EFFECT OF GEOTEXTILES ON ENGINEERING PROPERTIES OF SOIL.

Project Report submitted in partial fulfillment of the degree of
Bachelor of Technology
in
Civil Engineering

Under the Supervision of
Prof. Dr. Ashok Kumar Gupta &
Mr. Niraj Singh Parihar

By

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CERTIFICATE

This is to certify that project report entitled “Effect of geotextiles on Engineering properties of soil.”, submitted by Shivom Dhawan (101679) and Rishabh Chopra (101606) in partial fulfillment for the award of degree of Bachelor of Technology in Civil Engineering to Jaypee University of Information Technology, WakNaghat, Solan has been carried out under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Signature of Supervisor: ___________________

Name of Supervisor: Prof. Dr. Ashok Kumar Gupta
(HOD, Civil Engineering , JUIT)
Mr. Niraj Singh Parihar
(Assistant professor , JUIT)

Date: 15/05/2014

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We express our sincere gratitude to our respected project supervisors Prof. Dr. Ashok Kumar Gupta & Mr.Niraj Singh Parihar, Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat under whose supervision and guidance this work has been carried out. His whole hearted involvement, advice, support and constant encouragement throughout, have been responsible for carrying out this project work with confidence. We are thankful to him for showing confidence in us to take up this project. It was due to his planning and guidance that we were able to complete this project in time.

We are sincerely grateful to Dr. Ashok Kumar Gupta, Professor and Head of Department of Civil Engineering, Jaypee University of Information Technology, WakNaghat for providing all the necessities for the successful completion of our project.

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Date: 15/05/2014

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ABSTRACT

Geotextiles, a newly emerging field in the civil engineering and other fields, offer great potential in varied areas of applications globally. Geotextiles play a significant part in modern pavement design and maintenance techniques. The growth in their use worldwide for transportation applications in particular, has been nothing short of phenomenal. Geotextiles are ideal materials for infrastructural works such as roads, harbors and many others.

This project aims at observing the effect of using geotextiles on some Engineering properties of soil using different variations of both non-woven and woven geotextiles in with main emphasis on performing proctor compaction test, unconfined compressive strength test and triaxial test(UU) on clayey soil and observing and analyzing the results obtained. Concluding with analyzing the results, deducing their scope and usefulness for Civil Engineers in various fields of civil Engineering.

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1. INTRODUCTION

Geotextiles were one of the first textile products in human history. Excavations of ancient Egyptian sites show the use of mats made of grass and linen. Geotextiles were used in roadway construction in the days of the Pharaohs to stabilise roadways and their edges. These early geotextiles were made of natural fibres, fabrics or vegetation mixed with soil to improve road quality, particularly when roads were made on unstable soil. Only recently have geotextiles been used and evaluated for modern road construction.

Geotextiles today are highly developed products that must comply with numerous standards. To produce tailor-made industrial fabrics, appropriate machinery is needed. Geotextiles have been used very successfully in road construction for over 30 years. Their primary function is to separate the sub base from the sub grade resulting in stronger road construction. The geotextile perform this function by providing a dense mass of fibres at the interface of the two layers. Geotextiles have proven to be among the most versatile and cost-effective ground modification materials. Their use has expanded rapidly into nearly all areas of civil, geotechnical, environmental, coastal, and hydraulic engineering. They form the major component of the field of geosynthetics, the others being geogrids, geomembranes and geocomposites. The ASTM (1994) defines geotextiles as permeable textile materials used in contact with soil, rock, earth or any other geotechnical related material as an integral part of civil engineering project, structure, or system. Geotextiles should fulfill certain requirements like it must permit material exchange between air and soil without which plant growth is impossible, it must be penetrable by roots etc. and it must allow rain water to penetrate the soil from outside and also excess water to drain out of the earth without erosion of the soil. To obtain all these properties in geotextiles, the proper choice of textile fibre is of paramount importance. The different synthetic fibres used in geotextiles are nylon, polyester, polypropylene while some natural fibres like ramie, jute etc. can also be used.

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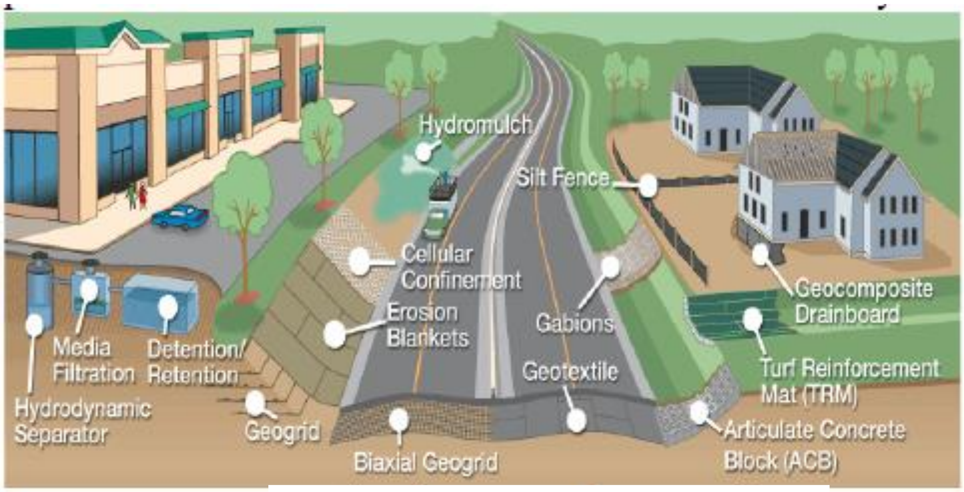
Non-Woven Geotextiles

Woven Geotextiles

1.1 Applications of Geotextiles

Geotextiles are permeable fabrics which, when used in association with soil, have the ability to separate, filter, reinforce, protect, or drain. Typically made from polypropylene or polyester, geotextile fabrics come in three basic forms: woven (looks like mail bag sacking), needle punched (looks like felt), or heat bonded (looks like ironed felt)

Every textile product applied under the soil is a geotextile. The products are used for reinforcement of streets, embankments, ponds, pipelines, and similar applications. Depending on the required function, they are used in open-mesh versions, such as a woven or, rarely, warp-kNitted structure, or with a closed fabric surface, such as a non-woven. The mode of operation of a geotextile in any application is defined by six discrete functions: separation, filtration, drainage, reinforcement, sealing and protection. Depending on the application the geotextile performs one or more of these functions simultaneously.



Application areas of geotextiles

2. LITERATURE REVIEW

2.1 Literature 1

Author, Gohil D.P., Issued in IGC 2009

Due to various functions and advantages geosynthetics are best option in geotechnical projects. New immerging field for geosynthetics as foundation isolator to reduce seismic energy transmitted to buildings can be a very cost effective. It is also a simpler alternative to earthquake hazard mitigation measures conventionally used in current engineering practice.

2.2 Literature 2

Author, Raju, N. Ramakrishna, Issued on December 16, 2010

Polypropylene is one of the excellent filter materials for drainage. It has been observed physically for last 2 years and no problem has been found for Kandaleru reservoir dam.

2.3 Literature 3

Author, Dr. Bipin J Agrawal, Issued on May 13, 2011

Extensive awareness should be created among the people about the application of geotextiles. Geotextiles are effective tools in the hands of the civil engineer that have proved to solve a myriad of geotechnical problems.

2.4 Literature 4

Author, Ajjarapu Sreerama Rao.

A case study of a road section reinforced with jute geotextile has been presented. While water content, void ratio and compression index decreased, dry density and CBR increased on introduction of jute geotextiles. Hence, jute geotextile is very effective in weak subgrade soils in reducing their compressibility and increasing their strength.

3. MATERIALS AND EXPERIMENTAL PROCEDURES

3.1 Materials

Soil, classified as clayey sand, was brought from Domehar, Himachal Pradesh, having the following properties:-

- Effective size , D_{10} of soil = 0.019 mm
- Uniformity Coefficient, C_u = 14.21
- Coefficient of Curvature, C_c = 1.949
- % of gravel = 1.649%
- % of coarse sand = 7.59%
- % of medium sand = 27.29%
- % of fine sand = 40.017%
- % of silt and clay = 23.442%

Geotextiles were brought from Virendra Textile, Delhi. Both woven and non-woven types were brought having thickness 240 GSM and 120 GSM respectively.

3.2 Experimental Procedures

3.2.1 Grain Size Analysis (I.S 460-1962)

On passing a sample of 500g of soil through 75 micron sieve , 329.3g (65.86%) of soil retained on 75 micron sieve. Hence, followed the procedure of grain size analysis of coarse grained soil.

Apparatus:

- Balance
- I.S sieves
- Rubber pestle and mortar
- Mechanical Sieve Shaker

Procedure:

- I.S sieves are selected and arranged in the order as shown in the table.
- The soil sample was separated into various fractions by sieving through above sieves placed in the above mentioned order.
- The weight of soil retained on each sieve was recorded.
- The moisture content of soil if above 5% it was to be measured and recorded.

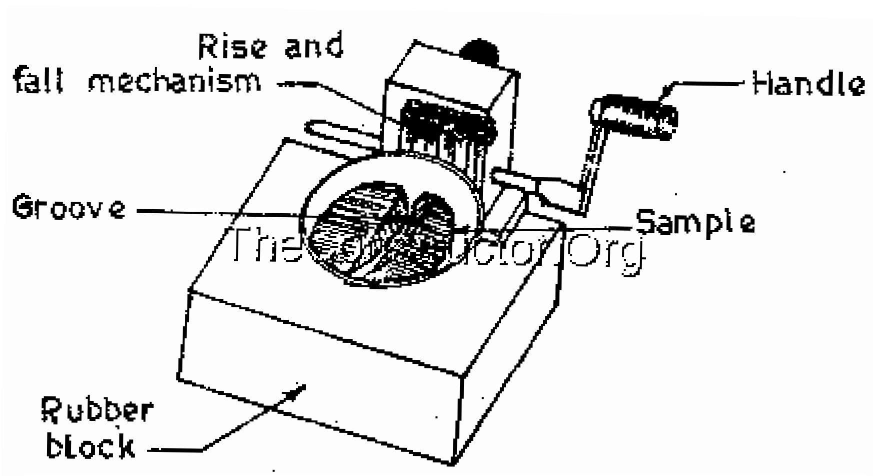
Calculation:

- The percentage of soil retained on each sieve was calculated on the basis of total weight of soil sample taken.
- Cumulative percentage of soil retained on successive sieve was found.

3.2.2 Liquid Limit (IS: 2720 (Part V) – 1985)

Apparatus:

- Mechanical liquid limit device (Casagrande's Apparatus)
- Grooving Tool
- Balance
- Oven
- Wash bottle or Beaker
- Containers



Mechanical liquid limit device (Casagrande's Apparatus)

Procedure:

- About 120 gm of the soil sample passing 425-micron IS sieve was mixed thoroughly with distilled water in the evaporating dish or on the flat glass plate to from a uniform paste. The paste has a consistency that will require 30 to 35 drops of the cup to cause the required closure of the standard groove. In the case of clayey soils, the soil paste was left to stand for a sufficient time (24 hour) so as to ensure uniform distribution of moisture throughout the soil mass.
- The soil should then be re-mixed thoroughly before the test. A portion of the paste was placed in the cup above the spot where the cup rests on the base, squeezed down and spread into position shown in Fig above, with as few strokes of the spatula as possible and at the same time trimmed to a depth of one centimeter at the point of maximum thickness, returning the excess soil to the dish.
- A little extra of the soil mixture was added to cup and mixed with the soil in the cup. The pat was made in the cup and the test repeated as in no case shall dried soil be added to the thoroughly mixed soil that was being tested. The procedure given in and in this clause was repeated until two consecutive runs give the same under of drops for closure of the groove.
- A representative slice of soil approximately the width of the spatula extending from about edge to the soil cake at right angle to the groove and including that portion of the groove in which the soil flowed together, was taken in a suitable container and its moisture content expressed as a percentage of the oven dry weight.
- The operation specified was repeated for at least three more additional trails.

3.2.3 Plastic Limit (IS: 2720 (Part V) – 1985)

Apparatus:

- Porcelain Evaporating Dish
- Flat glass Plate
- Spatula
- Palette Knives
- Surface for Rolling
- Containers
- Balance
- Oven
- Rod

Procedure:

- The soil sample was mixed thoroughly with distilled water in an evaporating dish or on the flat glass plate till the soil mass became plastic enough to be easily molded with fingers.
- A ball was formed with about 8 gm of this plastic soil mass and rolled between the fingers and the glass plate with just sufficient pressure to roll the mass into a thread of uniform diameter throughout its length.
- The rate of rolling was between 80 and 90 strokes/min counting a stroke as one complete motion of the hand forward and back to the starting position again.
- The rolling was done till the threads are of 3mm diameter. The soil was kneaded together to a uniform mass and rolled again. This process of alternate rolling and kneading was continued until the thread crumbles under the pressure required for rolling and the soil can no longer be rolled into a thread.
- The crumbling may occur when the thread has a diameter greater than 3 mm. This was considered a satisfactory end point and the moisture content was determined.

Plasticity Index:

- The plasticity index is calculated as the difference between its liquid limit and plastic limit.
- Plasticity index (Ip) = Liquid limit (wL) – Plastic limit (wp)

3.2.4 Proctor Compaction test (IS: 2720 (PART- VII)-1980)

Objective:

The method for the determination of the relation between the water content and the dry density of soils using light compaction. In this test a 2.6 kg rammer falling through a height of 310 mm was used.

Apparatus:

- **Cylindrical metal mold---** 100 mm diameter and 1000 cm^3 volume and conform to IS: 10074-1982.
- Sample Extruder (optional)
- Balances
- Oven
- Container
- Steel Straightedge
- Sieve— 4.75 mm and 19 mm
- Mixing Tools

Procedure:

- A 5 kg sample of air dried soil passing the 19 mm IS test sieve was taken. The sample was mixed thoroughly with a suitable amount of water depending on the soil type.
- The mold of 1000 cm^3 capacity with base plate attached was weighed to the nearest 1gm .
- The mold was placed on a solid base, such as a concrete floor or plinth and the moist soil was compacted into the mold, with the extension attached, in three layers of approximately equal mass, each layer being given 25 blows from the 2.6 Kg rammer dropped from a height of 310 mm above the soil. The blows was distributed uniformly over the surface of each layer. The operator ensure that the tube of the rammer was kept clear of soil so that the rammer always falls freely.
- The extension was removed and the compacted soil was leveled off carefully to the top of the mold by means of the straightedge. The mold and soil was weighed to 1gm.
- The compacted soil specimen was removed from the mold and placed on the mixing tray. The water content of a representative sample of the specimen was determined.
- The remainder of the soil specimen was broken up, rubbed through the 19 mm IS test sieve, and then mixed with the remainder of the original sample. Suitable increments of water was added successively and mixed into the sample, and the above procedure from operation was repeated for each increment of water added. The total number of determinations made was at least five, and the range of moisture contents should be such that the optimum moisture content, at which the maximum dry density occurs, was within that range.

3.2.5 Unconfined Compression Test (IS: 2720 (PART 10)-1991)

Apparatus:

1) Compression Device
2) proving Ring
3) Deformation Dial Gauge
4) Vernier Calipers
5) Timer
6) Oven
7) Weighing Balances
8) Miscellaneous Equipment

Preparation of test specimen:

- The type of soil specimen to be used for test depend on the purpose for which it is tested and may be compacted, remolded or undisturbed. The specimen used in this test was compacted disturbed specimen.
- The specimen for the test has a minimum diameter of 38 mm and the Largest particle contained within the test specimen was smaller than 1/8 of the specimen diameter. When compacting disturbed material it was done using a mold of circular cross section with dimensions corresponding to those given in compacted specimen may be prepared at any predetermined water content and density.
- After the Specimen was formed the ends were trimmed perpendicular to the long axis and removed from the mold using extruder. representative sample cuttings was obtained or the entire specimen was used for the determination of water content after the test.

Procedure:

- The initial length diameter and weight of the specimen was measured and the specimen placed on the bottom plate of the loading device .The upper plate was adjusted to make contact with the specimen.

- The deformation dial gauge was adjusted to a suitable reading preferably in multiples of 100 Force was applied so as to produce axial strain at a rate of 0.5 to 2 percent per minute causing failure with 5 to 10. The force reading was taken at suitable intervals of the deformations dial reading.
- The specimen was compressed until failure surfaces have definitely developed or the stress strain of 20 percent is reached
- The failure pattern was sketched carefully and shown on the date sheet or on the sheet presenting the stress strain plot. The angle between the failure surface and the horizontal may be measured if possible and reported.
- The water content of the specimen was determined in accordance with using samples taken from the failure zone of the specimen.

3.2.6 Triaxial Test (Unconsolidated Undrained) IS: 2720 (PART 11) – 1993

Apparatus:

- Split Mold: of diameter and length to suit the test specimen.
- Trimming knife – sharp-bladed for example a spatula or pallet knife.
- Piano wire saw
- Metal straightedge
- Metal scale
- Non-corrodible metal or plastic end-caps
- Seamless Rubber Membrane
- Membrane Stretcher
- Rubber rings
- Apparatus for moisture content determination
- Balance
- Sample Extruder

Apparatus Required for Triaxial –Test:

- **Triaxial Test Cell-** A triaxial test cell of dimensions appropriate to the size of the specimen, capable of being opened for the insertion of the specimen, suitable for use with the fluid selected.
- An apparatus for applying and maintaining the desired pressure on the fluid within the cell.
- Machine capable of applying axial compression to the specimen.

Preparation of test specimen:

- The type of soil specimen to be used for test depend on the purpose for which it is tested and may be compacted, remolded or undisturbed. The specimen used in this test was compacted disturbed specimen.
- The specimen for the test has a minimum diameter of 38 mm and the Largest particle contained within the test specimen was smaller than 1/8 of the specimen diameter. When compacting disturbed material it was done using a mold of circular cross section with dimensions corresponding to those given in compacted specimen may be prepared at any predetermined water content and density.

- After the Specimen is formed the ends was trimmed perpendicular to the long axis and removed from the mold using extruder. Representative sample cuttings was obtained or the entire specimen was used for the determination of water content after the test.

Testing Procedure:

- The specimen was placed centrally on the pedestal of the tri-axial cell. The cell was assembled with the loading ram initially clear of the top cap of the specimen and the cell containing the specimen was placed in the loading machine. The operating fluid was admitted to the cell and the pressure raised to the desired value.
- The loading machine was adjusted to bring the loading ram a short distance away from the seat on the top cap of the specimen and the initial reading of the load measuring gauge was recorded. The loading machine was further adjusted to bring the loading ram just in contact with the seat on the top cap of the specimen and the initial reading of the gauge measuring the axial compression of the specimen was recorded.
- A rate of axial compression was selected such that failure was produced within a period of approximately 5 to 15 minutes. The test was commenced a sufficient number of simultaneous readings of the load and compression measuring gauges being taken to define the stress strain curve. The test was continued until the maximum value of the stress has been reached.
- The cell was determined of fluid and dismantled and the specimen taken out. The rubber membrane was removed from the specimen and the mode of failure was noted. The specimen was weighed and samples for the determination of the moisture content of the specimen was taken.

3.2.7 Moisture Content Determination (Oven drying method) IS: 2720 (PART II)-1973

Apparatus:

- Container
- Balance
- Oven
- Desiccators

Procedure:

- The container was cleaned with lid, dried and weighed (W1)
- The required quantity of the soil specimen in the container was crumbled and placed loosely, and weighed with lid (W2).
- Then kept in an oven with the lid removed, and the temperature of the oven maintained at 110 +5C.
- The specimen was dried in the oven for 24 h.
- Every time the container was taken out for weighing, replace the lid on the container.
- Record the final mass (W3) of the container with lid with dried soil sample.

4. OBJECTIVE OF STUDY

Performing various tests on soil samples mixed with geotextiles in different arrangements and analyzing and comparing the results obtained.

4.1 Proctor Compaction test

- Proctor compaction test on normal soil.
- Proctor compaction test on soil with 3 layers of woven geotextiles placed parallel to the base.
- Proctor compaction test on soil with 3 layers of woven geotextiles placed at an angle of 30^o to the base
- Proctor compaction test with 3 layers of non- woven geotextiles placed parallel to the base.
- Proctor compaction test on soil with 3 layers of non-woven geotextiles placed at an angle of 30^o to the base.

4.2 Unconfined Compression Test

- Unconfined compression test on soil sample without geotextiles.
- Unconfined compression test on soil sample with woven geotextiles placed uniformly spaced in the failure plane of the sample tested without geotextiles.
- Unconfined compression test on soil sample with non- woven geotextiles placed uniformly spaced in the failure plane of the sample tested without geotextiles.
- Unconfined compression test on soil sample with woven geotextiles placed uniformly spaced in between the sample.
- Unconfined compression test on soil sample with non-woven geotextiles placed uniformly spaced in between the sample.

