IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 1, March 2024

Plastic as a Soil Stabilizer

Rajebhosale S. H., Siddhesh Prashant Gorle, Hariom Bandu More
Rameshwar Rajendra Avhad, Sumit Popat Chavan, Chaitanya Kanifnath Kahandal
Department of Civil Engineering
Amrutvahini Polytechnic Sangamner, Ahmednagar, Maharashtra

Abstract: *Soil stabilization is any process which improves the physical properties of soil, such as increasing shear strength, bearing capacity etc. which can be done by use of controlled compaction or addition of suitable admixtures like cement, lime and waste materials like fly ash, phosphogypsum etc. The cost of introducing these additives has also increased in recent years which opened the door widely for the development of other kinds of soil additives such as plastics, bamboo etc. This new technique of soil stabilization can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials. Use of plastic products such as polythene bags, bottles etc. is increasing day by day leading to various environmental concerns.Therefore the disposal of the plastic wastes without causing any ecological hazards has become a real challenge. Thus using plastic bottles as a soil stabilizer is an economical utilization since there is scarcity of good quality soil for embankments. This project involves the detailed study on the possible use of waste plastic bottles for soil stabilization. The analysis was done by conducting plate load tests on soil reinforced with layers of plastic bottles filled with sand and bottles cut to halves placed at middle and one-third positions of tank.The comparison of test results showed that cut bottles placed at middle position were the most efficient in increasing strength of soil. The optimum percentage of plastic strips in soil was found out by California Bearing Ratio Test and using this percentage of plastic, plate load test was also performed. The size and contentof strips of waste plastic bottles have significant effect on the enhancement of strength of the soil].*

Keywords: Soil stabilization

I. INTRODUCTION

Soil stabilization is the process of altering some soil properties by different methods, mechanical or chemical in order to produce an improved soil material which has all the desired engineering properties. Soils are generally stabilized to increase their strength and durability or to prevent soil erosion. The properties of soil vary a great deal at different places or in certain cases even a tone place the success of soil stabilization depends on soil testing. Various methods are there to stabilize soil and the method should be verified in the lab with the soil material before applying it on the field. Dr.A.I.Dhatrak in 2015 after reviewing performance of plastic waste mixed soil as a geotechnical material. It was observed that for construction of flexible pavement to improve the sub grades oil of pavement using waste plastic bottles chips is an alternative method. AKSHAT MALHOTRA & HADI GHASEMAIN in 2014 studied the effect of HDPE plastic waste on the UCS of soil. In a proportion of 1.5%, 3%, 4.5% and 6% of the weight of dry soil, HDPE plastic waste was added. They concluded that the UCS of black cotton soil increased on addition of plastic waste. CHOUDHARY, JHA & GILL in 2010 demonstrated the potential of HDPE to convert as soil reinforcement by improving engineering properties of sub grade soil. RAJKUMAR NAGLE in 2014 performed CBR studied for improving engineering performance of sub grade soil. They mixed polyethylene, bottles, food packaging and shopping bags etc., as reinforcement within black cotton soil, yellow soil and sandy soil. MERCY JOSEPH POWETH in 2013 investigated on safe and productive disposal of quarry dust, type of waste and wastes-plastic by using them in the pavements sub grade. In their paper, a series of CBR and SPT test were carried out for finding the optimum percentages of waste plastics, quarry dust in soil sample. ACHMAD FAUZI in 2016 calculated the engineering properties by mixing waste plastic High Density Polyethylene (HDPE) and waste crushed glass as reinforcement for sub grade improvement. CHEBET in 2014 did laboratory investigations to determine the increase in

Shear strength and bearing capacity of locally available and due to random mixing of strips of HDPE (high density polyethylene) material from plastic shoppingbags.

Principles of Soil Stabilization: Evaluating the soil properties of the area under-consideration. Deciding the property of soil which needs to be altered to get the design value and choose the effective and economical method for stabilization.

Designing the Stabilized soil mix sample and testing it in the lab for intended stability and durability values.Expansive clay soils are type of soils that's how a significant change in volume once they come in contact with moisture. They expand when exposed to excess water and shrink in hot weather conditions where there is scarce amount of water.They can easily be identified in the field in dry seasons as they show deep cracks of polygonal patterns. This behavior of swelling and shrinking of expansive clay soils in turn affects the stability of structures that is built over these soils causing a serious hazard. It majorly affects the bearing capacity and strength of foundations by uplift as they swell and may cause from cracks to differential movements to structural failures [1]. In order to build on expansive soils, they need to be stabilized to reduce their swelling and improve their mechanical capacities.Soil stabilization is the process by which the engineering properties of the soil are improved and it is made more stable.It is used to decrease thes oil'sun qualified characteristics such as permeability and consolidation potential and increase the shear capacity[2].The method is mainly adopted for highway and airfield construction projects. Commonly, activities such as compaction and pre-consolidation are used to improve types of soils which are already in good form.But soil stabilization goes way up to encouraging usage of weak soil and reducing the uneconomical process of weak soil replacement. Other than working on the soil mass- interaction,chemically altering the soil material it-self is a focus of this process. Sometimes, soil stabilization is used for city and suburban streets to make them more noise-absorbing [3]. Different methods have been developed previously to stabilize weak and unsuitable soils.

Some of these methods include mechanical (granular) stabilization, cement stabilization, lime stabilization, bituminous-stabilization, chemical

Stabilization ,thermal-stabilization, electrical-stabilization,as well as grouting stabilization by geo-textile and fabrics. Recently, researchers have introduced another way of soil stabilization by using waste materials. Plastics are one of the leading waste materials that are found to be suitable for this purpose. They reduce the cost of stabilization at a large rate [4]. Using plastics for this purpose simultaneously solves the challenges of improper plastic waste recycling that is currently a teething problem in most developing countries. Improper plastic waste disposal is becoming a pressing environmental issue in most African countries. They are currently covering landfills and water bodies, clogging sewerage systems,disrupting the ecologicaly clean dcreating and aesthetically unpleasing environment. This in turn causes serious damage to animal, plant and human lives. Polyethylene Terephthalate (PET) bottle sare conventional plastic bottles that currently are highly utilized.They are used to package water,softdrinks,liquidfoods,and various other beverages. With their increasing demand, their disposal is becoming difficult. The degradation of waste PET bottles takes a very long time in nature (more than a hundred years) [5]. Recycling and using these plastic bottles to stabilize expansive clay soil are moves in the right direction making the construction industry an appropriate candidate with its high consumption ability. This will be a decent alternative for Soil stabilization means the improvement of stability or bearing power of the soil by the use of controlled compaction, proportioning and/or the addition of suitable admixture or stabilizers. The basic principles of soil stabilization are: x Evaluating the properties of given soil. x Deciding the lacking property of soil and choose effective and economical method of soils stabilization.

x Designing the stabilized soil mix for intended stability and durability values.

