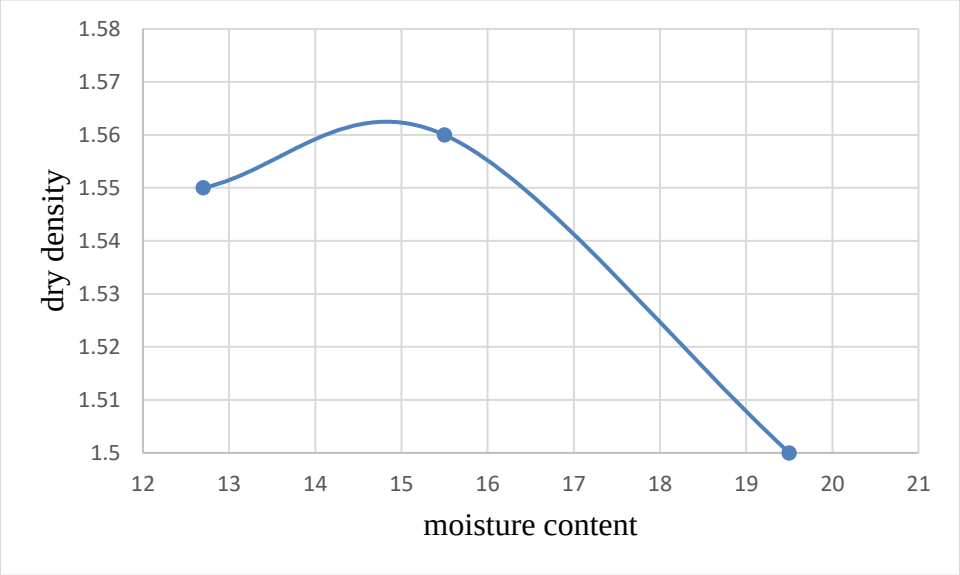


Fig 4.6 Graph for soil replaced with 10% granite dust

The above graph is drawn between dry density and moisture content through standard proctor test for the soil treated with 10% granite dust. The dry density and moisture content obtained from the above graph are 1.56 and 14.8%

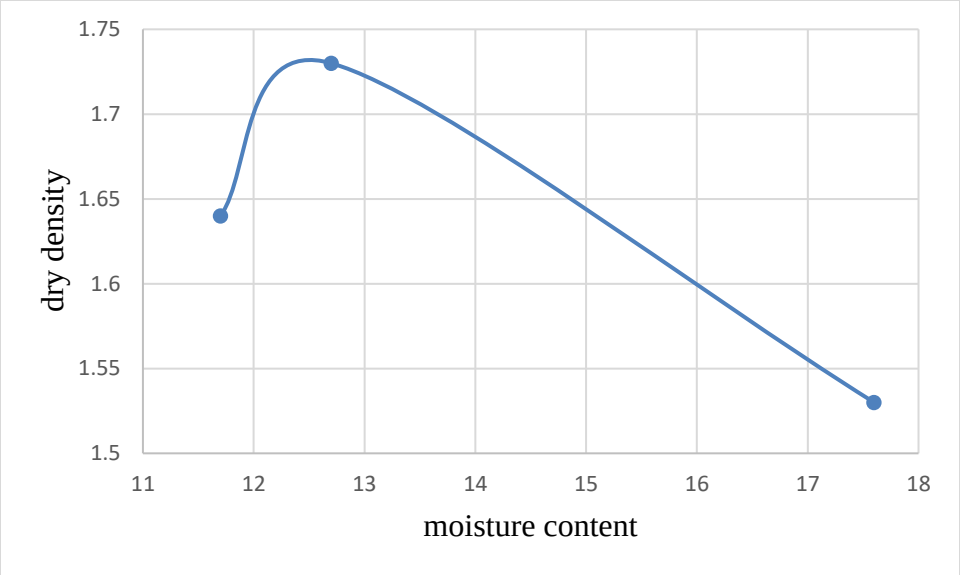


Fig 4.7 Graph for soil replaced with 20% granite dust

The above graph is drawn between dry density and moisture content through standard proctor test for the soil treated with 20% granite dust. The dry density and the moisture content obtained from the above graph are 1.73 and 12.5

