IMPROVEMENT IN STRENGTH OF SOIL BY USING STONE DUST AND PLASTIC WASTES

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Abstract – In the Present Study We Select Two different types of soil from different sites. and The main objective of this study to investigate to use of waste dust and waste plastics as stabilizer of the clayey soil. And also study the how affects its shear strength and other properties by adding these unwanted wastes as a stabilizer materials. These solid wastes are increasing day by day in environment. These are not environment friendly. So we have to be best utilizing these materials as a reinforcement. We see here the impact of these materials on two different types of soil and conclude that the which one will be best suited for it. The results obtained with varying percentage of stone dust(5%,10%,15%)and waste plastic(0.05%,0.15%,0.25%).

KeyWords- Soil Stabilization, Unconfiend Compressive Strength, Direct Shear And comparision of both the soil Samples.

Introduction

For any land-based totally structure, the foundation is extremely important and need to be strong to support the complete shape. so as for the use to be study, the soil around it plays a highly essential role. Aclay soil in engineering means that soil that composed of clay minerals and different mineral parts, has malleability and additionally cohesive. Clays area unit fine-grained soils however it can't be merely aforesaid that each one of finegrainedsoils area unit clays. Chemically, clays area unit combination of hydrated aluminosilicatesand different bronze ions. Flakes or little plates type is however the individual crystals seem like and various crystal sheets consist in these flakes and that they have repetition atomic structure. The tetrahedral or silicon oxide and octahedral or corundum area unit the sole 2 basic sheets out there. completely different clay minerals area unit supported the sheets area unit stacked, {the completely different|the various} bonding they need further as different bronze ions consist within the space lattice. Tetrahedral sheet could be a combination of silicon oxide tetrahedral units that have four element atomsbasically at the corners and that they area unit encompassing one element atom. Since the element atoms placed at the bottom of every polyhedron in order that they area unit combined to make a structure of sheet. Octahedral could be a combination of octahedral units that have six element or hydroxyls encompassing Al, magnesium, iron or the other atom. Octahedrons additionally mix to make a structure of sheet wherever the rows of element or hydroxyl radical area unit in 2 planes within the sheet. The presence of water is powerfully influenced the clay soils. Absorbed water is that the layers of water encompassing every crystal of the clay. The absorption of water happened owing to 3 reasons. the primary one is as a result of the water has 2 separate of charges that area unit positive and negative. therefore this can caused the molecule of water to be electrostatically drawn to the clay crystal. Second, thanks to the chemical element bonding or it is aforesaid the water is truly drawn to the oxygens or hydroxyls on the surface of clay. (Holtz and Kovacs, 1981).

Property of soil

- Volume of shear Box- 90cm^3 Optimum moisture content of soil- 12.6%

  Dry density of soil- 1.91gm/cm^3

Experimental Works

4.5 Direct Shear Test

Weight of the soil to be filled in the box- 1.91X90=171.9gm

Weight of the water to be added- (12.6/100)x171.9= 21.66 gm

Soil sample- 1

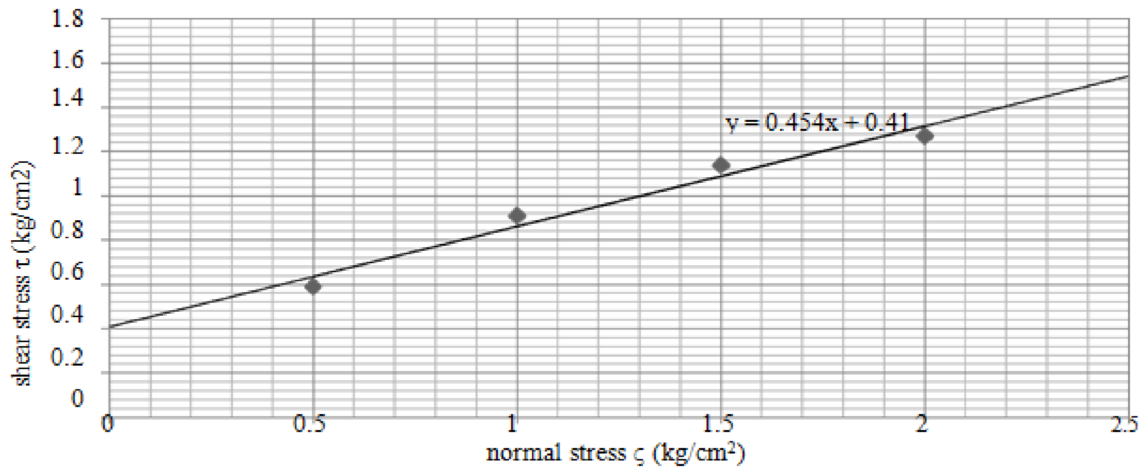
According to USUC Classification of Soil 1 is ML- Silt, Low Plasticity

Ip = WL – WP = 28.90 – 22.58 = 6.32

1-Unreinforced soil

Sample No.	Normal Stress(kg/cm 2)	Proving ring Reading	Shear Load (N)	Shear Load (kg)	Shear Stress (kg/cm2)
1	0.5	54	206.58	21.06	0.59
2	1	84	321.35	32.76	0.91
3	1.5	106	405.51	41.34	1.14
4	2	168	451.42	46.02	1.27

Table-2

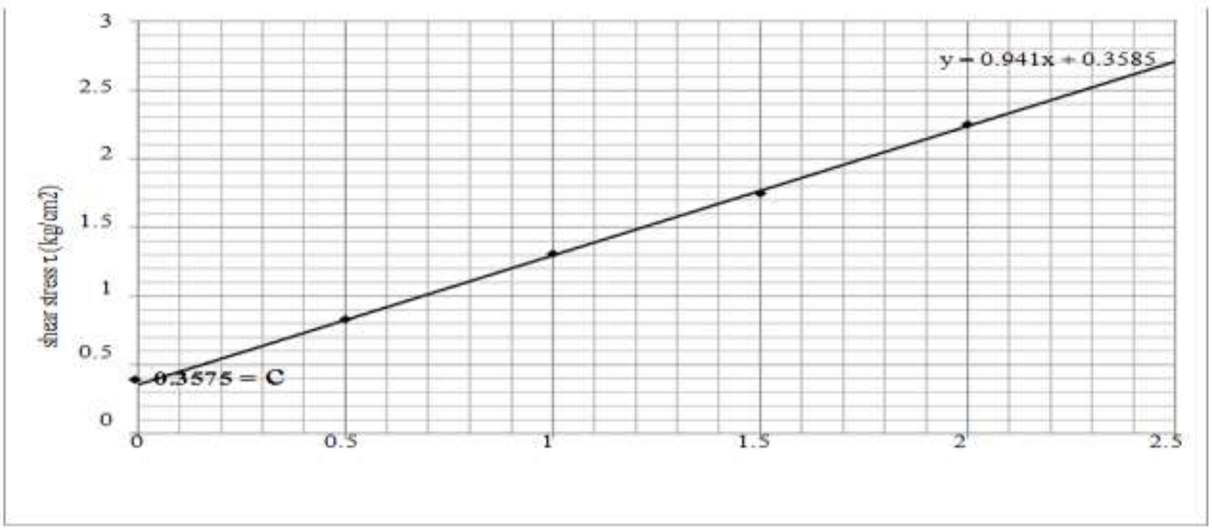


Computing from graph,

Cohesion (C) = 0.325 kg/cm2 ; Angle of internal friction (φ) = 47.72

2- Reinforcement = 0.05%(plastic fiber)+5%(rock dust)

Sample no.	Normal load (ς)	Proving Constant	Shear load (N)	Shear load (kg)	Shear stress (kg/cm2)
1	0.5	76	290.27	29.62	0.83
2	1.0	120	458.19	46.75	1.31
3	1.5	160	612.08	62.45	1.75



3-Reinforcement = 0.15%(plastic fiber)+10%(rock dust)

Sample no.	Normal load (ς)	Proving Constant	Shear load (N)	Shear load (kg)	Shear stress (kg/cm2)
1	0.5	78	297.23	30.33	0.85
2	1.0	121	461.68	47.11	1.32
3	1.5	164	626.07	63.88	1.79
4	2.0	207	793.99	81.02	2.27