4.3 Triaxial Test (UU)

- Triaxial test on soil sample without geotextiles.
- Triaxial test on soil sample with woven geotextiles placed uniformly spaced in 2 layers.
- Triaxial test on soil sample with non-woven geotextiles placed uniformly spaced in 2 layers.
- Triaxial test on soil sample with woven geotextiles placed uniformly spaced in 3 layers.
- Triaxial test on soil sample with non-woven geotextiles placed uniformly spaced in 2 layers.
- Triaxial test on soil sample with geotextile thread mixed in the soil , 10% by wt. of the sample.
- Triaxial test on soil sample with geotextile thread mixed in the soil , 15% by wt. of the sample

5. RESULTS AND DISCUSSION

5.1 Grain Size Analysis (Sieve analysis)

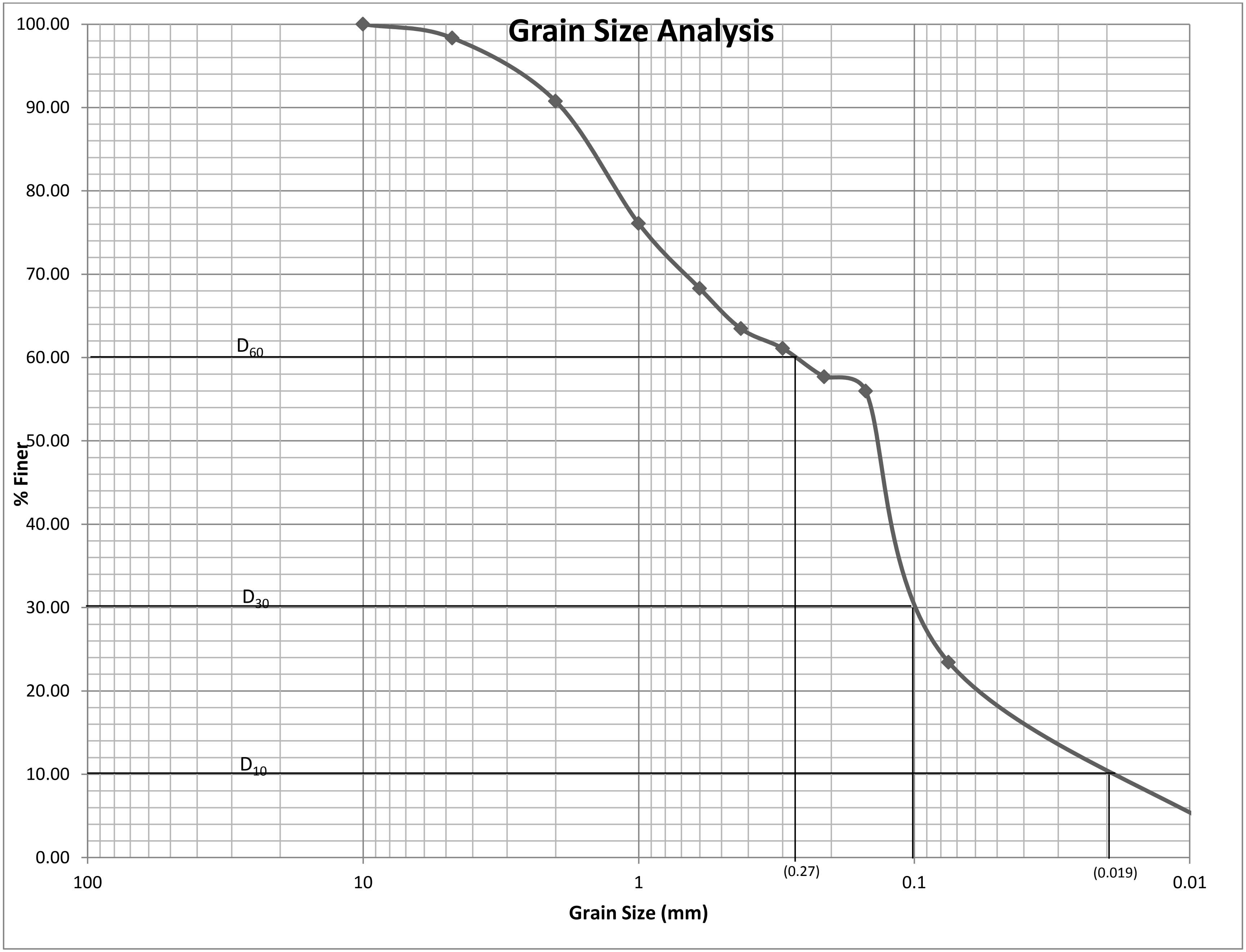
- The following results were obtained on performing grain size analysis on the soil under consideration:

I.S sieve No. or size	Wt. of empty sieve(g)	Wt. of soil + sieve(g)	Wt. Retained on each sieve (g)	Cumulative mass retained(g)	Cumulative %age retained on each sieve	% Finer
10 mm	503.5	503.5	0	0	0.00	100.00
4.75 mm	418.5	435	16.5	16.5	1.65	98.35
2 mm	402	478	76	92.5	9.25	90.75
1 mm	374.3	521	146.7	239.2	23.91	76.09
600 µ	362.8	440.9	78.1	317.3	31.72	68.28
425 µ	351	399.2	48.2	365.5	36.54	63.46
300 µ	354.6	378.2	23.6	389.1	38.90	61.10
212 µ	336.9	371	34.1	423.2	42.31	57.69
150 µ	357.9	375	17.1	440.3	44.02	55.98
75 µ	329.8	655.3	325.5	765.8	76.56	23.44
Pan	255.9	490.4	234.5	1000.3	100.00	0.00

5.1.1 Discussion

The various soil parameters calculated from the result obtained and the graph are as follows:

- Effective size , D_{10} of soil = 0.019 mm
- Uniformity Coefficient, $C_u = D_{60}/D_{10} = 0.27/0.019 = 14.21$
- Coefficient of Curvature, $C_c = D_{30}^2/(D_{60} X D_{10}) = 1.949$
- % of gravel = 1.649%
- % of coarse sand = 7.59%
- % of medium sand = 27.29%
- % of fine sand = 40.017%
- % of silt and clay = 23.442%


Grain Size Analysis
% Finer
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
D60
D30
D10
100
10
1
(0.27)
0.1
(0.019)
0.01
Grain Size (mm)

5.2 Plastic Limit Test

The following results were obtained on performing plastic limit test on the concerned soil:-

Sl No.	Wt. of container (g)	Wt. of container+ wet soil(g)	Wt. of container +dry soil (g)	Moisture content (%)
1	18.8	27.8	26.2	21.6%
2	17.0	28.5	26.4	22.10%

Plastic limit of soil was taken as average of the two moisture contents.

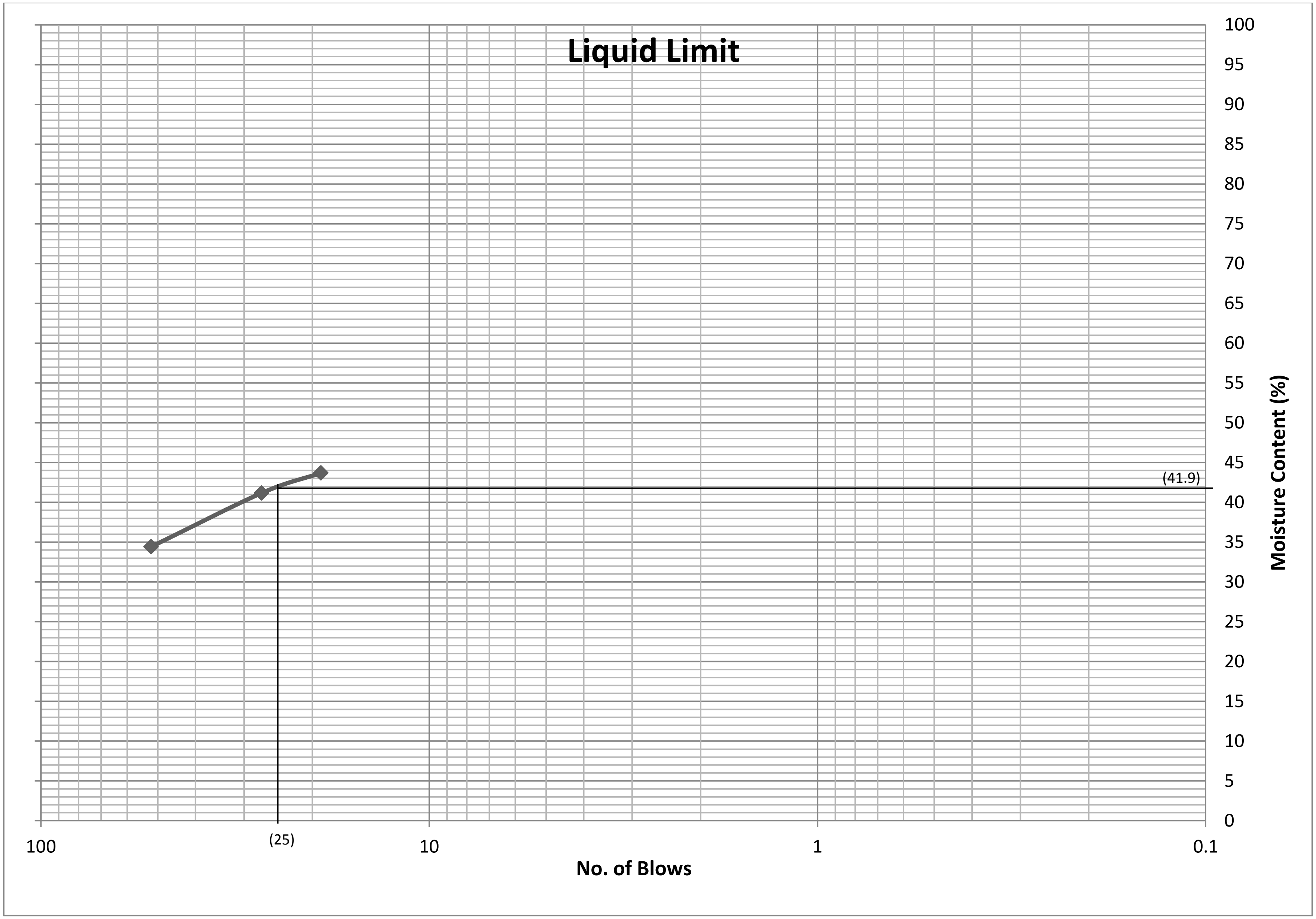
Plastic limit of soil was found to be 21.85%.

5.3 Liquid Limit Test

The following results were obtained on performing Liquid limit test on the concerned soil:-

No. of blows	**Wt. of empty container (g)**	**Wt. of container + soil (g)**	**Wt. of container +dry soil (g)**	**Moisture content (%)**
52	20.4	28.6	26.5	34.426
27	19.5	29.1	26.3	41.176
19	20.6	35.4	30.9	43.689

From the graph obtained the liquid limit of soil was obtained as **41.9%**



Liquid Limit
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Moisture Content (%)
(41.9)
(25)
100
10
1
0.1
No. of Blows

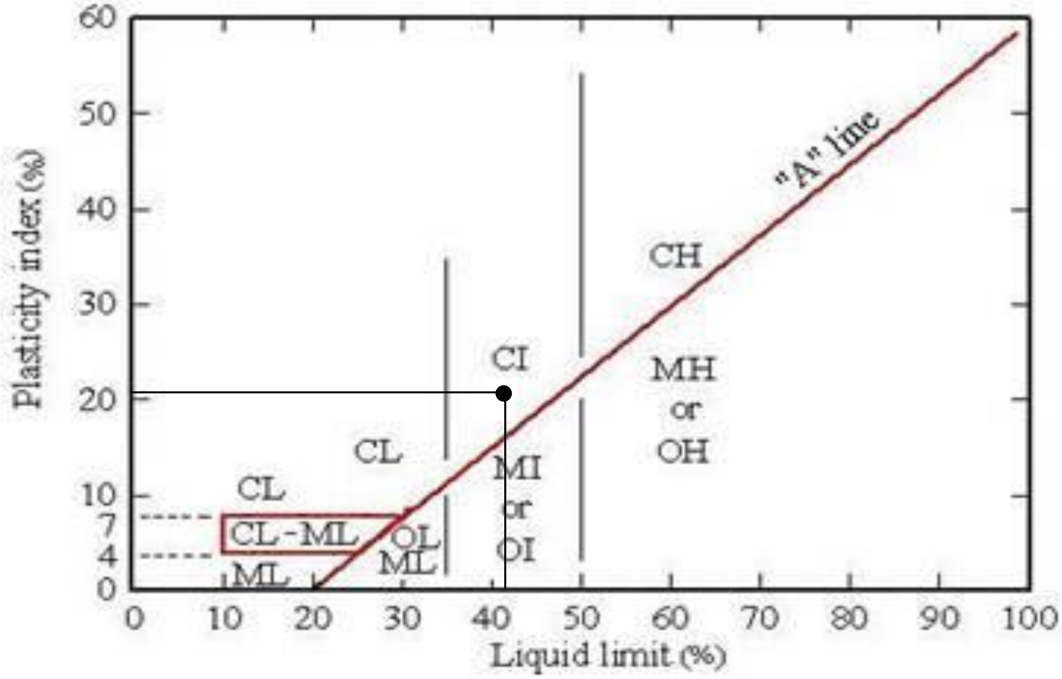
5.4 Soil Classification

On the basis of results obtained from above experiments , soil was classified as follows:-

- Plasticity Index

  Plasticity Index (I_P) = Liquid Limit(W_L) – Plastic Limit(W_P)

$$\mathbf{I_P = 41.9 - 21.85 = 20.05}$$



Casagrande's Plasticity chart

- On plotting the plasticity index and liquid limit on the plasticity chart it is found that the intersecting point lies above 'A' line and the hatched zone.

- Thus the soil is classified as **Clayey Sand,** symbolized as **SC**.

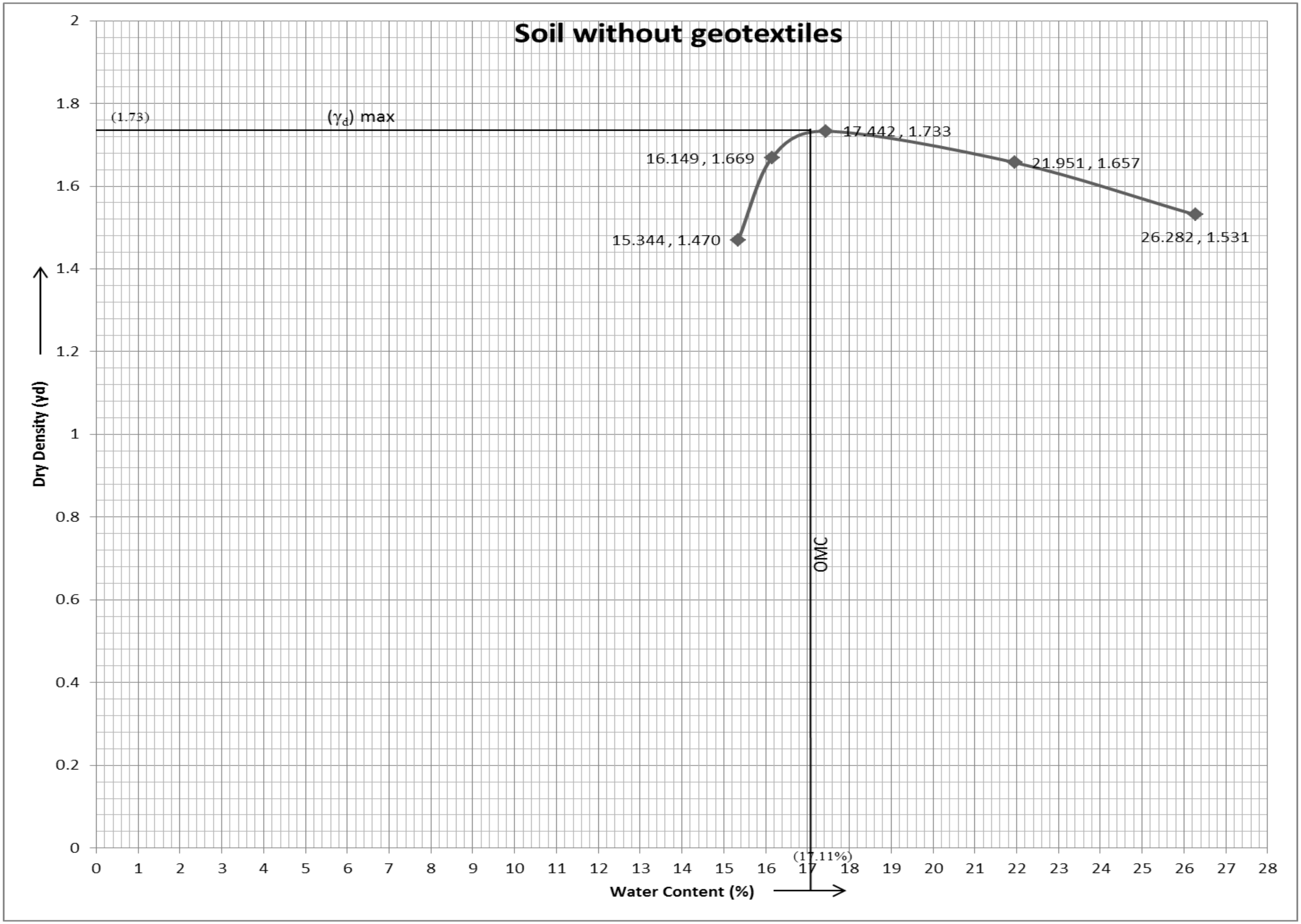
5.5 Proctor Compaction Test

5.5.1 Test done on soil without any geotextiles

Determination No.	1	2	3	4	5
Weight of the mold + base in gm (1)	5525	5526	5527	5527	5527
Weight of the mold + base + soil compacted in gm (2)	7220.2	7464	7562.4	7562.4	7562.4
Weight of soil after compaction (2) - (1) (W)	1695.2	1938	2035.4	2035.4	2035.4
Weight of moisture container gm (3)	19.1	18.8	19.1	19.1	19.1
Weight of moisture container + wet soil in gm (4)	40.9	37.5	39.3	39.3	39.3
Weight of moisture container + dry soil in gm (5)	38	34.9	36.3	36.3	36.3
Volume of mold cm^3 (V)	1000	1000	1000	1000	1000
Bulk Density (γ_t) =W/V kN/m^3	1.6952	1.938	2.0354	2.0354	2.0354
Water Content (%) $w = \frac{(4)-(5)}{(5)-(3)} X100$	15.3439 2	16.1490 7	17.4418 6	17.4418 6	17.4418 6
Dry Density (γ_d) $= \frac{\gamma_t}{1+w}$ kN/m^3	1.4696	1.6685	1.7331	1.7331	1.7331

- On the basis of the above obtained data the graph between dry density (γ_d) and Water content (w%) was plotted, the maximum dry density and Optimum moisture content (OMC) found out.

- From the graph the maximum dry density was obtained as 1.73 kN/m^3 and Optimum moisture content (OMC) 17.11%


Soil without geotextiles
(1.73)
(γd) max
17.442 , 1.733
16.149 , 1.669
21.951 , 1.657
15.344 , 1.470
26.282 , 1.531
OMC
(17.11%)
Dry Density (γd)
Water Content (%)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

5.5.2 Proctor compaction test on soil with 3 layers of woven geotextiles placed parallel to the base.

3 Layers of woven geotextiles uniformly placed at a distance of 2.9 cm ..

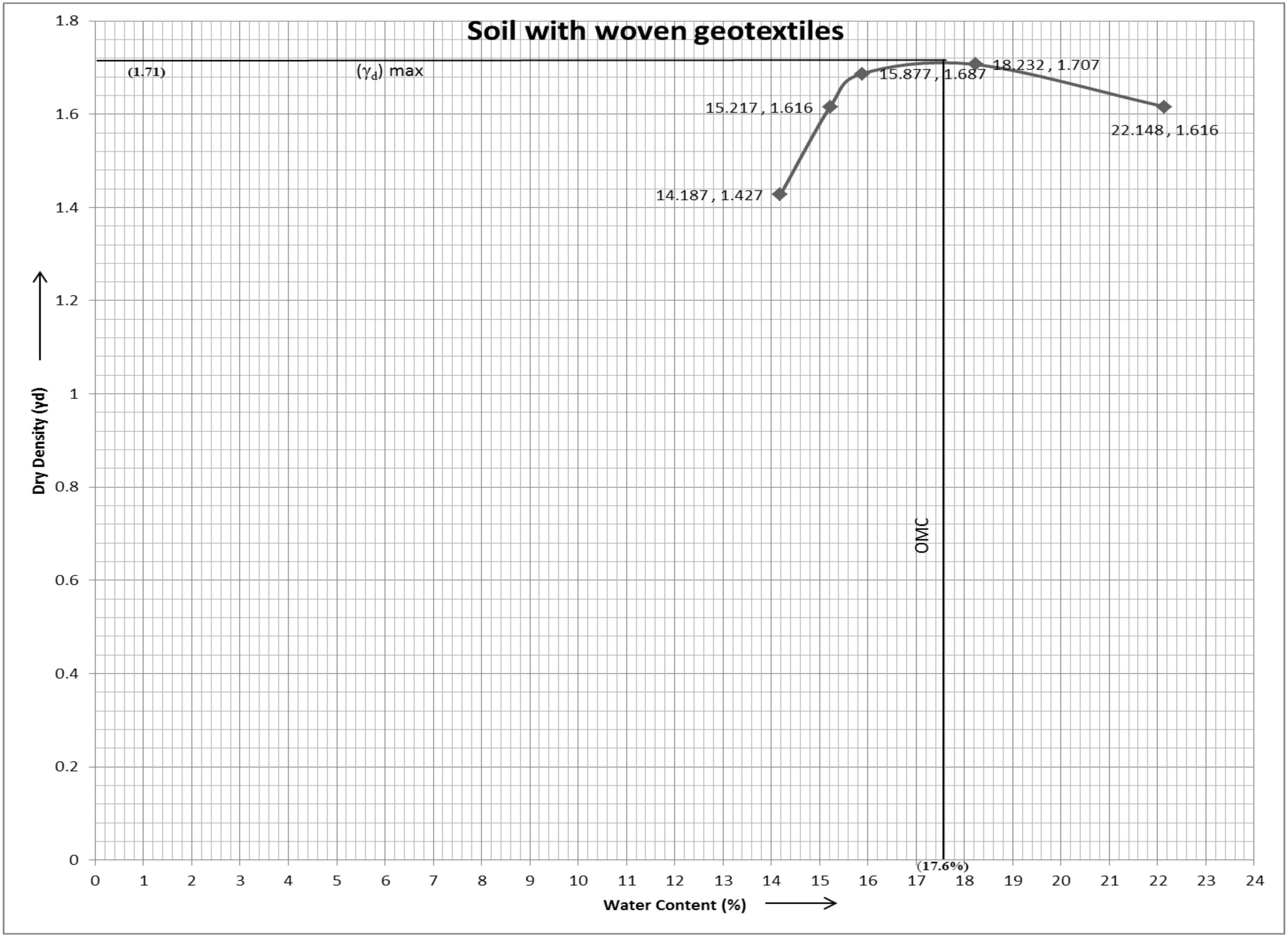
- One Layer at the base.

- Second layer at a distance of 2.9 cm from the base

- Third layer at a distance of 5.8 cm from the base

Determination No.	1	2	3	4	5
Weight of the mold + base in gm (1)	5526.1	5526.1	5526.1	5526.1	5526.1
Weight of the mold + base + soil compacted in gm (2)	7164.9	7164.9	7164.9	7164.9	7164.9
Weight of geotextiles in gm (6)	9.3	9.3	9.3	9.3	9.3
Weight of soil after compaction (2) - (1+6) (W)	1629.5	1629.5	1629.5	1629.5	1629.5
Weight of moisture container gm (3)	18.6	18.6	18.6	18.6	18.6
Weight of moisture container + wet soil in gm (4)	35.1	35.1	35.1	35.1	35.1
Weight of moisture container + dry soil in gm (5)	33.05	33.05	33.05	33.05	33.05
Volume of mold cm^3 (V)	1000	1000	1000	1000	1000
Bulk Density (γ_t) =W/V kN/m^3	1.6295	1.6295	1.6295	1.6295	1.6295
Water Content (%) w = $\frac{(4)-(5)}{(5)-(3)}$X100	14.18685	14.18685	14.18685	14.18685	14.18685
Dry Density (γ_d) = $\frac{\gamma_t}{1+w}$ kN/m^3	1.427047	1.427047	1.427047	1.427047	1.427047

- On the basis of the above obtained data the graph between dry density (γ_d) and Water content (w%) was plotted, the maximum dry density and Optimum moisture content (OMC) found out.
- From the graph the maximum dry density was obtained as 1.71 kN/m^3 and Optimum moisture content (OMC) 17.6% .


Soil with woven geotextiles
(1.71)
(γ_d) max
18.232 , 1.707
15.877 , 1.687
15.217 , 1.616
22.148 , 1.616
14.187 , 1.427
Dry Density (γd)
OMC
(17.6%)
Water Content (%)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

5.5.3 Proctor compaction test on soil with 3 layers of woven geotextiles placed at an angle of 30^o to the base

3 Layers of woven geotextiles uniformly placed at a distance of 2.9 cm .

- One Layer at the base.

