

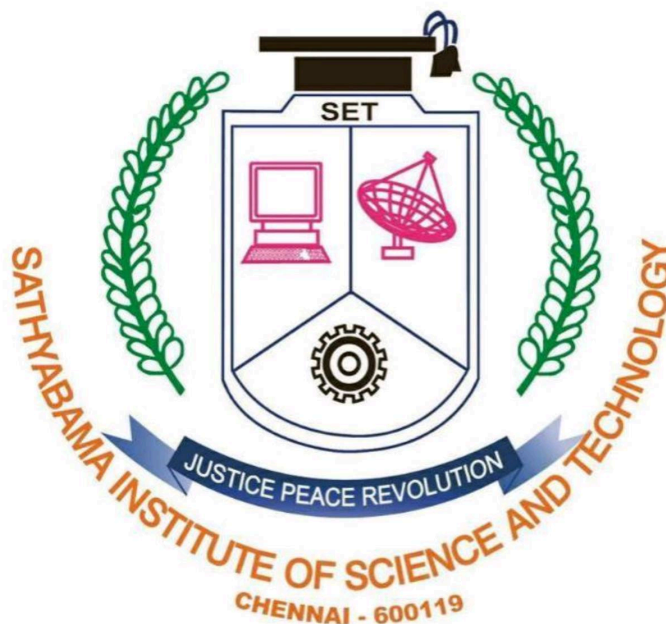
SOIL STABILIZATION USING JUTE FIBER IN MANNIVAKKAM NEAR TAMBARAM

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Civil Engineering

by

NALLABOTHULA JEEVAN KUMAR (38200020)

GOTURU VIBHISHAN (38200039)



DEPARTMENT OF CIVIL ENGINEERING

SCHOOL OF BUILDING AND ENVIRONMENT

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI – 600 119

MAY 2022



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafede work of **NALLABOTHULAJEEVANKUMAR (Reg.No.38200020)** and **GOTURUVIBHISHAN (Reg.No.38200039)** who carried out the project entitled "**Soil Stabilization Using Jute Fiber in Mannivakkam Near Tambaram**" under my supervision from Dec 2021 to May 2022.

INTERNAL GUIDE
(Mrs. B. PRIYADHARSHINI)

Head of the Department
(Dr. S. PACKIALAKSHMI)

Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

We, Nallabothula Jeevan Kumar (Reg.No.38200020) And Goturu Vibhishan (Reg.No.38200039) hereby declare that the Project Report entitled "**Soil Stabilization Using Jute Fibre In Mannivakkam Near Tambaram** " done by us under the guidance of Mrs B. Priyadharshini., M.E at Sathyabama Institute of Science And Technology, Chennai is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering.

1. N. Jeevan Kumar.

2. G. Vibhishan

SIGNATURE OF THE CANDIDATE

DATE: 27/4/22

PLACE: Chennai

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ABSTRACT

This study focuses on soil adjustment through the use of jute fibre in soil stabilizers. stabilization is the process of altering the characteristics of the soil to improve its structural performance and make it acceptable for a wide range of construction operations. The potential for soil stabilization utilizing jute fibre cut into 30mm lengths as stabilizers were investigated in this study area. Various proportions of jute fibre were used and miscellaneous with soil, including 0.5%, 0.75%, 1%, and 1.25%. As per the results, 1% of soil mixed with jute is good in optimum moisture content, maximum dry density, and CBR. The research has undertaken tests such as the California Bearing Proportion (CBR) test and Proctor density changes in the soil's building qualities.

By using 30mm-sized particles of jute to stabilise soil, researchers have shown that the soil's quality may be improved and employed as a reinforcing material in road building, halting ranges, and location progression extend.

Keywords:

Jute fiber, standard proctor test, soil strengthening, CBR test, and wet sieve analysis

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Before beginning any geotechnical project, it is highly recommended that a site feasibility analysis be performed. Before the design process starts, a site survey is often conducted to provide an understanding of the subsoil on which the placement of the project might be based.

Site selection must take into account the following geotechnical design requirements

- The structure's intended load and purpose.
- The foundation to be utilized.
- Ground support capacity.

The third bullet used to be a significant factor in on-site selection decision-making. When the soil's bearing capacity was low,

The alternatives were as follows:

- Adapt the design to the site's requirements.
- Remove the existing dirt and replenish it.
- Leaving the site is a bad idea.

Increased abandonment owing to poor mud holding capacity has resulted in a lack of land and an increase in the claim for natural resources. Liquefaction-prone areas, and those with clay soil and organic soils, are examples of artificial locales. Other threats included mudslides and poisoned soil. The problem is that in most geotechnical projects, a construction site that matches design standards cannot be achieved without altering the surrounding ground. Soil engineering attributes are altered to meet design criteria in the present practice. Civil engineering criteria may now be met by

upgrading soft clays and organic soils. This examination focuses on the soil.

By linking or waterproofing the soil particles, or by a combination of the two, soil stabilization seeks to strengthen its strength and resistance to water softening. In many cases, technology provides an alternative structural solution to a practical problem.

There are two primary ways to stabilise a structure:

compaction and drainage (if water drains out of wet soil it becomes stronger).

Another way to increase particle size gradation is to add binders to poor soils.

1.2 Mechanical stabilization

It's possible to stabilize the soil by physical processes such as vibration or compaction, as well as the incorporation of other physical properties like barriers and nailing, in this category. In this review, mechanic stabilization will not be discussed further.

1.3 Chemical stabilization

To achieve the desired effect, soil stabilization in this category relies mostly on chemical reactions between the stabilizer (cementitious material) and the soil minerals (pozzolanic materials). For the relaxation of this review, the time "soil stabilization" will refer to biochemical stabilization, which is the primary method of stabilization Using Cementitious Materials for Soil Stabilization, loose materials may be stabilized (Cement, Lime, Fly Ash, Bitumen, or a Combination of These). Compared to the native soil, the stabilized soil materials have lower permeability and compressibility.