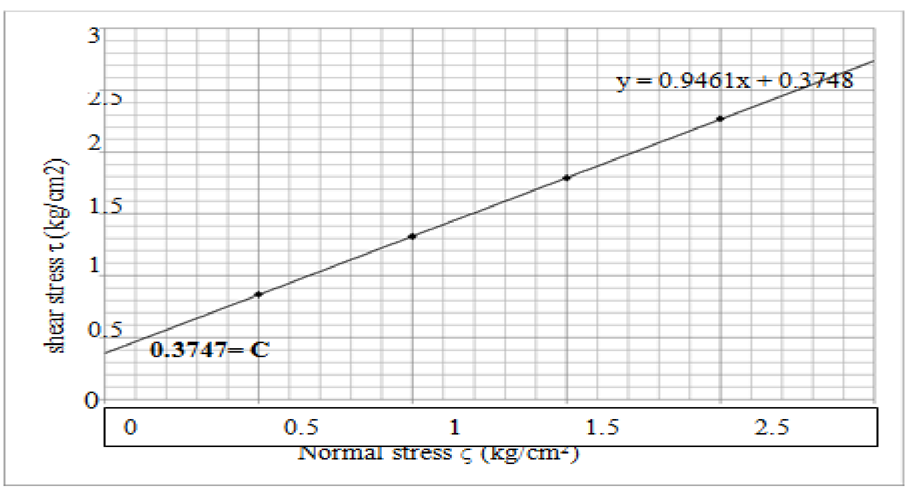


Fig-2

Computing from graph,

Cohesion (C) = 0.3747 kg/cm2

Angle of internal friction (φ) = 48.254°

4- Reinforcement = 0.25%(plastic fiber)+15%(rock dust)

Sample no.	Normal load (ς)	Proving Constant	Shear load (N)	Shear load (kg)	Shear stress (kg/cm2)
1	0.5	79	300.79	30.69	0.86
2	1.0	122	468.64	47.82	1.34
3	1.5	166	636.61	64.96	1.82
4	2.0	209	800.95	81.73	2.29

Table- 5

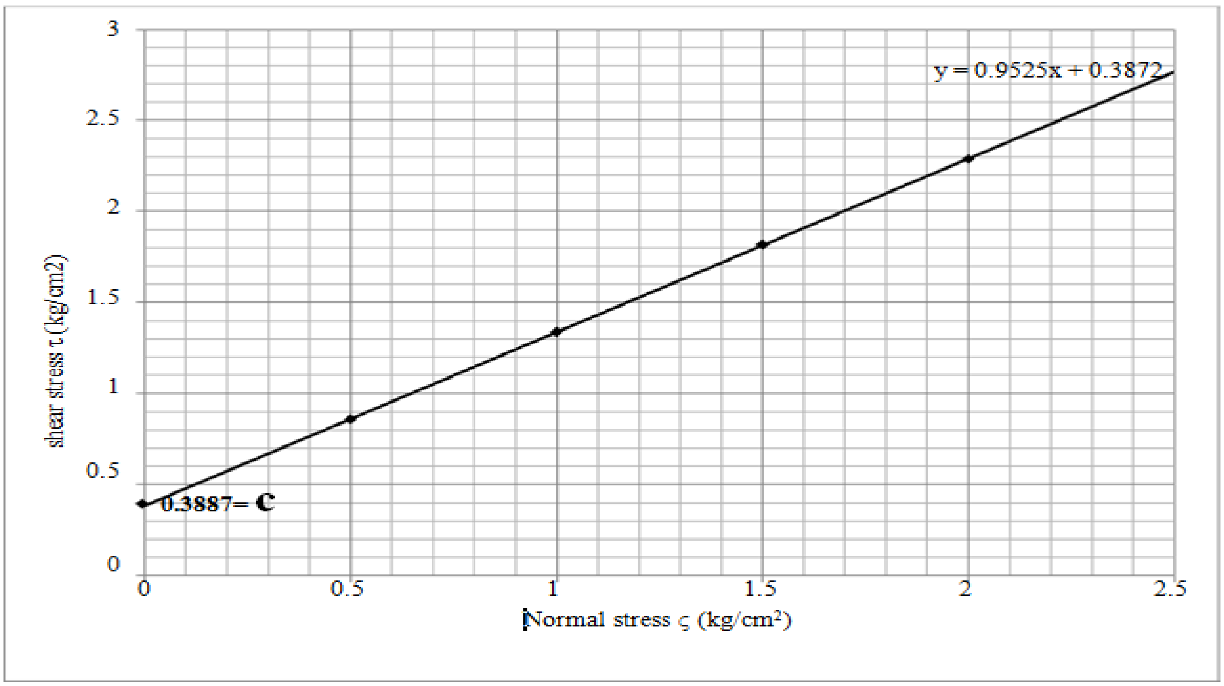


Fig. -3

Computing from graph,

Cohesion (C) = 0.3887 kg/cm2

Angle of internal friction (φ) = 48.483°

Soil sample-2

Ip = WL – WP = 43.41 – 19.56 = 23.93According to USUC Classification of Soil 1 is ML- Silt, Low Plasticity

Volume of shear box	90 cm3
Maximum Dry Density	1.96 g/cc
Optimum Moisture Content of soil	17.02%
Weight of the soil to be filled in the shear box	90*1.96= 176.4 gms.
Weight of water to be added	30.0238 gms.

Table- 6

1-Unreinforced

Sample no.	Normal load (ς)	Proving Constant	Shear load (N)	Shear load (kg)	Shear stress (kg/cm2)
1	0.5	53	202.86	20.70	0.58
2	1.0	75	286.74	29.26	0.82
3	1.5	96	367.20	37.47	1.05
4	2.0	117	447.66	45.68	1.28

Table- 7

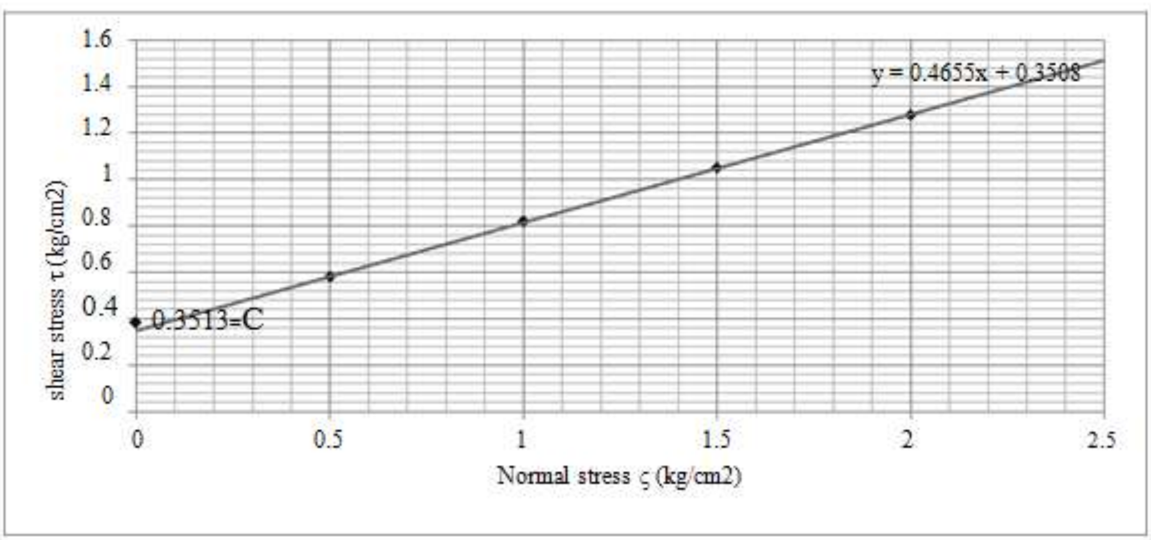


Fig. - 4

Computing from graph,

Cohesion (C) = 0.3513 kg/cm2 ; Angle of internal friction (ϕ) = 27.82°

2-Reinforcement = 0.05%(plastic fiber)+5%(rock dust)

Sample no.	Normal load (ς)	Proving ring Reading	Shear load (N)	Shear load (kg)	Shear stress (kg/cm2)
1	0.5	66	252.11	25.70	0.72
2	1.0	88	336.09	34.26	0.96
3	1.5	111	427.13	43.54	1.22
4	2.0	130	497.17	50.68	1.42