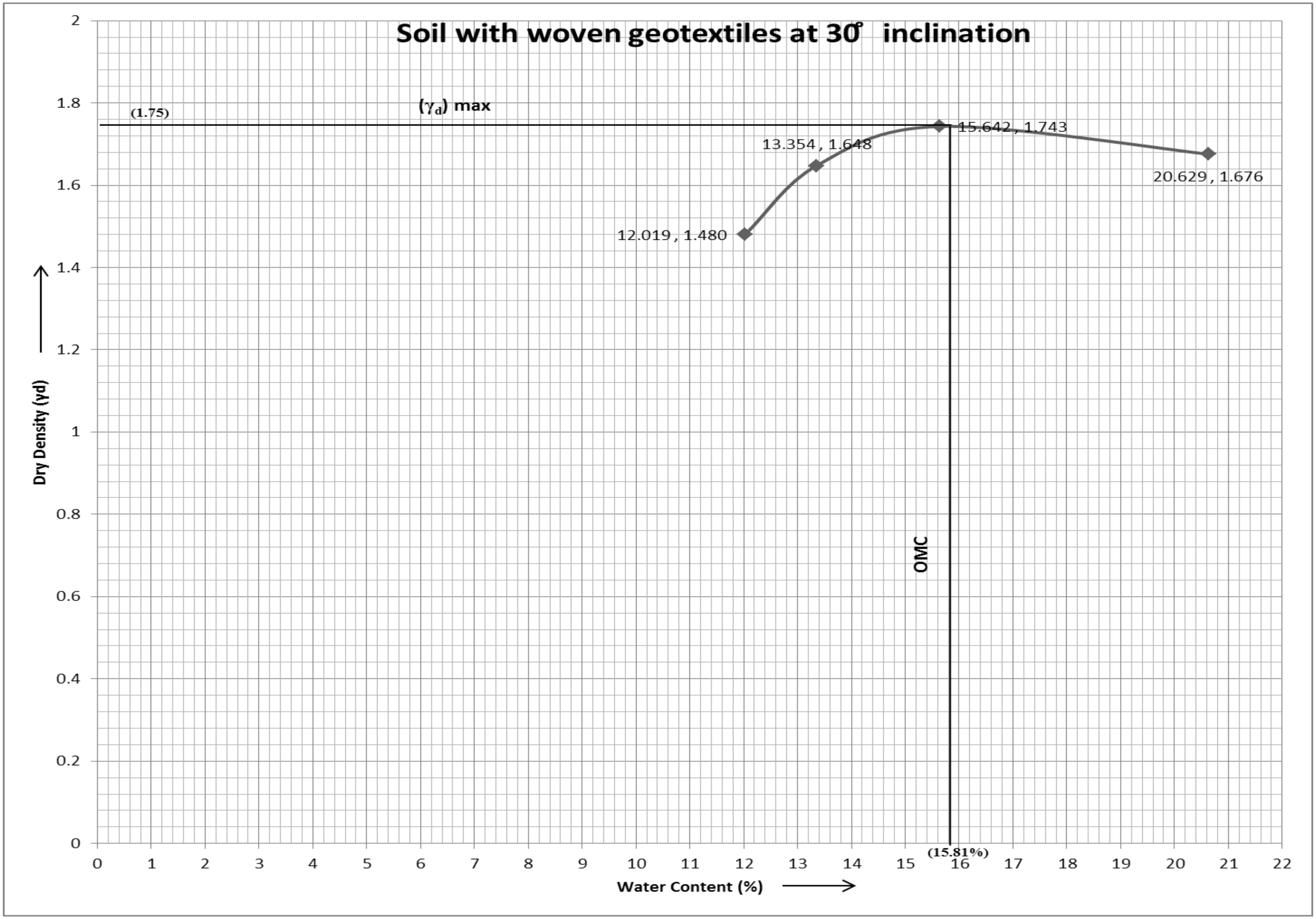
- Second layer at a distance of 2.9 cm from the base.

- Third layer at a distance of 5.8 cm from the base.

Determination No.	1	2	3	4
Weight of the mold + base in gm (1)	5526	5526	5526	5526
Weight of the mold + base + soil compacted in gm (2)	7189.2	7189.2	7189.2	7189.2
Weight of geotextiles in gm (6)	5.8	5.8	5.8	5.8
Weight of soil after compaction (2) - (1+6) (W)	1657.4	1657.4	1657.4	1657.4
Weight of moisture container gm (3)	20.5	20.5	20.5	20.5
Weight of moisture container + wet soil in gm (4)	43.8	43.8	43.8	43.8
Weight of moisture container + dry soil in gm (5)	41.3	41.3	41.3	41.3
Volume of mold cm^3 (V)	1000	1000	1000	1000
Bulk Density (γ_t) =W/V kN/m^3	1.6574	1.6574	1.6574	1.6574
Water Content (%) w = $\frac{(4)-(5)}{(5)-(3)}$X100	12.01923	12.01923	12.01923	12.01923
Dry Density (γ_d) = $\frac{\gamma_t}{1+w}$ kN/m^3	1.479567	1.479567	1.479567	1.479567

- On the basis of the above obtained data the graph between dry density (γ_d) and Water content (w%) was plotted, the maximum dry density and Optimum moisture content (OMC) found out.

- From the graph the maximum dry density was obtained as 1.75 kN/m^3 and Optimum moisture content (OMC) 15.81% .


Soil with woven geotextiles at 30° inclination
(γd) max
(1.75)
15.642 , 1.743
13.354 , 1.648
20.629 , 1.676
12.019 , 1.480
OMC
(15.81%)
Dry Density (γd)
Water Content (%)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

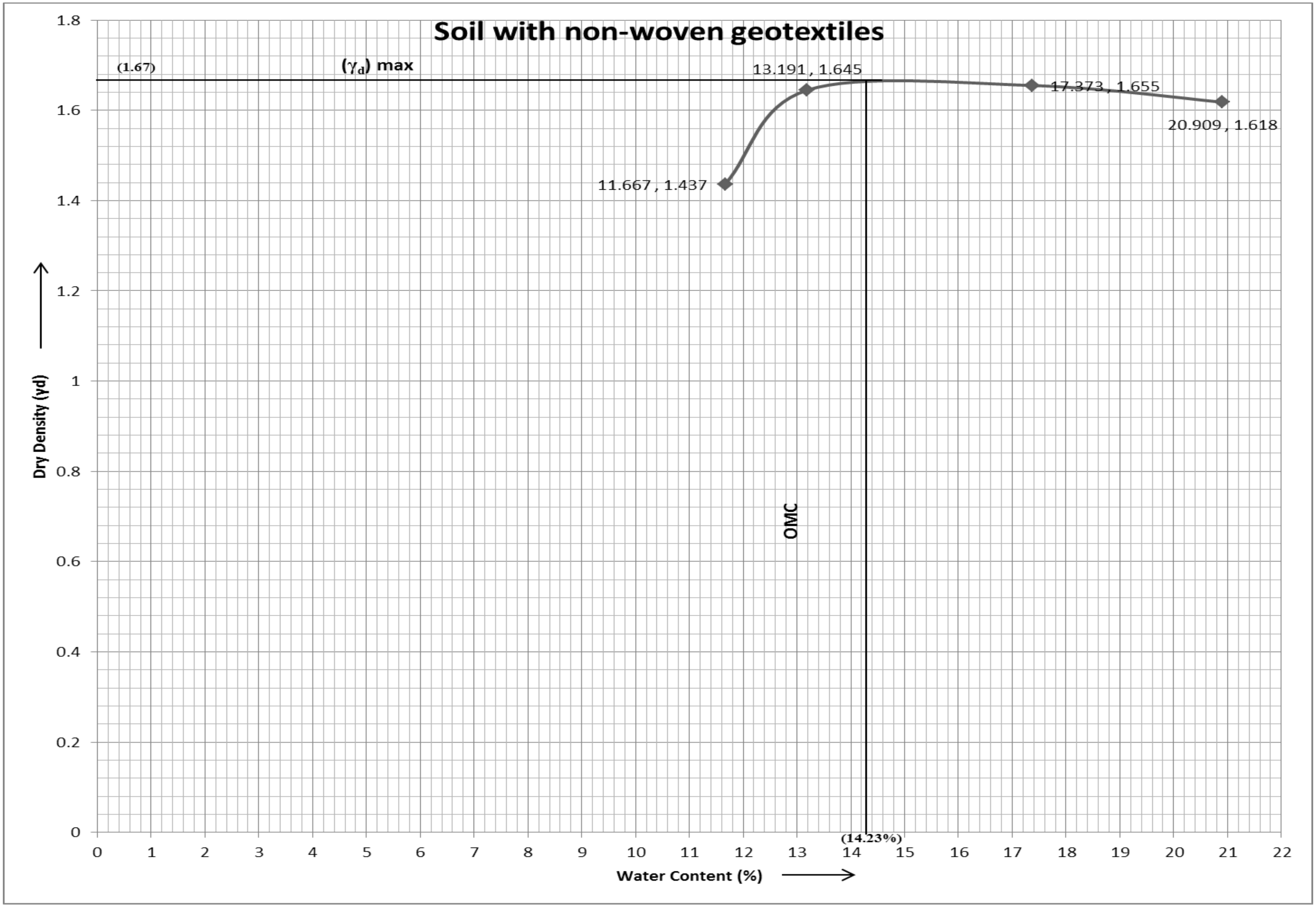
5.5.4 Proctor compaction test with 3 layers of non- woven geotextiles placed parallel to the base.

3 Layers of non-woven geotextiles uniformly placed at a distance of 2.9 cm

- One Layer at the base.
- Second layer at a distance of 2.9 cm from the base.
- Third layer at a distance of 5.8 cm from the base.

Determination No.	1	2	3	4
Weight of the mold + base in gm (1)	5526.5	5526.5	5526.5	5526.5
Weight of the mold + base + soil compacted in gm (2)	7135.6	7135.6	7135.6	7135.6
Weight of geotextiles in gm (6)	4.8	4.8	4.8	4.8
Weight of soil after compaction (2) - (1+6) (W)	1604.3	1604.3	1604.3	1604.3
Weight of moisture container gm (3)	20.4	20.4	20.4	20.4
Weight of moisture container + wet soil in gm (4)	40.5	40.5	40.5	40.5
Weight of moisture container + dry soil in gm (5)	38.4	38.4	38.4	38.4
Volume of mold cm^3 (V)	1000	1000	1000	1000
Bulk Density (γ_t) =W/V kN/m^3	1.6043	1.6043	1.6043	1.6043
Water Content (%) w = $\frac{(4)-(5)}{(5)-(3)}$X100	11.66667	11.66667	11.66667	11.66667
Dry Density (γ_d) = $\frac{\gamma_t}{1+w}$ kN/m^3	1.436687	1.436687	1.436687	1.436687

- On the basis of the above obtained data the graph between dry density (γ_d) and Water content (w%) was plotted, the maximum dry density and Optimum moisture content (OMC) found out.
- From the graph the maximum dry density was obtained as 1.67 kN/m^3 and Optimum moisture content (OMC) 14.23% .


Soil with non-woven geotextiles
(1.67)
(γd) max
13.191 , 1.645
17.373 , 1.655
20.909 , 1.618
11.667 , 1.437
OMC
(14.23%)
Dry Density (γd)
Water Content (%)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

5.5.5 Proctor compaction test on soil with 3 layers of non-woven geotextiles placed at an angle of 30° to the base.

3 Layers of non-woven geotextiles uniformly placed at a distance of 2.9 cm .

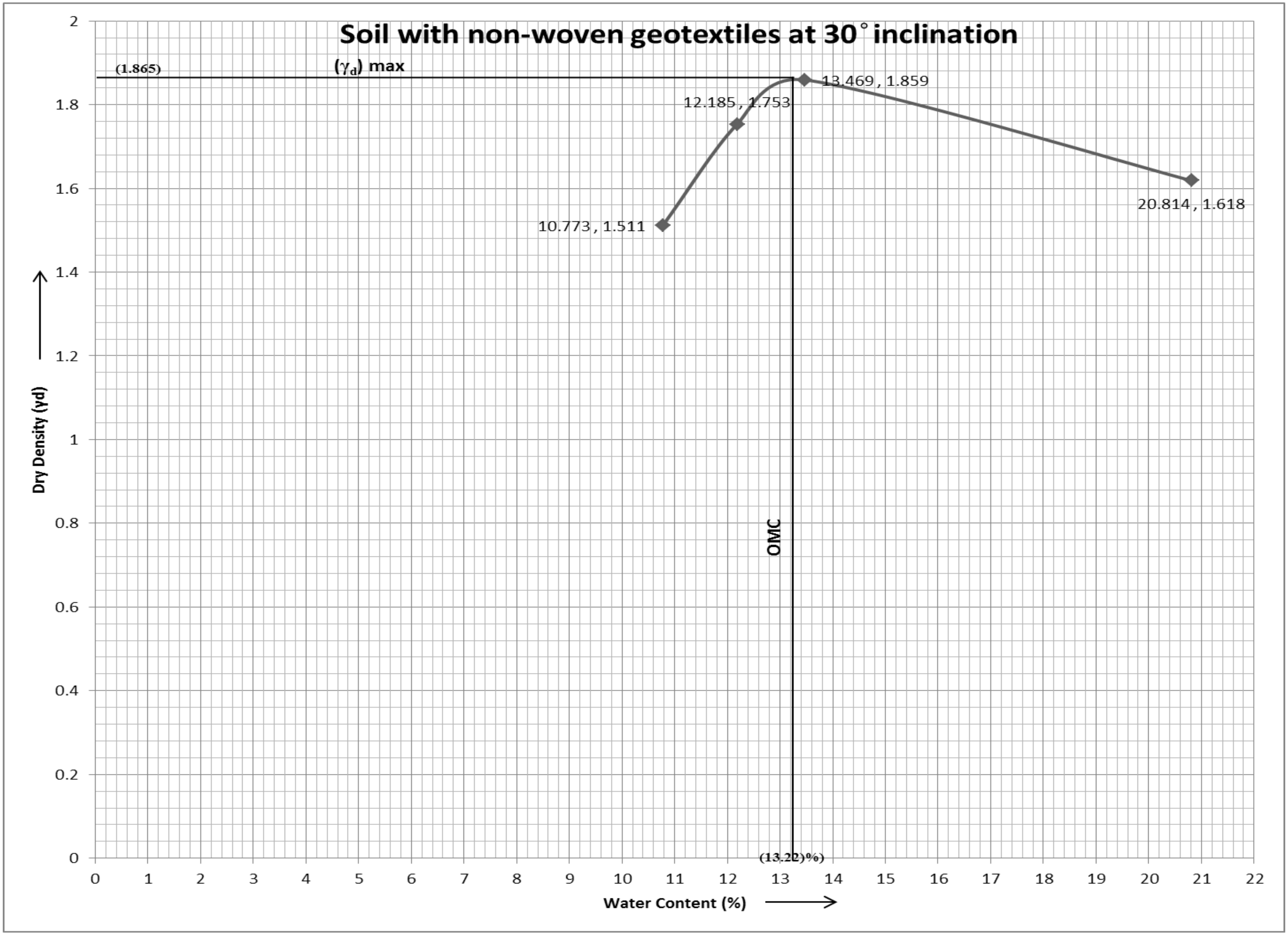
- One Layer at the base.

- Second layer at a distance of 2.9 cm from the base

- Third layer at a distance of 5.8 cm from the base yielded the following results:-

Determination No.	1	2	3	4
Weight of the mold + base in gm (1)	5526.5	5526.5	5526.5	5526.5
Weight of the mold + base + soil compacted in gm (2)	7205.6	7205.6	7205.6	7205.6
Weight of geotextiles in gm (6)	4.8	4.8	4.8	4.8
Weight of soil after compaction (2) - (1+6) (W)	1674.3	1674.3	1674.3	1674.3
Weight of moisture container gm (3)	20.3	20.3	20.3	20.3
Weight of moisture container + wet soil in gm (4)	40.35	40.35	40.35	40.35
Weight of moisture container + dry soil in gm (5)	38.4	38.4	38.4	38.4
Volume of mold cm^3 (V)	1000	1000	1000	1000
Bulk Density (γ_t) =W/V kN/m^3	1.6743	1.6743	1.6743	1.6743
Water Content (%) $w = \frac{(4)-(5)}{(5)-(3)} X100$	10.77348	10.77348	10.77348	10.77348
Dry Density (γ_d) = $\frac{\gamma_t}{1+w}$ kN/m^3	1.511463	1.511463	1.511463	1.511463

- On the basis of the above obtained data the graph between dry density (γ_d) and Water content (w%) was plotted, the maximum dry density and Optimum moisture content (OMC) found out.
- From the graph the maximum dry density was obtained as 1.865 kN/m^3 and Optimum moisture content (OMC) 13.22% .



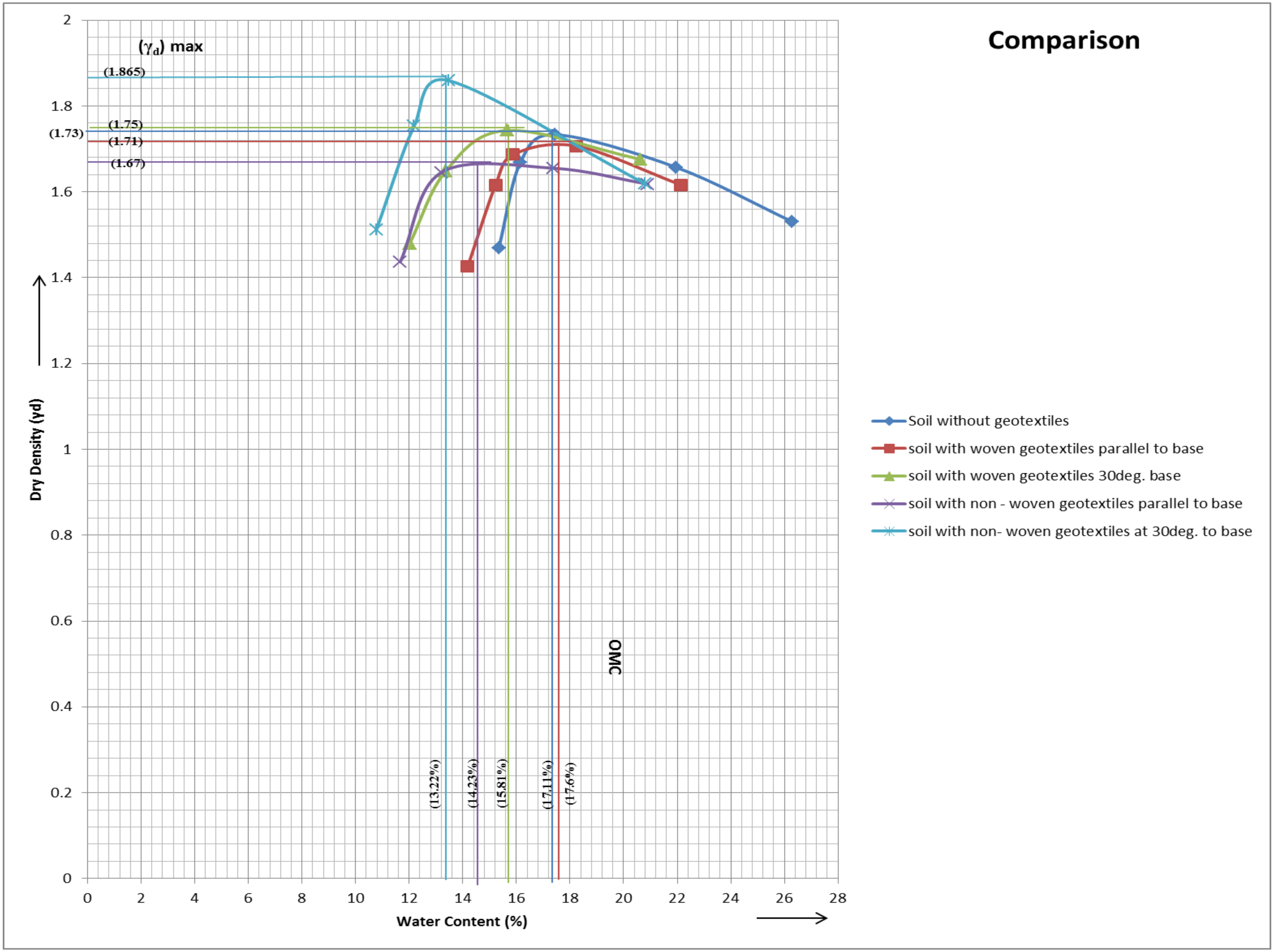
Soil with non-woven geotextiles at 30° inclination
(1.865)
(γd) max
13.469 , 1.859
12.185 , 1.753
10.773 , 1.511
20.814 , 1.618
OMC
(13.22)%
Dry Density (γd)
Water Content (%)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

DISCUSSION

TYPE	Inclination	% increase (γ_d) max	% increase OMC
Woven	Parallel to base	-1.15%	2.86%
Woven	30^O to base	1.15%	-7.60%
Non-woven	Parallel to base	-3.46%	-16.83%
Non-woven	30^O to base	7.80%	-22.74%

% increase with respect to test results on soil without geotextiles

- It was observed that when the geotextiles were kept parallel to the base there was not much change in the dry density of soil, using woven geotextiles max. dry density was found to be 1.71 kN/m^3, while using non-woven geotextiles max. dry density was 1.67 kN/m^3.
- On keeping the geotextiles at an angle of 30° to the base the dry density of soil increased to about 7.80% with a value of 1.865 kN/m^3 in case of non-woven geotextiles. Using woven geotextiles kept at an angle of 30° the dry density of soil increased to about 1.15% with a value of 1.75 kN/m^3.
- Thus, it can be concluded that by using non-woven geotextiles inclined at an angle of 30^o to the base, the maximum dry density (γ_d) of soil increase by 7.80% and can be achieved at a lower moisture content (13.22%).