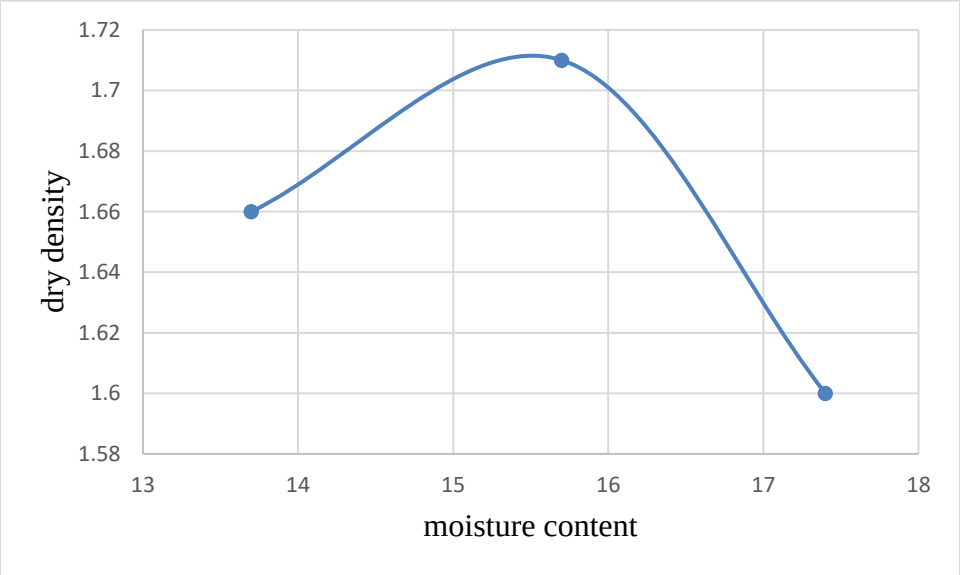


Fig 4.8 Graph for soil replaced with 30% granite dust

The above graph is drawn between dry density and moisture content through standard proctor test for the soil treated with 30% granite dust. The dry density and the moisture content obtained from the above graph are 1.74 and 15.6%

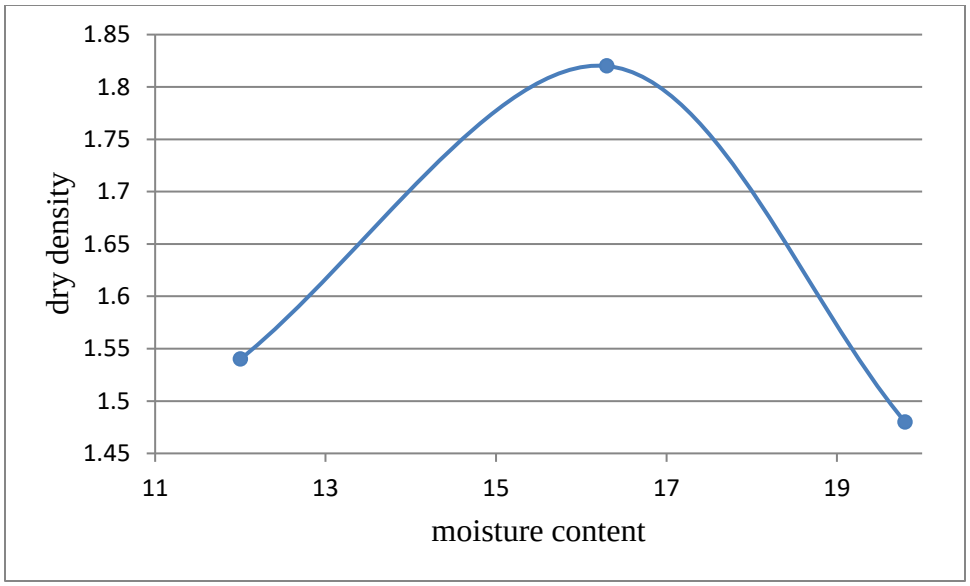


Fig 4.9 Graph for soil replaced with 40% granite dust

The above graph is drawn between dry density and moisture content through standard proctor test for the soil treated with 40% granite dust. The dry density and the moisture content obtained from the above graph are 1.85 and 16.8%