Stabilization can increase the shear strength of a soil and/or control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundations. Stabilization can be used to treat a wide range of sub-grade materials from expansive clays to granular materials. The most common improvements achieved through stabilization include better soil gradation, reduction of plasticity index or swelling potential, and increases in durability and strength. In wet weather, stabilization may also be used to provide a working platform for construction operations. These types of soil quality improvement are referred to as soil modification. Benefits of soil stabilization are higher resistance values, reduction in plasticity, lower permeability, reduction of pavement thickness, elimination of excavation, material hauling and handling, and base importation, aidscompaction, provides all-weatheraccessonto and within projectssites.The determining factors associated with soil stabilization may be the existing moisture content, theenduseofthesoilstructureandultimatelythecostbenefitprovided.Asgoodsoilbecomes scarcer and their location becomes more difficult and costly, the need to improve quality of soil using soil stabilization is becoming more important. Soil stabilization using raw plastic bottles is an alternative method for the improvement sub-grade soil of pavement. It can significantly enhance the properties of the soil used in the construction of road infra-structure.

II. LITERATURE REVIEW

Tarun Kumar, Suryaketan "Behaviour of Soil By Mixing Of Plastic Strips", International Research Journal Of Engineering & Technology e-ISSN: 2395-0056, Vol. 5, Issue 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 un-soaked 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.

KirankumarPatil, Shruti Neeralagi "Soil Stabilization Using Plastic Waste", International Journal of Advanced Technology in Engineering & Science, ISSN 2348- 7550, Vol. 5, Issue No. 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 reinforcingthesoilforimprovingthevariouspropertiesofsoil.Applicationsofstabilizingof 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 bags trips 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.

ai D. Madavi, Divya Patel "Soil Stabilization Using Plastic Waste" International Journal of Research in Science & Engineering, Vol. 3, Issue 2, 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 upto 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.

Shran Veer Singh, Mahabir Dixit, "Stabilization of Soil by Using Waste Plastic Material: A Review", International Journal of Innovative Research in Science, Engineering & Technology, ISSN(Online) 2319-8753, Vol. 6, Issue 2, 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

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

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.

Literature Survey No.5

A. K. Choudhary, J.N. Jha and K.S. Gill, "A Study on Behaviour of Waste Plastic Strip Reinforced Soil" Emirates Journal for Engineering Research, 15 (1), 51-57 (2010)

IN the present time the performance of paved and unpaved roads is often poor after every monsoon. Attempts have been made in this study to demonstrate the potential of reclaimed HDPE as soil reinforcement for improving engineering properties of the subgrade soil.Strips obtained from waste plastic with various dimensions were mix randomly with soil and find out appropriate amount of HDPE strips. They performed tests and interpreted the data based on the ratio of length to width of the strip. He also mentioned that as most of the plastic bags are made of high-density polyethylene material, hence there is increase in the amount of the plastic material in the environment.

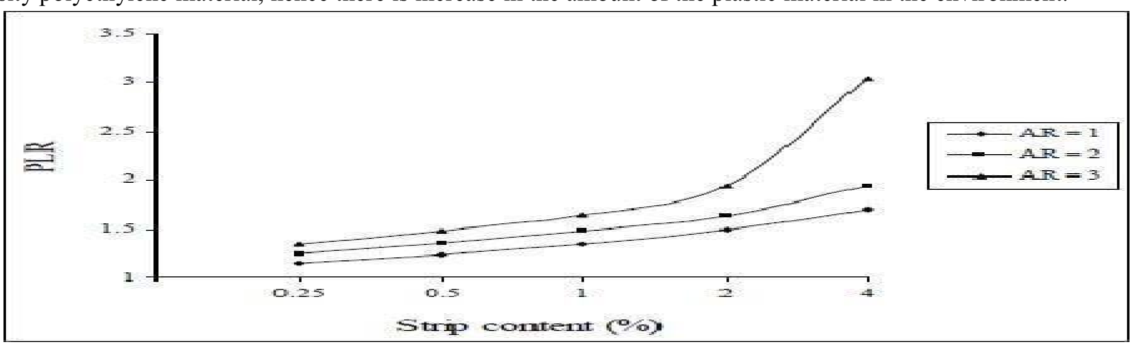


Fig. 1. Variation of Piston Load Ratio (PLR) with strip content at different Aspect ratio

It is seen from the curve that the maximum CBR and the secant modulus is obtained at theaspect ratio of 3 and strip content of 4%.Thereinforcementbenefitisdirectlyproportionalto the length of the strip content. The maximum CBR value of reinforced system is equal to the 3 times of unreinforced system.It is seen from the curve that the thickness of the base course is reduced by adding the strip content of particular aspect ratio and CBR value. Thus, from this study the feasibility of reinforcing oil with strips of HDPE is investigated and the results of this study proves useful as soil reinforcement in highway application

III. REASERCH OF METHODOLOGY

The scope of the work includes addition of plastic bottle strips to the locally available black cotton soil to enhance the engineering properties. The work presented in this paper aims to investigate the improvement of soil properties such as shear strength, maximum dry density (MDD) and CBR values by adding strips cut from plastic bottles. A series of laboratory test were conducted on both plain as well as plastic reinforced soil to compare the improvement of soil properties.

Through this project, a small attempt has been made at deducing a new method of waste disposal in effective manner. This project aims at proposing a new method of disposal of waste plastic (PET)by using them in stabilization admixture.

ADVANTAGES OF SOILSTABILIZATION

It improves the strength of the soil, thus, increasing the soil bearing capacity. It is more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation. It is also used to provide more stability to the soil in slopes or other such places.

MATERIALS AND METHODS MATERIALS

In this research work conducted various experiment to find the stabilization of the sub base using the industrial waste and plastic waste the various test conducted to find the stabilization of the sub based on the ASTM procedure are listed:1.Liquid Limit,2.Plastic Limit, 3. Shrinkage limit, 4. Specific Gravity.

1)LIQUID LIMIT: Liquid limit is defined as the moisture content at which soil begins to behave as a liquid material and begins to flow. The importance of the liquid limit test is to classify soils. Different soils have varying liquid limits. Also, once must use the plastic limit to determine its plasticity index.