Table- 8

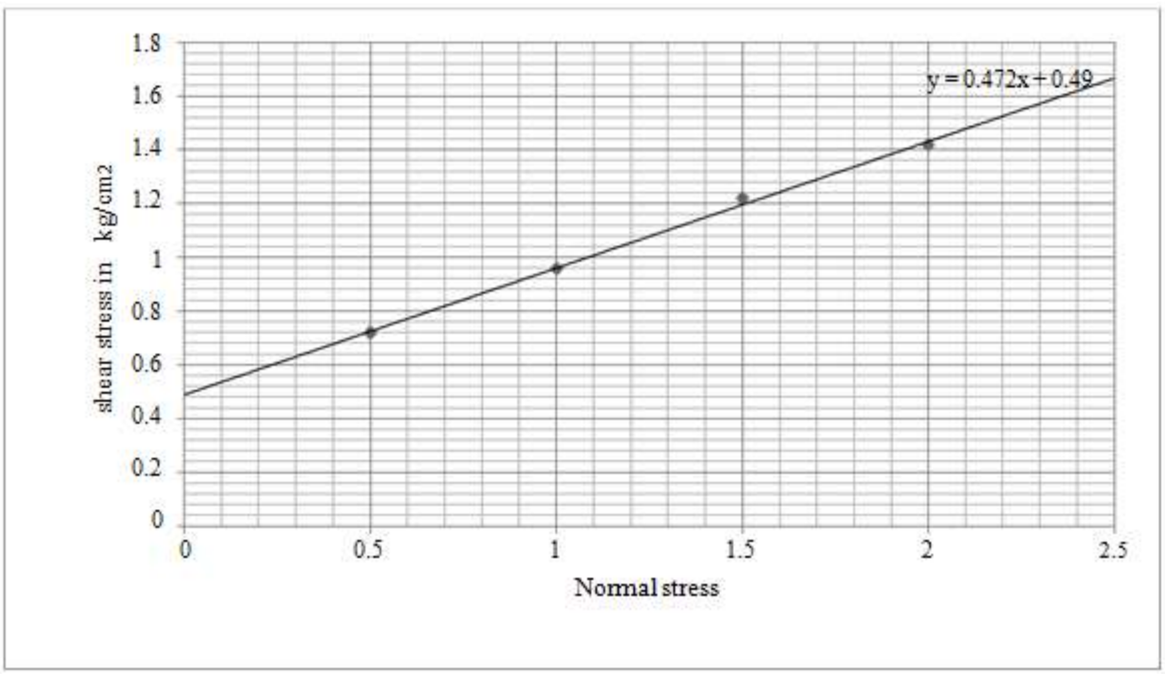


Fig. -5

Computing from graph,

Cohesion (C) = 0.4732 kg/cm2

Angle of internal friction (ϕ) = 29.02°

3-Reinforcement = 0.15%(plastic fiber)+10%(rock dust)

Sample no.	Normal load (ς)	Proving ring reading	Shear load (N)	Shear load (kg)	Shear stress (kg/cm2)
1	0.5	72	275.46	28.11	0.788
2	1	99	378.75	38.65	1.083
3	1.5	126	482.05	49.19	1.378
4	2	151	577.7	58.93	1.651

Table- 9

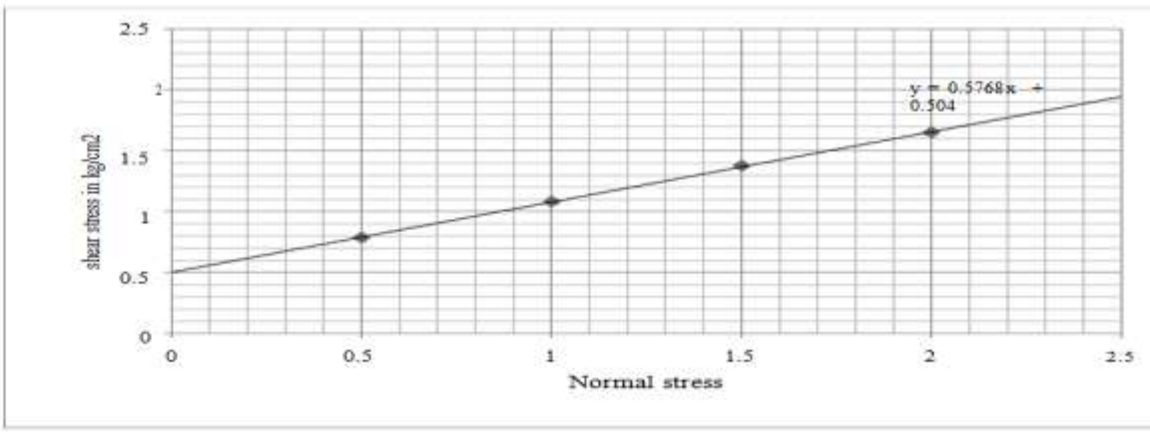


Fig. -6

Computing from graph,

Cohesion (C) = 0.504 kg/cm2

Angle of internal friction (ϕ) = 29.95°

4-Reinforcement = 0.25%(plastic fiber)+15%(rock dust)

Sample no.	Normal load (ς)	Proving ring reading	Shear load (N)	Shear load (kg)	Shear stress (kg/cm2)
1	0.5	78	298.41	30.45	0.85
2	1	107	409.36	41.77	1.17
3	1.5	137	524.69	53.54	1.5
4	2	164	626.02	63.88	1.79

Table- 10

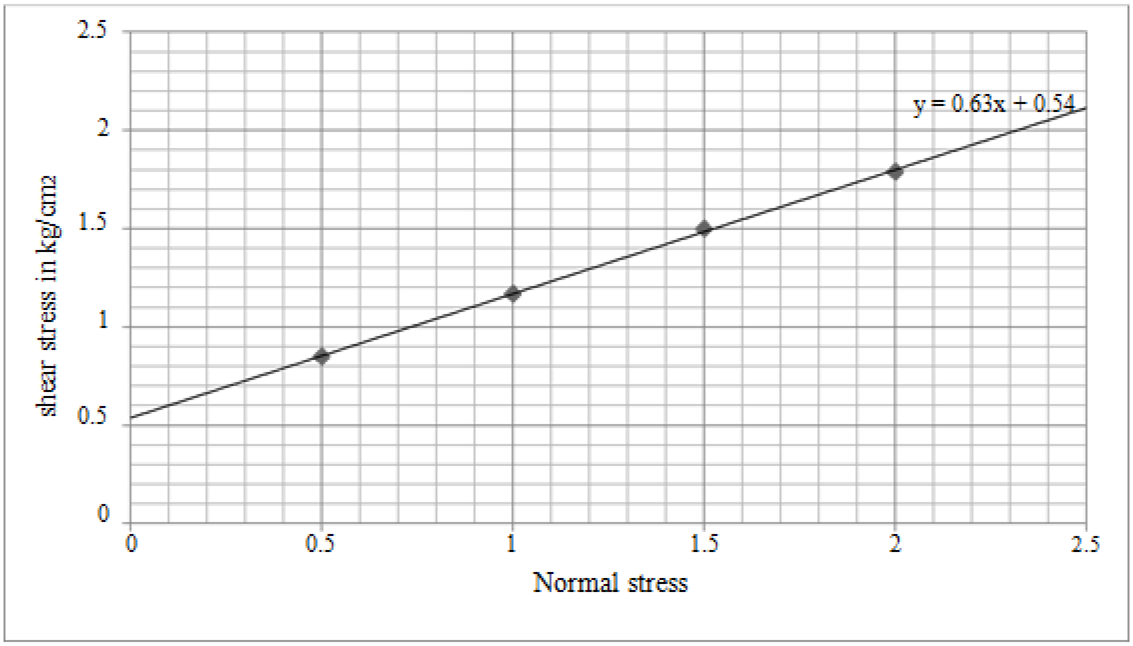


Fig. - 7

Computing from graph,

Cohesion (C) = 0.5375 kg/cm2

Angle of internal friction (ϕ) = 32°

4.6 Unconfined Compression Strength Test

Soil sample- 1

1- Unreinforced

Dial gauge reading	Strain(ϵ)	Proving ring reading	corrected area	load (N)	Axial Stress (Mpa)
50	0.0033	35	19.72	40.81	0.0207
100	0.0067	62	19.82	69.19	0.0349
150	0.0100	79	19.92	92.11	0.0462
200	0.0133	91	20.03	106.12	0.0530
250	0.0167	98	20.13	114.27	0.0567
300	0.0200	93	20.24	108.44	0.0536
350	0.0233	85	20.34	99.11	0.0487