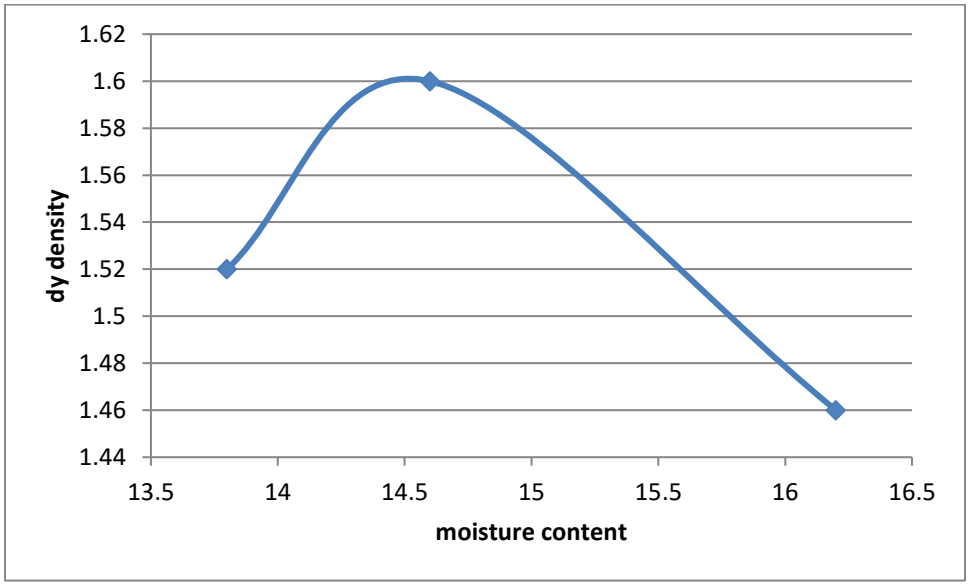


Fig 4.10 Graph for soil replaced with 50% granite dust

The above graph is drawn between dry density and moisture content through standard proctor test for the soil treated with 50% granite dust. The dry density and the moisture content obtained from the above graph are 1.60 and 14.2%