2) PLASTIC LIMIT: Plastic limit is defined as the moisture content and expressed as a percentage of the oven dried soil at which the soil can be rolled into the threads one- eight inch in a diameter without soil breaking into pieces. This is also the moisture content of a solid at which a soil changes from a plastic state to a semi solid state.

3) SHRINKAGE LIMIT: This breaking point is accomplished when further loss of water from the soil does not reduce the volume of the soil. It can be defined more precisely as the least water content at which the soil can in any case be completely saturated.

4) SPECIFIC GRAVITY: Specific gravity is defined as the ration of the unit of soil solids unit of water. The specific gravity is needed for various calculation purposes in soil mechanics, e.g. void ratio,density.

METHODS

MECHANICAL METHODS OF STABILIZATION

In this procedure, soils of different gradations are mixed together to obtain the desired property in the soil. This may be done at the site or at some other place from where it can be transported easily. The last blend is then compacted by the regular strategies to get the required thickness.

ADDITIVE METHOD OF STABILIZATION

The addition of manufactured products into the soil, which in appropriate amounts improves the nature of the soil. Materials such as cement, lime, bitumen, fly ash etc., are used as synthetic additives. Sometimes different fibers are also used as reinforcements in the soil.

Oriented fiber reinforcement the fibers are arranged in some order and all the fibers are placed in the same orientation. The fibers are laid layer by layer in this type of orientation. Continuous fibers in the form of sheets ,strips or bars etc .are used systematically in this type of arrangement.

•It enhances the quantity of the soil hence, expanding the soil bearing limit.

•Stabilization enhances the workability and the strength of the soil.

•It helps in lessening the soil volume change.

The materials which are considered are soil and plastic with chemical composition of polypropylene.

Theexperimentalworkconsistsofthe following steps,

1.Moisture content

2.Specific gravity of the soil,

3.Determination of soil index properties (Atterberg Limits),

4.Liquid limit by Casagrande's apparatus,

5.Plastic limit,

6.Particle size distribution by sieve analysis,

7.Preparation of reinforced soil samples, 8.Determination of shear strength by:

a.Directshear stress,

b.Unconfined compression test.

1.MOISTURE CONTENT

Soil mass is a porous structure, having void filled with water or air. Moisture content (W) is defined as the ratio of the mass of water(Wa) in voids to the mass of soil-solids(Ws) expressed as a percentage thus:

$W = W_a / W_s$

2. SPECFIC GRAVITY

Specific gravity of soil particles is used in determination of voids ratio, porosity, degree of saturation and critical hydraulic gradient. It is also used in finding particle size by means of hydrometer analysis. Acceptable Values of G-2.60-2.72 for course grained soils

-2.70-2.80 for fine grained soils

-2.30-2.50 for organic soils

3. LIQUID LIMIT BY CASAGRANE'SMETHOD

The liquid limit (WL) is the minimum water content at which a part of soil is grooving tool of standard dimensions, will flow together for a distance of 13mm under the impact of 25 blows in a standard liquid limit apparatus, it is the water content at which the soil first shows a small shearing resistance as the water content is reduced.

WHY PLASTIC

Plastic increases the shear strength and tensile strength of soil. It can significantly enhance the properties of the soil used in the construction of road infrastructure and available abundance.

PROPERTIES OF PLASTIC

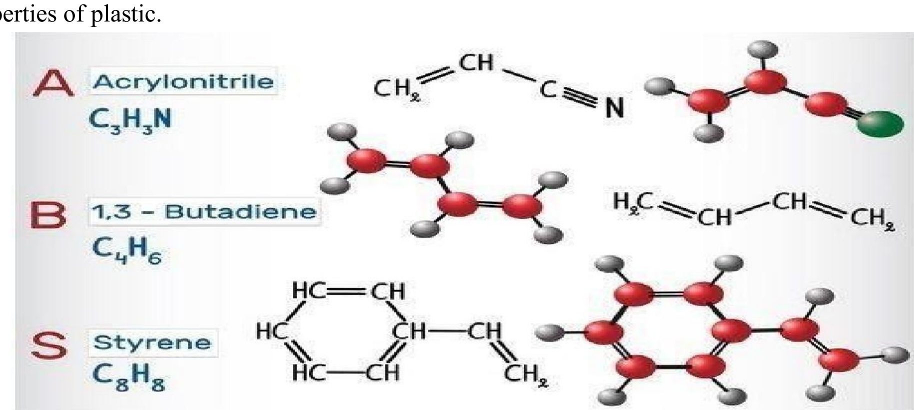
Plastic have a numerous properties that make them superior to other materials in many applications.The different types of properties are physical properties and chemical properties.

PHYSICAL PROPERTIES

Plastic has transparency, flexibility, elasticity, water resistant, electrical resistance and soft when it is hot. Soil are naturally occurring material‟ that are used for the construction of all except the surface layers of pavement and that are subjected to classification tests to provide a general concept of their engineering characteristics.

CHEMICAL-PROPERTIES

Chemical-resistance, thermal-resistance ,reactivity with water, flammability, heat of combustion etc., are the basic chemical properties of plastic.



Plastic Used

Acrylonitrile-butadienestyrene: Acrylonitrile-butadienestyrene(ABS),(chemicalformula $(C_8H_8)_x$·,$(C_4H_6)_y$·$(C_3H_3N)_z$ is a common thermo-plastic polymer.

Acrylonitrile: It is a synthetic monomer produced from propyleneand-ammonia .This component contributes to ABS chemical resistance & heat-stability.

Butadiene: It is produced as a by-product of ethylene production from steamcrackers.This component delivers toughness & impact strength to ABSpolymer.

Styrene: It is manufactured by dehydrogenation of ethylbenzene. It providesrigidity & processability to ABS plastic.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

IV. RESULTS & DISCUSSIONS

Specific-gravity

Soil sample - it was collected from a construction site near Banashankri III Stage

Sample number	1	2	3
Mass of empty bottle (M1) in gms	66.3	66.2	66.2
Mass of bottle + dry soil (M2) in gms	114.2	120	118
Mass of bottle + dry soil + water (M3) in gms	192.66	195.8	194.7
Mass of bottle + water (M4) in gms	165	165.1	165.2
Specific gravity	2.35	2.32	2.32

Table No: 1. Specific Gravity of Soil Sample

AVERAGE SPECIFIC GRAVITY = 2.33

Acceptable values of G = 2.60 – 2.72 for coarse grained soils

=2.70-2.80 for fine – grained soils =2.30-2.50for organic soils.