Table-11

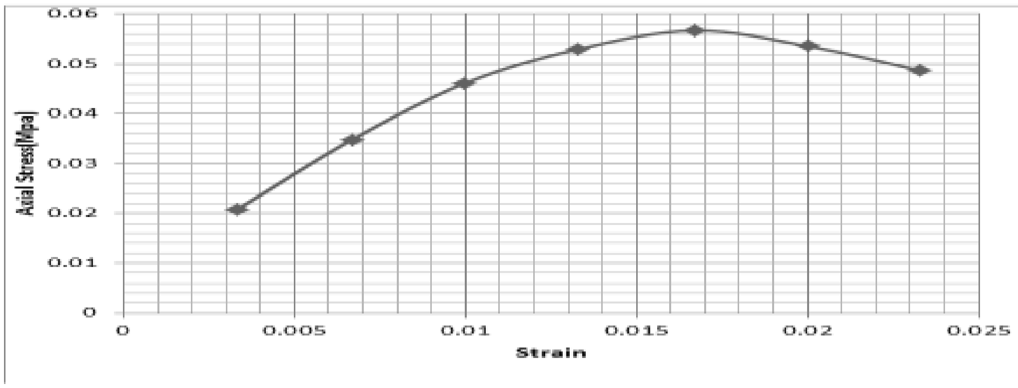


Fig-8

As obtained from graph,

UCS = 0.0562 MPa

2-Reinforcement = 0.05%(plastic fiber)+5%(rock dust)

Dial gauge reading	Strain(ϵ)	Proving ring reading	corrected area	load (N)	Axial Stress (Mpa)
50	0.0033	48	19.72	55.97	0.0284
100	0.0067	65	19.82	75.79	0.0382
150	0.0100	93	19.92	108.44	0.0544
200	0.0133	102	20.03	118.93	0.0594
250	0.0167	109	20.13	127.09	0.0631
300	0.0200	105	20.24	122.43	0.0605
350	0.0233	96	20.34	111.94	0.0551

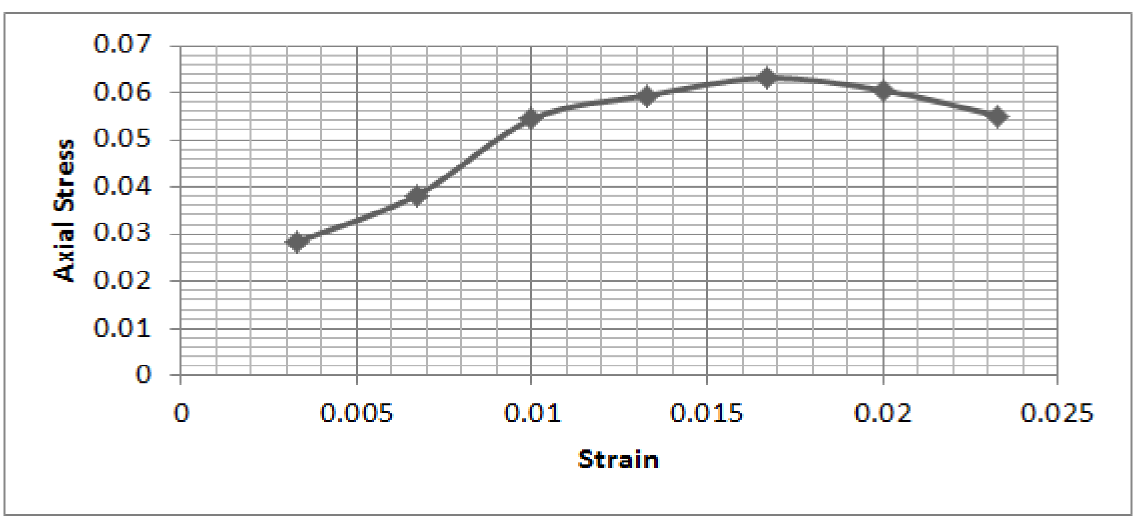


Fig-9

As obtained from graph,

UCS = 0.0631 MPa

3- Reinforcement = 0.15%(plastic fiber)+10%(rock dust)

Dial gauge reading	Strain(ϵ)	Proving ring reading	corrected area	load (N)	Axial Stress (Mpa)
50	0.0033	47	19.72	54.8	0.0277
100	0.0067	71	19.82	82.79	0.0417
150	0.0100	94	19.92	109.6	0.0550
200	0.0133	105	20.03	122.43	0.0612
250	0.0167	110	20.13	128.26	0.0639
300	0.0200	103	20.24	120.1	0.0593
350	0.0233	92	20.34	107.27	0.0527

Table- 13

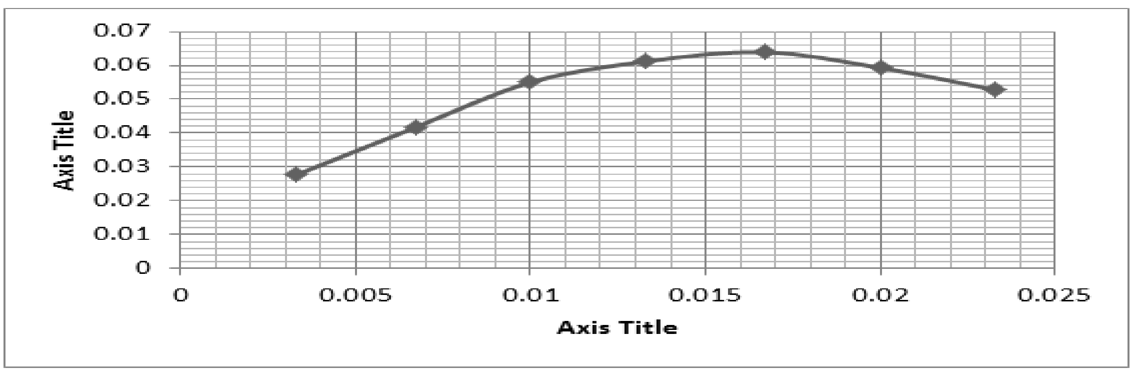


Fig-10

As obtained from graph,

UCS = 0.0637 MPa

4-Reinforcement = 0.25%(plastic fiber)+15%(rock dust)

Dial gauge reading	Strain(ϵ)	Proving ring Reading	corrected area	load (N)	Axial Stress (Mpa)
50	0.0033	51	19.72	59.47	0.0302
100	0.0067	69	19.82	80.45	0.0406
150	0.0100	94	19.92	109.6	0.0550
200	0.0133	105	20.03	122.43	0.0612
250	0.0167	111	20.13	129.43	0.0643
300	0.0200	106	20.24	123.6	0.0611
350	0.0233	93	20.34	108.44	0.0533

Table-14

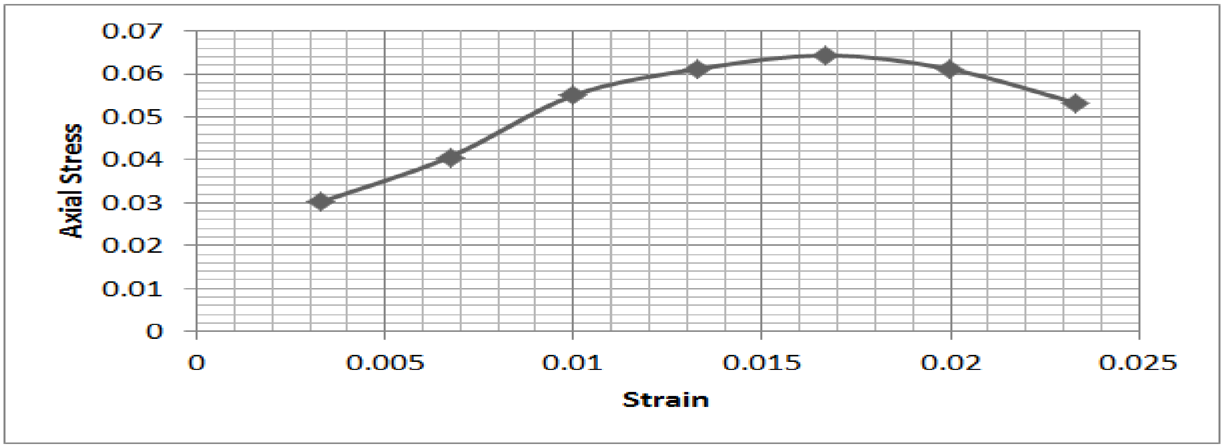


Fig-11

As Obtain From Graph

UCS=0.0643M

Soil sample- 2

i) Unreinforced

Dial gauge reading	Strain(ϵ)	Proving ring Reading	corrected area	load (N)	Axial Stress (Mpa)
50	0.0033	42	19.72	48.97	0.0248
100	0.0067	78	19.82	90.95	0.0459
150	0.0100	102	19.92	118.93	0.0597
200	0.0133	114	20.03	132.92	0.0663
250	0.0167	119	20.13	138.75	0.0689
300	0.0200	115	20.24	134.09	0.0662
350	0.0233	107	20.34	124.76	0.0613