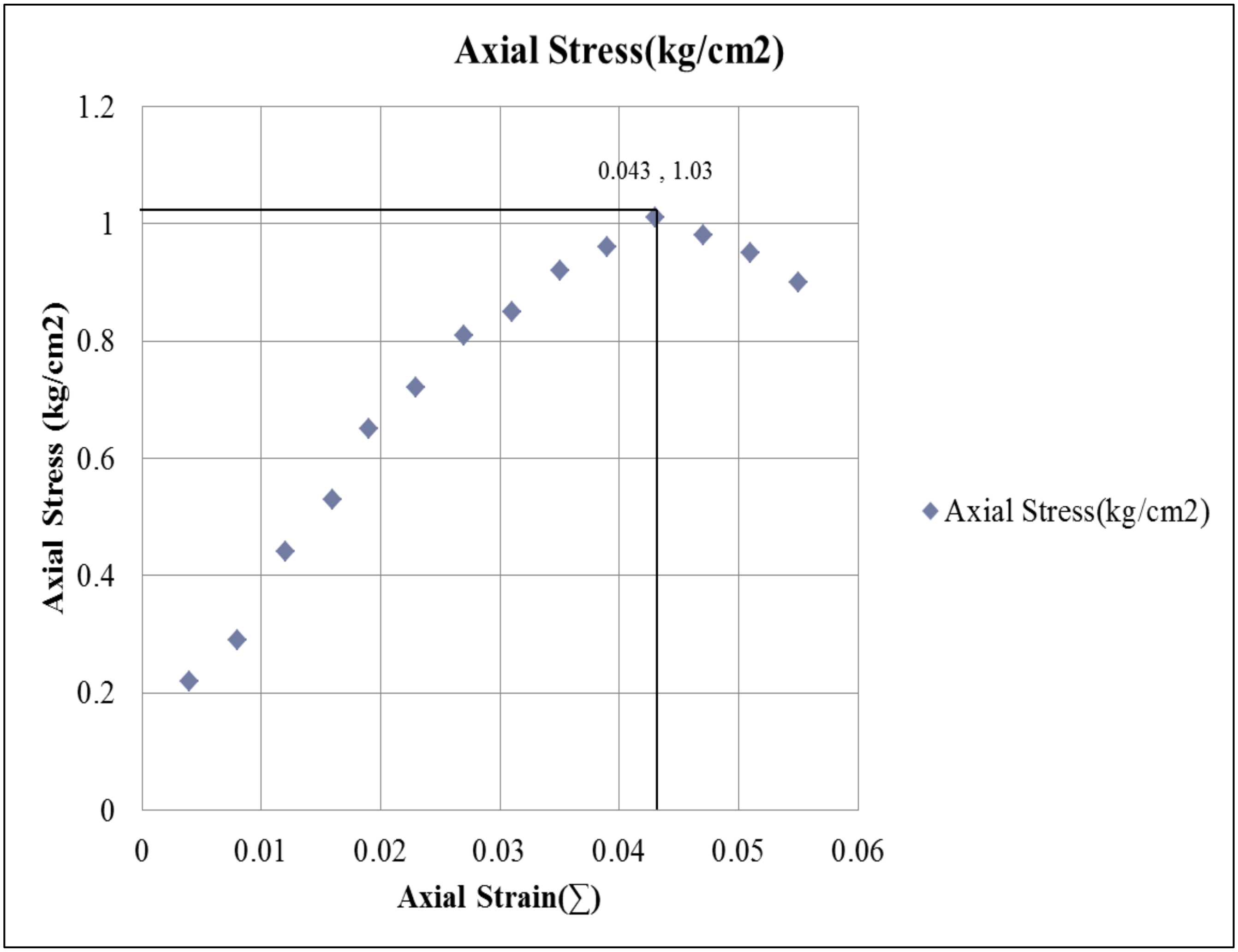


Comparison
(γd) max
(1.865)
(1.75)
(1.73)
(1.71)
(1.67)
Dry Density (γd)
Water Content (%)
OMC
(13.22%)
(14.23%)
(15.81%)
(17.11%)
(17.6%)
Soil without geotextiles
soil with woven geotextiles parallel to base
soil with woven geotextiles 30deg. base
soil with non - woven geotextiles parallel to base
soil with non- woven geotextiles at 30deg. to base

5.6 Unconfined Compressive Strength test

5.6.1 On Normal Soil (Without geotextiles)

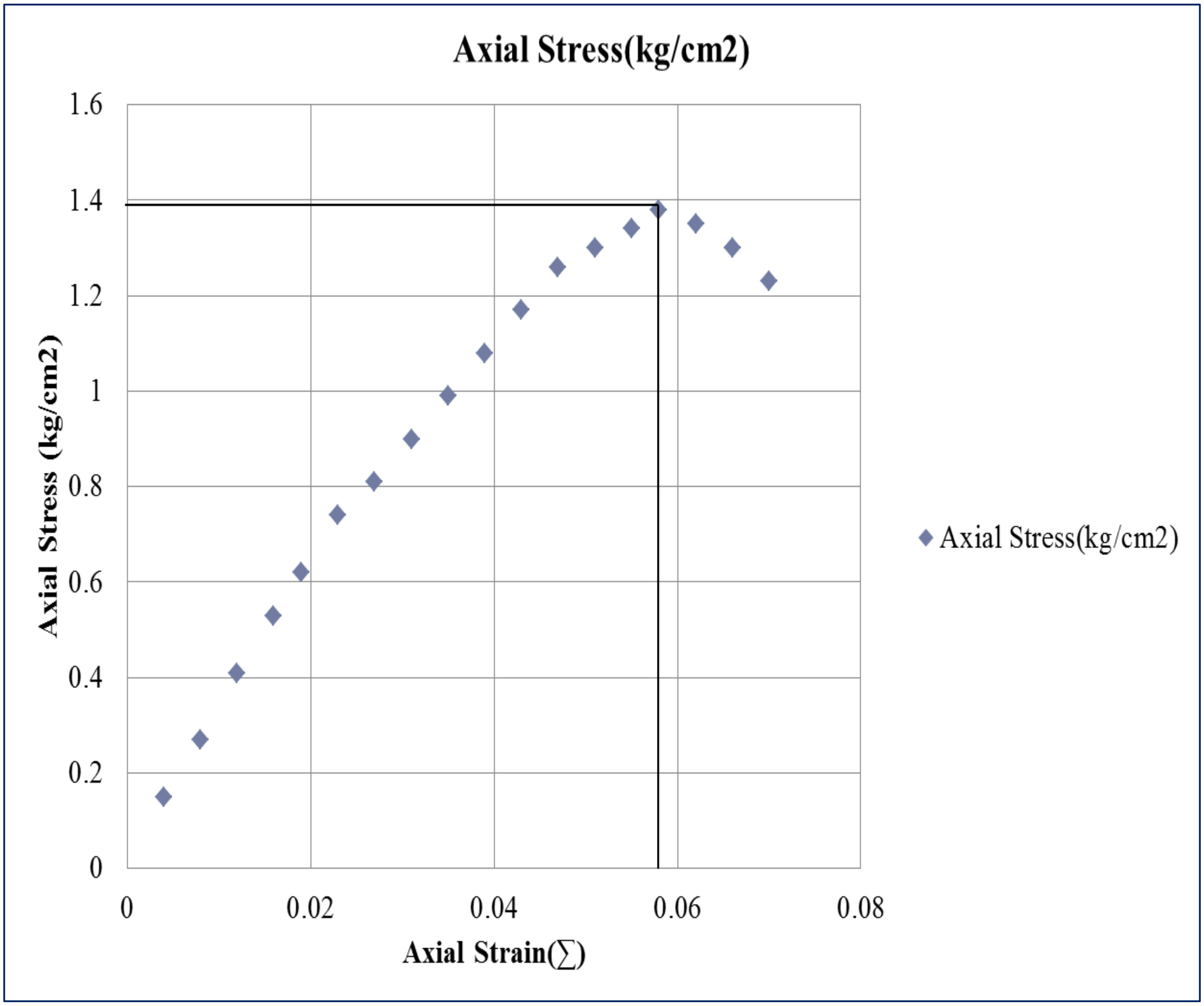
The failure plane was observed at a distance of 1.5 cm upto 3.5 cm from the base.



Unconfined Compressive Strength of soil was found to be **1.03 kg/cm^2**

5.6.2 On soil with woven geotextiles

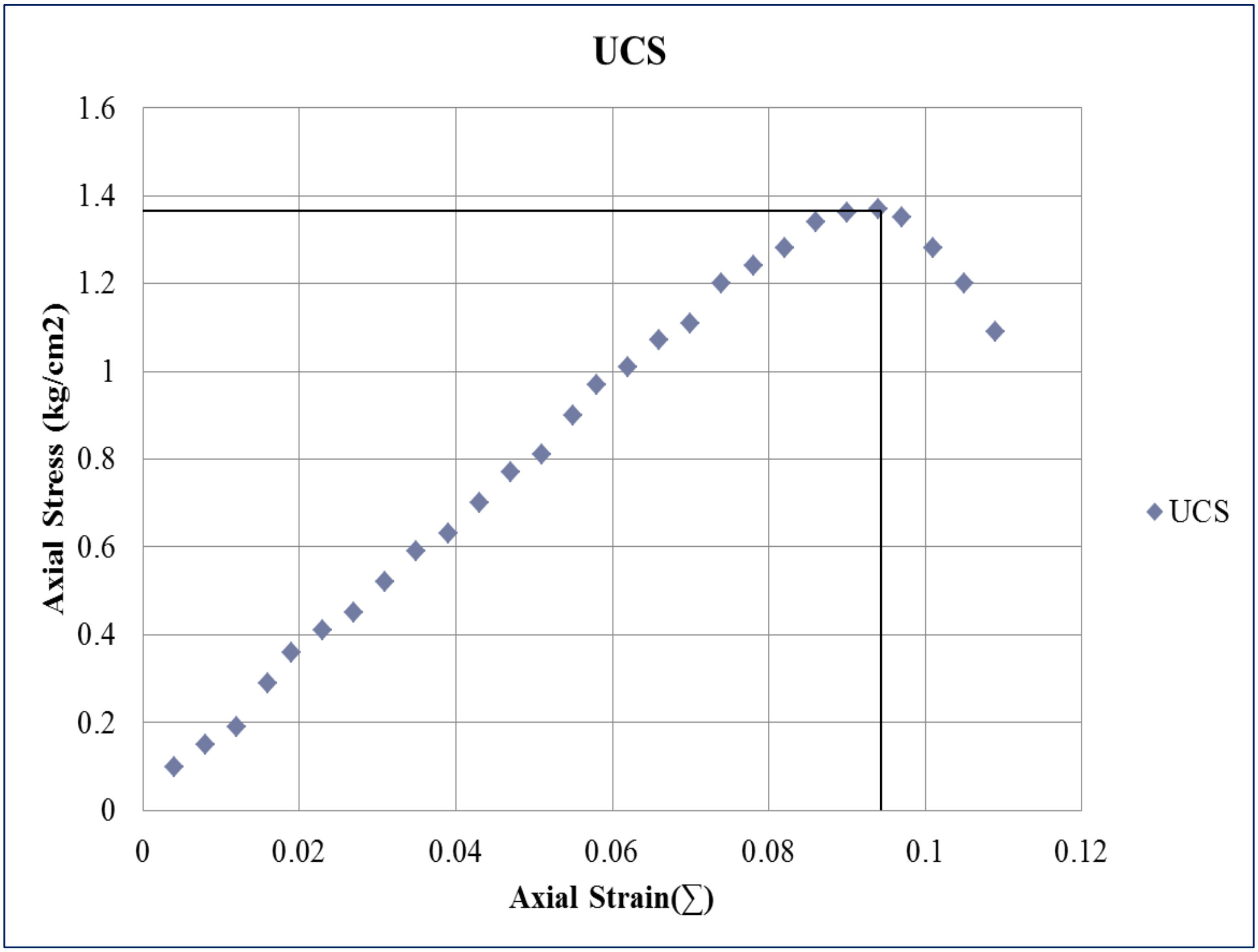
- _Woven Geotextile placed at 1/3rd and 2/3rd of the length of failure plane. (i.e at a distance of approximately 2.16 cm and 2.83 cm from the base of the sample.)
- Failure plane was observed above the geotextile placed at 2/3rd position. (i.e at a distance of 2.9 cm from the base of the sample)



Unconfined Compressive Strength of soil was found to be **1.38 kg/cm^2**

5.6.3 On soil with non – woven geotextiles

- Non-Woven Geotextile placed at 1/3rd and 2/3rd of the length of failure plane. (i.e at a distance of approximately 2.16 cm and 2.83 cm from the base of the sample.)
- Failure plane was observed above the geotextile placed at 2/3rd position. (i.e at a distance of 2.9 cm from the base of the sample)

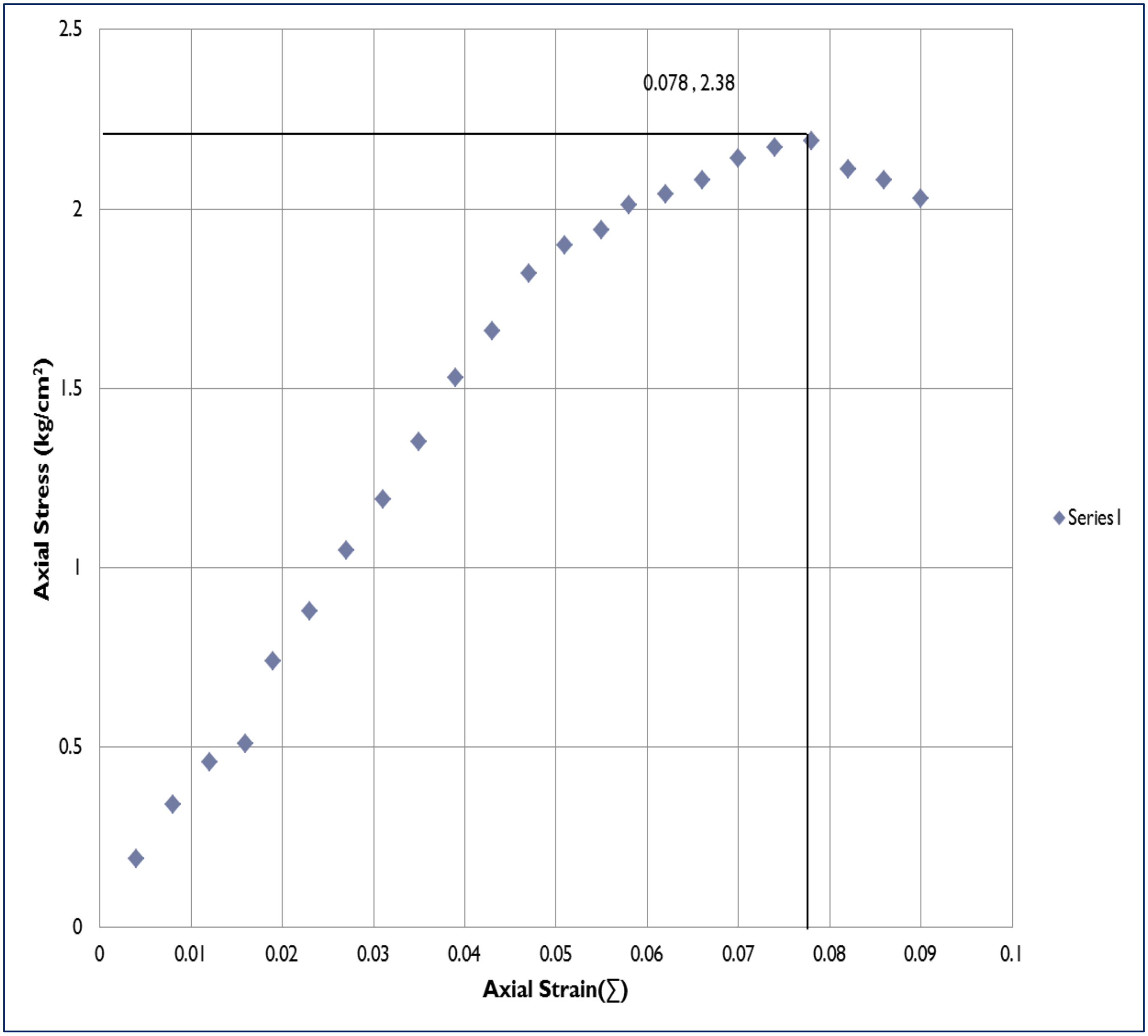


Unconfined Compressive Strength of soil was found to be **1.38 kg/cm^2**

5.6.4 On soil with woven geotextiles

- Woven Geotextile placed at 1/3rd, middle and 2/3rd of the length of sample.

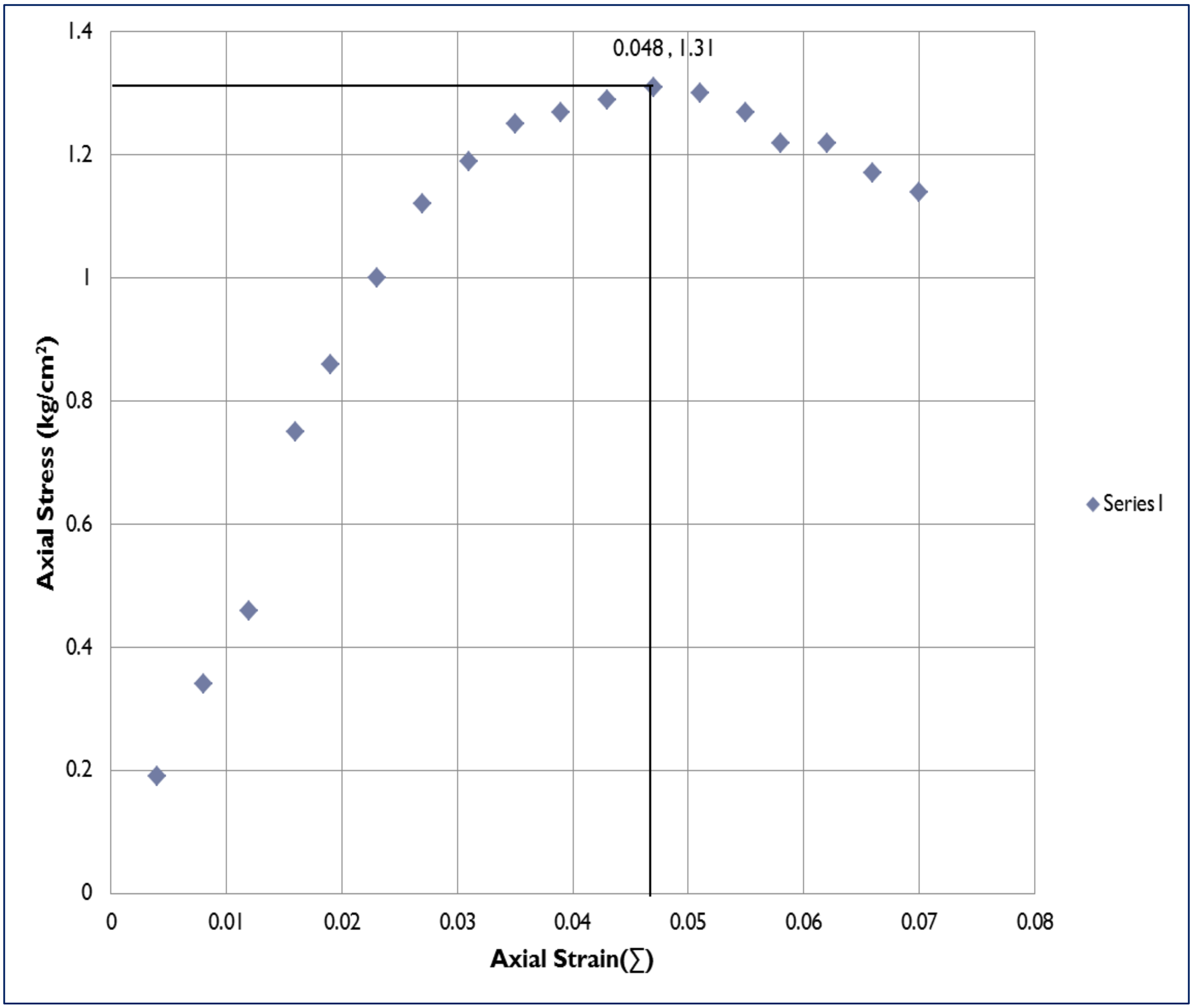
  (i.e at a distance of approximately 2.4 cm, 4.8 cm and 6.0 cm from the base of the sample.)



Unconfined Compressive Strength of soil was found to be **2.38 kg/cm^2**

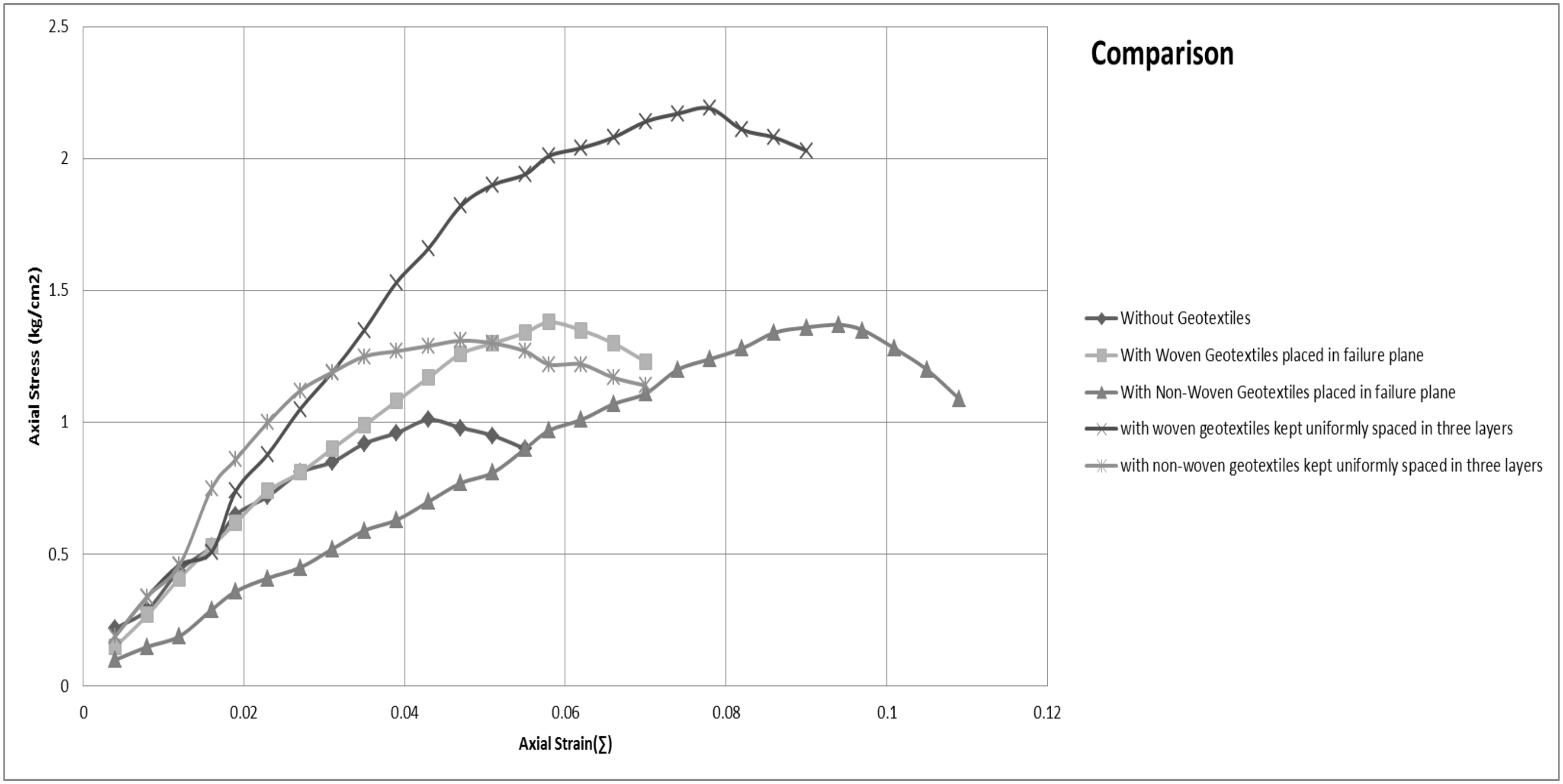
5.6.5 On soil with non-woven geotextiles

- Non-Woven Geotextile placed at 1/3rd, middle and 2/3rd of the length of sample. (i.e at a distance of approximately 2.4 cm, 4.8 cm and 6.0 cm from the base of the sample.)