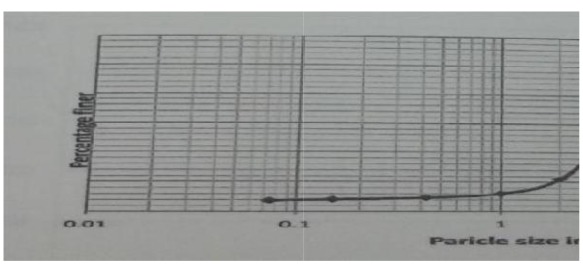
Since the result of the specific gravity of soil sample is 2.33. It comes under Organic Soil.

Sieve analysis

Sieve analysis observations and calculations of Soil Sample

IS sieve size	Mass retained(m/100)	Mass of soil retained (g) %	Cumulativeretained (%)	Cumulative %finer (N)
1	2	3	4	5
20	0	0	0	100%
10	83.98	9.94	9.94	90.06%
6.25	126.41	14.56	24.9	74.4%
4.75	64.15	7.59	32.49	60.39%
2	447.58	52.97	85.46	22%
1	18.94	2.24	87.7	12.3%
0.425	29.91	2.83	90.43	9.471%
0.15	9.76	1.16	9169	8.32%
0.075	5.96	0.7	92.39	7.61%
Pan	64	7.57	99.96	0.04%

Table NO: 2 Sieve Analysis of Soil Sample



Graph No 1. Sieve Analysis

Liquid Limit

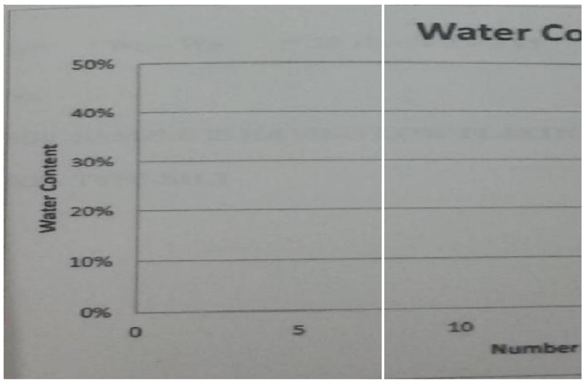
Observation no	1	2	3	4
Number of Revolutions	27	23	22	18
Crucible no	1	2	3	4
Wt. Of crucible wet soil(g)	20.94	21.1	21.6	21.4
Wt. of crucible +dry soil(g)	19.78	20	20.7	20.2
Wt. of crucible(g)	15.5	15.7	16	15.4
Wt. of water	1.16	1.2	1.2	1.2

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

Wt. of dry soil(g)	4.28	4.2	4.4	4.4
Water content (%)	27%	28.5%	27.2%	27.2%

Table No: 3. Liquid Limit of Soil Sample

AVERAGE LIQUID LIMIT WL = 28.1%



Graph No: 2. Water content of Soil Sample

PLASTIC LIMIT

Observation No	1	2	3	4
Container No	1	2	3	4
Wt. of container + wet soil(g)	32.6	33.8	32.6	36.2
Wt. of container + dry soil(g)	30	31	29.7	33.4
Wt. of container(g)	19	16.2	18.5	22.3
Wt. of drysoil(g)	11	12.5	11.2	11.1
Wt. of water(g)	2.6	2.8	2.9	2.8
Plastic limit (wp)	23.63%	22.9%	25.8%	25.2%

Plastic Limit of Soil Sample

AVERAGE PLASTIC LIMIT=24.25%

PLASTICITY INDEX

IP = WL-WP = 28.1%-24.25% = 3.85%

So,

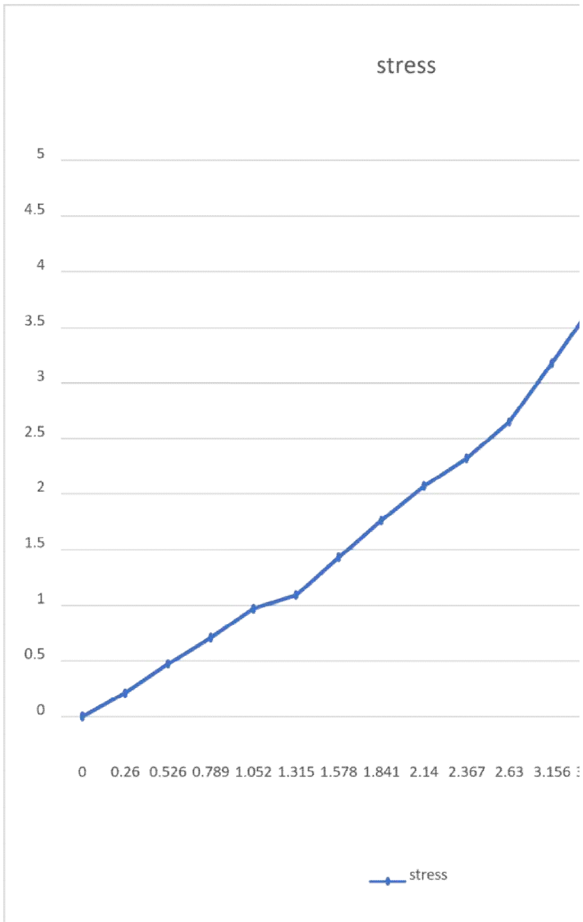
SOIL SAMPLE IS HAVINGLOWPLASTICITY (SOIL TYPE-SILT)

UNCONFINED COMPRESSION TEST SOIL SAMPLE

Dial gauge reading	Strain(c)	Provingring	Reading correctedarea	Load(N)	Axial stress(Kg/cm2)
0	0	0	11.330	0	0
20	0.26	8	11.364	2.4	0.211
40	0.526	18	11.398	5.4	0.473
60	0.789	27	11.420	8.1	0.709
80	1.052	37	11.450	11.1	0.969
100	1.315	42	11.480	12.6	1.09
120	1.578	55	11.510	16.5	1.430
140	1.841	68	11.540	20.4	1.760
160	2.140	80	11.570	24	2.070
180	2.367	90	11.600	27	2.320
200	2.630	103	11.630	30.9	2.650
240	3.156	124	11.700	37.2	3.180

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

280	3.628	146	11.760	43.8	3.720
320	4.208	166	11.830	49.8	4.200
360	4.734	180	11.890	54	4.540
400	5.260	191	11.960	57.3	4.700
440	5.786	190	12.020	57	4.700