Table-15

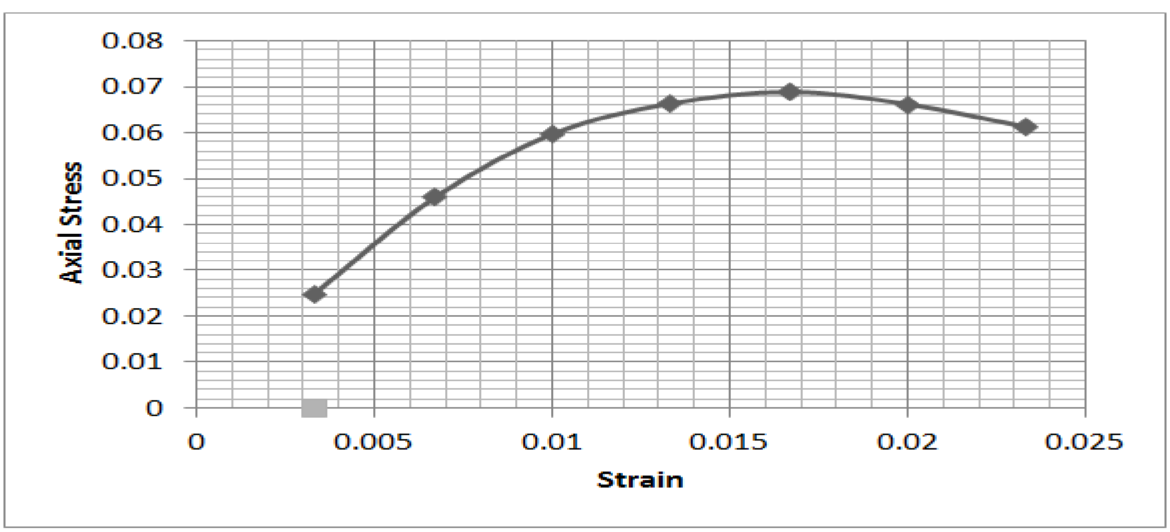


Fig-12

As Obtain From Graph

UCS= 0.0692 MPa

2-Reinforcement = 0.05%(plastic fiber)+5%(rock dust)

Dial gauge Reading	Strain(ϵ)	Proving ring Reading	corrected area	load (N)	Axial Stress (Mpa)
50	0.0033	63	19.72	73.46	0.0372
100	0.0067	105	19.82	122.43	0.0617
150	0.0100	130	19.92	151.58	0.0760
200	0.0133	154	20.03	179.56	0.0897
250	0.0167	162	20.13	188.89	0.0938
300	0.0200	155	20.24	180.73	0.0893
350	0.0233	142	20.34	165.57	0.0814

Table-16

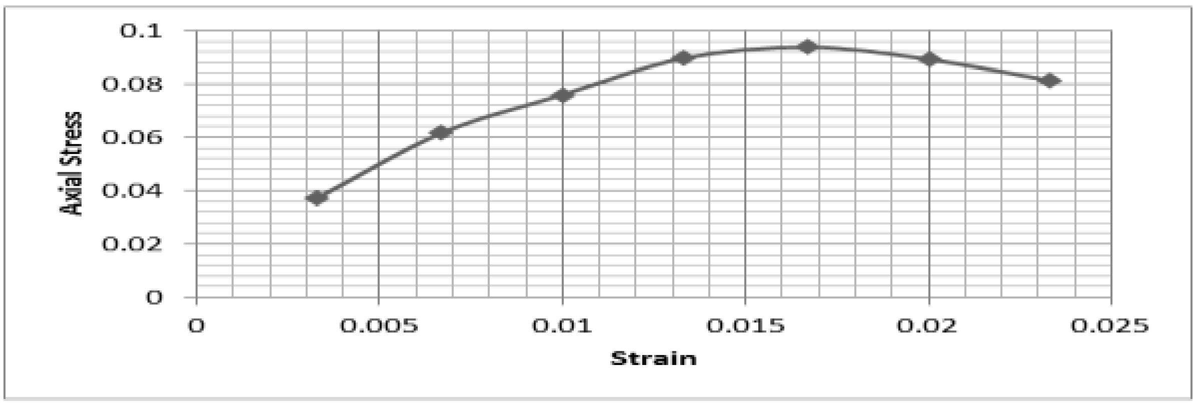


Fig-13

As Obtain From Graph

UCS= 0.0938 MPa

3-Reinforcement = 0.15%(plastic fiber)+10%(rock dust)

Dial gauge Reading	Strain(ϵ)	Proving ring Reading	corrected area	load (N)	Axial Stress (Mpa)
50	0.0033	63	19.72	73.46	0.0408
100	0.0067	105	19.82	122.43	0.0635
150	0.0100	130	19.92	151.58	0.0849
200	0.0133	154	20.03	179.56	0.0919
250	0.0167	162	20.13	188.89	0.0961
300	0.0200	155	20.24	180.73	0.0927
350	0.0233	142	20.34	165.57	0.0871

Table-17

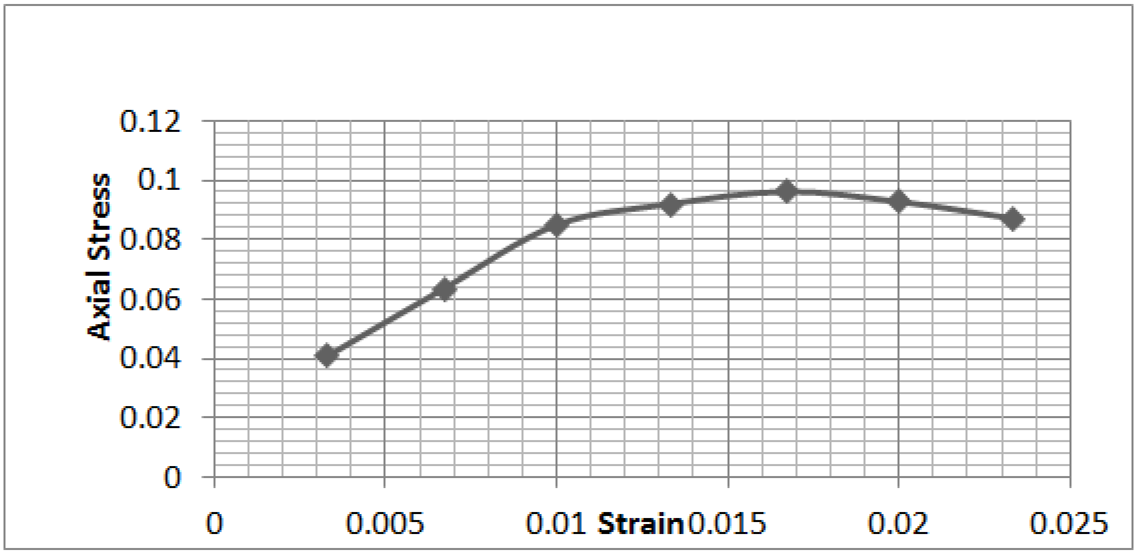


Fig-14

As Obtain From Graph

UCS= 0.0965 MP

4-Reinforcement = 0.25%(plastic fiber)+15%(rock dust)

