International Journal of Innovative Research in Engineering & Management (IJIREM)
ISSN: 2350-0557, Volume-3, Special Issue-1, April-2015
Fifth National Conference on Innovative Practice in Construction Waste Management (IPCWM'15) On 8th & 9th April, 2015
Organized by Department of CIVIL Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, India

# Stabilisation of Expansive Soil Using Geotextile

**R.Gayathri**
Assistant Professor,
Sri Krishna
College of Technology
Coimbatore

**P.Kannan**
PG Student,
Department of Civil Engineering,
Sri Ramakrishna Institute of Technology,
Coimbatore

## ABSRACT

The performance of the soil in the designs depends upon the characteristics of soil. Therefore the testing of soil with relation to the determination of its physical properties, and the evaluation of effects of certain other factors such as seepage conditions etc., forms the most essential part of the development of soil engineering. It is through research only that design and construction methods are modified to give maximum safety or economy, and new methods are evolved. The knowledge of theoretical soil mechanics assuming the soil to be an ideal elastic isotropic and homogeneous materials helps in predicting the behaviour of the soil in the field.

## LITERATURE REVIEW

### Ali A. Mahmood et,al.,(2008):

Shear frictional behavior of soil/geosynthetic interfaces plays a pivotal role in the overall performance of geotextile-reinforced roads. Since a substantial proportion of the total land area in many Southeast Asian countries is composed of organic soils, it was seen of particular importance to investigate the shear frictional behavior of such soils when subjected to loading with geotextiles used as reinforcement. Two types of soils were used; organic silty clay and a fill material, which is a sandy type of soil. Shear box tests were performed to determine the shear strength parameters of the soils and to investigate the shear frictional behavior of the soil/geotextile interfaces. It appears from the results of the shear box tests performed that there exists a relationship between the tensile strength of the geotextile used and the shear strength of its interface with the organic clay, with the shear strength of the interface increasing with the increasing tensile strength of the geotextile. The shear strength of geotextile/fill interfaces did not show a consistent relationship with the geotextile tensile strength.

### M. Mirzakhanlari and S.A.Naeini (2009):

Geotextiles have been successfully used for reinforcement of soils to improve the bearing capacity. In this paper the geotextile as a tensional material have been used for reinforcement of granular soils. Laboratory California bearing ratio (CBR) tests were performed to investigate the load-penetration behaviour of reinforced granular soils with geotextile. Samples of granular soil with different grading are selected and tested without reinforcement. Then by placing geotextile at certain depth within sample height in one and two layers, the effects of the number of geotextile on the increase in bearing capacity of reinforced granular soils and grading on performance of geotextile is discussed. The result of these tests shows that, bearing ratio of reinforced granular soils with geotextile.

**P. Senthil Kumar and S. Pandiammal Devi (2009):** This paper deals with an experimental study on the utilization of the needle punched nonwoven geotextiles made of coir and jute fibers, for unpaved roads over soft subgrade, otherwise undergoes large deformation. Since the CBR reinforcement ratio is used for the design of unpaved road, the CBR reinforcement ratio value of the geotextile-sub grade is obtained by conducting CBR test with the geotextile, to study the effect of the natural geotextiles on the soft sub grade. The CBR strength using both the nonwoven geotextiles is improved, whereas jute geotextile performs better.

**1. INTRODUCTION:** Geotextiles are planar, permeable, polymeric materials used for the functions of separation, filtration, drainage and protection. These geotextiles are tested in accordance with internationally accepted ASTM and BIS standards. The geotextiles are resistant to ultraviolet degradation and to all biological and chemical environments normally found in soils. Geotextiles can improve soil strength at a lower cost than conventional soil nailing. In addition, geotextiles allow planting on steep slopes, further securing the slope.

**2. ACTION OF GEOTEXTILES:** Geotextiles are normally used as separators only, but if they are designed to reinforce a pavement by developing tension then they must form a "Tensional Membrane". This requires large deformations and fixed wheel paths. It is not suitable for the uses in the design of normal surfaced permanent pavements. Geotextiles cannot interlock with the aggregate particles, so they cannot generate the same efficient interaction and confinement of the aggregate.

## 3. MATERIALS AND METHODS:

Soil sample: **CLAY**
Materials: Two types of Geotextile materials were used in the study.

- **Woven**
- **Non-woven**

## METHODOLOGY:

- Collecting the sample from the source
- Collected sample mixed thoroughly.
- Testing the index property of soil.