Axial Stress=4.7Kg/Cm2 Axial Stress forSoil Sample With 0%
Reinforcement 0.05%
REINFORCED SOIL SAMPLE WITH POLYPROPYLENE

Dial gauge reading	Strain(c)	Provingring	Reading corrected area	Load(N)	Axial stress(Kg/Cm2)
0	0	0	11.330	0	0
20	0.263	7	11.364	2.1	0.180
40	0.526	16	11.398	4.8	0.420
60	0.789	28	11.420	8.4	0.730
80	1.052	46	11.450	13.8	1.200
100	1.315	58	11.480	17.4	1.510
120	1.578	70	11.510	21	1.820
140	1.841	81	11.540	24.3	2.100
160	2.104	92	11.570	27.6	2.380
180	2.367	123	11.600	36.9	3.180

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

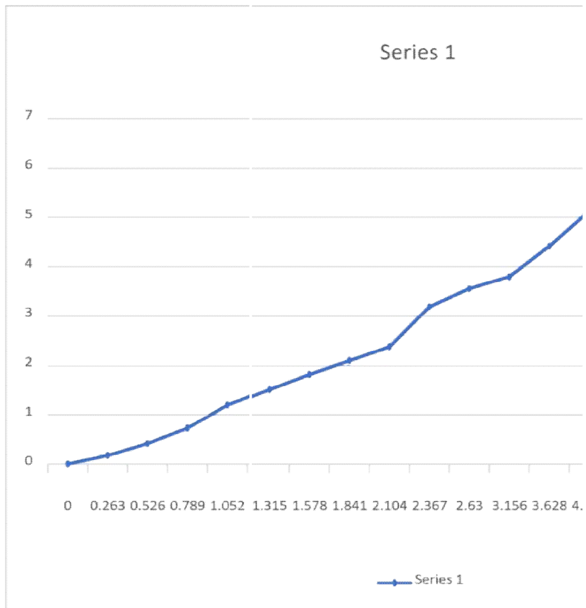
Impact Factor: 7.53

Volume 4, Issue 1, March 2024

200	2.630	138	11.630	41.4	3.550
240	3.156	148	11.700	44.4	3.790
280	3.628	173	11.760	51.9	4.410
320	4.208	202	11.830	60.6	5.120
360	4.734	225	11.890	67.5	5.670
400	5.260	240	11.960	72	6.020
440	5.786	256	12.020	76.8	6.380
480	6.312	260	12.08	78	6.420
520	6.875	256	12.14	76.8	6.360

UCS Test for Soil Sample With 0.05% Reinforcement

Axial Stress = 6.42 Kg/Cm2



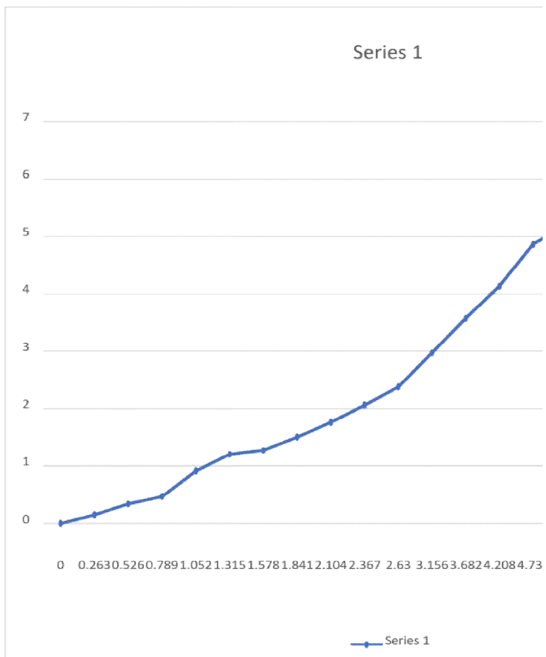
Axial Stress for Soil Sample with 0.05% Reinforcement0.15%

REINFORCED SOIL SAMPLE WITH POLYPROPYLENE

Dial gauge reading	Strain(c)	Provingring	Reading corrected area	Load(N)	Axial stress(Kg/Cm2)
0	0	0	11.330	0	0
20	0.263	6	11.364	1.8	0.150
40	0.526	13	11.398	3.9	0.340
60	0.789	18	11.420	5.4	0.470
80	1.052	35	11.450	10.5	0.910
100	1.315	46	11.480	13.8	1.200
120	1.578	49	11.510	14.7	1.270
140	1.841	58	11.540	17.4	1.500
160	2.104	68	11.570	21.4	1.760
180	2.367	80	11.600	24	2.060
200	2.630	92	11.630	27.6	2.370
240	3.156	116	11.700	34.8	2.970
280	3.682	140	11.760	42	3.570
320	4.208	163	11.830	48.9	4.130

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

360	4.734	193	11.890	57.9	4.860
400	5.260	207	11.960	62.1	5.190
440	5.786	230	12.020	69	5.740
480	6.312	245	12.08	73.5	6.070
520	6.875	256	12.14	76.8	6.320
560	7.364	264	12.20	79.2	6.500
600	7.890	263	12.26	78.9	6.430



Axial Stress = 6.5 Kg/Cm2

Axial Stress for Soil Sample with 0.15% Reinforcement 0.25%

REINFORCED SOIL SAMPLE WITH POLYPROPYLENE

Dial gauge reading	Strain(c)	Provingring	Reading corrected area	Load(N)	Axial stress(Kg/Cm2)
0	0	0	11.330	0	0
20	0.263	5	11.364	1.5	0.131
40	0.526	12	11.398	3.6	0.315
60	0.789	21	11.420	6.3	0.550
80	1.052	34	11.450	10.2	0.890
100	1.315	43	11.480	12.9	1.120
120	1.578	49	11.510	14.7	1.277
140	1.841	57	11.540	17.1	1.480
160	2.104	70	11.570	21	1.850
180	2.367	83	11.600	24.9	2.140
200	2.630	97	11.630	29.1	2.500
240	3.156	125	11.700	37.5	3.200
280	3.682	150	11760	45	3.820
320	4.208	178	11.830	53.4	4.490
360	4.734	205	11.890	61.5	5.170
400	5.260	235	11.960	70.5	5.890