Dial gauge Reading	Strain(ε)	Proving ring Reading	corrected area	load (N)	Axial Stress (Mpa)
50	0.0033	63	19.72	73.46	0.0449
100	0.0067	105	19.82	122.43	0.0659
150	0.0100	130	19.92	151.58	0.0884
200	0.0133	154	20.03	179.56	0.0972
250	0.0167	162	20.13	188.89	0.1037
300	0.0200	155	20.24	180.73	0.0979
350	0.0233	142	20.34	165.57	0.0900

Table-18

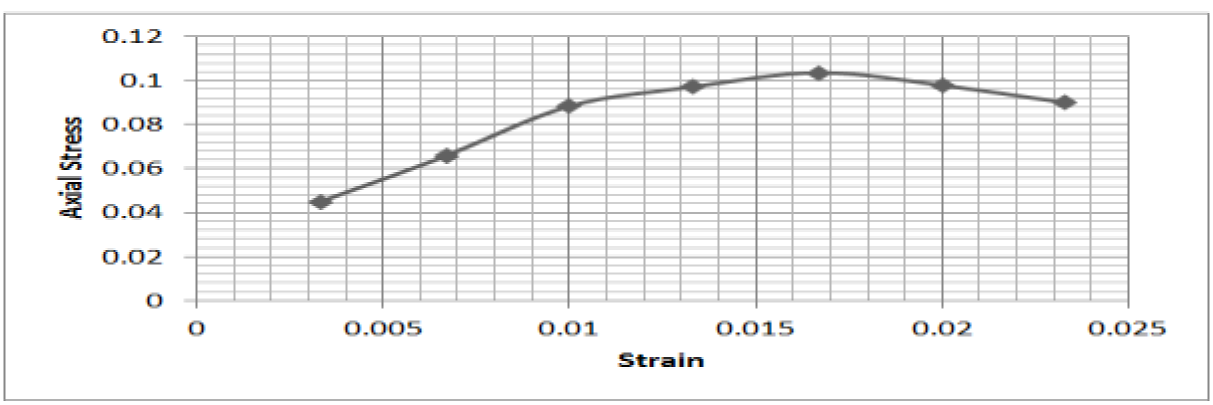


Fig-15

As Obtain From Graph

UCS= 0.1037 MP

4.7 Discussions

The relationship between shear strength parameters and fiber content-cohesion and fiber and Stone Dust content Soil sample- 1