4.4 RESULTS OF CALIFORNIA BEARING RATIO (CBR):

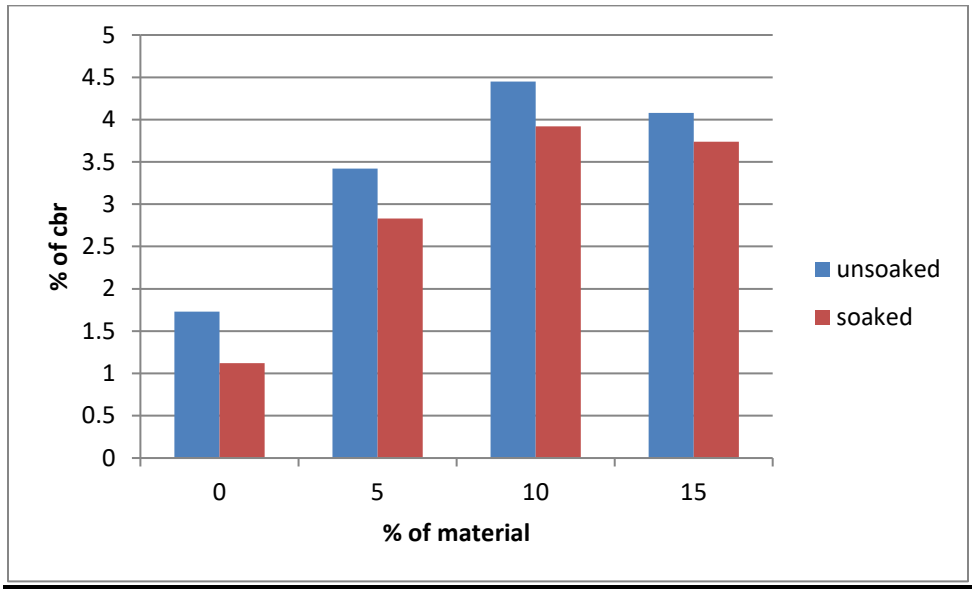
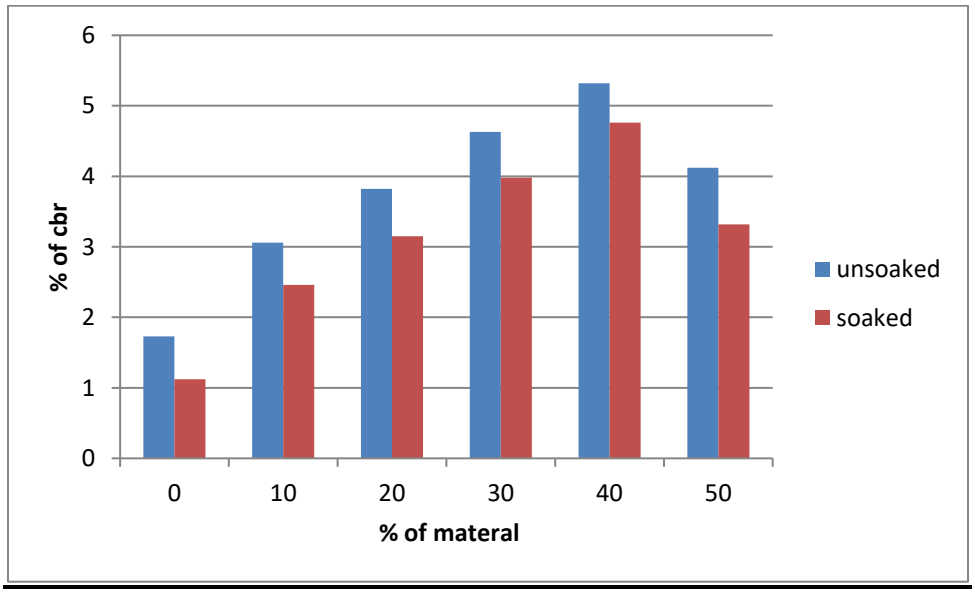


Fig 4.11 Graph for soil replaced with press mud



4.12 Graph for soil replaced with granite dust

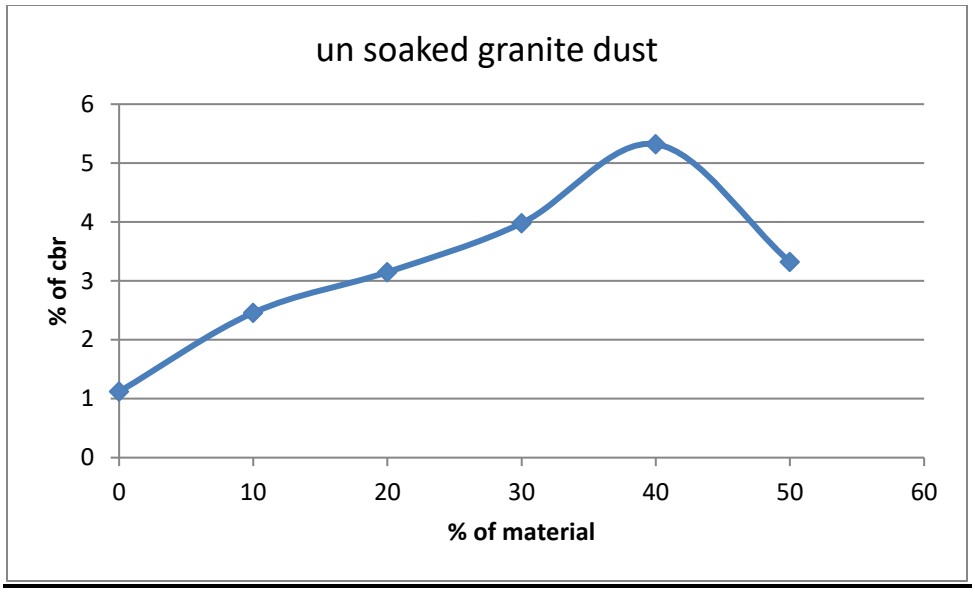


Fig 4.13 Graph for un soaked condition with granite dust

The above graph is drawn between California bearing ratio values and the percentage of material replaced with soil. The maximum CBR value is 5.32% obtained at 40% for un soaked condition of sample.