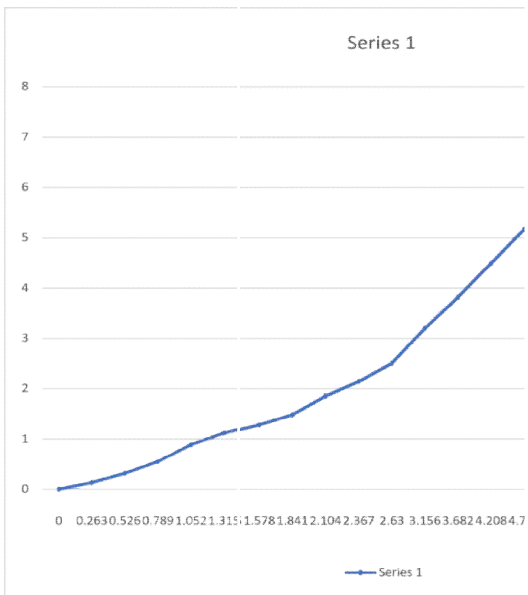
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

440	5.786	258	12.020	77.4	6.430
480	6.312	273	12.08	81.9	6.770
520	6.875	283	12.14	84.9	6.990
560	7.364	286	12.20	85.8	7.030
600	7.890	283	12.26	84.9	6.990

UCS Test for Soil Sample With 0.25% Reinforcement

Axial Stress = 7.03 Kg/Cm2 Axial Stress for Soil Sample with0.25% Reinforcement

DIRECT SHEAR STRESS



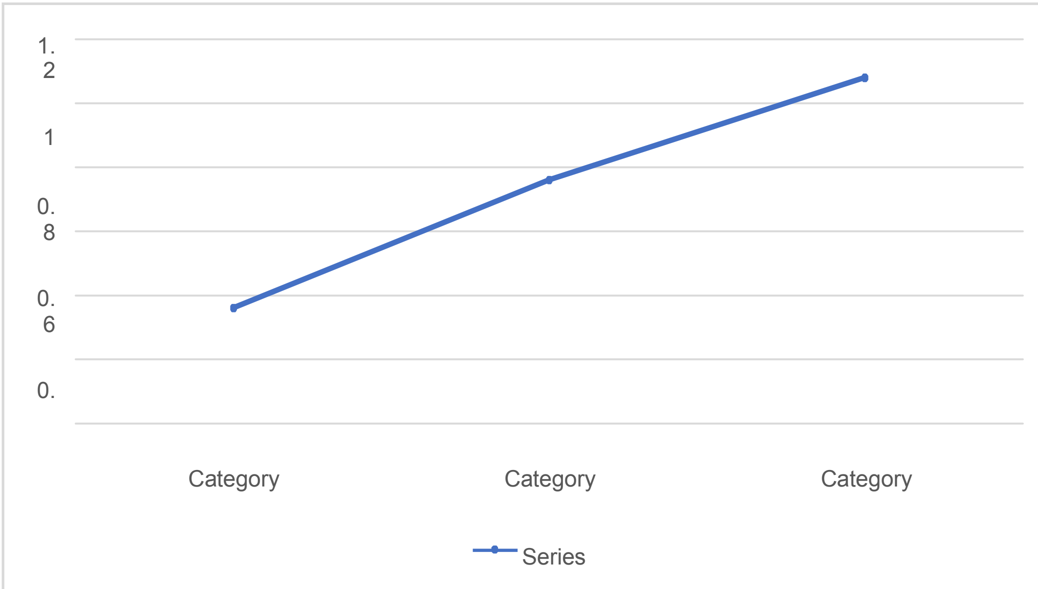
Volume of Shear Box	90 cm2
Maximum dry density of soil	1.76%
Optimum moisture content of soil	14%
Weight of the soil to befilled in the shear box	176.4 gms
Weight of water to be added	30 gms

SOIL SAMPLE

SampleNo	Normal stress (Kg/Cm2)	Provingring reading	Shearload (n)	Shear load(kg)	Shearstress (kg/cm2)
1	0.5	26	125.9	12.85	0.360
2	1.0	50	265.8	27.13	0.760
3	1.5	70	377.8	38.55	1.080

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

Direct Shear Test for Soil Sample



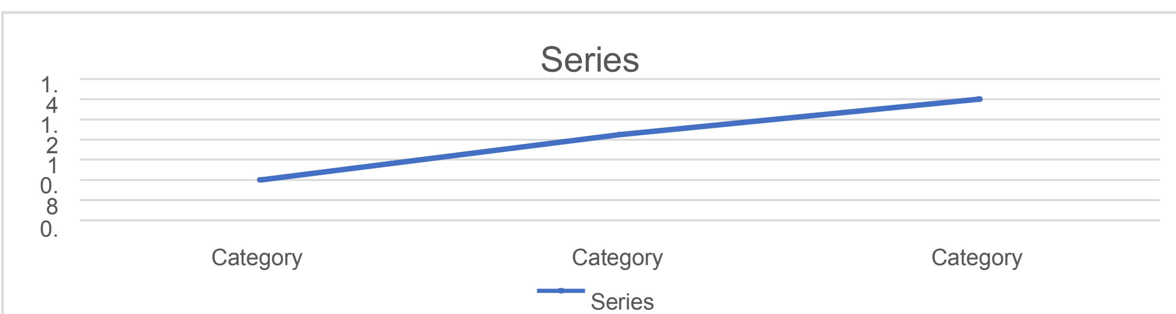
Shear Stress = 1.080 Kg/Cm2

Shear Strength for Soil Sample with 0.0% Reinforcement

Volume of Shear Box	90 cm3
Maximum dry density of Soil	1.76%
Optimum moisture content of soil	14%
Weight of the soil to befilled in the shear box	176.4 gms
Weight of water to be added	30 gms

0.05% REINFORCEMENT SOIL SAMPLE WITH POLYPROPYLENE

SampleNo	Normal stress (Kg/Cm2)	Proving ring reading	Shearload (n)	Shear load (kg)	Shearstress (kg/cm2)
1	0.5	28	140	14.28	0.400
2	1.0	57	29	30.30	0.850
3	1.5	82	420	42.80	1.200