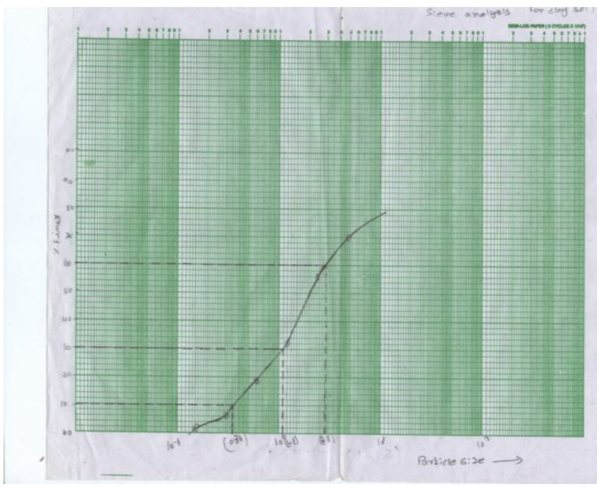
- Testing the strength parameters of soil.
- Adding reinforcement into the soil.
- Again testing the strength parameters of soils
- Comparing the test results

## 4. RESULTS AND DISCUSSIONS:

INDEX PROPERTIES OF SAMPLE:

### SIEVE ANALYSIS:

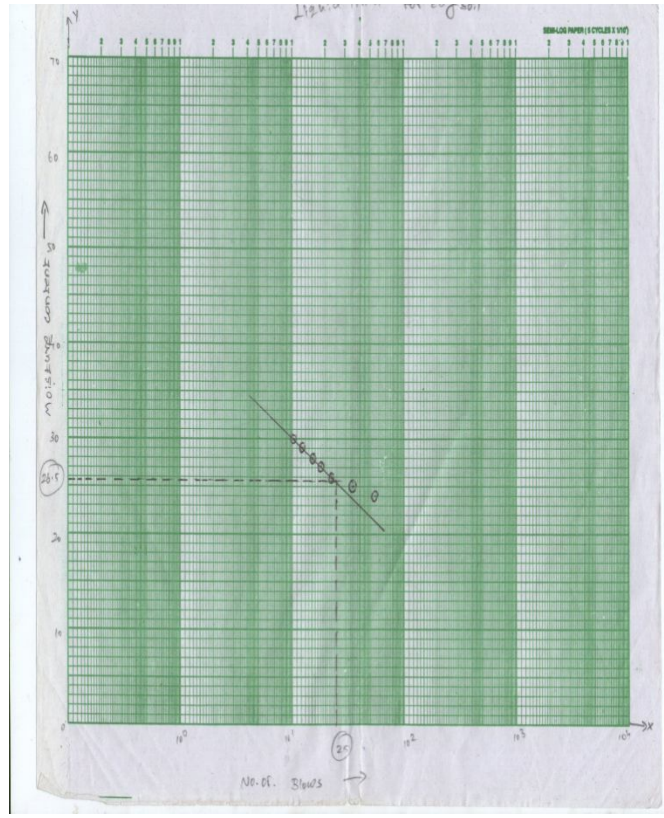
From graph :
$D_{10}$ = Soil diameter at 10% finer = 0.2
$D_{30}$ = Soil diameter at 30% finer = 0.37
$D_{60}$= Soil dimeter at 60% finer =0.6
Uniformity co-efficient $C_u = D_{60}/D_{10}$
$= 0.6/0.2 = 3$
Co-efficient of curvature = $D_{30}^2 / D_{10}*D_{60}$
$= 0.37^2/ (0.2 * 0.6) \quad = 0.14$




The graph is plotted between Particle size on the x-axis and percentage of finer on the y-axis. From the graph , the particle size distribution is defined.

### LIQUID LIMIT:

From the graph liquid limit value is 26.5%. The graph is plotted between No.of blows on x-axis and Percentage of water only-axis.
From the graph, the water contentfor25blows is taken as Liquid limit.




### DETERMINATION OF PLASTIC LIMIT:

The Plastic Limit for clay sample is 8.6%

### DETERMINATION OF MOISTURE CONTENT:

The Moisture content value for clay sample is 20%.