In situ stabilization and ex-situ stabilization are the two options for implementing the approach.

Keep in mind that stabilization is not a wand that can be waved over all soil properties to improve. Which Soil Properties Must Be Modified Affects the Use of Technological Means. Volume Stability, Strength, Compression, Permeability, and Durability are among the most important properties of soil for engineers. It may be necessary to conduct laboratory and field tests to regulate the engineering and eco-friendly possessions of a stabilization. Stabilized materials may be evaluated in the field, even if laboratory studies generate smart choices than for the comparable field material. Binders and amounts might be selected based on the results of lab testing.

1.4 Component Of Stabilization

To increase geotechnical qualities including compressibility, strength, permeability, and durability, soil stabilization includes the application of stabilizing agents (binder materials) in weak soil. Using stabilizers, soil minerals, and solvents is part of the stabilization process (cementitious materials).

1.5 Soils

The majority of stabilization work must be done on soft soils to achieve the required engineering features (silty, clayey peat, or organic soils). The flat and elongated particle forms of clay soil provide it with a larger surface area than other soil types. Silty materials, on the other hand, maybe dismayed bet to stabilize since they are sensitive to even tiny changes in moisture. Peat soils and organic soils have high water content, high porosity, and a high organic content of up to roughly 2000percentt circumstances, peat soil deposits are shallow and just a few feet deep, but in the worst of cases, they might extend several feet below the surface. When calcium silicate and aluminate are hydrated in organic soils, the exchange capacity is strong enough to keep the calcium ions freed from the cement ttomeet the exchange capacity. Binder selection and binder addition quantity are critical in such soils for optimal stabilization.

1.6 Stabilizing Agents

To create cementitious composite materials, these hydraulic (primary) or non-hydraulic (secondary) ingredients react with water or pozzolanic minerals.

A few of the most popular binders include:

1. cement
2. lime
3. Fly ash
4. Jute Fiber

1.7 Temperature

The temperature affects the pozzolanic process. The weather on the field is always changing. At low temperatures, pozzolanic reactions between binders and soil particles will slow down, resulting in a decrease in the mass's strength. During the warm season in chilly places, it may be beneficial to stabilize the soil.

1.8 Wet and Dry Effects Of Freezing And Thawing

Frozen-thaws cycles can't take place on stabilized soil Therefore, it is possible that stabilized soils must be protected against frost damage in the field. The chemical reactions of the binder will affect the shrinkage forces in stabilized soil. It is important to preserve cement stabilized soil from the impacts of diurnal fluctuations in temperature because of the numerous dry-wet cycles they are prone to.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

The primary goal of a literature review is to provide readers with an overview of the numerous fields of study that have been explored by scholars all around the globe. This gives us a better sense of how to proceed with our project. The following literature review elaboration on how to analyze groundwater after an estimate the heavy metal pollution and removal of identified heavy metals using an adsorbent.

2.2 LITERATURE REVIEW

Andersland and Khattak (1979) the following qualities were studied: 200, LL =47.8 per cent (PL = 20.3 per cent), G=2.7 fibre (f1=0.0016m; dia =0.02mm; fibre contented 16–40 per cent) f1=0.02mm, G=2.7 If fibre is added at 16% to pure Kaolinite, peak shear strength increases by 43%, according to the triaxial test findings obtained.

Gray and Ohashi (1983) studied the shear strength of fibre-reinforced soil extensively and came to the conclusion that adding fibres boosts peak shear strength while limiting post-peak shear resistance decline.

Gray and Al-Refeai (1986) Tests on Muskegon pure sand with D50= 0.41mm, cu= 1.5 and = 390 and 320 reinforced with three kinds of fibres were carried out in this study. In tests, a 2% weight increase in the amount of fibre leads in a significant boost in strength.

Setty and Rao(1987) At an ideal moisture level of 16 per cent, we tested on lateritic soil with G=16 per cent (60percent), S=60 per cent (21per cents), M=21per cents (1%),

C=1 per cent, and = 390 with polypropene fibre reinforcement with dia 0.0005m and fibre content of 0-5 Cohesion and stretchy strength have been enhanced by two times up to 2 per cent fibre content, and the CBR value has also been increased by this amount. Moreover, dry strength has been increased by a factor of three.

Maher and Gray (1990) It was found that adding low modulus fibres (rubber) had no impact on strength despite the increasing interface friction and that the failure surface was oriented plainly at $(45^\circ \pm 2^\circ)$.

Bauer and Fatani's (1991) Research on silt sand reinforcement using steel fibers and copper fibre found that the outstanding strength of composites is 200% to 300% greater than unreinforced soil, based on direct shear tests and standard proctor compaction density tests.

Michalowski and Zaho (1996) The introduction of steel fibres in polyamide monofilament led to a 20 percent increase in peak stress, and the fibres impeded sample dilatation and made the sample inflexible.

Ranjan et al (1996) investigated several kinds of soils, such as silt and silt with polypropylene monofilamentcoir, and found that they had stronger ductility and no damage of post-peak strength and increased stiffness in the triaxial test. A higher than necessary confining pressure is achieved because fibres have higher tensile strengths.

Charan (1996) Fiber coir and baba and polypropylene were used in the triaxial and CBR tests to study the effects of the natural fibres. Results show that a fibre content of 1.5 per cent contentmentcent results in lower confining pressure and a two-fold increase in the CBR value.

Santoni et al (2001) Using six various types of non-cohesion-less cohesion-less soils underlined with monofilament polypropylene fibres, researchers found that the optimum

fibre content was 0.8 per cent, and that fibre content or less than 0.6 per cent caused strain trying to soften, while fibre content greater than 0.85 per cent caused strain hardening.

Kumar, Walia and Bajaj (2007) We've added polyester synthetic reinforcements to the black cotton dirt. They looked at the geotechnical properties of expansive soils using uniaxial compression fly ash, lime, and randomly oriented fibers. With increasing fiber content, the unconfined compressive strength rises.