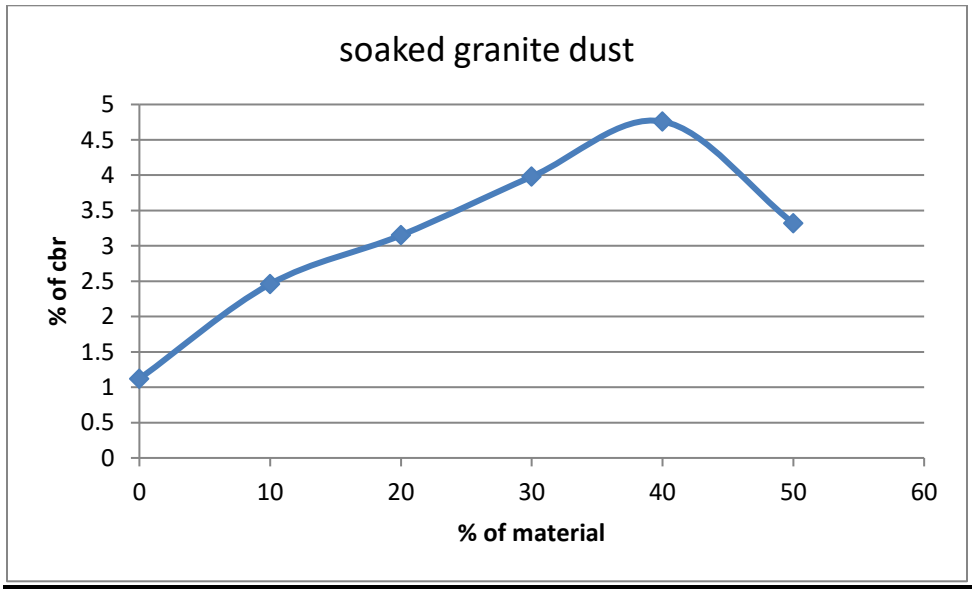


Fig 4.14 Graph for soaked condition with granite dust

The above graph is drawn between California bearing ratio values and the percentage of material replaced with soil. The maximum CBR value is 4.76% obtained at 40% for soaked condition of sample.