### DETERMINATION OF UNIT WEIGHT OF CLAY SAMPLE USING CORE CUTTER:

The bulk unit weight and the dry unit weight are calculated from the core cutter test.
The values are
Bulk unit weight of the soil is 1.346g/cc
Dry unit weight of the soil is 1.121g/cc

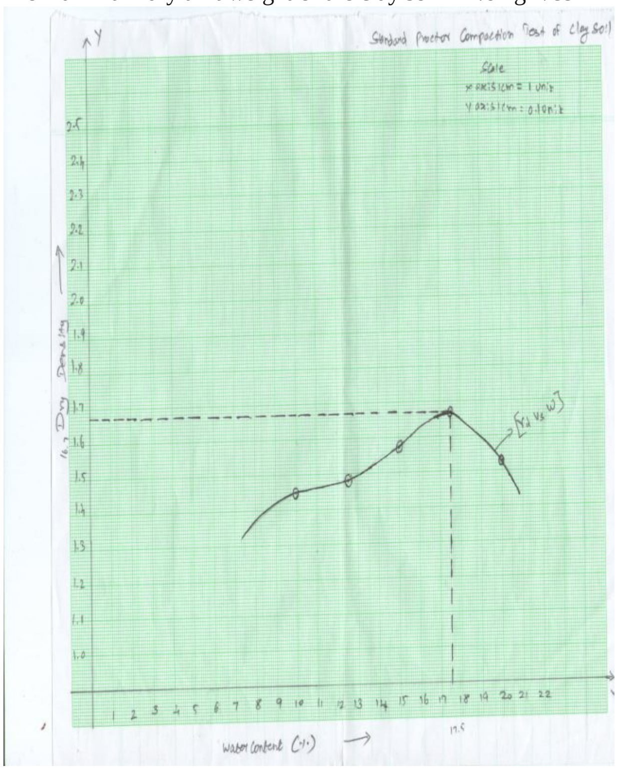
### DETERMINATION OF SPECIFIC GRAVITY OF THE CLAY SAMPLE:

The specific gravity value for the clay sample is calculated and the value is found to be 2.59.

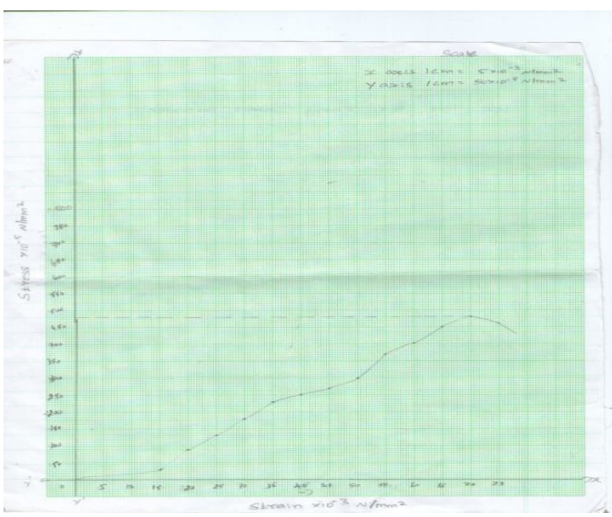
### DETERMINATION OF OPTIMUM MOISTURE CONTENT BY STANDARD PROCTOR COMPACTION TEST FOR CLAY SAMPLE:

The graph is drawn between water content on the x-axis and dry density on the y-axis. The corresponding water content value at which the curve starts to get decrease is the optimum moisture content value.
From graph,

The optimum moisture content (%) = 17.5%
The maximum dry unit weight of the clay soil = 1.67 gm/cc

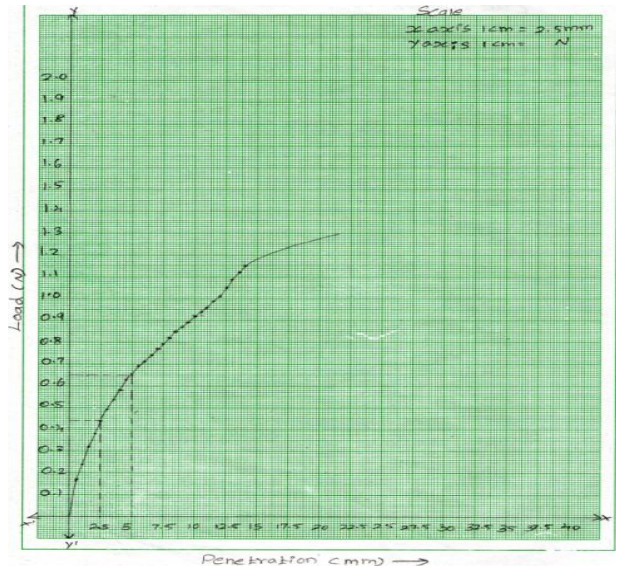



## DETERMINATOIN OF UNCONFINED COMPRESSIVE STRENGTH:




The graph is drawn between strain on the x-axis and strain on the y-axis. The maximum point on the curve is the unconfined compressive strength of the soil and the calculations are done correspondingly. Unconfined compressive strength
q= $478.38 \times 10^{-5}$ N/mm$^2$
shearstrength,S=$q_u/2$ = $239.19 \times 10^{-5}$ N/mm$^2$