Unconfined Compressive Strength of soil was found to be **1.31 kg/cm^2**

COMPARISION AND CONCLUSION



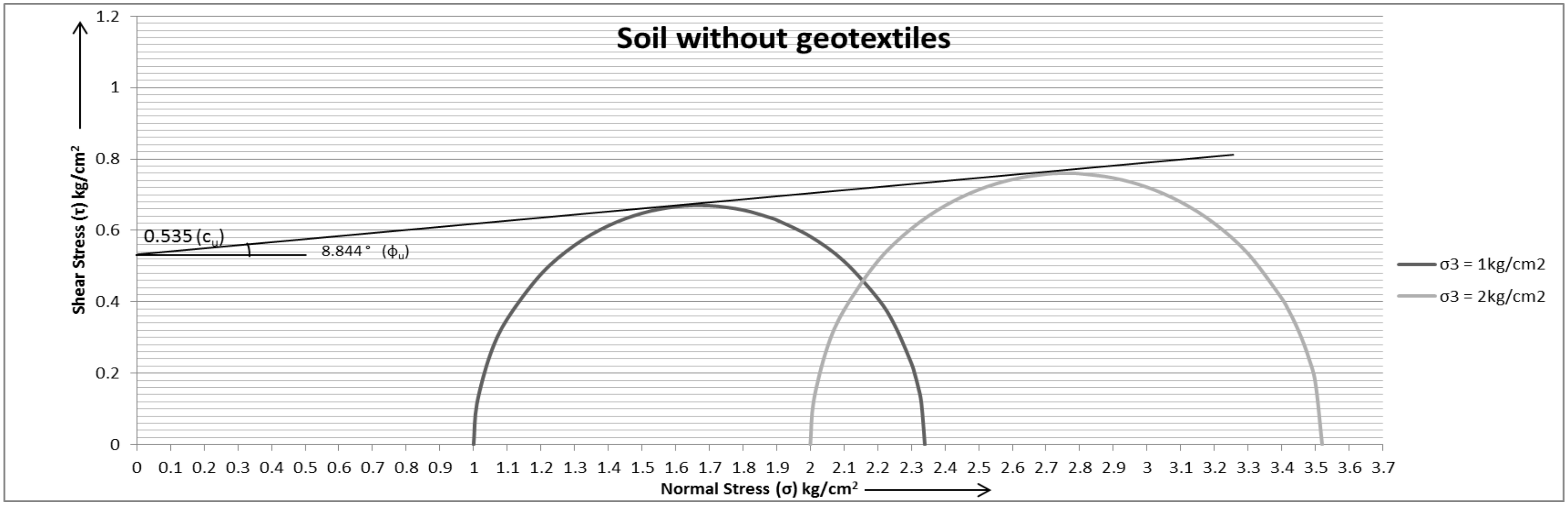
TEST TYPE	UNCONFINED COMPRESSIVE STRENGTH (kg/cm^2)	% INCREASE
Soil without geotextile	1.03	-
Soil with Woven Geotextile kept in between the failure plane	1.38	33.98%
Soil with Non-woven Geotextile kept in between the failure plane	1.38	33.98%
Soil with Woven Geotextile kept uniformly spaced in between the sample	2.38	131.06%
Soil with Non - Woven Geotextile kept uniformly spaced in between the sample	1.31	27.184%

Conclusion

- Unconfined Compressive Strength of soil increased by **33.98%** with the incorporation of geotextiles, both woven and non-woven, in the **failure plane** of sample tested without any geotextiles.
- Unconfined Compressive Strength of soil increased substantially by **131.06%** when woven geotextiles were **kept uniformly spaced in between the sample.**
- Unconfined Compressive Strength of soil increased by **27.184%** when non-woven geotextiles were **kept uniformly spaced in between the sample.**

5.7 Triaxial Test (Unconsolidated Undrained)

5.7.1 On Soil Without Geotextiles



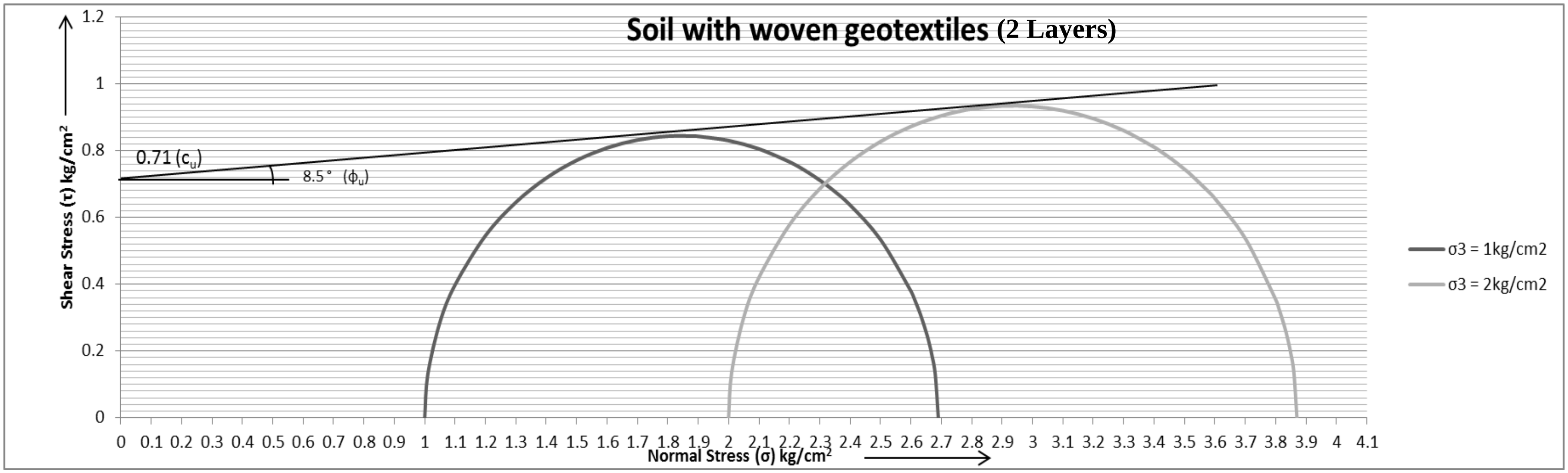
Cohesive strength of the soil (c_u) was found to be **0.535 kg/cm^2**

Unconfined compressive strength of soil **(q_u)** was found to be **1.07 kg/cm^2**

Angle of internal friction **(ϕ_u)** was found to be **8.844°**

5.7.2 On soil with woven geotextiles

2 layers of woven geotextiles placed uniformly at a distance of 2.5 cm and 5.0 cm, respectively, from the base of the sample.



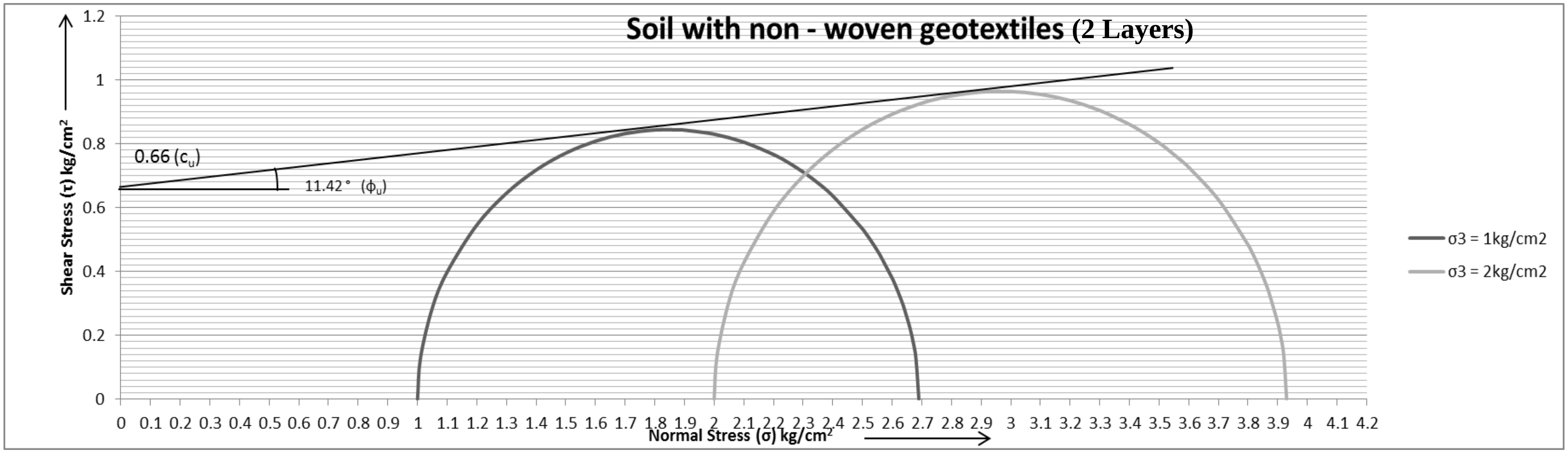
Cohesive strength of the soil (**c_u**) was found to be **0.71 kg/cm^2**

Unconfined compressive strength of soil **(q_u)** was found to be **1.42 kg/cm^2**

Angle of internal friction **(ϕ_u)** was found to be **8.5°**

5.7.3 On soil with non-woven geotextiles

2 layers of non-woven geotextiles placed uniformly at a distance of 2.5 cm and 5.0 cm, respectively, from the base of the sample.



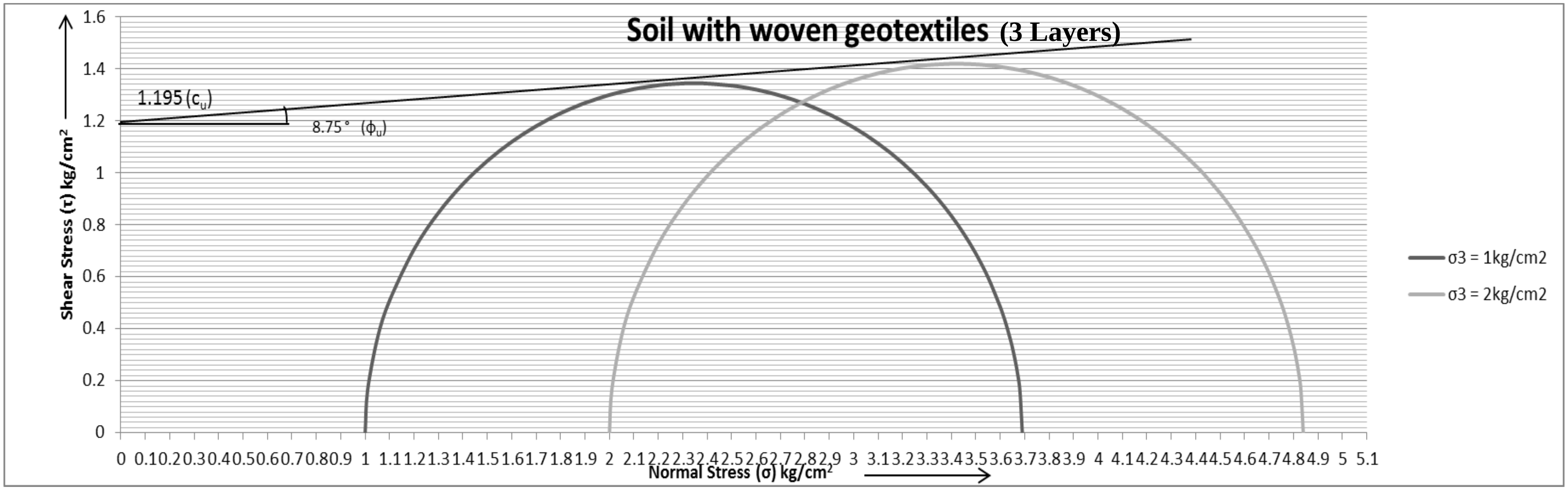
Cohesive strength of the soil (c_u) was found to be **0.66 kg/cm^2**

Unconfined compressive strength of soil **(q_u)** was found to be **1.32 kg/cm^2**

Angle of internal friction **(ϕ_u)** was found to be **11.42°**

5.7.4 On soil with woven geotextiles

3 layers of woven geotextiles placed uniformly at a distance of 1.9 cm, 3.8 cm and 5.7 cm, respectively, from the base of the sample.



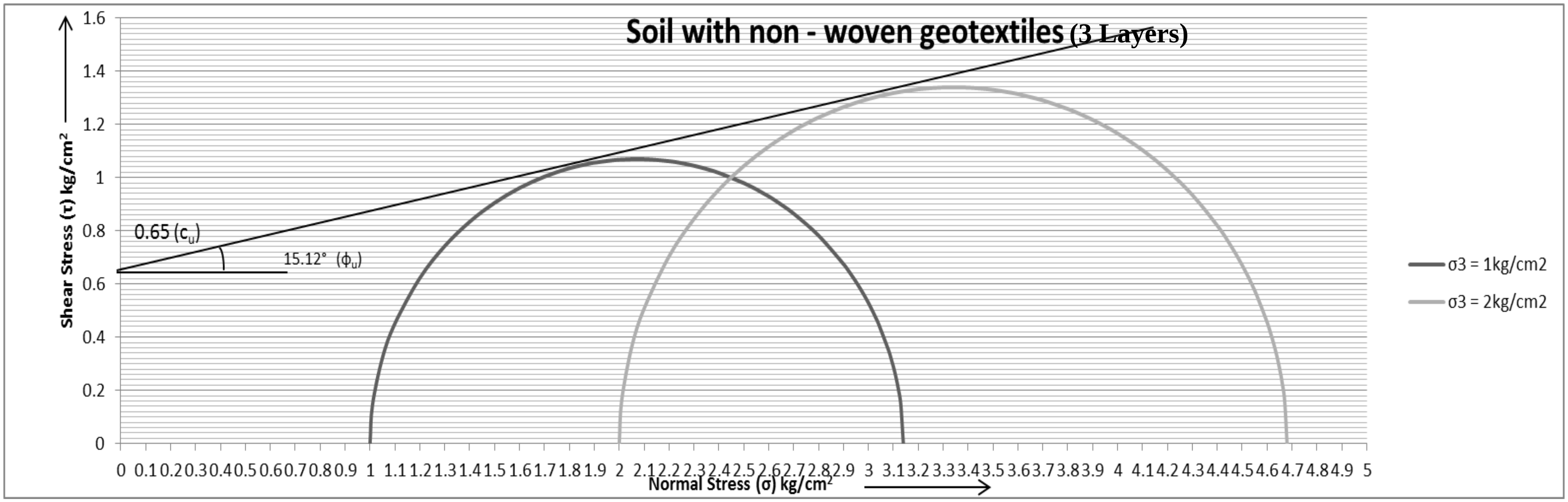
Cohesive strength of the soil (c_u) was found to be **1.195 kg/cm^2**

Unconfined compressive strength of soil **(q_u)** was found to be **2.39 kg/cm^2**

Angle of internal friction **(ϕ_u)** was found to be **8.75°**

5.7.5 On soil with woven geotextiles

3 layers of non-woven geotextiles placed uniformly at a distance of 1.9 cm, 3.8 cm and 5.7 cm, respectively, from the base of the sample.



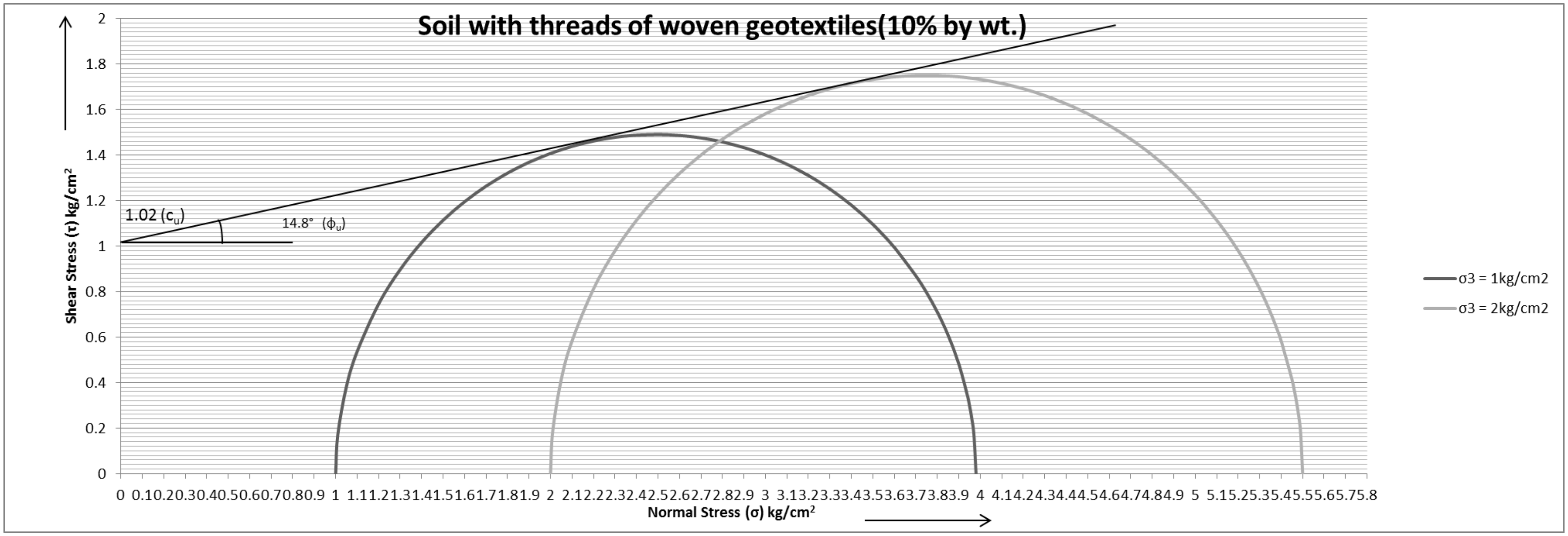
Cohesive strength of the soil (**c_u**) was found to be **0.65 kg/cm^2**

Unconfined compressive strength of soil **(q_u)** was found to be **1.30 kg/cm^2**

Angle of internal friction **(ϕ_u)** was found to be **15.12°**

5.7.6 On soil with geotextile thread

On soil sample with geotextile thread mixed in the soil , 10% by wt. of the soil.



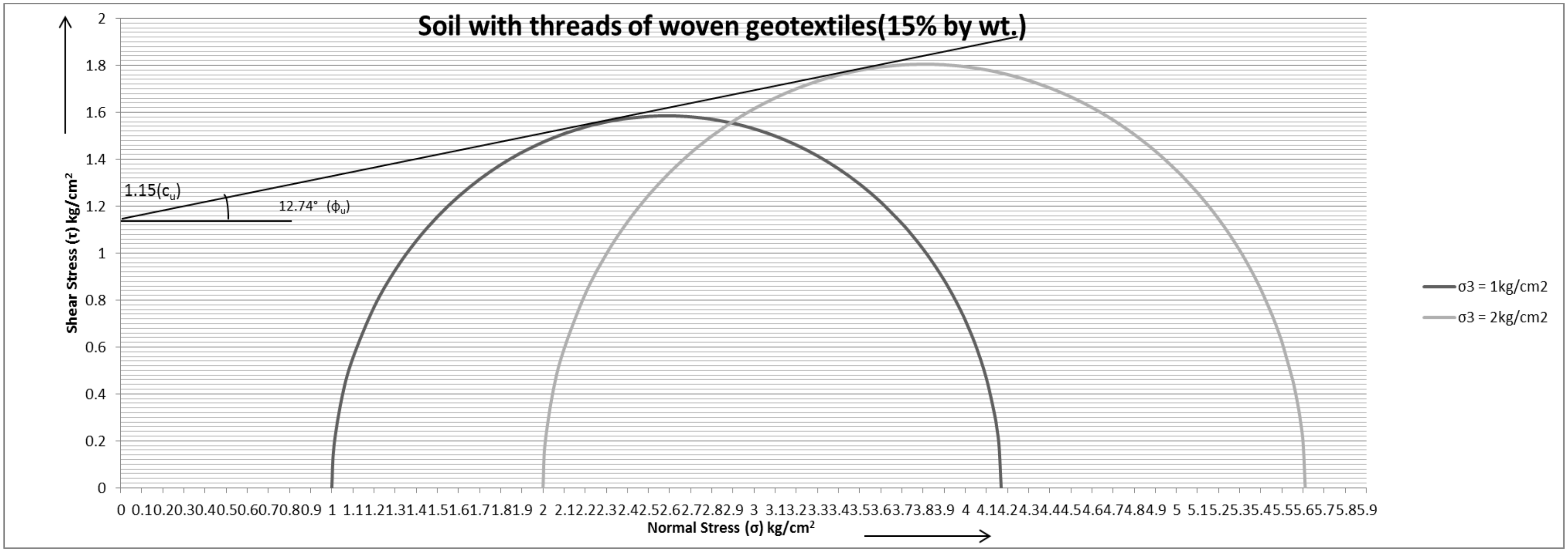
Cohesive strength of the soil (c_u) was found to be **1.02 kg/cm^2**

Unconfined compressive strength of soil **(q_u)** was found to be **2.04 kg/cm^2**

Angle of internal friction **(ϕ_u)** was found to be **14.8°**

5.7.7 On soil with geotextile thread

On soil sample with geotextile thread mixed in the soil , 15% by wt. of the soil.



Cohesive strength of the soil (**c_u**) was found to be **1.15 kg/cm^2**

Unconfined compressive strength of soil **(q_u)** was found to be **2.30 kg/cm^2**

Angle of internal friction **(ϕ_u)** was found to be **12.74°**

Arrangement	c_u (kg/cm^2)	q_u (kg/cm$_2$)	ϕ_u (Degrees)	% increase (c_u)	% increase (q_u)	% increase (ϕ_u)
Soil without geotextiles	0.535	1.07	8.844	-	-	-
Soil with woven geotextiles (2 layers)	0.71	1.42	8.5	32.70%	32.71%	-3.89%
Soil with non-woven geotextiles (2 layers)	0.66	1.32	11.42	23.36%	23.36%	29.13%
Soil with woven geotextiles (3 layers)	1.195	2.39	8.75	123.36%	123.36%	-1.06%
Soil with non-woven geotextiles (3 layers)	0.65	1.30	15.12	21.49%	21.49%	70.96%
Soil with geotextiles thread (10% by wt.)	1.02	2.04	14.8	90.65%	90.65%	67.34%
Soil with geotextiles thread (15% by wt.)	1.15	2.30	12.74	114.95%	114.95%	44.05%

* % increase w.r.t test results on soil without geotextiles.

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6. CONCLUSION

By analysis of the test results, it can be concluded that with the incorporation of geotextiles the bearing capacity of soil increased.

By placing non-woven geotextiles in 3 layers at an angle of 30° max. dry density of soil increased to 1.865 kN/m^3 accounting to 7.80% increase w.r.t max. dry density of soil tested without geotextiles. In case of Woven geotextiles kept at an angle of 30° max. dry density of soil increased about 1.15% with a value of 1.75 kN/m^3.

By placing 3 layers of non-woven geotextiles at an angle of 30° the dry density of the soil under consideration increased, which can be quite useful in soil stabilization.

The unconfined compressive strength of soil increased substantially by placing geotextile layers in between the soil samples, showing a sharp increase of approximately 125% accounting to 2.38 kg/cm^2 with the use of woven geotextiles in more than 2 layers. Non-woven geotextiles did not show a great influence on the unconfined compressive strength of soil when compared to woven geotextiles but use of non-woven geotextiles showed an increase in the angle of internal friction (ϕ_u) when placed in three layers of the soil with an increase of approximately 70% accounting to 15.12°

Considerable increase in the unconfined compressive strength of soil and angle of internal friction was observed when geotextile threads were mixed in the proportion of 10% and 15% by weight of the soil. The unconfined compressive strength increased to approximately 90% and 115% with a value of 2.04 kg/cm^2 and 2.30 kg/cm^2 respectively.

7. APPENDEX

7.1 Data Tables

7.1.1 Unconfined Compressive Strength Test

7.1.1.1 On soil sample without geotextiles

LOAD					
DIV	**P(Div * 0.263)**	**ΔL(mm)**	**∑= ΔL/L**	**$A_f = A_o /1-∑$ (cm²)**	**$σ = P_f/A_f$ (kg/cm²)**
9	2.367	0.3	0.004	10.79	0.22
12	3.156	0.6	0.008	10.84	0.29
18	4.734	0.9	0.012	10.88	0.44
22	5.786	1.2	0.016	10.92	0.53
27	7.101	1.5	0.019	10.96	0.65
30	7.89	1.8	0.023	11	0.72
34	8.942	2.1	0.027	11.05	0.81
36	9.468	2.4	0.031	11.09	0.85
39	10.257	2.7	0.035	11.14	0.92
41	10.783	3	0.039	11.19	0.96
43	11.309	3.3	0.043	11.23	1.01
42	11.046	3.6	0.047	11.28	0.98
41	10.783	3.9	0.051	11.33	0.95
39	10.257	4.2	0.055	11.38	0.9

7.1.1.2 On soil sample with woven geotextiles placed uniformly spaced in the failure plane of the sample tested without geotextiles.