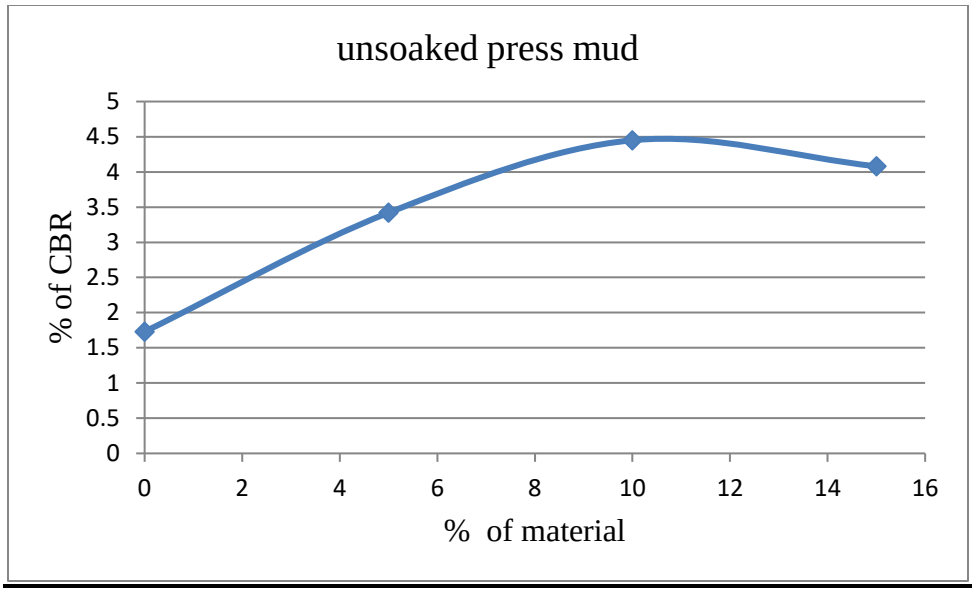


Fig4.15 graph for un soaked condition with press mud

The above graph is drawn between California bearing ratio values and the percentage of material replaced with soil. The maximum CBR value is 4.45% obtained at 10% for un soaked condition of sample.

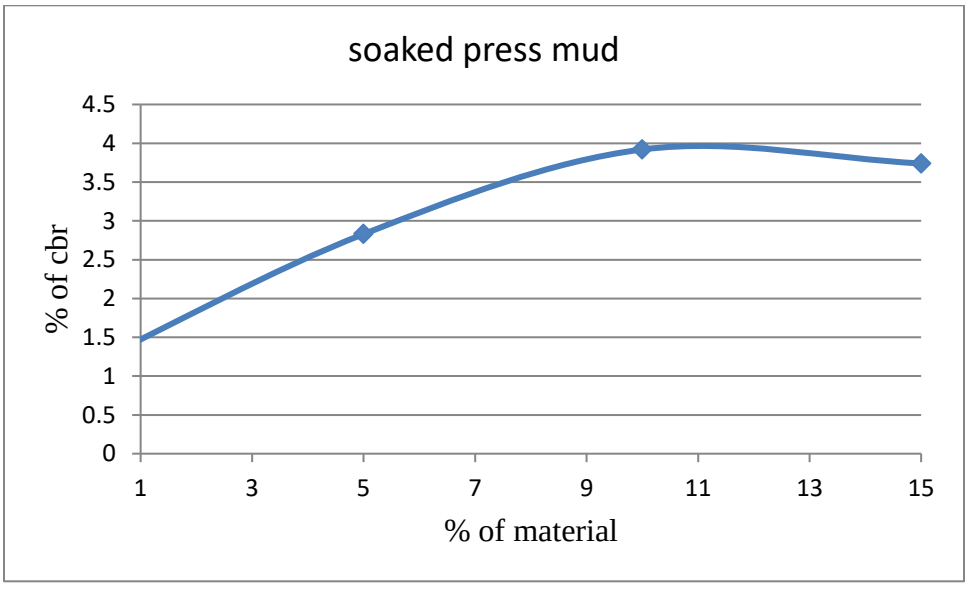


Fig4.16 graph for soaked condition with press mud

The above graph is drawn between California bearing ratio values and the percentage of material replaced with soil. The maximum CBR value is 3.92% obtained at 10% for soaked condition of sample.

4.4.1 CBR VALUES:

Press mud	Un-soaked	Soaked
0	1.73	1.12
5	3.42	2.83
10	4.45	3.92
15	4.08	3.74

Table 4.5 CBR values for soil + press mud

Granite dust	Un-soaked	Soaked
0	1.75	1.17
10	3.06	2.46
20	3.82	3.15
30	4.63	3.98
40	5.32	4.70
50	4.12	3.32

Table 4.6 CBR values for soil + granite dust

4.5 Design of Flexible Pavement As Per IRC 37-2012

The average rain fall at the site is considered as 625mm. the CBR values are considered at the soaked condition. Because the rain fall at the area taken is more than 500cm

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

A=Number of Commercial Vehicles per day

D=Lane Distribution Factor

F= Vehicle Damage Factor

r=Growth Rate

n=Design life

The traffic can be estimated using formula

$$A=P\ (1+r)^{\wedge x}$$

According to the traffic condition of the area considered for the stabilization is normal. For example the traffic is 20msa. As per IRC:37-2012 thickness of the pavement is considered as shown below in table.