Chandra et al (2008) The static test procedure of reinforced and unreinforced soils demonstrates that the unconfined compression strength is 3.824, 4.836, and 9.712 Mpa, respectively, for the three types of soil investigated.

2.3 OBJECTIVES OF THE PROJECT

1. To determine the properties of soil and jute fiber.
2. To determine the optimum moisture content of the soil.
3. Stabilization of the soil by using the jute fibre and comparative study on the soil with and without jute fiber.

CHAPTER: 3

AIM AND SCOPE OF THE STUDY

3.1 AIM OF THE STUDY

1. To collect the soil sample from the areas like clay types area.
2. To analyze the present strength of soil by collected sample.

3.2 SCOPE OF THE STUDY

1. Increased strength may be applied to a wide range of waste materials.
2. Savings in the disposal of unsuitable materials
3. Large savings in aggregate consumption.
4. Savings in the transportation of material.
5. Protection of roads (less truck transport)

Jute fibre is currently widely utilized across the globe due to research showing that it is a versatile material with appealing properties and benefits. It is possible to utilize waste jute fibres to improve the structural qualities of soil (stabilization of soil) and to minimise seepage because of their high strength, low cost, and long life. In addition to reducing the environmental effect, the utilisation of waste fibres will minimize the amount of land needed to dispose of wastes. An effort was made to use jute fiber materials created for improving soil engineering qualities, and this was a result.

APPLICATIONS:

- Road construction
- Dams and reservoirs
- Construction of paths
- Parks and sports grounds
- Motorways
- Backfilling

CHAPTER 4

METHODOLOGY AND MATERIALS USED

4.1 METHODOLOGY

Basic tests for clay were carried out, followed by a thorough investigation of unreinforced and Jute fiber-reinforced soil. The major tests used to determine soil engineering behavior were CBR and Triaxial. To test the performance properties of jute fibers, three layers were placed down. The incorporation of 1, 2, and 3 layers of jute fiber resulted in axial and CBR tests for strengthened soil. The fibre was put in the center of the sample for one layer $1/4$ th, $2/4$ th, and $3/4$ th of a specimen for 2 layers, and three fourths, $2/3$ rd, and $2/3$ rd of the material for three layers. For clay, preliminary tests were carried out, followed by a more comprehensive analysis.

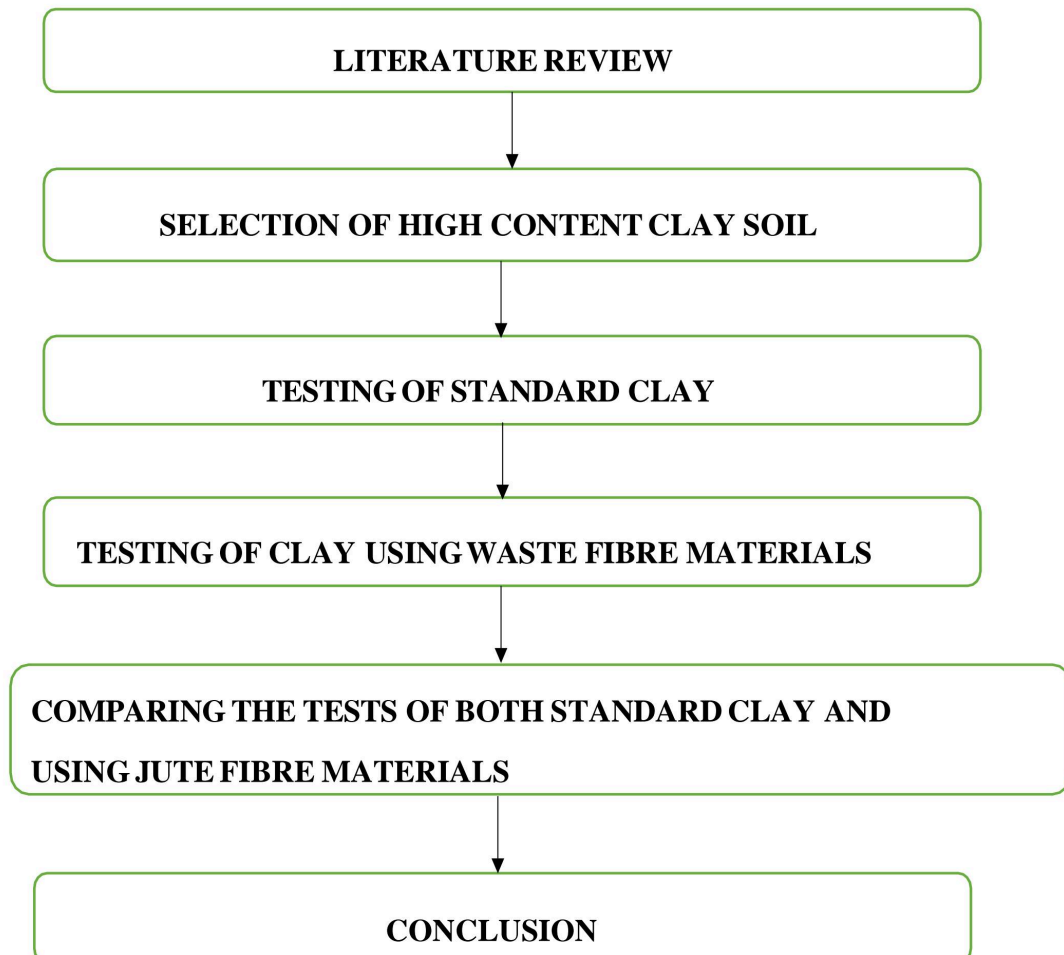


FIG 4.1: METHODOLOGY

4.2 MATERIALS USED

- At the suggested trial location in Mannivaakam, the disturbed expansive soil was recovered from an open excavation 1.5 metres below the natural ground surface.
- Jute Fibre

4.3 Jute Fibre

Jute is a natural fibre that is often referred to as "golden fibre" because of its colour. Known as a fibre of the future, it is one of the most cost-effective and strongest all-natural fibres available today.