LOAD					
DIV	**P(Div * 0.263)**	**ΔL(mm)**	**∑= ΔL/L**	**$A_f = A_o /1-∑$ (cm²)**	**$σ = P_f/A_f$ (kg/cm²)**
6	1.578	0.3	0.004	10.79	0.15
11	2.893	0.6	0.008	10.84	0.27
17	4.471	0.9	0.012	10.88	0.41
22	5.786	1.2	0.016	10.92	0.53
26	6.838	1.5	0.019	10.96	0.62
31	8.153	1.8	0.023	11	0.74
34	8.942	2.1	0.027	11.05	0.81
38	9.994	2.4	0.031	11.09	0.9
42	11.046	2.7	0.035	11.14	0.99
46	12.098	3	0.039	11.19	1.08
50	13.15	3.3	0.043	11.23	1.17
54	14.202	3.6	0.047	11.28	1.26
56	14.728	3.9	0.051	11.33	1.3
58	15.254	4.2	0.055	11.38	1.34
60	15.78	4.5	0.058	11.41	1.38
59	15.517	4.8	0.062	11.46	1.35
57	14.991	5.1	0.066	11.51	1.3
54	14.202	5.4	0.07	11.56	1.23

7.1.1.3 On soil sample with non-woven geotextiles placed uniformly spaced in the failure plane of the sample tested without geotextiles

LOAD					
DIV	P(Div * 0.263)	ΔL(mm)	∑= ΔL/L	$A_f = A_o / 1-\sum$ (cm^2)	$\sigma = P_f/A_f$ (kg/cm^2)
4	1.052	0.3	0.004	10.79	0.1
6	1.578	0.6	0.008	10.84	0.15
8	2.104	0.9	0.012	10.88	0.19
12	3.156	1.2	0.016	10.92	0.29
15	3.945	1.5	0.019	10.96	0.36
17	4.471	1.8	0.023	11	0.41
19	4.997	2.1	0.027	11.05	0.45
22	5.786	2.4	0.031	11.09	0.52
25	6.575	2.7	0.035	11.14	0.59
27	7.101	3	0.039	11.19	0.63
30	7.89	3.3	0.043	11.23	0.7
33	8.679	3.6	0.047	11.28	0.77
35	9.205	3.9	0.051	11.33	0.81
39	10.257	4.2	0.055	11.38	0.9
42	11.046	4.5	0.058	11.41	0.97
44	11.572	4.8	0.062	11.46	1.01
47	12.361	5.1	0.066	11.51	1.07
49	12.887	5.4	0.07	11.56	1.11
53	13.939	5.7	0.074	11.61	1.2
55	14.465	6	0.078	11.66	1.24
57	14.991	6.3	0.082	11.71	1.28
60	15.78	6.6	0.086	11.76	1.34
61	16.043	6.9	0.09	11.81	1.36
62	16.306	7.2	0.094	11.87	1.37
61	16.043	7.5	0.097	11.9	1.35
58	15.254	7.8	0.101	11.96	1.28
55	14.465	8.1	0.105	12.01	1.2
50	13.15	8.4	0.109	12.07	1.09

7.1.1.4 On soil sample with woven geotextiles placed uniformly spaced in between the sample.

LOAD					
DIV	P(Div * 0.263)	ΔL(mm)	∑= ΔL/L	$A_f = A_o/1-\sum$ (cm^2)	$\sigma = P_f/A_f$ (kg/cm^2)
8	2.104	0.3	0.004	10.79	0.19
14	3.682	0.6	0.008	10.84	0.34
19	4.997	0.9	0.012	10.88	0.46
21	5.523	1.2	0.016	10.92	0.51
31	8.153	1.5	0.019	10.96	0.74
37	9.731	1.8	0.023	11	0.88
44	11.572	2.1	0.027	11.05	1.05
50	13.15	2.4	0.031	11.09	1.19
57	14.991	2.7	0.035	11.14	1.35
65	17.095	3	0.039	11.19	1.53
71	18.673	3.3	0.043	11.23	1.66
78	20.514	3.6	0.047	11.28	1.82
82	21.566	3.9	0.051	11.33	1.9
84	22.092	4.2	0.055	11.38	1.94
87	22.881	4.5	0.058	11.41	2.01
89	23.407	4.8	0.062	11.46	2.04
91	23.933	5.1	0.066	11.51	2.08
94	24.722	5.4	0.07	11.56	2.14
96	25.248	5.7	0.074	11.61	2.17
97	25.511	6	0.078	11.66	2.19
94	24.722	6.3	0.082	11.71	2.11
93	24.459	6.6	0.086	11.76	2.08
91	23.933	6.9	0.09	11.81	2.03

7.1.1.5 On soil sample with woven geotextiles placed uniformly spaced in between the sample.

LOAD					
DIV	P(Div * 0.263)	ΔL(mm)	∑= ΔL/L	$A_f = A_o/1-\sum$ (cm^2)	$\sigma = P_f/A_f$ (kg/cm^2)
8	2.104	0.3	0.004	10.79	0.19
14	3.682	0.6	0.008	10.84	0.34
19	4.997	0.9	0.012	10.88	0.46
31	8.153	1.2	0.016	10.92	0.75
36	9.468	1.5	0.019	10.96	0.86
42	11.046	1.8	0.023	11	1
47	12.361	2.1	0.027	11.05	1.12
50	13.15	2.4	0.031	11.09	1.19
53	13.939	2.7	0.035	11.14	1.25
54	14.202	3	0.039	11.19	1.27
55	14.465	3.3	0.043	11.23	1.29
56	14.728	3.6	0.047	11.28	1.31
56	14.728	3.9	0.051	11.33	1.3
55	14.465	4.2	0.055	11.38	1.27
53	13.939	4.5	0.058	11.41	1.22
53	13.939	4.8	0.062	11.46	1.22
51	13.413	5.1	0.066	11.51	1.17
50	13.15	5.4	0.07	11.56	1.14

7.1.2 Triaxial Test (UU)

7.1.2.1 On soil sample without geotextiles

- Sample 1 (σ_3 = 1kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain $\sum = \Delta L/L$	Corrected Area $A_f = A_o/1-\sum$ (cm^2)	Vertical Stress $\sigma_1 = P_f/A_f$ (kg/cm^2)
DIV	P(Div * 0.263)				
18	4.734	0.3	0.004	11.38	0.42
31	8.153	0.6	0.008	11.43	0.71
43	11.309	0.9	0.012	11.48	0.99
51	13.413	1.2	0.016	11.52	1.16
60	15.78	1.5	0.020	11.57	1.36
76	19.988	1.8	0.024	11.62	1.72
83	21.829	2.1	0.028	11.66	1.87
87	22.881	2.4	0.032	11.71	1.95
90	23.67	2.7	0.036	11.76	2.01
92	24.196	3	0.039	11.81	2.05
94	24.722	3.3	0.043	11.85	2.09
96	25.248	3.6	0.047	11.90	2.12
99	26.037	3.9	0.051	11.95	2.18
103	27.089	4.2	0.055	12.00	2.26
107	28.141	4.5	0.059	12.05	2.33
110	28.93	4.8	0.063	12.10	2.39
114	29.982	5.1	0.067	12.16	2.47
119	31.297	5.4	0.071	12.21	2.56
123	32.349	5.7	0.075	12.26	2.64
126	33.138	6	0.079	12.31	2.69
124	32.612	6.3	0.083	12.36	2.64
122	32.086	6.6	0.087	12.42	2.58

- Sample 2 (σ_3 = 2kg/cm^2)

LOAD		Compression	Vertical Strain	Corrected Area	Vertical Stress
DIV	**P(Div * 0.263)**	**ΔL(mm)**	**$\sum = \Delta L/L$**	**$A_f = A_o/1-\sum$ (cm^2)**	**$\sigma_1 = P_f/A_f$ (kg/cm^2)**
16	4.208	0.3	0.004	11.38	0.37
38	9.994	0.6	0.008	11.43	0.87
55	14.465	0.9	0.012	11.48	1.26
68	17.884	1.2	0.016	11.52	1.55
78	20.514	1.5	0.020	11.57	1.77
87	22.881	1.8	0.024	11.62	1.97
96	25.248	2.1	0.028	11.66	2.16
103	27.089	2.4	0.032	11.71	2.31
108	28.404	2.7	0.036	11.76	2.42
112	29.456	3	0.039	11.81	2.49
116	30.508	3.3	0.043	11.85	2.57
120	31.56	3.6	0.047	11.90	2.65
124	32.612	3.9	0.051	11.95	2.73
128	33.664	4.2	0.055	12.00	2.80
132	34.716	4.5	0.059	12.05	2.88
135	35.505	4.8	0.063	12.10	2.93
138	36.294	5.1	0.067	12.16	2.99
140	36.82	5.4	0.071	12.21	3.02
142	37.346	5.7	0.075	12.26	3.05
144	37.872	6	0.079	12.31	3.08
145	38.135	6.3	0.083	12.36	3.08
146	38.398	6.6	0.087	12.42	3.09
149	39.187	6.9	0.091	12.47	3.14
152	39.976	7.2	0.095	12.53	3.19
154	40.502	7.5	0.099	12.58	3.22
157	41.291	7.8	0.103	12.64	3.27
159	41.817	8.1	0.107	12.69	3.29
162	42.606	8.4	0.111	12.75	3.34
164	43.132	8.7	0.114	12.81	3.37
164	43.132	9	0.118	12.86	3.35
165	43.395	9.3	0.122	12.92	3.36
165	43.395	9.6	0.126	12.98	3.34
166	43.658	9.9	0.130	13.04	3.35
168	44.184	10.2	0.134	13.10	3.37
171	44.973	10.5	0.138	13.16	3.42
174	45.762	10.8	0.142	13.22	3.46
176	46.288	11.1	0.146	13.28	3.49
178	46.814	11.4	0.150	13.34	3.51
179	47.077	11.7	0.154	13.40	3.51
180	47.34	12	0.158	13.47	3.52
181	47.603	12.3	0.162	13.53	3.52
180	47.34	12.6	0.166	13.59	3.48
178	46.814	12.9	0.170	13.66	3.43

7.1.2.2 On soil sample with woven geotextiles placed uniformly spaced in 2 layers

- Sample 1 (σ_3 = 1kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain ∑= ΔL/L	Corrected Area $A_f = A_o /1-\sum$ (cm^2)	Vertical Stress σ_1 $=P_f/A_f$ (kg/cm^2)
DIV	P(Div * 0.263)				
18	4.734	0.3	0.004	11.38	0.42
31	8.153	0.6	0.008	11.43	0.71
43	11.309	0.9	0.012	11.48	0.99
51	13.413	1.2	0.016	11.52	1.16
60	15.78	1.5	0.020	11.57	1.36
76	19.988	1.8	0.024	11.62	1.72
83	21.829	2.1	0.028	11.66	1.87
87	22.881	2.4	0.032	11.71	1.95
90	23.67	2.7	0.036	11.76	2.01
92	24.196	3	0.039	11.81	2.05
94	24.722	3.3	0.043	11.85	2.09
96	25.248	3.6	0.047	11.90	2.12
99	26.037	3.9	0.051	11.95	2.18
103	27.089	4.2	0.055	12.00	2.26
107	28.141	4.5	0.059	12.05	2.33
110	28.93	4.8	0.063	12.10	2.39
114	29.982	5.1	0.067	12.16	2.47
119	31.297	5.4	0.071	12.21	2.56
123	32.349	5.7	0.075	12.26	2.64
126	33.138	6	0.079	12.31	2.69
124	32.612	6.3	0.083	12.36	2.64
122	32.086	6.6	0.087	12.42	2.58

- Sample 2 (σ_3 = 2kg/cm^2)

LOAD		Compression	Vertical Strain	Corrected Area	Vertical Stress σ_1
DIV	**P(Div * 0.263)**	**ΔL(mm)**	**$\sum = \Delta L/L$**	**$A_f = A_o / 1-\sum$ (cm^2)**	**$=P_f/A_f$ (kg/cm^2)**
16	4.208	0.3	0.004	11.38	0.37
32	8.416	0.6	0.008	11.43	0.74
48	12.624	0.9	0.012	11.48	1.10
56	14.728	1.2	0.016	11.52	1.28
64	16.832	1.5	0.020	11.57	1.46
76	19.988	1.8	0.024	11.62	1.72
83	21.829	2.1	0.028	11.66	1.87
88	23.144	2.4	0.032	11.71	1.98
93	24.459	2.7	0.036	11.76	2.08
97	25.511	3	0.039	11.81	2.16
101	26.563	3.3	0.043	11.85	2.24
105	27.615	3.6	0.047	11.90	2.32
109	28.667	3.9	0.051	11.95	2.40
113	29.719	4.2	0.055	12.00	2.48
118	31.034	4.5	0.059	12.05	2.57
122	32.086	4.8	0.063	12.10	2.65
126	33.138	5.1	0.067	12.16	2.73
128	33.664	5.4	0.071	12.21	2.76
130	34.19	5.7	0.075	12.26	2.79
133	34.979	6	0.079	12.31	2.84
134	35.242	6.3	0.083	12.36	2.85
137	36.031	6.6	0.087	12.42	2.90
141	37.083	6.9	0.091	12.47	2.97
145	38.135	7.2	0.095	12.53	3.04
148	38.924	7.5	0.099	12.58	3.09
151	39.713	7.8	0.103	12.64	3.14
154	40.502	8.1	0.107	12.69	3.19
157	41.291	8.4	0.111	12.75	3.24
160	42.08	8.7	0.114	12.81	3.29
164	43.132	9	0.118	12.86	3.35
168	44.184	9.3	0.122	12.92	3.42
172	45.236	9.6	0.126	12.98	3.49
175	46.025	9.9	0.130	13.04	3.53
178	46.814	10.2	0.134	13.10	3.57
181	47.603	10.5	0.138	13.16	3.62
185	48.655	10.8	0.142	13.22	3.68
188	49.444	11.1	0.146	13.28	3.72
191	50.233	11.4	0.150	13.34	3.77
195	51.285	11.7	0.154	13.40	3.83
198	52.074	12	0.158	13.47	3.87
195	51.285	12.3	0.162	13.53	3.79
194	51.022	12.6	0.166	13.59	3.75
193	50.759	12.9	0.170	13.66	3.72

7.1.2.3 On soil sample with non-woven geotextiles placed uniformly spaced in 2 layers

- Sample 1 (σ_3 = 1kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain $\sum = \Delta L/L$	Corrected Area $A_f = A_o / 1-\sum$ (cm^2)	Vertical Stress $\sigma_1 = P_f/A_f$ (kg/cm^2)
DIV	P(Div * 0.263)				
18	4.734	0.3	0.004	11.38	0.42
31	8.153	0.6	0.008	11.43	0.71
43	11.309	0.9	0.012	11.48	0.99
50	13.15	1.2	0.016	11.52	1.14
59	15.517	1.5	0.020	11.57	1.34
70	18.41	1.8	0.024	11.62	1.59
79	20.777	2.1	0.028	11.66	1.78
87	22.881	2.4	0.032	11.71	1.95
92	24.196	2.7	0.036	11.76	2.06
93	24.459	3	0.039	11.81	2.07
94	24.722	3.3	0.043	11.85	2.09
96	25.248	3.6	0.047	11.90	2.12
99	26.037	3.9	0.051	11.95	2.18
102	26.826	4.2	0.055	12.00	2.23
106	27.878	4.5	0.059	12.05	2.31
108	28.404	4.8	0.063	12.10	2.35
112	29.456	5.1	0.067	12.16	2.42
116	30.508	5.4	0.071	12.21	2.50
120	31.56	5.7	0.075	12.26	2.57
123	32.349	6	0.079	12.31	2.63
125	32.875	6.3	0.083	12.36	2.66
126	33.138	6.6	0.087	12.42	2.67
127	33.401	6.9	0.091	12.47	2.68
128	33.664	7.2	0.095	12.53	2.69
126	33.138	7.5	0.099	12.58	2.63
124	32.612	7.8	0.103	12.64	2.58

- Sample 2 (σ_3 = 2kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain ∑= ΔL/L	Corrected Area $A_f = A_o /1-\sum$ (cm^2)	Vertical Stress σ_1 $=P_f/A_f$ (kg/cm^2)
DIV	P(Div * 0.263)				
16	4.208	0.3	0.004	11.38	0.37
32	8.416	0.6	0.008	11.43	0.74
49	12.887	0.9	0.012	11.48	1.12
55	14.465	1.2	0.016	11.52	1.26
68	17.884	1.5	0.020	11.57	1.55
79	20.777	1.8	0.024	11.62	1.79
85	22.355	2.1	0.028	11.66	1.92
88	23.144	2.4	0.032	11.71	1.98
93	24.459	2.7	0.036	11.76	2.08
97	25.511	3	0.039	11.81	2.16
101	26.563	3.3	0.043	11.85	2.24
105	27.615	3.6	0.047	11.90	2.32
111	29.193	3.9	0.051	11.95	2.44
113	29.719	4.2	0.055	12.00	2.48
120	31.56	4.5	0.059	12.05	2.62
123	32.349	4.8	0.063	12.10	2.67
127	33.401	5.1	0.067	12.16	2.75
128	33.664	5.4	0.071	12.21	2.76
130	34.19	5.7	0.075	12.26	2.79
133	34.979	6	0.079	12.31	2.84
134	35.242	6.3	0.083	12.36	2.85
135	35.505	6.6	0.087	12.42	2.86
139	36.557	6.9	0.091	12.47	2.93
143	37.609	7.2	0.095	12.53	3.00
145	38.135	7.5	0.099	12.58	3.03
148	38.924	7.8	0.103	12.64	3.08
150	39.45	8.1	0.107	12.69	3.11
154	40.502	8.4	0.111	12.75	3.18
160	42.08	8.7	0.114	12.81	3.29
164	43.132	9	0.118	12.86	3.35
168	44.184	9.3	0.122	12.92	3.42
172	45.236	9.6	0.126	12.98	3.49
175	46.025	9.9	0.130	13.04	3.53
179	47.077	10.2	0.134	13.10	3.59
183	48.129	10.5	0.138	13.16	3.66
186	48.918	10.8	0.142	13.22	3.70
189	49.707	11.1	0.146	13.28	3.74
192	50.496	11.4	0.150	13.34	3.78
195	51.285	11.7	0.154	13.40	3.83
199	52.337	12	0.158	13.47	3.89
202	53.126	12.3	0.162	13.53	3.93
200	52.6	12.6	0.166	13.59	3.87
197	51.811	12.9	0.170	13.66	3.79

7.1.2.4 On soil sample with woven geotextiles placed uniformly spaced in 3 layers

- Sample 1 (σ_3 = 1kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain ∑= ΔL/L	Corrected Area $A_f = A_o/1-\sum$ (cm^2)	Vertical Stress σ_1 $=P_f/A_f$ (kg/cm^2)
DIV	P(Div * 0.263)				
15	3.945	0.3	0.004	11.38	0.35
28	7.364	0.6	0.008	11.43	0.64
40	10.52	0.9	0.012	11.48	0.92
50	13.15	1.2	0.016	11.52	1.14
59	15.517	1.5	0.020	11.57	1.34
71	18.673	1.8	0.024	11.62	1.61
79	20.777	2.1	0.028	11.66	1.78
86	22.618	2.4	0.032	11.71	1.93
92	24.196	2.7	0.036	11.76	2.06
94	24.722	3	0.039	11.81	2.09
96	25.248	3.3	0.043	11.85	2.13
98	25.774	3.6	0.047	11.90	2.17
101	26.563	3.9	0.051	11.95	2.22
102	26.826	4.2	0.055	12.00	2.23
105	27.615	4.5	0.059	12.05	2.29
108	28.404	4.8	0.063	12.10	2.35
112	29.456	5.1	0.067	12.16	2.42
115	30.245	5.4	0.071	12.21	2.48
119	31.297	5.7	0.075	12.26	2.55
122	32.086	6	0.079	12.31	2.61
124	32.612	6.3	0.083	12.36	2.64
126	33.138	6.6	0.087	12.42	2.67
129	33.927	6.9	0.091	12.47	2.72
131	34.453	7.2	0.095	12.53	2.75
133	34.979	7.5	0.099	12.58	2.78
134	35.242	7.8	0.103	12.64	2.79
137	36.031	8.1	0.107	12.69	2.84
140	36.82	8.4	0.111	12.75	2.89
143	37.609	8.7	0.114	12.81	2.94
147	38.661	9	0.118	12.86	3.01
150	39.45	9.3	0.122	12.92	3.05
153	40.239	9.6	0.126	12.98	3.10
156	41.028	9.9	0.130	13.04	3.15
160	42.08	10.2	0.134	13.10	3.21
164	43.132	10.5	0.138	13.16	3.28
168	44.184	10.8	0.142	13.22	3.34
172	45.236	11.1	0.146	13.28	3.41
174	45.762	11.4	0.150	13.34	3.43
176	46.288	11.7	0.154	13.40	3.45
178	46.814	12	0.158	13.47	3.48
180	47.34	12.3	0.162	13.53	3.50
182	47.866	12.6	0.166	13.59	3.52
184	48.392	12.9	0.170	13.66	3.54

186	48.918	13.2	0.174	13.72	3.56
188	49.444	13.5	0.178	13.79	3.59
190	49.97	13.8	0.182	13.86	3.61
192	50.496	14.1	0.186	13.92	3.63
194	51.022	14.4	0.189	13.99	3.65
196	51.548	14.7	0.193	14.06	3.67
198	52.074	15	0.197	14.13	3.69
199	52.337	15.3	0.201	14.20	3.69
200	52.6	15.6	0.205	14.27	3.69
198	52.074	15.9	0.209	14.34	3.63
195	51.285	16.2	0.213	14.41	3.56

- Sample 2 (σ_3 = 2kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain $\sum = \Delta L/L$	Corrected Area $A_f = A_o/1-\sum$ (cm^2)	Vertical Stress σ_1 $=P_f/A_f$ (kg/cm^2)
DIV	P(Div * 0.263)				
18	4.734	0.3	0.004	11.38	0.42
29	7.627	0.6	0.008	11.43	0.67
47	12.361	0.9	0.012	11.48	1.08
55	14.465	1.2	0.016	11.52	1.26
68	17.884	1.5	0.020	11.57	1.55
78	20.514	1.8	0.024	11.62	1.77
85	22.355	2.1	0.028	11.66	1.92
88	23.144	2.4	0.032	11.71	1.98
93	24.459	2.7	0.036	11.76	2.08
97	25.511	3	0.039	11.81	2.16
101	26.563	3.3	0.043	11.85	2.24
104	27.352	3.6	0.047	11.90	2.30
108	28.404	3.9	0.051	11.95	2.38
112	29.456	4.2	0.055	12.00	2.45
117	30.771	4.5	0.059	12.05	2.55
122	32.086	4.8	0.063	12.10	2.65
127	33.401	5.1	0.067	12.16	2.75
131	34.453	5.4	0.071	12.21	2.82
134	35.242	5.7	0.075	12.26	2.87
138	36.294	6	0.079	12.31	2.95
142	37.346	6.3	0.083	12.36	3.02
146	38.398	6.6	0.087	12.42	3.09
154	40.502	6.9	0.091	12.47	3.25
156	41.028	7.2	0.095	12.53	3.28
158	41.554	7.5	0.099	12.58	3.30
161	42.343	7.8	0.103	12.64	3.35
164	43.132	8.1	0.107	12.69	3.40
166	43.658	8.4	0.111	12.75	3.42
169	44.447	8.7	0.114	12.81	3.47
172	45.236	9	0.118	12.86	3.52
175	46.025	9.3	0.122	12.92	3.56
178	46.814	9.6	0.126	12.98	3.61
181	47.603	9.9	0.130	13.04	3.65
184	48.392	10.2	0.134	13.10	3.69
188	49.444	10.5	0.138	13.16	3.76
192	50.496	10.8	0.142	13.22	3.82
195	51.285	11.1	0.146	13.28	3.86
196	51.548	11.4	0.150	13.34	3.86
199	52.337	11.7	0.154	13.40	3.90
199	52.337	12	0.158	13.47	3.89
202	53.126	12.3	0.162	13.53	3.93
205	53.915	12.6	0.166	13.59	3.97
208	54.704	12.9	0.170	13.66	4.01