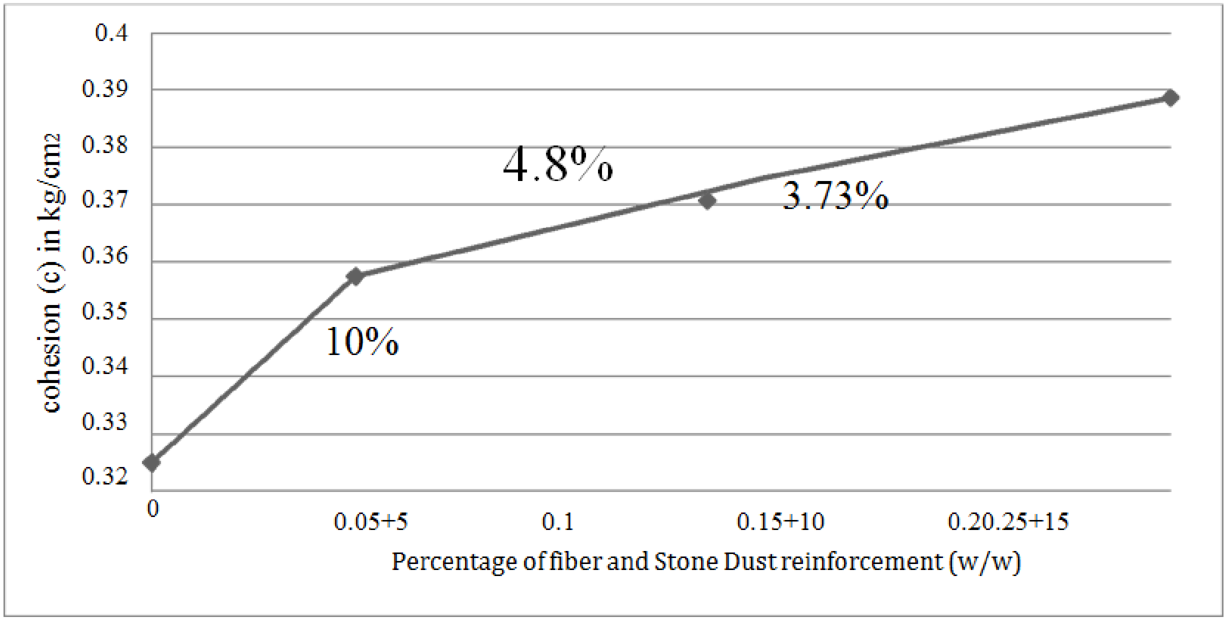


Fig. - 16

Soil sample- 2

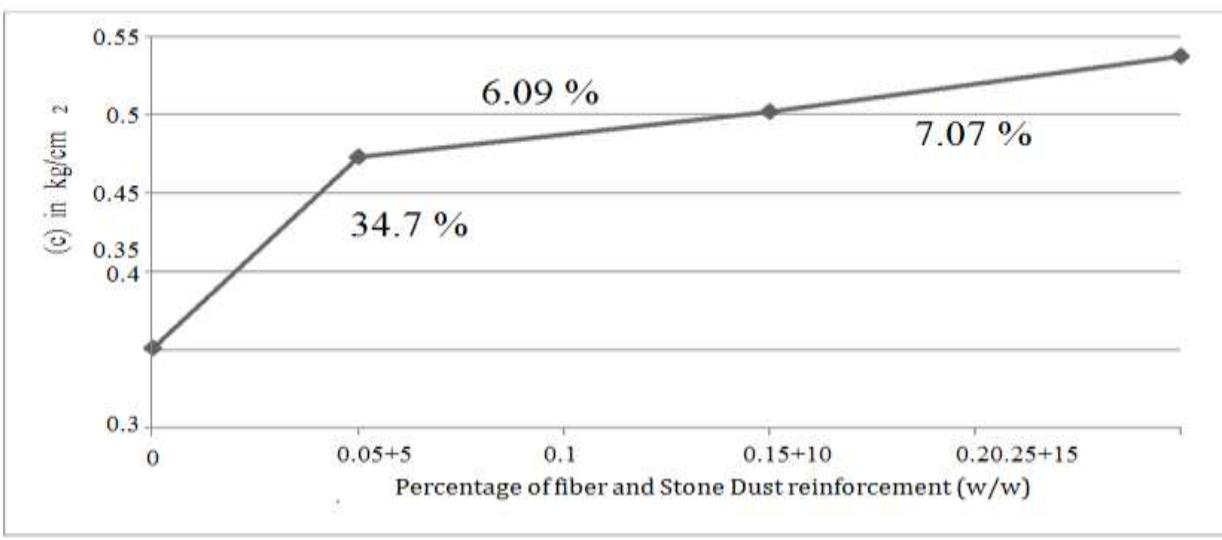


Fig. - 17

(b) Angle of internal friction and fiber and Stone Dust content Soil sample- 1

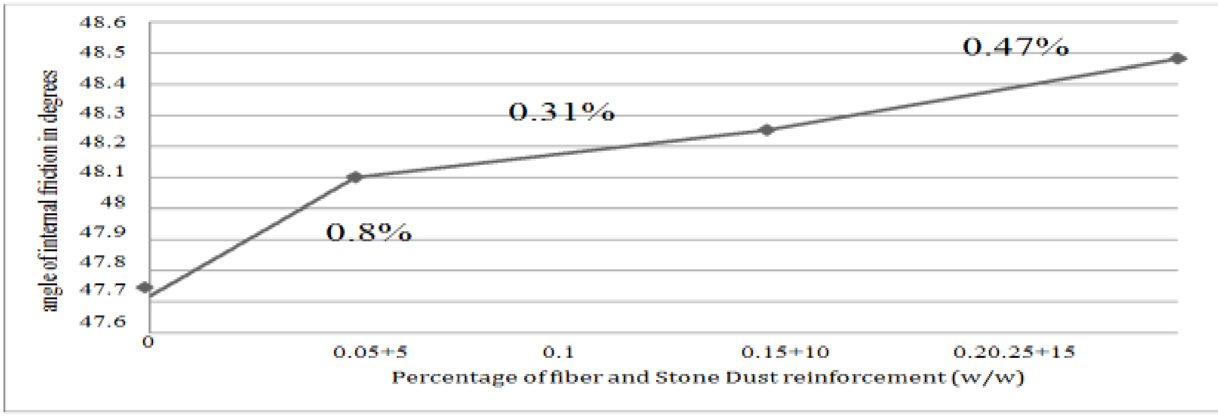


Fig. - 18

Soil sample- 2

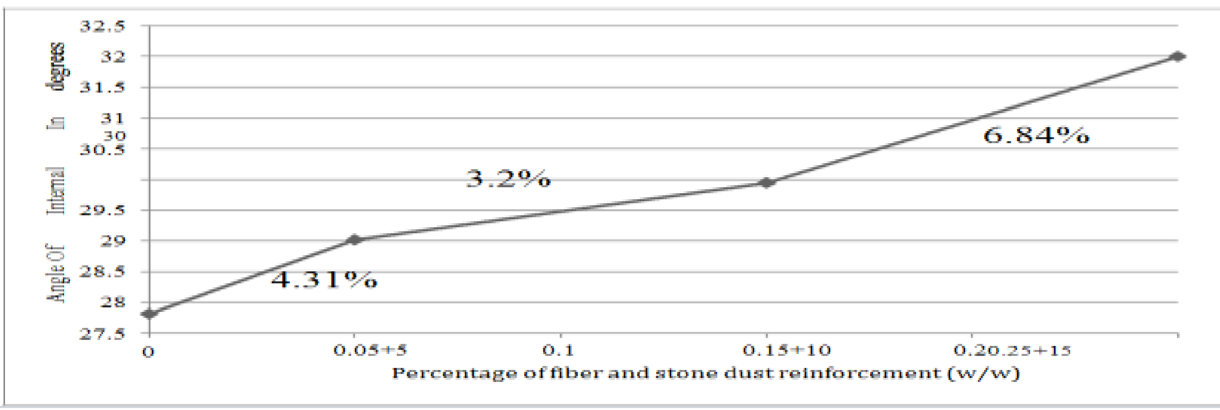


Fig. - 19

The relationship between the UCS and fiber content and Stone Dust.

Soil sample- 1

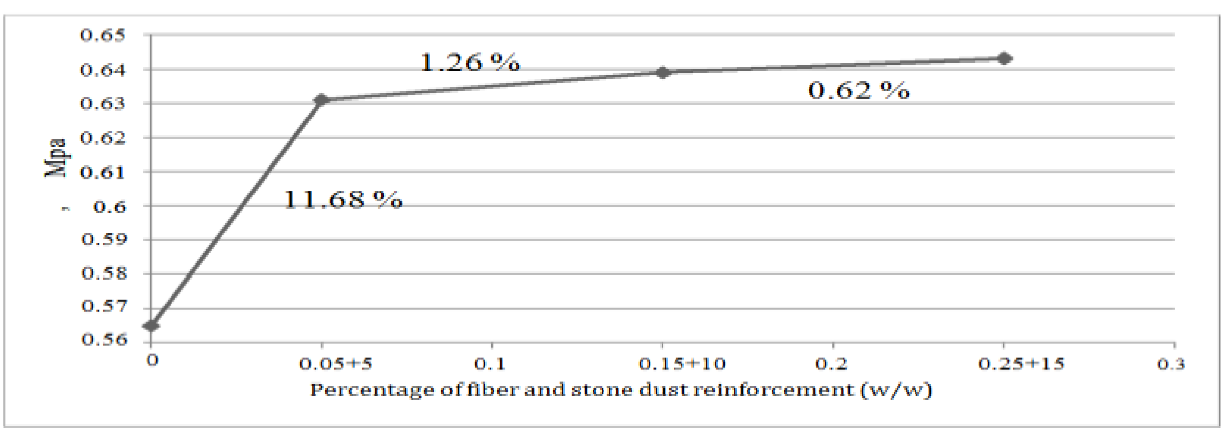


Fig. - 20

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Soil sample- 2

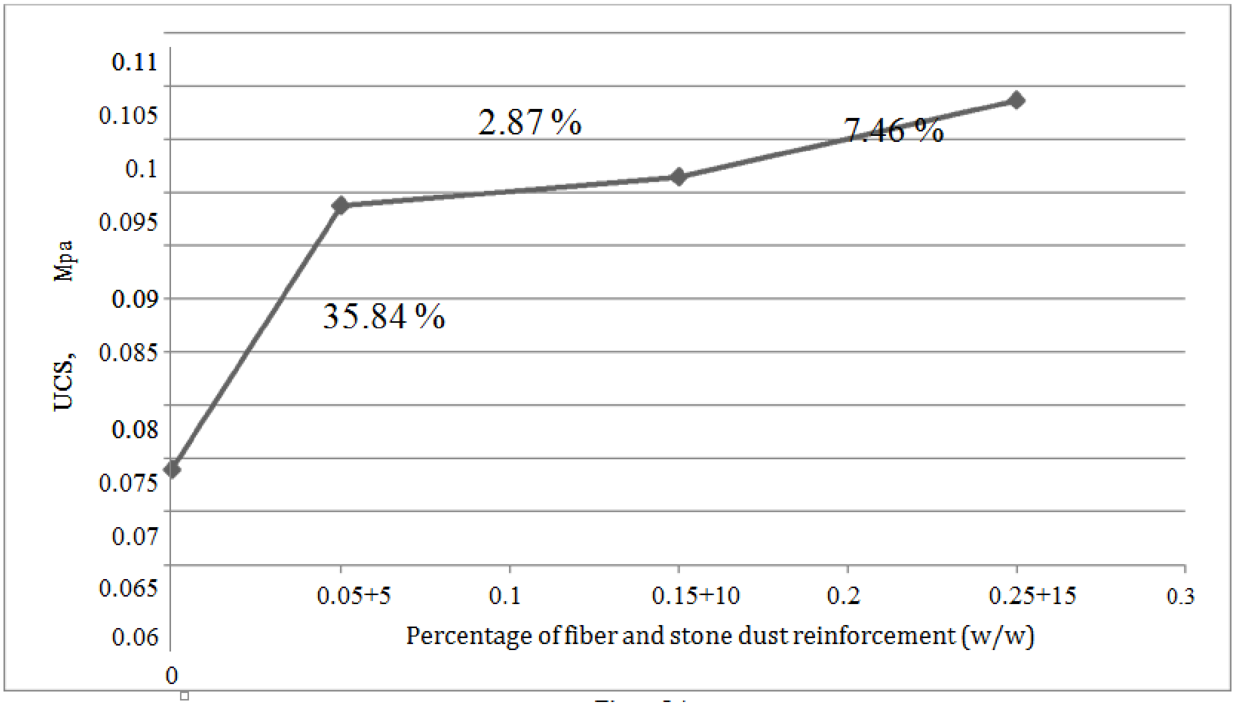


Fig. - 21

Conclusion:-

4.7.1 Inferences from Direct Shear Test

Soil sample- 1

- Cohesion value increases from 0.325 kg/cm2 to 0.3887 kg/cm2, a net 19.6%
- The increment graph shows a gradual decline in slope.
- The angle of internal friction increases from 47.72 to 48.483 degrees, a net 1.59%
- The increment in shear strength of soil due to reinforcement is marginal.

Soil sample- 2

- Cohesion value increases from 0.3513 kg/cm2 to 0.5375 kg/cm2, a net 53.0%
- The increment graph for cohesion shows a gradual decline in slope.
- The angle of internal friction increases from 27.82 to 32 degrees, a net 15.02%
- The increment graph for φ shows a variation in slope- alternate rise and fall.
- The increment in shear strength of soil due to reinforcement is substantial.

Utilization of plastic wastes and stone dust is increasing day by day. This has an adverse effect in nature and it is not possible to resticct its uses. So we are utilizing these wastes as a reinforcing as well as a stabilizer materials in soil stabilization.From the above result and Camparion analysis of soil sample 1 and soil sample 2. There is appropriate increment in the value of shear strength of the soil sample-2 that is low plastic clayey soil is best suited for stabilizes with stone dust and plastic wastes.