Jute is the second-largest textile fibre producer in the world, behind cotton. Jute is produced mostly in India, Bangladesh, China, and Thailand. When it comes to quality, durability, sturdiness, and powerful nature they are head and shoulders above the others.

A wide range of sizes and dimensions are available to meet the specific needs of each activity. In comparison to synthetic geotextiles, jute geotextiles are the cheapest on the market.



Figure 4.2 JUTE FIBRE

4.4 LIST OF TESTS DONE

The experimental work is initiated to find out the effect of jute fibre on the various geotechnical

properties of an expansive soil like grain size distribution, Waterberg's limits optimum moisture content (OMC), maximum dry density (MDD) and California bearing ratio (CBR). The study is also extended to evaluate the strength characteristics of the sample taken to check the suitability of the composite material for utilization in the subgrade, sub-base, and embankment.

1. Sieve Analysis
2. Liquid Limit
3. Plastic Limit
4. Standard Proctor Compaction Test
5. CBR
6. Free swelling test



FIG 4.3 COLLECTION OF SAMPLE

TABLE 4.1: Possessions of Soil

Property of soil	Rate
Liquid limit	33.82%
Plastic limit	19.24%
Free Swell Index	42.9%
OMC	17.37%
MDD	1.72Kn/m
CBR	1.01%

TABLE 4.2: Property of Fibre

Property range	value
Types	Dark Jute
Fibre l,	30mm
Fibre dia, mm	1
Specific Gravity	1.33
Bulk density, K/m3	1301
UTL, N/mm2	3317
Elongation at break, (%)	2.7
Modulus of elasticity, N/mm2	77

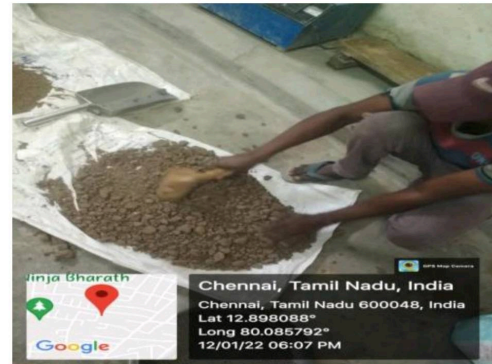


FIG 4.4 SAMPLES PREPARATION

4.4 GRADUATION TEST

The unit size dispersal test, which is frequently referred to as the gradation test, was performed using Indian Standard. In the laboratory, 4.75 mm, 2.36 mm, and 1.18 mm sieves, 600, 425-, 300-, 150-, and 75-mm pans, and a weigh balance is used. A nested column of sieves with wire mesh fabric is used in a conventional sieve analysis. The topmost sieve, which will have the biggest screen diameter at 4.75 mm, receives a sample of 1 kg. The diameter of each bottom sieve inside the columns is smaller than the diameter of the sieve above this one. The basis is the receiver, which is a spherical pan. A sieve shaker was used to violently shake the material for ten minutes. The number of material standard sieves was estimated after shaking.

4.5 WET SIEVE ANALYSIS



FIG 4.5 WET SIEVE ANALYSIS

4.5.1 THEORY:

The percentage of total dry weight stated in terms of particle size distribution is known as soil gradation (sieve analysis). Sieves with increasingly narrower apertures from top to bottom are used to evaluate the gradation of a sample by advisement of the particles taken on each sieve.

4.5.2 NEED AND SCOPE:

The results of testing will be influenced by the aggregation from which the specimen was collected. Grain size distribution affects soil engineering properties, hence it is critical to gather an undisturbed representative sample that accurately reflects the source.

4.5.3 Dry Sieving:

1. Obtain 500 grammes of dirt from the disturbed representative sample.
2. Perform a sieve analysis using the standard set of sieves provided in the

datasheet.

3. Both manual and motorized methods may be used for 10 minutes of sieving.
4. Weigh the material that has clung to each filter.
5. On the basis of the total weight of the soil sample obtained, the percentage retained on each sieve is computed.
6. The proportion passing through each of the sieves is computed based on these data.

4.5.4 Wet Sieving: If the soil contains more than 5% fine particles, wet sieving is required.

1. All lumps have been reduced to their smallest possible size.
2. 500 grams of oven-dried soil samples should be soaked for an hour in water.
3. A 2 per cent Calgon solution is used instead of water when deflocculation is required for heavy clays.
4. Set the sample aside to soak for at least ten min after mixing.
5. A 75-micron sieve is used to sift the material.
6. The debris is filtered and cleaned until the water is clear.
7. A 75-micron sieve is used to collect the dirt, which is then dried in the oven.
8. It is then sieved for ten minutes in a sieve shaker, with the residual material on each sieve being collected and weighed.
9. The total mass of soil collected for dry sieve analysis minus the sum of the masses of material retained on all sieves equals the material that would have been kept on a pan.

4.6 DETERMINATION OF LIQUID LIMIT

Soil Sample

1. From the well-mixed part of material passing the 425-micron IS Sieve, a sample weighing approximately 120 g must be collected.
2. If stones are present, only material passing the 425-micron IS Sieve should be utilised for the test; this may be done by rubbing moist dirt through the sieve until a sufficient amount of the size passes the 425-micron IS Sieve is achieved.

4.6.1 Mechanical Device Adjustment

1. If the cup doesn't come out easily or the hinge moves excessively to one side, do a thorough inspection of the mechanism that controls the amount of liquid that may be poured into the cup. The grooving tool must also be evaluated for cleanliness and dryness.
2. The height through which the cup is raised and lowered should be adjusted using the gauge on the handle of the grooving tool or a separate gauge, as well as the adjustment plate of the mechanical liquid limit device so that the point on the cup which comes in touch.



FIG 4.6 LIQUID LIMIT

4.7 DETERMINATION OF PLASTIC LIMIT

1. If you're using an evaporating dish, make sure the soil sample is well moistened with distilled water before you begin shaping it with your fingers.
2. The soil must be let to stand for at least 24 hours in clayey soils so that the

plastic soil specimen may be evenly distributed throughout the soil.