211	55.493	13.2	0.174	13.72	4.04
212	55.756	13.5	0.178	13.79	4.04
214	56.282	13.8	0.182	13.86	4.06
216	56.808	14.1	0.186	13.92	4.08
219	57.597	14.4	0.189	13.99	4.12
222	58.386	14.7	0.193	14.06	4.15
224	58.912	15	0.197	14.13	4.17
226	59.438	15.3	0.201	14.20	4.19
227	59.701	15.6	0.205	14.27	4.18
229	60.227	15.9	0.209	14.34	4.20
231	60.753	16.2	0.213	14.41	4.22
232	61.016	16.5	0.217	14.48	4.21
234	61.542	16.8	0.221	14.56	4.23
236	62.068	17.1	0.225	14.63	4.24
238	62.594	17.4	0.229	14.71	4.26
240	63.12	17.7	0.233	14.78	4.27
242	63.646	18	0.237	14.86	4.28
244	64.172	18.3	0.241	14.94	4.30
245	64.435	18.6	0.245	15.01	4.29
246	64.698	18.9	0.249	15.09	4.29
248	65.224	19.2	0.253	15.17	4.30
250	65.75	19.5	0.257	15.25	4.31
252	66.276	19.8	0.261	15.34	4.32
254	66.802	20.1	0.264	15.42	4.33
256	67.328	20.4	0.268	15.50	4.34
257	67.591	20.7	0.272	15.58	4.34
260	68.38	21	0.276	15.67	4.36
263	69.169	21.3	0.280	15.76	4.39
266	69.958	21.6	0.284	15.84	4.42
268	70.484	21.9	0.288	15.93	4.42
270	71.01	22.2	0.292	16.02	4.43
273	71.799	22.5	0.296	16.11	4.46
276	72.588	22.8	0.300	16.20	4.48
279	73.377	23.1	0.304	16.29	4.50
283	74.429	23.4	0.308	16.38	4.54
287	75.481	23.7	0.312	16.48	4.58
290	76.27	24	0.316	16.57	4.60
293	77.059	24.3	0.320	16.67	4.62
296	77.848	24.6	0.324	16.77	4.64
299	78.637	24.9	0.328	16.87	4.66
302	79.426	25.2	0.332	16.97	4.68
304	79.952	25.5	0.336	17.07	4.68
307	80.741	25.8	0.339	17.17	4.70
310	81.53	26.1	0.343	17.27	4.72
313	82.319	26.4	0.347	17.38	4.74
317	83.371	26.7	0.351	17.48	4.77
320	84.16	27	0.355	17.59	4.78
323	84.949	27.3	0.359	17.70	4.80
325	85.475	27.6	0.363	17.81	4.80
328	86.264	27.9	0.367	17.92	4.81

331	87.053	28.2	0.371	18.03	4.83
334	87.842	28.5	0.375	18.14	4.84
332	87.316	28.8	0.379	18.26	4.78
329	86.527	29.1	0.383	18.38	4.71

7.1.2.5 On soil sample with non- woven geotextiles placed uniformly spaced in 3 layers

- Sample 1 (σ_3 = 1kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain $\sum = \Delta L/L$	Corrected Area $A_f = A_o/1-\sum$ (cm^2)	Vertical Stress σ_1 $=P_f/A_f$ (kg/cm^2)
DIV	P(Div * 0.263)				
16	4.208	0.3	0.004	11.38	0.37
28	7.364	0.6	0.008	11.43	0.64
39	10.257	0.9	0.012	11.48	0.89
50	13.15	1.2	0.016	11.52	1.14
59	15.517	1.5	0.020	11.57	1.34
71	18.673	1.8	0.024	11.62	1.61
78	20.514	2.1	0.028	11.66	1.76
86	22.618	2.4	0.032	11.71	1.93
91	23.933	2.7	0.036	11.76	2.04
94	24.722	3	0.039	11.81	2.09
96	25.248	3.3	0.043	11.85	2.13
98	25.774	3.6	0.047	11.90	2.17
102	26.826	3.9	0.051	11.95	2.24
104	27.352	4.2	0.055	12.00	2.28
105	27.615	4.5	0.059	12.05	2.29
107	28.141	4.8	0.063	12.10	2.32
110	28.93	5.1	0.067	12.16	2.38
112	29.456	5.4	0.071	12.21	2.41
115	30.245	5.7	0.075	12.26	2.47
117	30.771	6	0.079	12.31	2.50
119	31.297	6.3	0.083	12.36	2.53
121	31.823	6.6	0.087	12.42	2.56
122	32.086	6.9	0.091	12.47	2.57
123	32.349	7.2	0.095	12.53	2.58
125	32.875	7.5	0.099	12.58	2.61
127	33.401	7.8	0.103	12.64	2.64
130	34.19	8.1	0.107	12.69	2.69
133	34.979	8.4	0.111	12.75	2.74
136	35.768	8.7	0.114	12.81	2.79
138	36.294	9	0.118	12.86	2.82
140	36.82	9.3	0.122	12.92	2.85
142	37.346	9.6	0.126	12.98	2.88
144	37.872	9.9	0.130	13.04	2.90
145	38.135	10.2	0.134	13.10	2.91
146	38.398	10.5	0.138	13.16	2.92
147	38.661	10.8	0.142	13.22	2.92
148	38.924	11.1	0.146	13.28	2.93
149	39.187	11.4	0.150	13.34	2.94

150	39.45	11.7	0.154	13.40	2.94
151	39.713	12	0.158	13.47	2.95
152	39.976	12.3	0.162	13.53	2.95
154	40.502	12.6	0.166	13.59	2.98
157	41.291	12.9	0.170	13.66	3.02
159	41.817	13.2	0.174	13.72	3.05
162	42.606	13.5	0.178	13.79	3.09
165	43.395	13.8	0.182	13.86	3.13
166	43.658	14.1	0.186	13.92	3.14
164	43.132	14.4	0.189	13.99	3.08
161	42.343	14.7	0.193	14.06	3.01

- Sample 2 ($\sigma_3 = 2kg/cm^2$)

LOAD		**Compression** $\Delta L(mm)$	**Vertical Strain** $\sum = \Delta L/L$	**Corrected Area** $A_f = A_o/1-\sum$ (cm^2)	**Vertical Stress** $\sigma_1 = P_f/A_f$ (kg/cm^2)
DIV	**P(Div * 0.263)**				
17	4.471	0.3	0.004	11.38	0.39
26	6.838	0.6	0.008	11.43	0.60
45	11.835	0.9	0.012	11.48	1.03
55	14.465	1.2	0.016	11.52	1.26
68	17.884	1.5	0.020	11.57	1.55
78	20.514	1.8	0.024	11.62	1.77
84	22.092	2.1	0.028	11.66	1.89
88	23.144	2.4	0.032	11.71	1.98
93	24.459	2.7	0.036	11.76	2.08
97	25.511	3	0.039	11.81	2.16
101	26.563	3.3	0.043	11.85	2.24
103	27.089	3.6	0.047	11.90	2.28
106	27.878	3.9	0.051	11.95	2.33
109	28.667	4.2	0.055	12.00	2.39
111	29.193	4.5	0.059	12.05	2.42
115	30.245	4.8	0.063	12.10	2.50
119	31.297	5.1	0.067	12.16	2.57
122	32.086	5.4	0.071	12.21	2.63
125	32.875	5.7	0.075	12.26	2.68
129	33.927	6	0.079	12.31	2.76
132	34.716	6.3	0.083	12.36	2.81
135	35.505	6.6	0.087	12.42	2.86
138	36.294	6.9	0.091	12.47	2.91
142	37.346	7.2	0.095	12.53	2.98
146	38.398	7.5	0.099	12.58	3.05
150	39.45	7.8	0.103	12.64	3.12
153	40.239	8.1	0.107	12.69	3.17
157	41.291	8.4	0.111	12.75	3.24
160	42.08	8.7	0.114	12.81	3.29
164	43.132	9	0.118	12.86	3.35
168	44.184	9.3	0.122	12.92	3.42

171	44.973	9.6	0.126	12.98	3.46
173	45.499	9.9	0.130	13.04	3.49
176	46.288	10.2	0.134	13.10	3.53
179	47.077	10.5	0.138	13.16	3.58
182	47.866	10.8	0.142	13.22	3.62
186	48.918	11.1	0.146	13.28	3.68
190	49.97	11.4	0.150	13.34	3.75
193	50.759	11.7	0.154	13.40	3.79
196	51.548	12	0.158	13.47	3.83
199	52.337	12.3	0.162	13.53	3.87
201	52.863	12.6	0.166	13.59	3.89
204	53.652	12.9	0.170	13.66	3.93
207	54.441	13.2	0.174	13.72	3.97
209	54.967	13.5	0.178	13.79	3.99
211	55.493	13.8	0.182	13.86	4.00
213	56.019	14.1	0.186	13.92	4.02
216	56.808	14.4	0.189	13.99	4.06
219	57.597	14.7	0.193	14.06	4.10
223	58.649	15	0.197	14.13	4.15
226	59.438	15.3	0.201	14.20	4.19
227	59.701	15.6	0.205	14.27	4.18
229	60.227	15.9	0.209	14.34	4.20
231	60.753	16.2	0.213	14.41	4.22
232	61.016	16.5	0.217	14.48	4.21
234	61.542	16.8	0.221	14.56	4.23
236	62.068	17.1	0.225	14.63	4.24
238	62.594	17.4	0.229	14.71	4.26
240	63.12	17.7	0.233	14.78	4.27
242	63.646	18	0.237	14.86	4.28
243	63.909	18.3	0.241	14.94	4.28
245	64.435	18.6	0.245	15.01	4.29
246	64.698	18.9	0.249	15.09	4.29
248	65.224	19.2	0.253	15.17	4.30
250	65.75	19.5	0.257	15.25	4.31
252	66.276	19.8	0.261	15.34	4.32
253	66.539	20.1	0.264	15.42	4.32
255	67.065	20.4	0.268	15.50	4.33
257	67.591	20.7	0.272	15.58	4.34
260	68.38	21	0.276	15.67	4.36
263	69.169	21.3	0.280	15.76	4.39
265	69.695	21.6	0.284	15.84	4.40
268	70.484	21.9	0.288	15.93	4.42
270	71.01	22.2	0.292	16.02	4.43
273	71.799	22.5	0.296	16.11	4.46
276	72.588	22.8	0.300	16.20	4.48
279	73.377	23.1	0.304	16.29	4.50
283	74.429	23.4	0.308	16.38	4.54
287	75.481	23.7	0.312	16.48	4.58
290	76.27	24	0.316	16.57	4.60
293	77.059	24.3	0.320	16.67	4.62

296	77.848	24.6	0.324	16.77	4.64
299	78.637	24.9	0.328	16.87	4.66
302	79.426	25.2	0.332	16.97	4.68
300	78.9	25.5	0.336	17.07	4.62
299	78.637	25.8	0.339	17.17	4.58
297	78.111	26.1	0.343	17.27	4.52

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7.1.2.6 On soil sample with geotextile thread mixed in the soil , 10% by wt. of the sample

- Sample 1 (σ_3 = 1kg/cm^2)

LOAD		**Compression ΔL(mm)**	**Vertical Strain ∑= ΔL/L**	**Corrected Area $A_f = A_o$ /1-∑ (cm^2)**	**Vertical Stress σ_1 =P_f/A_f (kg/cm^2)**
DIV	**P(Div * 0.263)**				
16	4.208	0.3	0.004	11.38	0.37
28	7.364	0.6	0.008	11.43	0.64
39	10.257	0.9	0.012	11.48	0.89
50	13.15	1.2	0.016	11.52	1.14
59	15.517	1.5	0.020	11.57	1.34
71	18.673	1.8	0.024	11.62	1.61
78	20.514	2.1	0.028	11.66	1.76
86	22.618	2.4	0.032	11.71	1.93
91	23.933	2.7	0.036	11.76	2.04
94	24.722	3	0.039	11.81	2.09
96	25.248	3.3	0.043	11.85	2.13
98	25.774	3.6	0.047	11.90	2.17
102	26.826	3.9	0.051	11.95	2.24
104	27.352	4.2	0.055	12.00	2.28
105	27.615	4.5	0.059	12.05	2.29
107	28.141	4.8	0.063	12.10	2.32
110	28.93	5.1	0.067	12.16	2.38
112	29.456	5.4	0.071	12.21	2.41
115	30.245	5.7	0.075	12.26	2.47
117	30.771	6	0.079	12.31	2.50
119	31.297	6.3	0.083	12.36	2.53
121	31.823	6.6	0.087	12.42	2.56
122	32.086	6.9	0.091	12.47	2.57
123	32.349	7.2	0.095	12.53	2.58
125	32.875	7.5	0.099	12.58	2.61
127	33.401	7.8	0.103	12.64	2.64
130	34.19	8.1	0.107	12.69	2.69
133	34.979	8.4	0.111	12.75	2.74
136	35.768	8.7	0.114	12.81	2.79
138	36.294	9	0.118	12.86	2.82
140	36.82	9.3	0.122	12.92	2.85
142	37.346	9.6	0.126	12.98	2.88
144	37.872	9.9	0.130	13.04	2.90
145	38.135	10.2	0.134	13.10	2.91

146	38.398	10.5	0.138	13.16	2.92
147	38.661	10.8	0.142	13.22	2.92
148	38.924	11.1	0.146	13.28	2.93
149	39.187	11.4	0.150	13.34	2.94
150	39.45	11.7	0.154	13.40	2.94
151	39.713	12	0.158	13.47	2.95
152	39.976	12.3	0.162	13.53	2.95
154	40.502	12.6	0.166	13.59	2.98
157	41.291	12.9	0.170	13.66	3.02
159	41.817	13.2	0.174	13.72	3.05
162	42.606	13.5	0.178	13.79	3.09
165	43.395	13.8	0.182	13.86	3.13
168	44.184	14.1	0.186	13.92	3.17
171	44.973	14.4	0.189	13.99	3.21
174	45.762	14.7	0.193	14.06	3.25
177	46.551	15	0.197	14.13	3.29
179	47.077	15.3	0.201	14.20	3.32
182	47.866	15.6	0.205	14.27	3.35
185	48.655	15.9	0.209	14.34	3.39
188	49.444	16.2	0.213	14.41	3.43
190	49.97	16.5	0.217	14.48	3.45
192	50.496	16.8	0.221	14.56	3.47
195	51.285	17.1	0.225	14.63	3.50
198	52.074	17.4	0.229	14.71	3.54
201	52.863	17.7	0.233	14.78	3.58
203	53.389	18	0.237	14.86	3.59
205	53.915	18.3	0.241	14.94	3.61
203	53.389	18.6	0.245	15.01	3.56
201	52.863	18.9	0.249	15.09	3.50
200	52.6	19.2	0.253	15.17	3.47
213	56.019	19.5	0.257	15.25	3.67
215	56.545	19.8	0.261	15.34	3.69
217	57.071	20.1	0.264	15.42	3.70
220	57.86	20.4	0.268	15.50	3.73
223	58.649	20.7	0.272	15.58	3.76
228	59.964	21	0.276	15.67	3.83
231	60.753	21.3	0.280	15.76	3.86
235	61.805	21.6	0.284	15.84	3.90
238	62.594	21.9	0.288	15.93	3.93
241	63.383	22.2	0.292	16.02	3.96
243	63.909	22.5	0.296	16.11	3.97
245	64.435	22.8	0.300	16.20	3.98
242	63.646	23.1	0.304	16.29	3.91
240	63.12	23.4	0.308	16.38	3.85

- Sample 2 (σ_3 = 2kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain $\sum = \Delta L/L$	Corrected Area $A_f = A_o/1-\sum$ (cm^2)	Vertical Stress $\sigma_1 = P_f/A_f$ (kg/cm^2)
DIV	**P(Div * 0.263)**				
18	4.734	0.3	0.004	11.38	0.42
25	6.575	0.6	0.008	11.43	0.58
42	11.046	0.9	0.012	11.48	0.96
52	13.676	1.2	0.016	11.52	1.19
66	17.358	1.5	0.020	11.57	1.50
74	19.462	1.8	0.024	11.62	1.68
84	22.092	2.1	0.028	11.66	1.89
88	23.144	2.4	0.032	11.71	1.98
91	23.933	2.7	0.036	11.76	2.04
95	24.985	3	0.039	11.81	2.12
99	26.037	3.3	0.043	11.85	2.20
103	27.089	3.6	0.047	11.90	2.28
106	27.878	3.9	0.051	11.95	2.33
109	28.667	4.2	0.055	12.00	2.39
111	29.193	4.5	0.059	12.05	2.42
115	30.245	4.8	0.063	12.10	2.50
119	31.297	5.1	0.067	12.16	2.57
122	32.086	5.4	0.071	12.21	2.63
125	32.875	5.7	0.075	12.26	2.68
129	33.927	6	0.079	12.31	2.76
132	34.716	6.3	0.083	12.36	2.81
135	35.505	6.6	0.087	12.42	2.86
138	36.294	6.9	0.091	12.47	2.91
142	37.346	7.2	0.095	12.53	2.98
146	38.398	7.5	0.099	12.58	3.05
150	39.45	7.8	0.103	12.64	3.12
154	40.502	8.1	0.107	12.69	3.19
158	41.554	8.4	0.111	12.75	3.26
162	42.606	8.7	0.114	12.81	3.33
166	43.658	9	0.118	12.86	3.39
171	44.973	9.3	0.122	12.92	3.48
175	46.025	9.6	0.126	12.98	3.55
179	47.077	9.9	0.130	13.04	3.61
184	48.392	10.2	0.134	13.10	3.69
188	49.444	10.5	0.138	13.16	3.76
192	50.496	10.8	0.142	13.22	3.82
196	51.548	11.1	0.146	13.28	3.88
200	52.6	11.4	0.150	13.34	3.94
204	53.652	11.7	0.154	13.40	4.00
208	54.704	12	0.158	13.47	4.06
212	55.756	12.3	0.162	13.53	4.12
216	56.808	12.6	0.166	13.59	4.18
219	57.597	12.9	0.170	13.66	4.22
222	58.386	13.2	0.174	13.72	4.25

225	59.175	13.5	0.178	13.79	4.29
228	59.964	13.8	0.182	13.86	4.33
231	60.753	14.1	0.186	13.92	4.36
234	61.542	14.4	0.189	13.99	4.40
237	62.331	14.7	0.193	14.06	4.43
240	63.12	15	0.197	14.13	4.47
243	63.909	15.3	0.201	14.20	4.50
247	64.961	15.6	0.205	14.27	4.55
251	66.013	15.9	0.209	14.34	4.60
255	67.065	16.2	0.213	14.41	4.65
259	68.117	16.5	0.217	14.48	4.70
263	69.169	16.8	0.221	14.56	4.75
267	70.221	17.1	0.225	14.63	4.80
271	71.273	17.4	0.229	14.71	4.85
275	72.325	17.7	0.233	14.78	4.89
280	73.64	18	0.237	14.86	4.96
284	74.692	18.3	0.241	14.94	5.00
287	75.481	18.6	0.245	15.01	5.03
290	76.27	18.9	0.249	15.09	5.05
294	77.322	19.2	0.253	15.17	5.10
299	78.637	19.5	0.257	15.25	5.16
302	79.426	19.8	0.261	15.34	5.18
305	80.215	20.1	0.264	15.42	5.20
308	81.004	20.4	0.268	15.50	5.23
311	81.793	20.7	0.272	15.58	5.25
314	82.582	21	0.276	15.67	5.27
317	83.371	21.3	0.280	15.76	5.29
320	84.16	21.6	0.284	15.84	5.31
322	84.686	21.9	0.288	15.93	5.32
324	85.212	22.2	0.292	16.02	5.32
327	86.001	22.5	0.296	16.11	5.34
329	86.527	22.8	0.300	16.20	5.34
331	87.053	23.1	0.304	16.29	5.34
333	87.579	23.4	0.308	16.38	5.35
335	88.105	23.7	0.312	16.48	5.35
338	88.894	24	0.316	16.57	5.36
341	89.683	24.3	0.320	16.67	5.38
344	90.472	24.6	0.324	16.77	5.40
347	91.261	24.9	0.328	16.87	5.41
350	92.05	25.2	0.332	16.97	5.43
353	92.839	25.5	0.336	17.07	5.44
356	93.628	25.8	0.339	17.17	5.45
358	94.154	26.1	0.343	17.27	5.45
360	94.68	26.4	0.347	17.38	5.45
362	95.206	26.7	0.351	17.48	5.45
366	96.258	27	0.355	17.59	5.47
369	97.047	27.3	0.359	17.70	5.48
372	97.836	27.6	0.363	17.81	5.49
375	98.625	27.9	0.367	17.92	5.50
377	99.151	28.2	0.371	18.03	5.50

376	98.888	28.5	0.375	18.14	5.45
374	98.362	28.8	0.379	18.26	5.39
372	97.836	29.1	0.383	18.38	5.32

7.1.2.6 On soil sample with geotextile thread mixed in the soil , 15% by wt. of the sample

- Sample 1 (σ_3 = 1kg/cm^2)

LOAD		**Compression ΔL(mm)**	**Vertical Strain ∑= ΔL/L**	**Corrected Area $A_f = A_o/1-\sum$ (cm^2)**	**Vertical Stress σ_1 $=P_f/A_f$ (kg/cm^2)**
DIV	**P(Div * 0.263)**				
16	4.208	0.3	0.004	11.38	0.37
28	7.364	0.6	0.008	11.43	0.64
39	10.257	0.9	0.012	11.48	0.89
50	13.15	1.2	0.016	11.52	1.14
59	15.517	1.5	0.020	11.57	1.34
71	18.673	1.8	0.024	11.62	1.61
78	20.514	2.1	0.028	11.66	1.76
86	22.618	2.4	0.032	11.71	1.93
91	23.933	2.7	0.036	11.76	2.04
94	24.722	3	0.039	11.81	2.09
96	25.248	3.3	0.043	11.85	2.13
98	25.774	3.6	0.047	11.90	2.17
102	26.826	3.9	0.051	11.95	2.24
104	27.352	4.2	0.055	12.00	2.28
105	27.615	4.5	0.059	12.05	2.29
107	28.141	4.8	0.063	12.10	2.32
110	28.93	5.1	0.067	12.16	2.38
112	29.456	5.4	0.071	12.21	2.41
115	30.245	5.7	0.075	12.26	2.47
117	30.771	6	0.079	12.31	2.50
119	31.297	6.3	0.083	12.36	2.53
121	31.823	6.6	0.087	12.42	2.56
122	32.086	6.9	0.091	12.47	2.57
123	32.349	7.2	0.095	12.53	2.58
125	32.875	7.5	0.099	12.58	2.61
127	33.401	7.8	0.103	12.64	2.64
130	34.19	8.1	0.107	12.69	2.69
133	34.979	8.4	0.111	12.75	2.74
136	35.768	8.7	0.114	12.81	2.79
138	36.294	9	0.118	12.86	2.82
140	36.82	9.3	0.122	12.92	2.85
142	37.346	9.6	0.126	12.98	2.88
144	37.872	9.9	0.130	13.04	2.90
145	38.135	10.2	0.134	13.10	2.91
146	38.398	10.5	0.138	13.16	2.92
147	38.661	10.8	0.142	13.22	2.92
148	38.924	11.1	0.146	13.28	2.93