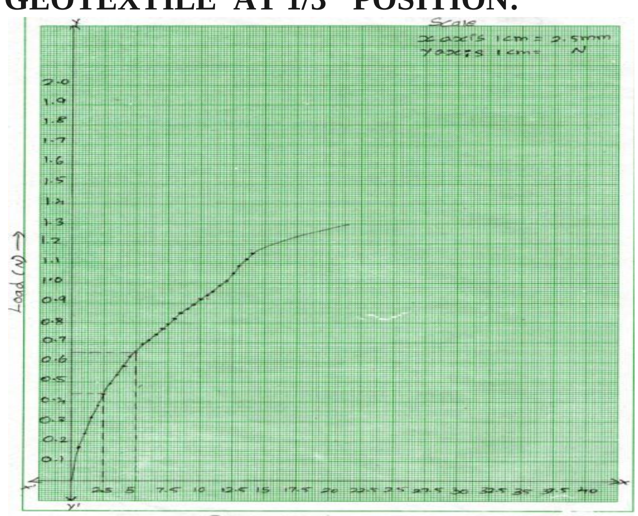
## DETERMINATION OF CBR VALUE:




GRAPH FOR CBR VALUE FOR NATURAL CLAY SAMPLE

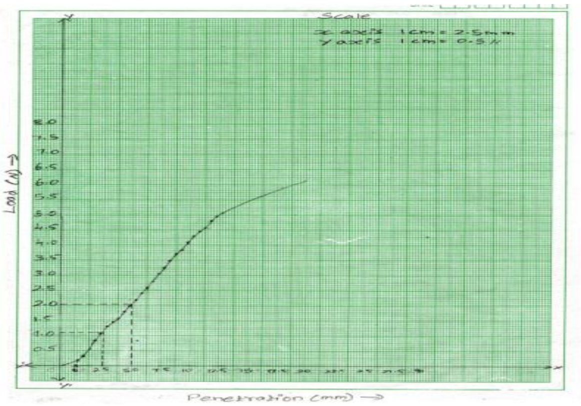
CBR value for 2.5mm penetration is
= (0.3288/13.44)x100
= 2.49 %
CBR value for 5mm penetration is
= (0.4384/20.16)x100
=2.19 %
CBR value is 2.49%

## DETEMINATION OF CBR VALUE FOR CLAY SOIL WITH WOVEN GEOTEXTILE AT 1/3rd POSITION:



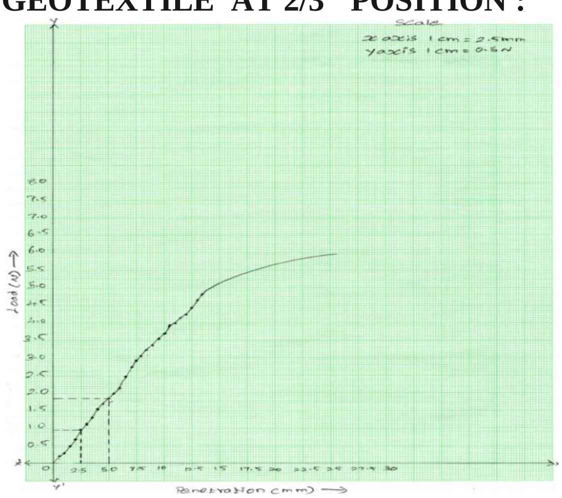
CBR value for 2.5mm penetration is
= (0.484/13.44)x100 = 3.26%
CBR value for 5mm penetration is
= (0.6576/20.16)x100 = 3.28%
CBR value is 3.28 %