3. The threads need to be rolled to a diameter of 3 mm.
4. It is necessary to continue rolling and kneading alternately until the thread breaks under the roll pressure and no longer forms a thread from the soil.
5. When the thread's diameter is more than 3 mm, crumbling may occur.

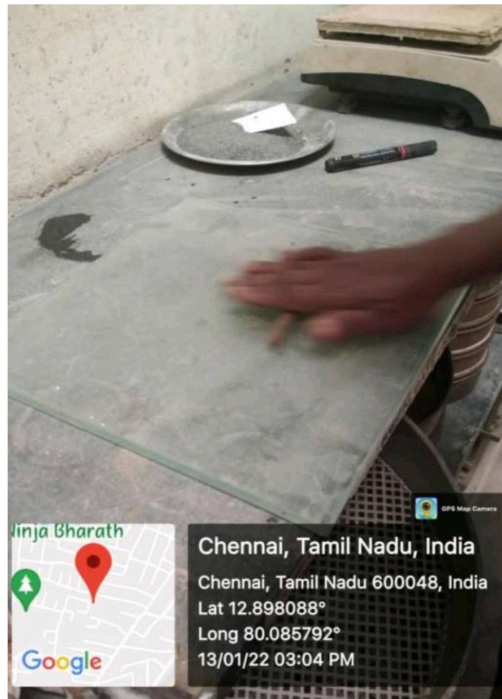


FIG 4.7 PLASTIC LIMIT

4.8 FREE SWELL INDEX

1. Using a 425-micron sieve, separate two typical oven-dried soil samples, each weighing 10 grams.
2. Pour one sample of dirt into individually of the 2 100ml glass progressed cylinders.
3. Fill 1 cylinder with kerosene and the other one with purified water to the 100ml mark in both cylinders.
4. Using a glass rod, gently shake and swirl the cylinder to release the contained air.

5. Allow the samples in both cylinders to settle.
6. Allow enough time, at least 24 hours, for the soil model to reach an equipoise condition of volume short of any additional charges in the measurements of the soils.
7. In each of the cylinders, record the decisive volume of the soils.

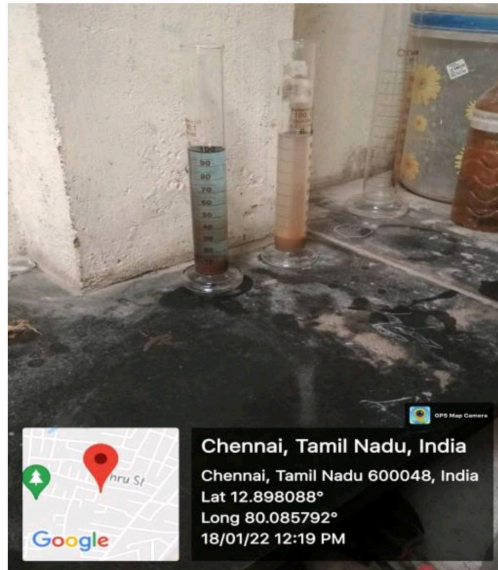


FIG 4.8 FREE SWELL INDEX

4.9 PROCTOR DENSITY TEST

A proctor density test is used to control the relationship between moisture and density. On good sand, the standard proctor test was performed in unity with IS 2720. This is an evaluation. When a conventional mould with a capacity of 1000 ml and an interior diameter of 100 mm is used, it comes with a removable base plate of 50 mm high removable collar on top. The soil was nutrient-dense. Three equal layers were compressed in the mould; each layer was struck 25 times by a 2.6 kg hammer will be lived at a height of 30cm.

4.9.1 NEED & SCOPE:

The association between moisture content and density of soils compacted in a

particular size Mould using a 2.5 kg rammer dropped from a height of 30 cm was determined. Among other things, the results of this study will help improve the bearing capacity of foundations, reduce the settling of structures, manage volume fluctuations unwelcome, reduce hydraulic conductivity, and improve slope sand stability.

Apparatus Required:

944 cubic centimetres of space Inside diameter is 10.2 cm and height is 11.6 cm in Proctor Mould.. In order to use the Mould, you'll need to remove the collar and base plate.

Mechanically driven metal rammer with a 5.08 cm face diameter and a weight of 2.5 kg. Allows the free fall of the rammer to be regulated by a mechanism of 30 centimetres. An extruder, a mixing pan, a spoon and a spatula are some of the tools needed for mixing.

a scale with a 15-kilogram capacity A delicate balancing act For example, a graded cylinder for storing moisture.



FIG 4.9 PROCTOR DENSITY

Gross a standard oven-dry sample of around 5000g and place it popular the pan provided. To achieve a water content of 4-6 per cent, thoroughly wet the sample.

Consider the proctor Mould's base plate and collar after removing them. Incorporate the collar and the base plate. Make three layers of dirt in the Proctor Mould and compress each sheet with the 2500g rammer falling over. The strikes must be dispersed uniformly throughout the surface of each layer in order to be effective. Mould should be level with the top of the compacted ground when the collar is removed and weighed.

Add 944 cc to the compressed specimen's weight to get the bulk density.

For measuring water content, remove a small portion of the mould and slice vertically through it.

Remaining material should be broken up until it can be seen to pass through an eye-calibrated no.4 sieve. Amount of water needed to boost soil moisture content by one or two percentage points, then repeat the procedure for each subsequent increment of water. Continue this procedure until the wet unit weight of the compacted soil drops or does not change.