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

- Based on direct shear test on soil sample- 1, with fiber and rock dust reinforcement of (0.05%+5%), (0.15%+10%) and (0.25%+15%), the increase in cohesion was found to be 10%, 4.8% and 3.73% respectively (illustrated in figure-25). The increase in the internal angle of friction (φ) was found to be 0.8%, 0.31% and 0. 47% respectively (illustrated in figure- 27). Since the net increase in the values of c and φ were observed to be 19.6%, from
- 0.325 kg/cm2 to 0.3887 kg/cm2 and 1.59%, from 47.72 to 48.483 degrees respectively, for such a soil, randomly distributed polypropylene fiber reinforcement is not recommended.
- The results from the UCS test for soil sample- 1 are also similar, for reinforcements of (0.05%+5%), (0.15%+10%) and (0.25%+15%),the increase in unconfined compressive strength from the initial value are 11.68%, 1.26% and 0.62% respectively (illustrated in figure-29). This increment is not substantial and applying it for soils similar to soil sample-1 is not effective.
- The shear strength parameters of soil sample- 2 were determined by direct shear test. Figure- 26 illustrates that the increase in the value of cohesion for fiber reinforcement of (0.05%+5%), (0.15%+10%) and (0.25%+15%), are 34.7%, 6.09% and 7.07% respectively. Figure 27 illustrates that the increase in the internal angle of friction (φ) was found to be 0.8%, 0.31% and 0. 47% respectively. Thus, a net increase in the values of c and φ were observed to be 53%, from 0.3513 kg/cm2 to 0.5375 kg/cm2 and 15.02%

Comparison of shear parameters between soil sample- 1 and soil sample- 2

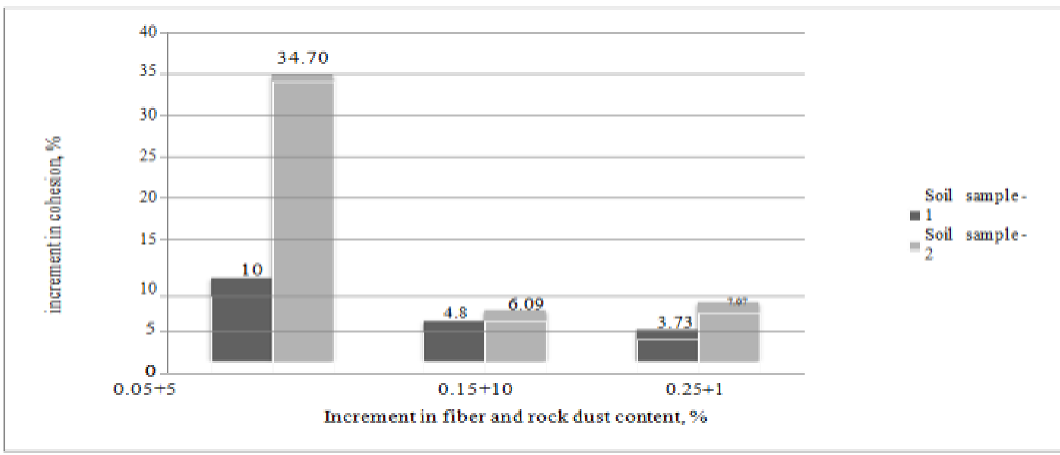
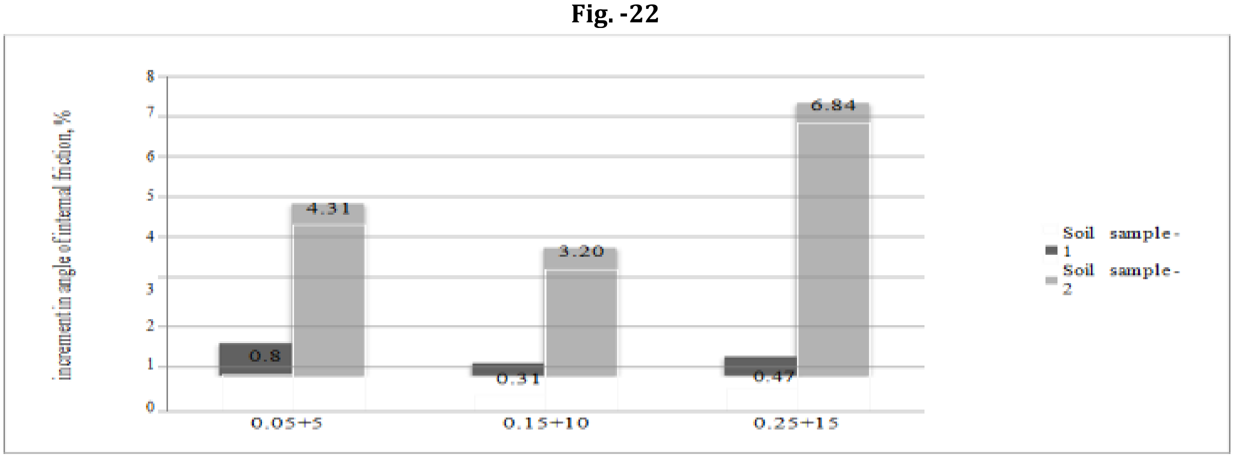


Fig. -22



Increment in fiber and rock dust content, %

Fig. – 23

4.7.2 Inferences from Unconfined Compression Test

Soil sample- 1

- UCS value increases from 0.0643 MPa to 0.0562 MPa, a net 14.4%
- The slope of increment graph is continuously decreasing with an initially steep slope

Soil sample- 2

- UCS value increases from 0.0692 MPa to 0.1037 MPa, a net 49.8%
- The slope of the increment graph varies with alternate rise and fall

Comparison between soil sample-1 and soil sample- 2 for UCS

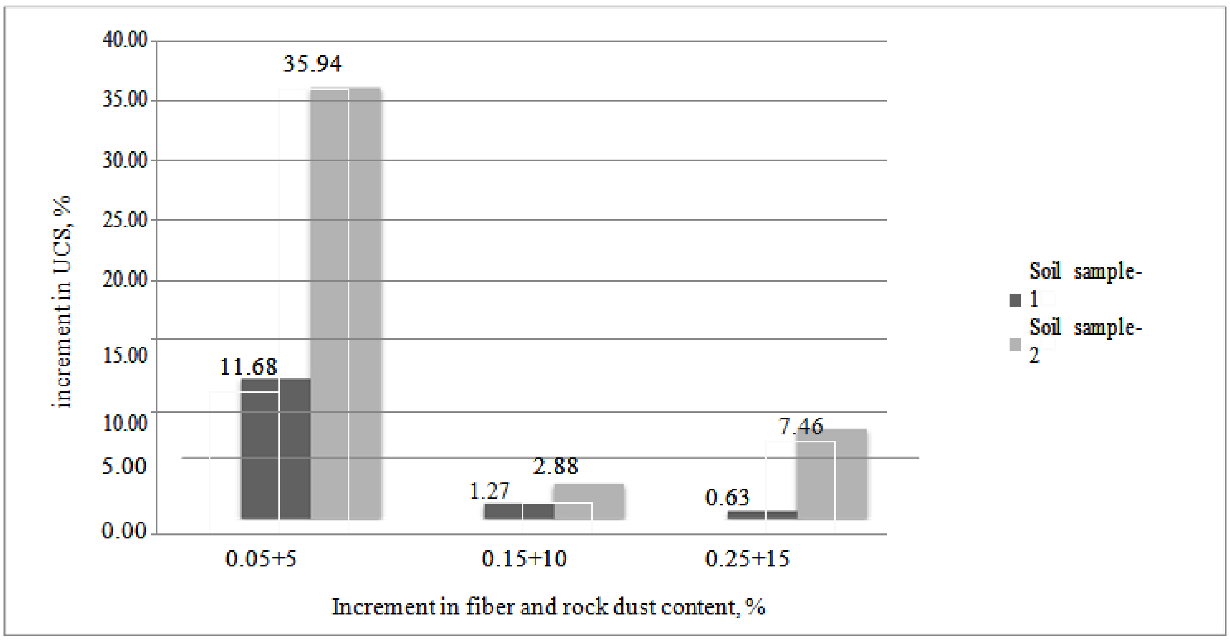


Fig.24

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