## DETEMINATION OF CBR VALUE FOR CLAY SOIL WITH WOVEN GEOTEXTILE AT 1/2nd POSITION:



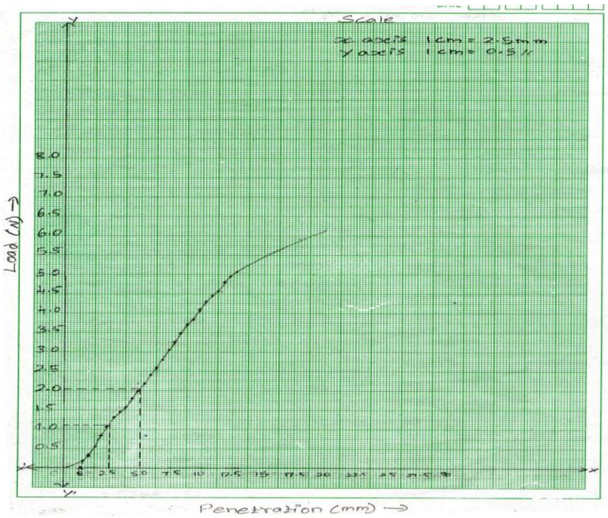

CBR value for 2.5mm penetration is
= (1.1/13.44)x100
= 8.18 %
CBR value for 5mm penetration is
= (2.05/20.16)x100
= 10.17 %
CBR value is 10.17 %

## DETEMINATION OF CBR VALUE FOR CLAY SOIL WITH WOVEN GEOTEXTILE AT 2/3rd POSITION :




CBR value for 2.5mm penetration is
= (0.9864/13.44)x100
= 7.36 %
CBR value for 5mm penetration is
= (1.8769/20.16)x100
= 9.30 %
CBR value is 9.30 %

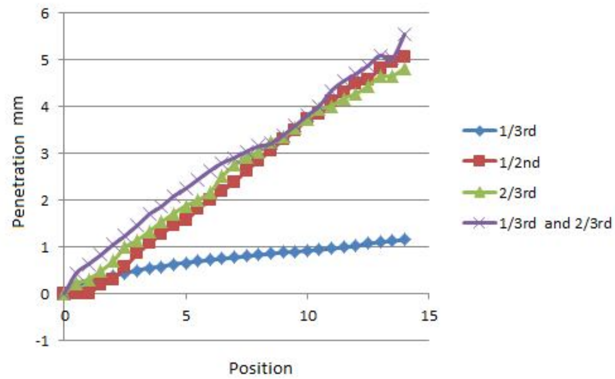
## DETEMINATION OF CBR VALUE FOR CLAY SOIL WITH WOVEN GEOTEXTILE AT 1/3rd AND 2/3rd POSITION:




CBR value for 2.5mm penetration is
= (1.233/13.44)x100
= 9.17 %
CBR value for 5mm penetration is
= (2.246/20.16)x100
= 11.12 %
CBR value is 11.12 %

## CBR VALUE FOR CLAY SAMPLE WITH WOVEN GEOTEXTILE :

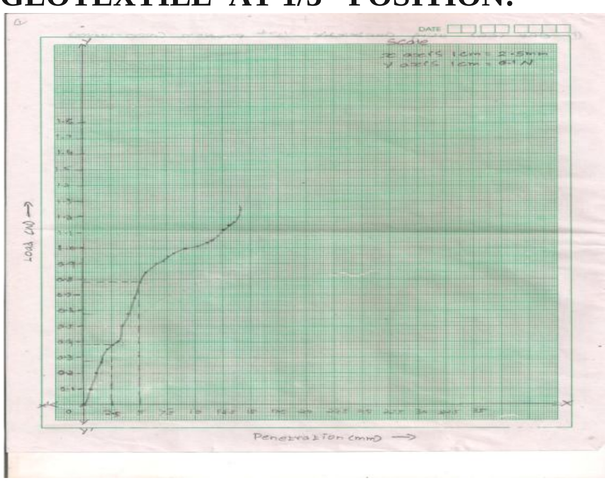
| TYPE OF SOIL | MATERIAL USED | POSITION OF GEOTEXTILE | CBR VALUE % |
|---|---|---|---|
| CLAY SAMPLE | WOVEN GEOTEXTILE | 1/3rd | 3.58 |
| | | 1/2nd | 10.17 |
| | | 2/3rd | 9.39 |
| | | 1/3rd and 2/3rd | 11.12 |




## CBR VALUE AFTER PLACING WOVEN GEOTEXTILE:

The Woven Geotextile is placed at the one-third, middle, two-third and both one-third and two-third position. The strength is found to be increased from 2.49 % to 11.12 %. The maximum CBR value attains at 1/3rd and 2/3rd position.