	CBR (%)	Thickness of pavement	BC/SDBC	DBM	GB	GSB
Normal soil	1.17	660	20PC		225	435
Soil with press mud	4.45	480	20PC	50	225	255
Soil with granite dust	5.32	430	20PC	50	225	205

Table 4.7 Thickness of pavement as per IRC37-2012

CHAPTER-5

CONCLUSION

5.1 COMPARISION BETWEEN GRANITE DUST AND PRESS MUD

GRANITE DUST	PRESS MUD
The specific gravity of granite dust is determined as 2.75 gm/cc.	The specific gravity of the press mud is determined as 2.62 gm/cc.
The optimum moisture content of the soil when it is treated with the granite dust is 16.8% at the 40%.	The optimum moisture content of the soil when it is treated with the press mud is 15.4% at the 15%.
The maximum dry density of the stabilized soil is 1.85 at 16.8% of moisture content	The maximum dry density of the stabilized soil is 1.82 at 15.4% of moisture content
The maximum California bearing ratio value of treated soil at soaked condition is 4.76%	The maximum California bearing ratio value of treated soil with press mud at soaked condition is 3.92%
The maximum California bearing ratio value of treated soil at un soaked condition with granite dust is 5.32%	The maximum California bearing ratio value of treated soil with press mud at un soaked condition is 4.45%

For the construction of roads the sub grade with poorly graded sandy soil may not full fill the requirements of sub grade strength. So the main aim of this investigation is to improve the sub grade strength by treating the soil with some waste materials.

By using granite dust and press mud the strength of sub grade has increased with the help of California bearing ratio test. The value of CBR has increased to 5.32% from 1.75% with granite dust at un soaked condition and at the soaked condition the value of CBR has increased to 4.76% from 1.12% with granite dust. The value of CBR has increased to 4.45% from 1.75% with replacement of press mud at un soaked condition and at soaked condition the value of CBR has increased to 3.92% from 1.12% with press mud.

While coming to the comparative studies granite dust is more suitable for the stabilization than the press mud. The thickness of the sub grade is less with granite dust when compared with press mud.

5.2 Future Scope:

In this investigation total work is based on the strength characteristics of the soil. It can also be done based on the atterberg limits by the addition of strength improvement materials like lime, cement, rise husk ash and etc. strength improvement can be conducted different types of tests like modified proctor test to find maximum dry density, optimum moisture content and plate load test to find strength of the soil sub grade. Plate load test is generally used in sites (In situ condition).

Thickness of the pavement can be reduced by the improvement in strength of the sub grade soil through the traffic calculation at the selected area. Thickness can find from the recommendations given by Indian road congress.

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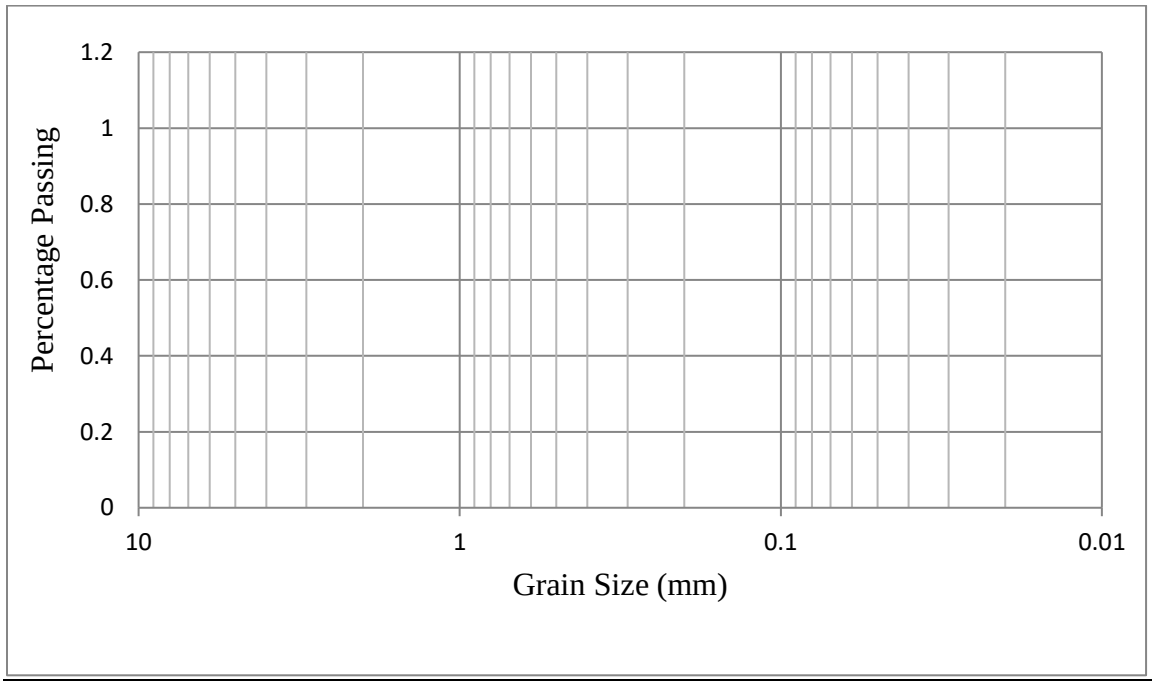
https://en.wikipedia.org/wiki/pressmud