4.10 CALIFORNIA BEARING RATIO TEST ON SOIL

Experiments on the CBR Ratio were carried out on soil tested samples of varied amounts of jute fibre. The fibre ranged from 0.5% to 1%. The penetration levels at 2.5mm and 5mm must be evaluated in order to understand the CBR values. At a penetration depth of 2.5mm, the CBR of the 0.5% fibre mix specimen was 6.9% unsoaked, and 5.2% soaked specimen. so their decrease meant in a soaked specimen compared to an unsoaked specimen. CBR for 1% jute fibre was 11.3per cent at 5mm penetration; here, the increase is exponential, increasing by approximately 3.9 per cent. The CBR for 1.25 per cent jute fibre was 9.2per cent at 5mm penetration; the CBR has decreased slightly.

4.10.1 Preparation Of Test Specimen:

Test material should be able to pass a 19-mm sieve and be retained on a 4-inch sieve. Reshaping calls for a dry density based on field density or a compaction test maximum dry density estimate.

Compaction that is both dynamic and reversible As a general rule, the soil sample should be 4500grams or more for fine-grained and 5500grams or more for grainy soil. In order to get max dry density at the ideal moisture content, the precise mass of soil needed must be obtained and the appropriate amount of water supplied to achieve that moisture content in the sample.

4.10.2 Method For Penetration Test

Set up the mould component and the test item on the machine's bottom plate. Before the sitting penetrating dive, 2500 grams of annular mass must be put upon that soil surface to avoid soil upheaval, after which the remainder of the additional weights will be added.

In order to ensure complete piston contact, place the piston in the middle of the specimen with the lightest feasible load, but no more than 4 kg.

Ensure that the load and deformation gauges are set to zero. In order to achieve a penetration rate of 1.25 mm/min, provide weight on the piston.

Measure the loads at 2.5- and 5.0-mm penetrations.

Remove the Mould from the loading equipment by raising the plunger. Find out how much water there is in an area by taking 20 to 50 g of soil and testing it for moisture content at that depth

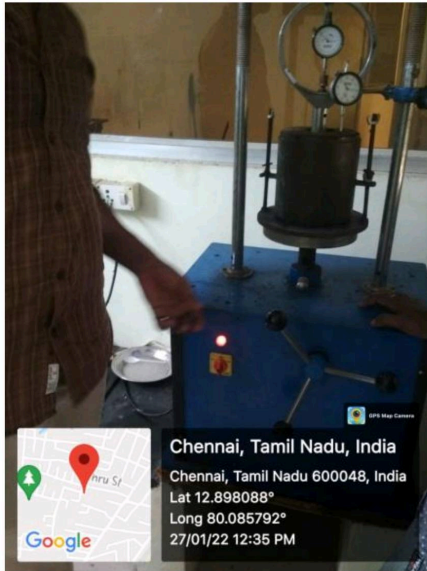


FIG 4.10 CBR TEST

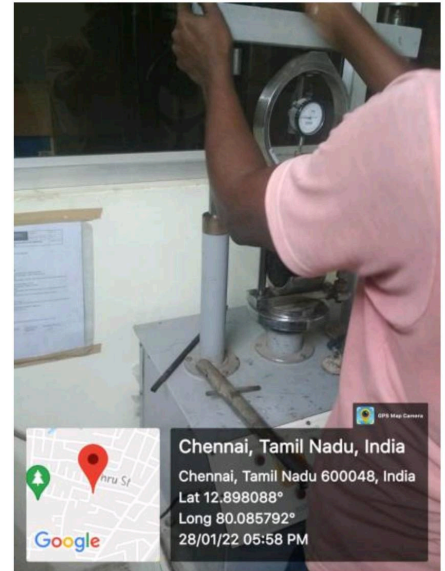


FIG 4.11 CBR TEST

CHAPTER 5

TEST RESULTS

5.1 WET SIEVE ANALYSIS

The result of the sieve analysis was the classification of soil was gravel 0%, and 3.3%, Silt and Clay 96.7%. So, it was clear the soil taken from the study area was clay soil for which the strength of the soil needs to be improved. To improve the soil density fibres were added and analysed.

TABLE: 5.1 WET SIEVE ANALYSIS

SL/NO	I.S Sieve (mm)	Weight retained in gms	Cumulative weight reserved in gms
1	4.75	0	0%
2	2.36	0.9	
3	1.18	0.3	
4	0.6	1.7	3.3%
5	0.3	0.6	
6	0.15	3.0	
7	0.075	10.0	
8	Below 0.075	483.5	96.7%

Result

- Gravel = 0%
- Sand = 3.3%
- Silt & Clay = 96.7%

5.2 LIQUID LIMIT TEST

The liquid limit test was conducted and the test result were shown in table 5.2. the result shows that the liquid limit of the soil sample was 34 %.

TABLE: 5.2 LIQUID LIMIT

PLUNGER	WET WEIGHT OF SOIL SAMPLE	DRY WEIGHT
20mm	18.2g	13.6g

CALCULATION

$$\begin{aligned}\text{LIQUID LIMIT} &= (\text{WET WEIGHT OF SOIL} - \text{DRY WEIGHT OF SOIL} / \text{DRY WEIGHT OF SOIL}) * 100 \\ &= (18.2 - 13.6 / 13.6) * 100 \\ \text{L.L} &= 33.82\%\end{aligned}$$

5.3 PLASTIC LIMIT TEST

The Plastic limit test was conducted and the test result were shown in table 5.3. the result shows that the plastic limit of the soil sample was 19%.

TABLE: 5.3 PLASTIC LIMIT

SL NO	WET WEIGHT	DRY WEIGHT
TRIAL 1	2.1g	1.8g
2	2.8g	2.5g

CALCULATION:

$$T_1 = (2.1 - 1.8 / 1.8) * 100$$

$$= 16.7\%$$

$$T_2 = (2.8 - 2.4 / 2.4) * 100$$

$$= 12.5\%$$

$$\text{Average of } T_1 \& T_2 = 14.58\%$$

$$\text{Plastic Index} = \text{liquid limit} - \text{Plastic limit}$$

$$= 33.82 - 14.58$$

$$\text{Result: } PI = 19.24\%$$

5.3 FREE SWELL INDEX

The swelling index of the soil can be calculated using the equation shown below,

$$\text{Free Swell Index, (\%)} = (V_d - V_k) / V_k \times 100\%$$

V_d = Volume of the soil specimen read from the graduated cylinder containing distilled water.