Direct Shear Test for Soil Sample with 0.05% Reinforcement

Shear Stress = 1.2 Kg/Cm2

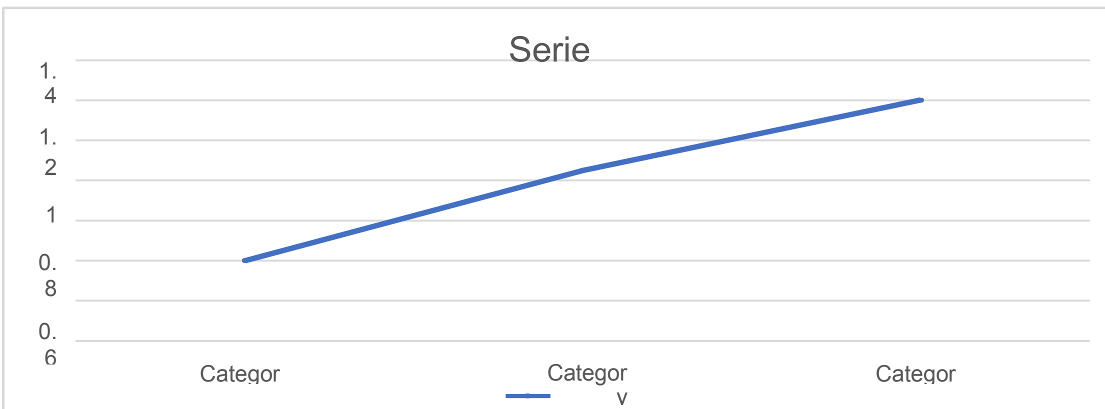
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

Shear Strength for Soil Sample with 0.05% Reinforcement

Volume of Shear Box	90 cm3
Maximum dry density of Soil	1.76%
Optimum moisture content of soil	14%
Weight of the soil to be filled in the shear box	176.4 gms
Weight of water to be added	30 gms

0.15% REINFORCEMENT SOIL SAMPLE WITH POLYPROPYLENE

SampleNo	Normal stress (Kg/Cm2)	Proving ring reading	Shearload (n)	Shearload (kg)	Shear stress (kg/cm2)
1	0.5	28	143	14.63	0.410
2	1.0	64	314.8	32.13	0.900
3	1.5	86	446.8	45.60	1.280



Direct Shear Test for Soil Sample with 0.15% Reinforcement

Shear Stress = 1.280Kg/Cm2 Shear Strength for soil sample with 0.015% Reinforcement

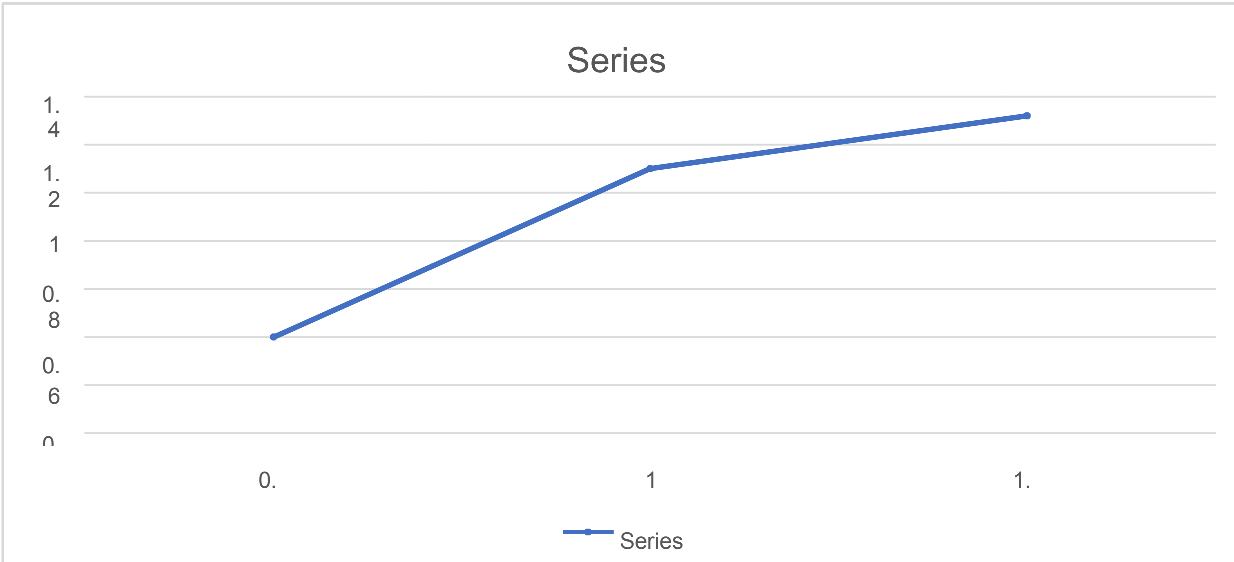
Volume of Shear Box	90 cm3
Maximum dry density of Soil	1.76%
Optimum moisture content of soil	14%
Weight of the soil to befilled in the shear box	176.4 gms
Weight of water to be added	30 gms

0.25% REINFORCEMENT SOIL SAMPLE WITH POLYPROPYLENE

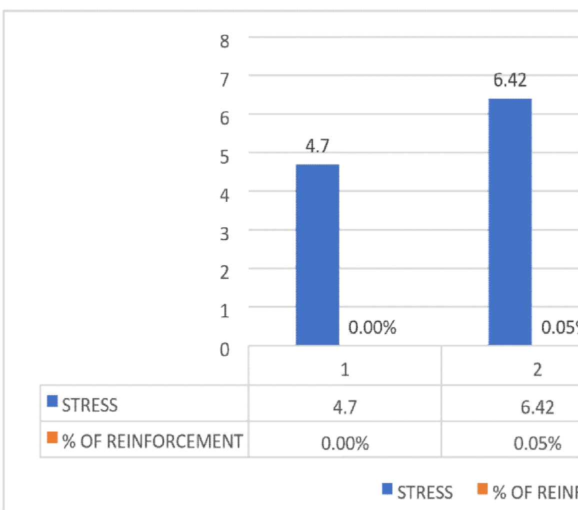
SampleNo	Normal stress (Kg/Cm2)	Proving ring reading	Shear load (n)	Shear load (kg)	Shear stress (kg/cm2)
1	0.5	30	147	15	0.42
2	1.0	70	384.16	39.2	1.1
3	1.5	88	461.58	47.1	1.32

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, March 2024

Direct Shear Test for Soil Sample with 0.25% Reinforcement



Shear Stress = 1.32 Kg/Cm2
Shear Strength for soil sample with 0.025% Reinforcement
DISCUSSTHERELEATIONSHIPBETWEENTHEUCSAND-FIBERCONTENT



The Relationship between the UCS and Fiber constant

IJARSCT

ISSN (Online) 2581-9429

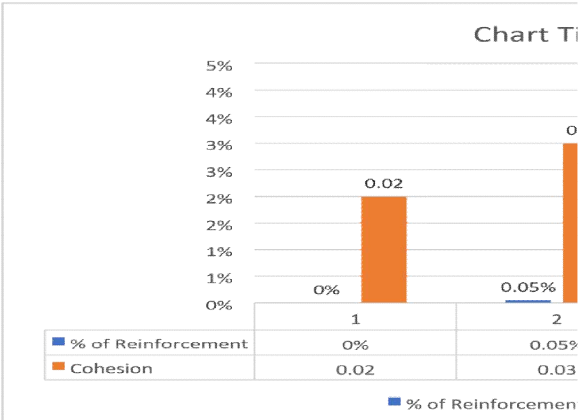
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