https://en.wikipedia.org/wiki/granitedust

ANNEXURE A

SIEVE ANALYSIS

Sieve sizes (mm)	mass retained in each sieve(grams)	% retained	% passing

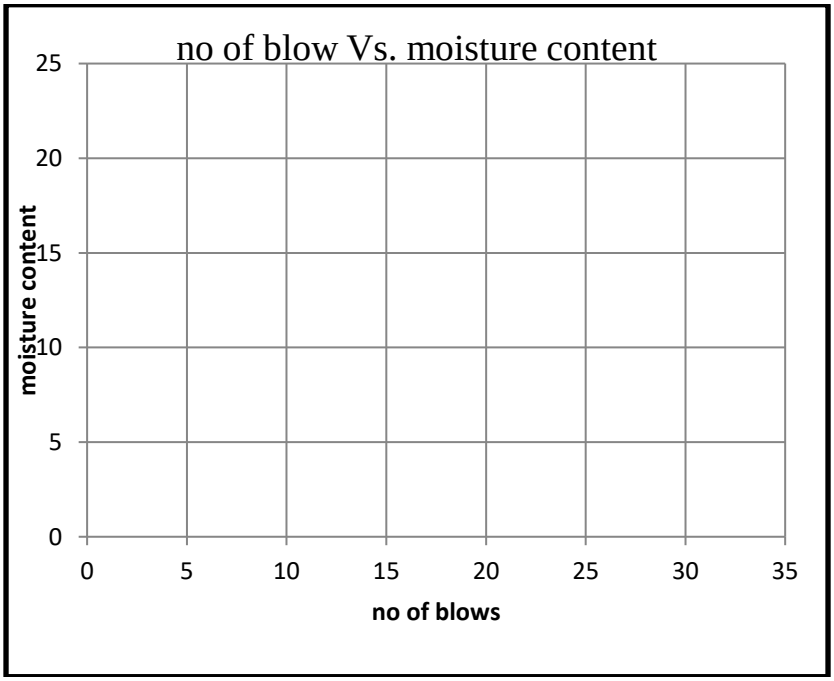


ANNEXURE B

LIQUID LIMIT

Table for calculating Moisture content and blows

Wt. of wet soil (g)	Dry Weight. of soil (g)	(Wt. of wet soil - Dry Wt. of soil) (g)	(weight of water/ Dry Wt. of soil)	MC (%)	Blows count



For finding liquid limit

ANNEXURE C

Observation table

Penetration reading, mm	Proving ring dial gauge reading	Load(kg)
.5		
1		
1.5		
2		
2.5		
4		
5		
7.5		
10		
12.5		

Standard load values on crushed stone aggregates

Penetration, mm	Standard load, kg	Unit standard load, kg/cm^2
2.5	1370	70
5.0	2055	105
7.50	2630	134
10.0	3180	162
12.50	3600	183