V_k = Volume of the soil specimen read from the graduated cylinder containing kerosene.

$$V_d = 10$$

$$V_k = 7$$

$$F S I = (10-7)/7$$

$$= 42.9\%$$

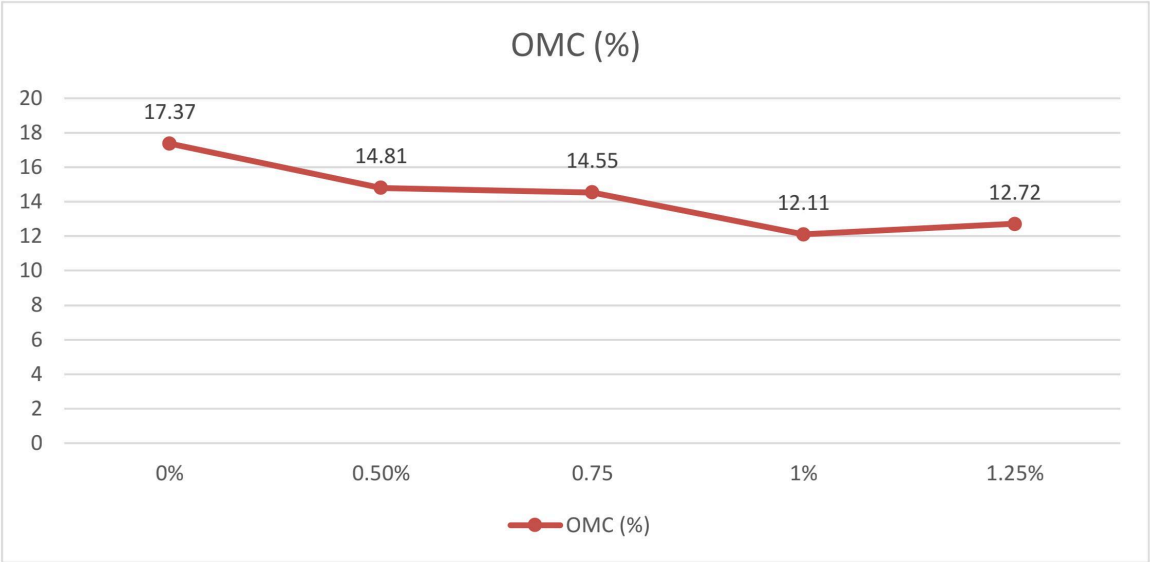
5.5 PROCTOR COMPACTION TEST

As per the study of the specimens' sample, we came to know that 1% of fibre mix specimen was having less OMC and good MDD. As we further trial of fibre specimen, OMC is increasing and MDD is reducing

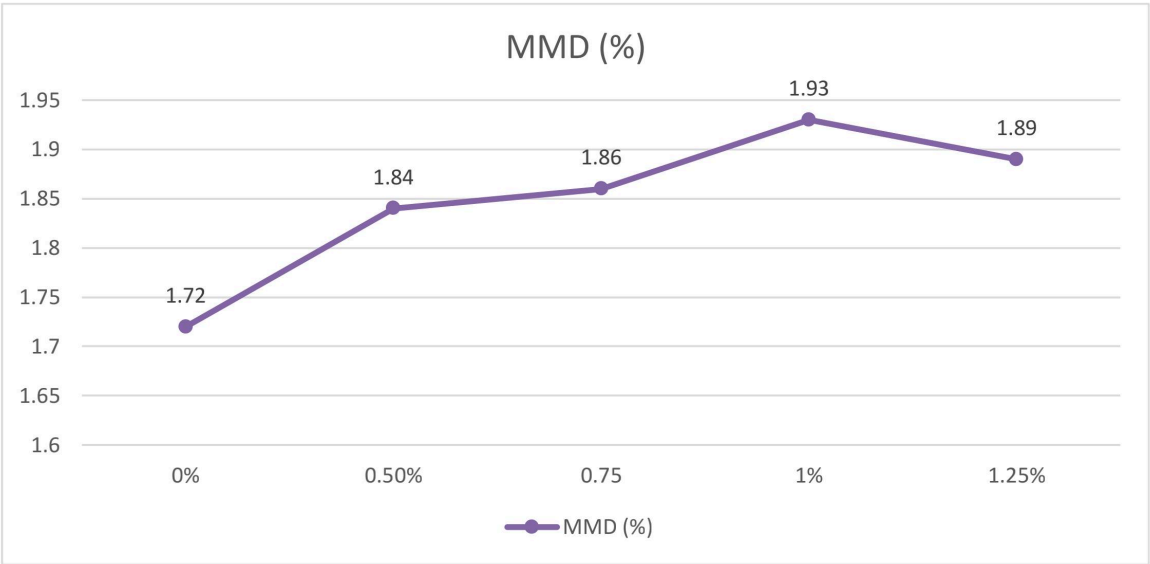
TABLE: 5.5 PROCTOR COMPACTION TEST

Type specimens	OMC (%)	MDD (%)
RAW SOIL	17.37	1.72
0.5% of fibre with soil specimen	14.81	1.84
0.75% of fibre with soil specimen	14.55	1.86
1% of fibre with soil specimen	12.11	1.93
1.25% of fibre with soil specimen	12.72	1.89

Optimum Moisture Content



Maximum Dry Density



5.5 DETERMINATION OF CALIFORNIA BEARING RATIO TEST ON SOIL

As per the study of the CBR test of specimen samples, we came to know samples. 1% of fibre mix sample has good penetration than other samples as per our research.