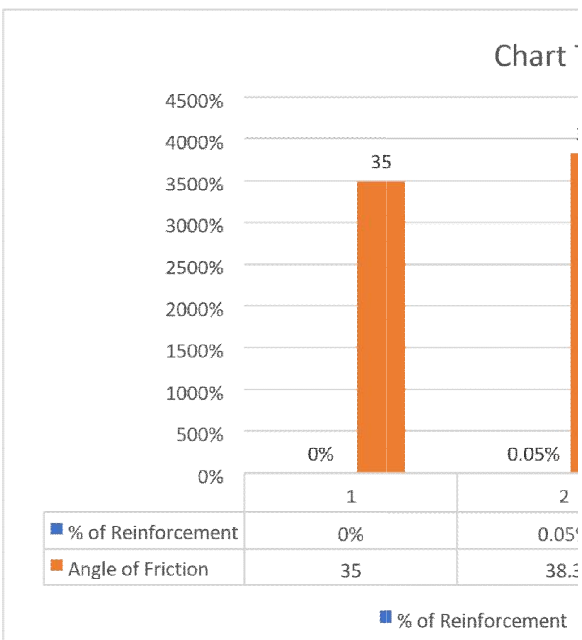
Volume 4, Issue 1, March 2024

THE RELEATIONSHIP BETWEEN COHESION AND FIBER CONSTANT



The Relationship between the Cohesion and Fiber content

THE RELATIONSHIP BETWEEN THE ANGLE OF FRICTION AND FIBERCONTENT



The Relationship between angle of friction and % of reinforcement

Inferences from Direct Shear Test for Soil Sample

Cohesion value increases from 0.02kg/cm2 to 0.04kg/cm2, a net 100.0% The increment graph for cohesion shows a gradual

decline inslope.

Theangleofinternalfrictionincreasesfrom35to42degrees,anet20.0%

The incremental graph for φ shows a variation in shape alternativeraise andfall The incremental inshear strength of soil due to reinforcement is substantial.

Inferences from UCS Test for Soil Sample

UCS value increases from 4.7kg/cm2 to 7.03kg/cm2, a net50%.

The shape of incremental graph varies with alternative raise andfall

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 1, March 2024

V. CONCLUSION

On the basis of present experimental study, the following conclusions are drawn,

1. Based on direct shear test on soil sample, with fiber reinforcementof0.05%,0.15% and 0.25%, the increase in cohesion was found to be 50%, 34.6%, and 22.4%, 3.9% and 6.1% respectively. The increase in the internal angle of friction(φ) was found to be 10%, 3.9% and 6.1%respectively.
2. Since the net increase in the value of c and φ were observed to be 100%, from 0.02kg/cm2 to 0.04kg/cm2 and 20%, from 35 to 42 degrees net increment respectively, for such soil, randomly distributed polypropylene fiber reinforcement is recommended.
3. The result from the UCS test for soil sample are also similar, for reinforcement of 0.05%, 0.15% and 0.25%, the increase in UCS from the initial value are 35.31%, 1.1% and 8.8% respectively. This increment is substantial and applying it for soil sample is effective.
4. Overall it can be concluded that fiber reinforced soil can be considered to be good ground improvement technique specially in engineering projects on weak soil where it can act as a substitute to deep/raft foundations, reducing the cost as well as energy.

REFERENCES

[1]. S. A. Naeini and S. M. Sadjadi, (2008)," Effect of Waste Polymer Materials on Shear Strength of Unsaturated Clays", EJGE Journal, Vol 13, Bundk,(1-12).

[2]. Yetimoglu,T.,Inanir,M.,Inanir,O.E.,2005.Astudyonbearingcapacityofrandomly distributed fiber-reinforced sand fills overlying soft clay. Geotextilesand Geomembranes 23 (2), 174–183.

[3]. Chaosheng Tang, Bin Shi, Wei Gao, Fengjun Chen, Yi Cai, 2006. Strength and mechanicalbehaviorofshortpolypropylenefiberreinforcedandcementstabilizedclayey soil. Geotextiles and Geomembranes 25 (2007) 194–202.

[4]. Mahmood R. Abdi, Ali Parsapajouh, and Mohammad A. Arjomand,(2008)," Effects of Random Fiber Inclusionon

[5]. Consolidation, Hydraulic Conductivity, Swelling, Shrinkage Limit and Desiccation Cracking of Clays", International Journal of Civil Engineering, Vol. 6, No. 4, (284292).

[6]. Consoli, N. C., Prietto, P. D. M. and Ulbrich, L. A. (1999). „„,The behavior of a fibre reinforced cemented soil.‟‟‟Ground Improvement,London,3(1),21–30.

[7]. IS 2720 – part (xiii) 1980-87

[8]. The need for soil stabilization, April 9, 2011 by Ana [online]Available at: e-need-for-soil-stabilization/

[9]. Methods of soil stabilization, December 24, 2010 [online] Availableat: <http://www.engineeringtraining.tpub.com/14070/css/14070_424.htm>

[10]. Prof. Krishna Reddy, UIC, 2008, Engineering Properties of Soils Based on Laboratory Testing.

[11]. UnderstandingtheBasicsofSoilStabilization:AnOverviewofMaterialsandTechniques [online] Available at: <http://www.cat.com>

[12]. Punmia B.C. 2007, "Soil Mechanics & Foundations" Laxmi Publications

[13]. YadavParit, Meena Kuldeep Kumar, (2011)" A comparative study in soil plasticity of Hall area and lecture complex area of NIT Rourkela" B.tech thesis, NIT,Rourkela.

[14]. IS: 2720(Part-2), 1973 Methods of Test for Soils. Determination of water content.

[15]. IS 2720(III/SEC-I): 1980 Methods of Test for Soils. Determination of specific gravity.

[16]. IS 2720(VII):1980 Methods of Test for Soils. Determination of water content dry density relation using light compaction.

[17]. IS 2720(XIII):1986 Methods of Test for Soils, direct shear test

[18]. IS 2720(X):1991 Methods of Test for Soils. Determination of unconfined compression test.

[19]. IS 2720(IV):1985 Methods of Test for Soils. Determination of grain size analysis.