149	39.187	11.4	0.150	13.34	2.94
150	39.45	11.7	0.154	13.40	2.94
151	39.713	12	0.158	13.47	2.95
152	39.976	12.3	0.162	13.53	2.95
154	40.502	12.6	0.166	13.59	2.98
157	41.291	12.9	0.170	13.66	3.02
159	41.817	13.2	0.174	13.72	3.05
162	42.606	13.5	0.178	13.79	3.09
165	43.395	13.8	0.182	13.86	3.13
168	44.184	14.1	0.186	13.92	3.17
171	44.973	14.4	0.189	13.99	3.21
174	45.762	14.7	0.193	14.06	3.25
177	46.551	15	0.197	14.13	3.29
179	47.077	15.3	0.201	14.20	3.32
182	47.866	15.6	0.205	14.27	3.35
185	48.655	15.9	0.209	14.34	3.39
188	49.444	16.2	0.213	14.41	3.43
190	49.97	16.5	0.217	14.48	3.45
192	50.496	16.8	0.221	14.56	3.47
195	51.285	17.1	0.225	14.63	3.50
198	52.074	17.4	0.229	14.71	3.54
201	52.863	17.7	0.233	14.78	3.58
203	53.389	18	0.237	14.86	3.59
205	53.915	18.3	0.241	14.94	3.61
203	53.389	18.6	0.245	15.01	3.56
201	52.863	18.9	0.249	15.09	3.50
200	52.6	19.2	0.253	15.17	3.47
213	56.019	19.5	0.257	15.25	3.67
215	56.545	19.8	0.261	15.34	3.69
217	57.071	20.1	0.264	15.42	3.70
220	57.86	20.4	0.268	15.50	3.73
223	58.649	20.7	0.272	15.58	3.76
228	59.964	21	0.276	15.67	3.83
231	60.753	21.3	0.280	15.76	3.86
235	61.805	21.6	0.284	15.84	3.90
238	62.594	21.9	0.288	15.93	3.93
241	63.383	22.2	0.292	16.02	3.96
243	63.909	22.5	0.296	16.11	3.97
245	64.435	22.8	0.300	16.20	3.98
248	65.224	23.1	0.304	16.29	4.00
252	66.276	23.4	0.308	16.38	4.04
256	67.328	23.7	0.312	16.48	4.09
260	68.38	24	0.316	16.57	4.13
263	69.169	24.3	0.320	16.67	4.15
266	69.958	24.6	0.324	16.77	4.17
264	69.432	24.9	0.328	16.87	4.12
261	68.643	25.2	0.332	16.97	4.05

- Sample 2 (σ_3 = 2kg/cm^2)

LOAD		Compression ΔL(mm)	Vertical Strain ∑= ΔL/L	Corrected Area $A_f = A_o/1-\sum$ (cm^2)	Vertical Stress σ_1 =P_f/A_f (kg/cm^2)
DIV	P(Div * 0.263)				
18	4.734	0.3	0.004	11.38	0.42
25	6.575	0.6	0.008	11.43	0.58
42	11.046	0.9	0.012	11.48	0.96
52	13.676	1.2	0.016	11.52	1.19
66	17.358	1.5	0.020	11.57	1.50
74	19.462	1.8	0.024	11.62	1.68
84	22.092	2.1	0.028	11.66	1.89
88	23.144	2.4	0.032	11.71	1.98
91	23.933	2.7	0.036	11.76	2.04
95	24.985	3	0.039	11.81	2.12
99	26.037	3.3	0.043	11.85	2.20
103	27.089	3.6	0.047	11.90	2.28
106	27.878	3.9	0.051	11.95	2.33
109	28.667	4.2	0.055	12.00	2.39
111	29.193	4.5	0.059	12.05	2.42
115	30.245	4.8	0.063	12.10	2.50
119	31.297	5.1	0.067	12.16	2.57
122	32.086	5.4	0.071	12.21	2.63
125	32.875	5.7	0.075	12.26	2.68
129	33.927	6	0.079	12.31	2.76
132	34.716	6.3	0.083	12.36	2.81
135	35.505	6.6	0.087	12.42	2.86
138	36.294	6.9	0.091	12.47	2.91
142	37.346	7.2	0.095	12.53	2.98
146	38.398	7.5	0.099	12.58	3.05
150	39.45	7.8	0.103	12.64	3.12
154	40.502	8.1	0.107	12.69	3.19
158	41.554	8.4	0.111	12.75	3.26
162	42.606	8.7	0.114	12.81	3.33
166	43.658	9	0.118	12.86	3.39
171	44.973	9.3	0.122	12.92	3.48
175	46.025	9.6	0.126	12.98	3.55
179	47.077	9.9	0.130	13.04	3.61
184	48.392	10.2	0.134	13.10	3.69
188	49.444	10.5	0.138	13.16	3.76
192	50.496	10.8	0.142	13.22	3.82
196	51.548	11.1	0.146	13.28	3.88
200	52.6	11.4	0.150	13.34	3.94
204	53.652	11.7	0.154	13.40	4.00
208	54.704	12	0.158	13.47	4.06
212	55.756	12.3	0.162	13.53	4.12
216	56.808	12.6	0.166	13.59	4.18
219	57.597	12.9	0.170	13.66	4.22
222	58.386	13.2	0.174	13.72	4.25

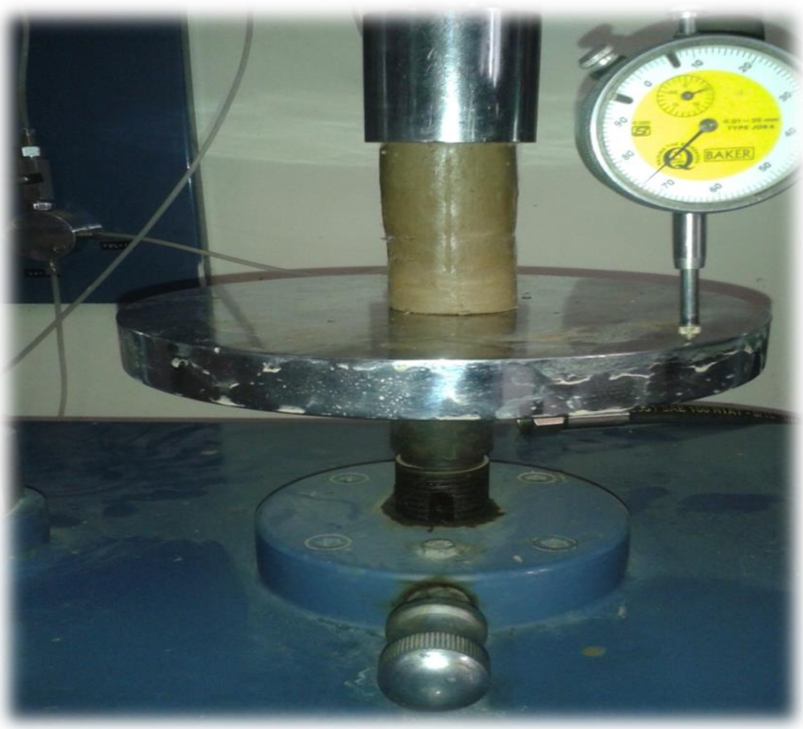
225	59.175	13.5	0.178	13.79	4.29
228	59.964	13.8	0.182	13.86	4.33
231	60.753	14.1	0.186	13.92	4.36
234	61.542	14.4	0.189	13.99	4.40
237	62.331	14.7	0.193	14.06	4.43
240	63.12	15	0.197	14.13	4.47
243	63.909	15.3	0.201	14.20	4.50
247	64.961	15.6	0.205	14.27	4.55
251	66.013	15.9	0.209	14.34	4.60
255	67.065	16.2	0.213	14.41	4.65
259	68.117	16.5	0.217	14.48	4.70
263	69.169	16.8	0.221	14.56	4.75
267	70.221	17.1	0.225	14.63	4.80
271	71.273	17.4	0.229	14.71	4.85
275	72.325	17.7	0.233	14.78	4.89
280	73.64	18	0.237	14.86	4.96
284	74.692	18.3	0.241	14.94	5.00
287	75.481	18.6	0.245	15.01	5.03
290	76.27	18.9	0.249	15.09	5.05
294	77.322	19.2	0.253	15.17	5.10
299	78.637	19.5	0.257	15.25	5.16
302	79.426	19.8	0.261	15.34	5.18
305	80.215	20.1	0.264	15.42	5.20
308	81.004	20.4	0.268	15.50	5.23
311	81.793	20.7	0.272	15.58	5.25
314	82.582	21	0.276	15.67	5.27
317	83.371	21.3	0.280	15.76	5.29
320	84.16	21.6	0.284	15.84	5.31
322	84.686	21.9	0.288	15.93	5.32
324	85.212	22.2	0.292	16.02	5.32
327	86.001	22.5	0.296	16.11	5.34
329	86.527	22.8	0.300	16.20	5.34
331	87.053	23.1	0.304	16.29	5.34
333	87.579	23.4	0.308	16.38	5.35
335	88.105	23.7	0.312	16.48	5.35
338	88.894	24	0.316	16.57	5.36
341	89.683	24.3	0.320	16.67	5.38
344	90.472	24.6	0.324	16.77	5.40
347	91.261	24.9	0.328	16.87	5.41
350	92.05	25.2	0.332	16.97	5.43
353	92.839	25.5	0.336	17.07	5.44
356	93.628	25.8	0.339	17.17	5.45
358	94.154	26.1	0.343	17.27	5.45
360	94.68	26.4	0.347	17.38	5.45
362	95.206	26.7	0.351	17.48	5.45
366	96.258	27	0.355	17.59	5.47
369	97.047	27.3	0.359	17.70	5.48
372	97.836	27.6	0.363	17.81	5.49
375	98.625	27.9	0.367	17.92	5.50
377	99.151	28.2	0.371	18.03	5.50

380	99.94	28.5	0.375	18.14	5.51
384	100.992	28.8	0.379	18.26	5.53
388	102.044	29.1	0.383	18.38	5.55
392	103.096	29.4	0.387	18.49	5.57
396	104.148	29.7	0.391	18.61	5.60
400	105.2	30	0.395	18.74	5.61
398	104.674	30.3	0.399	18.86	5.55
396	104.148	30.6	0.403	18.98	5.49

7.2 Photographs

Liquid Limit test

Proctor Compaction test



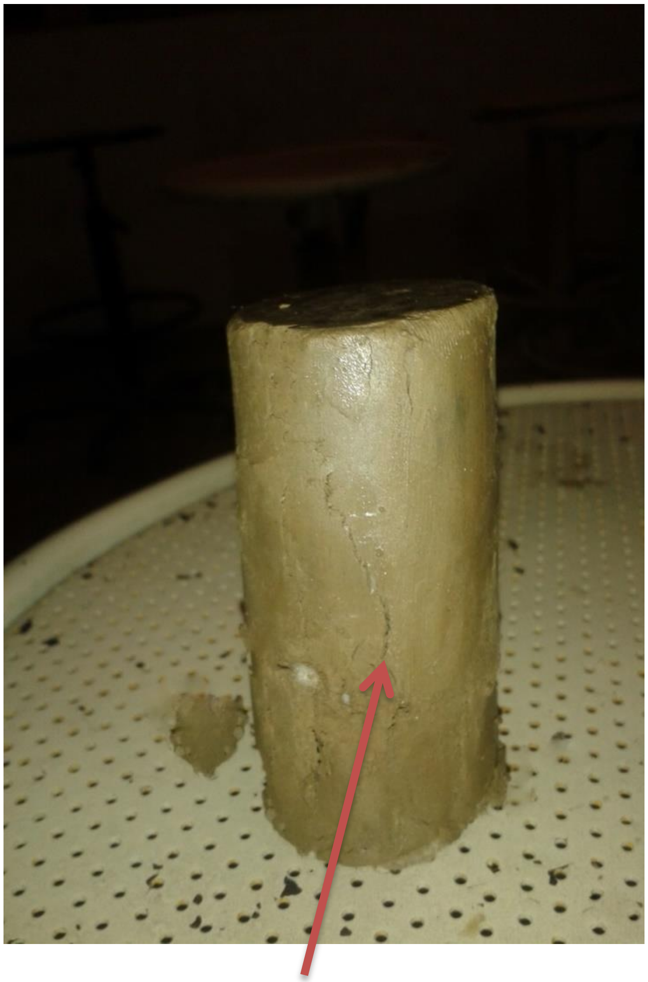
Unconfined Compressive Strength test

Unconfined Compressive Strength test

Failure with Woven Geotextile when kept in between the failure plane

Failure with Non-Woven Geotextile when kept in between the failure plane

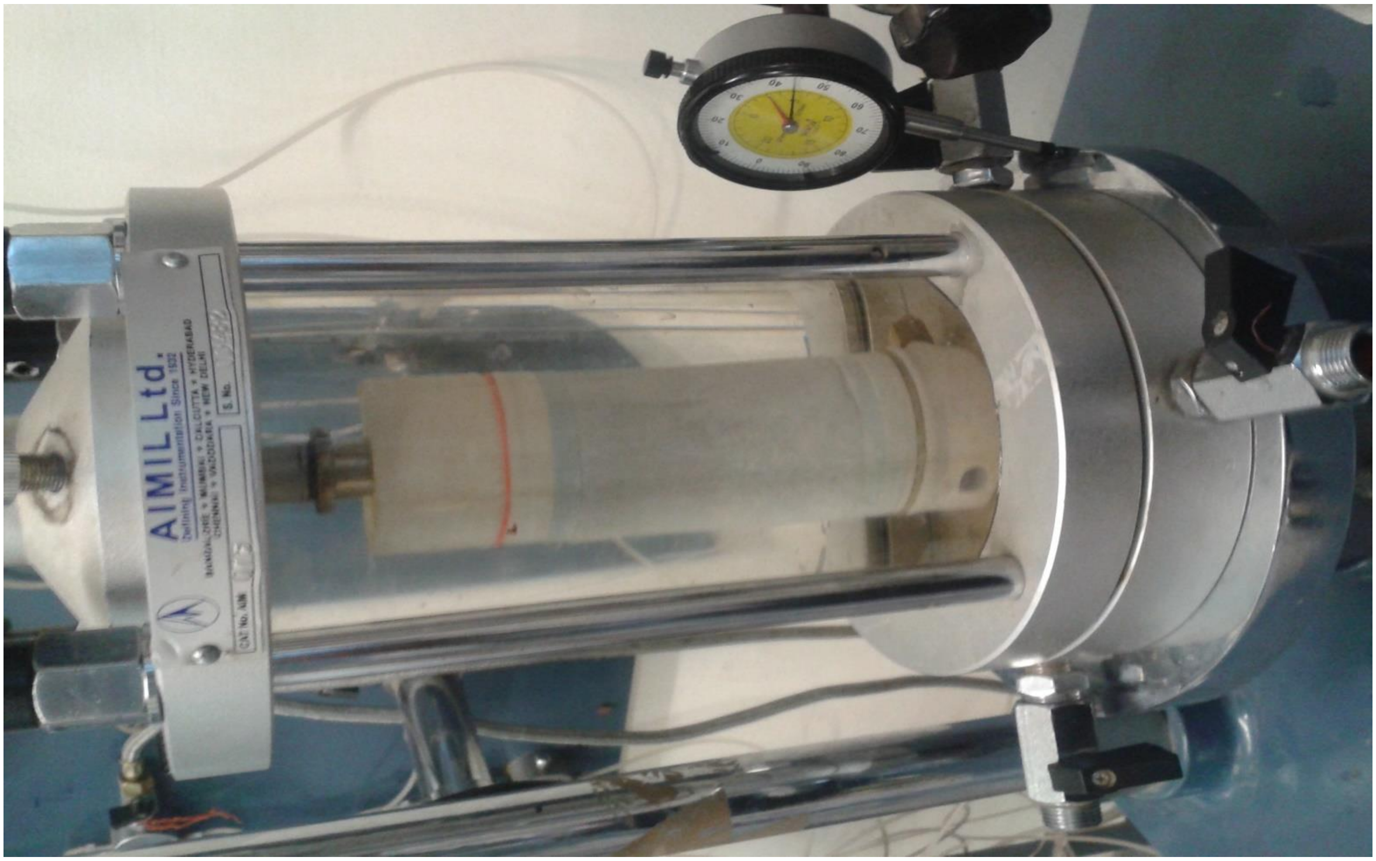
Failure without Geotextile

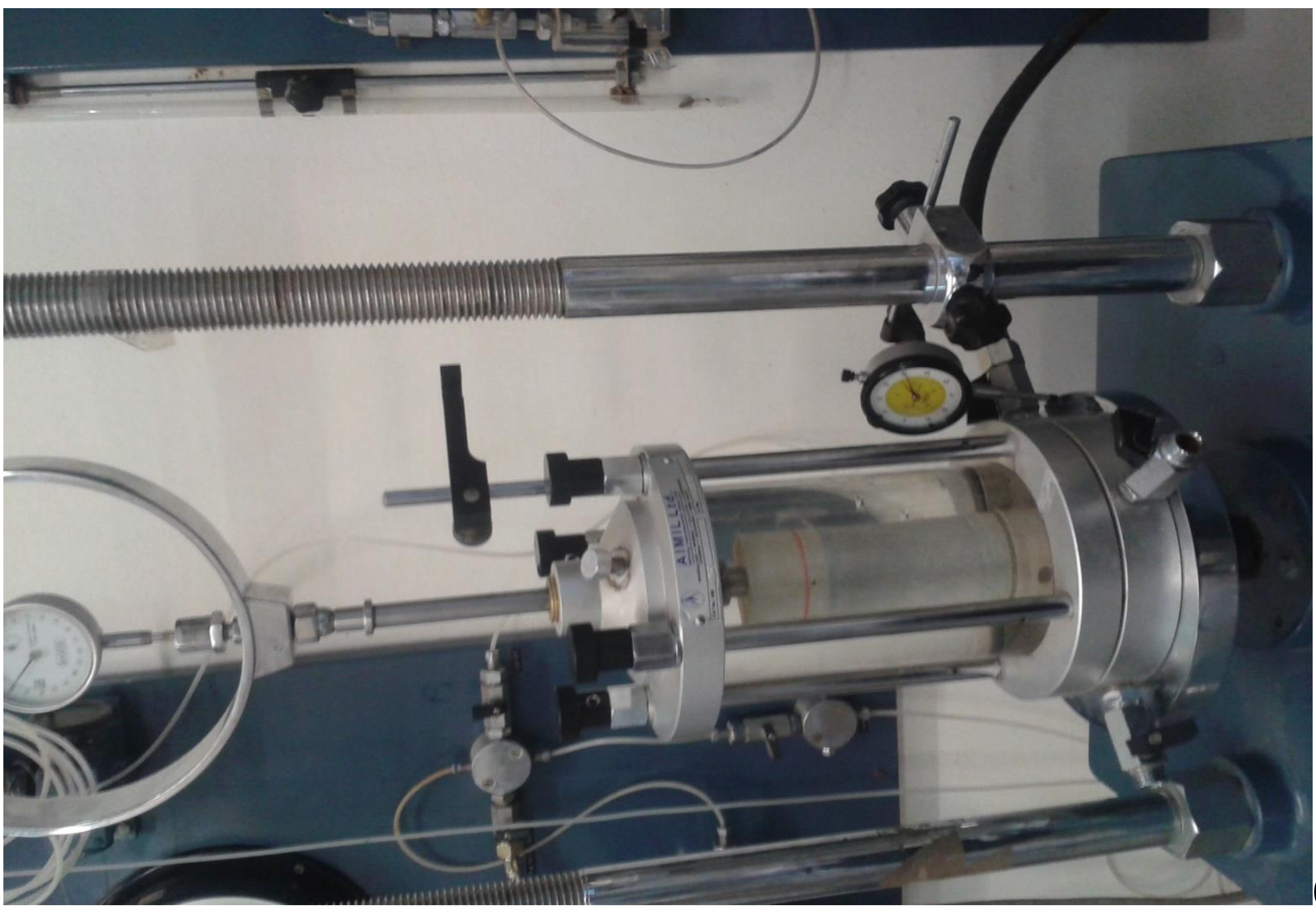


Failure with Non-Woven Geotextile when kept uniformly spaced in between the sample

Failure with Woven Geotextile when kept uniformly spaced in between the sample

Triaxial Test





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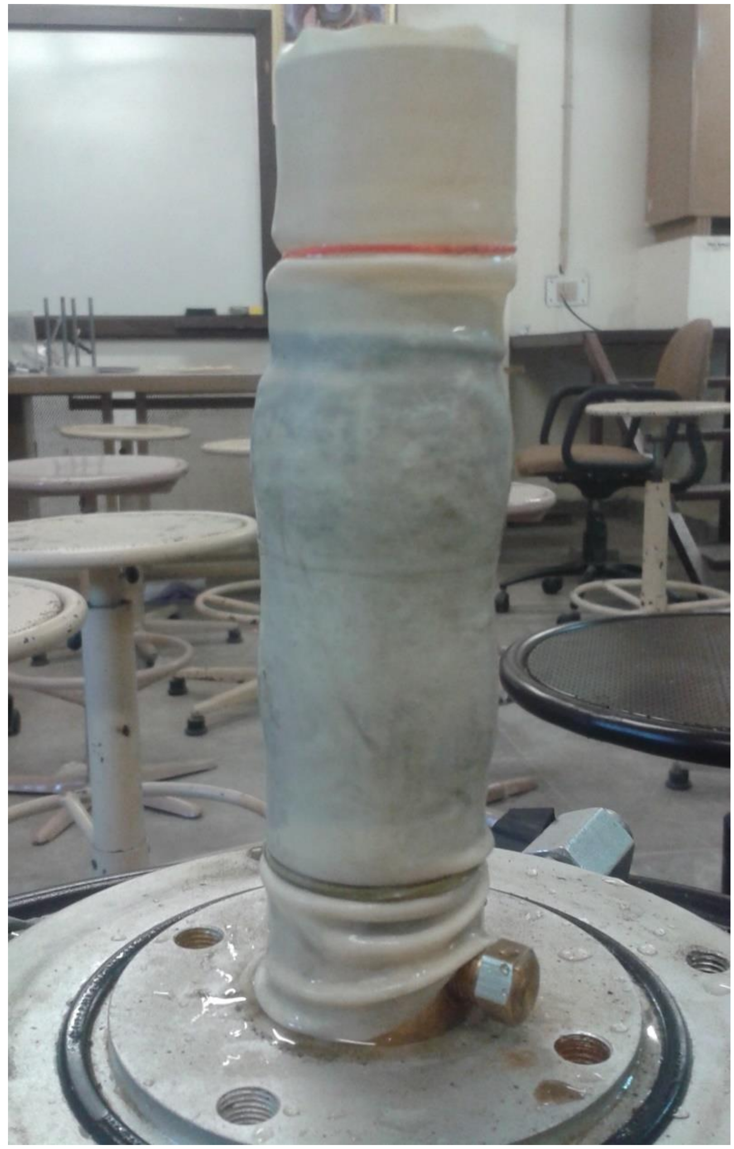
Triaxial Test (failed sample)



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