$$\text{C.B.R.} = (P_T/P_S) \times 100$$

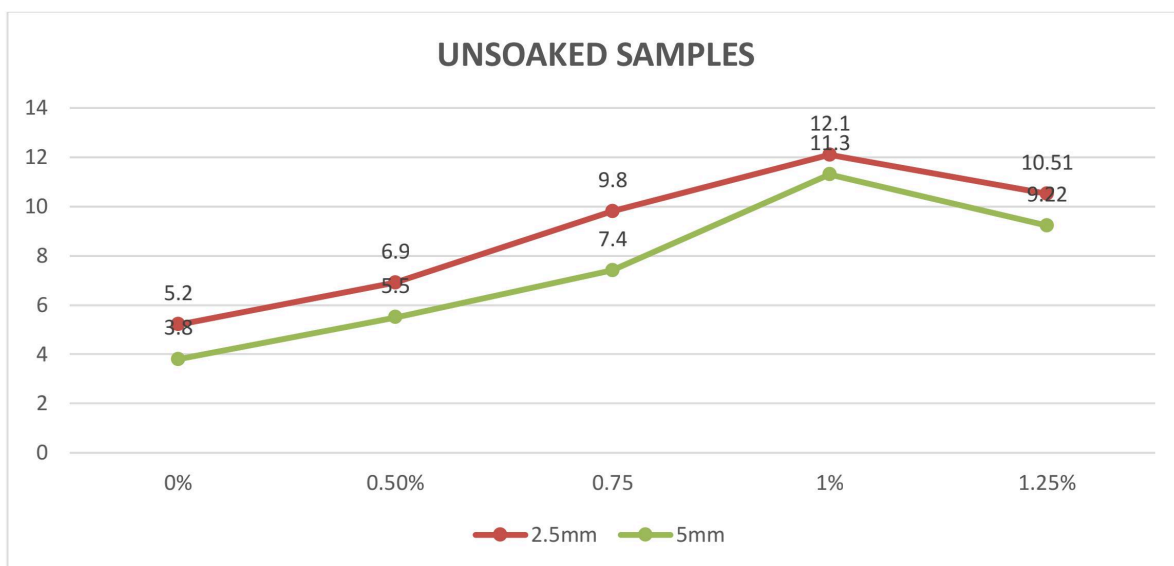
P_T = Corrected test load matching to the selected penetration from the load penetration curve.

P_S = stands for "standard load" when referring to the same penetration.

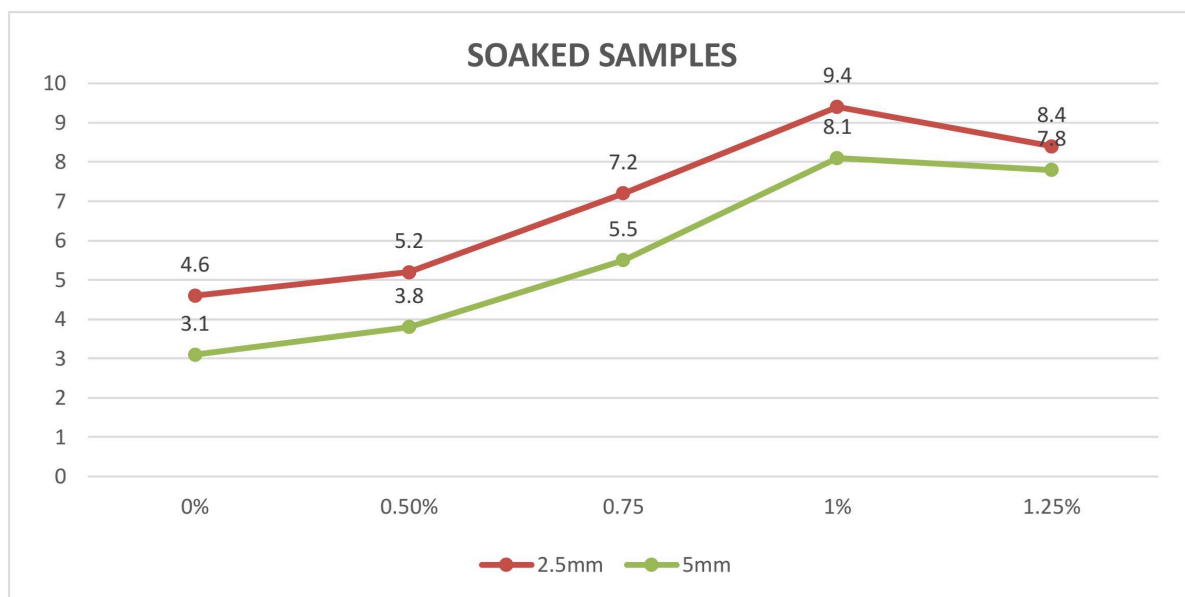
TABLE: 5.5 DETERMINATION OF CALIFORNIA BEARING RATIO TEST ON SOIL

Types	Unsoaked		Soaked	
Penetration(mm)	2.5	5	2.5	5
Raw soil	5.2	3.8	4.6	3.1
0.5% of fibre with soil specimen	6.9	5.5	5.2	3.8
0.75% of fibre with soil specimen	9.8	7.4	7.2	5.5
1% of fibre with soil specimen	12.1	11.3	9.4	8.1
1.25% of fibre with soil specimen	10.51	9.22	8.4	7.8

UNSOAKED SAMPLES



SOAKED SAMPLES



CHAPTER 6

CONCLUSION

6.1 CONCLUSION

Environmental protection is critical. a global issue Jute is in high demand as a future environmentally sustainable material. This will be investigated during this investigation. To conduct the investigation, various proportions of jute fibre pieces were used. its effect on the varied geotechnical properties of soil the testing results indicate that the engineering is sound. As a result, soil quality is critical. Stability is provided by a geotextile made of jute fibres. As the highest density, it increases the plants' optimal moisture content (OMC). The earth's fertility will increase. On the basis of the observation, the conclusion is drawn. Density increases with the addition of jute. Jute is added at a rate of 1% after the highest dry density is achieved. This is accomplished by increasing the MDD's jute fibre content, whereas OMC's jute fibre content is higher. Rises. Geo jute is available in a range of colours.

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