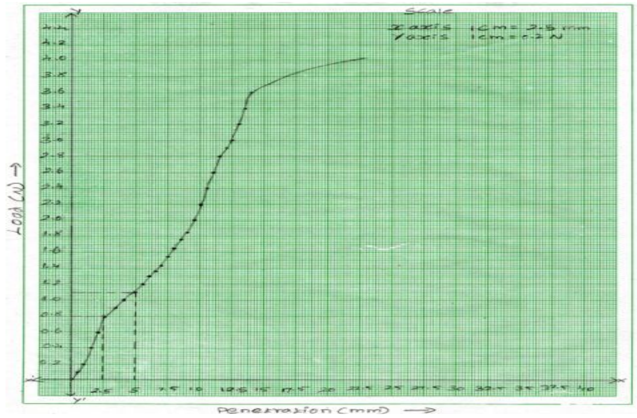
## DETEMINATION OF CBR VALUE FOR CLAY SOIL WITH NON- WOVEN GEOTEXTILE AT 1/3rd POSITION:



GRAPH FOR CBR VALUE FOR CLAY SOIL WITH NON-WOVEN GEOTEXTILE AT 1/3rd POSITION

CBR value at 2.5mm penetration
= ( 0.3836/13.44)x 100
= 2.85%
CBR value at 5mm penetration
= ( 1.1097/20.16)x 100
= 3.9%
CBR value is 3.9%

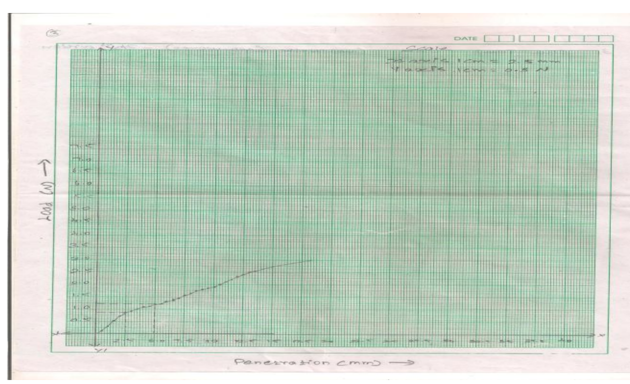
## DETEMINATION OF CBR VALUE FOR CLAY SOIL WITH NON-WOVEN GEOTEXTILE AT 1/2nd POSITION:



CBR value at 2.5mm penetration
= ( 0.3836/13.44)x 100
= 5.91%
CBR value at 5mm penetration
= ( 1.1097/20.16)x 100
= 5.52%
CBR value is 5.91%

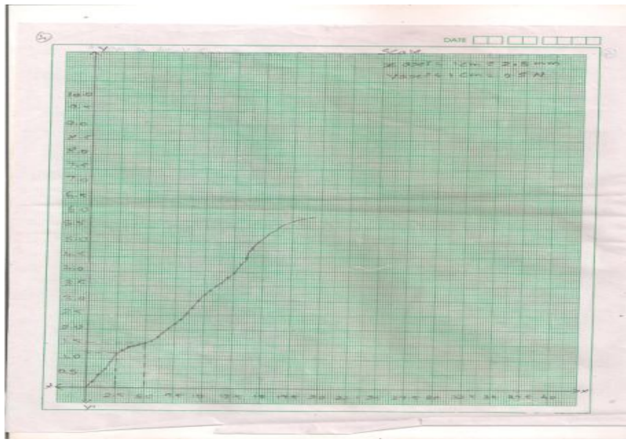
## DETEMINATION OF CBR VALUE FOR CLAY SOIL WITH NON-WOVEN GEOTEXTILE AT 2/3rd POSITION:

| TYPE OF SOIL | MATERIAL USED | POSITION OF GEOTEXTILE | CBR VALUE % |
|---|---|---|---|
| CLAY SAMPLE | NON-WOVEN GEOTEXTILE | 1/3rd | 3.90 |
| | | 1/2nd | 5.91 |
| | | 2/3rd | 6.43 |
| | | 1/3rd and 2/3rd | 9.17 |



CBR value at 2.5mm penetration
= ( 0.864/13.44)x 100
= 6.43%
CBR value at 5mm penetration
= ( 1.161/20.16)x 100
= 5.77%
CBR value is 6.43 %

## DETEMINATION OF CBR VALUE FOR CLAY SOIL WITH NON-WOVEN GEOTEXTILE AT 1/3rd AND 2/3rd POSITION :

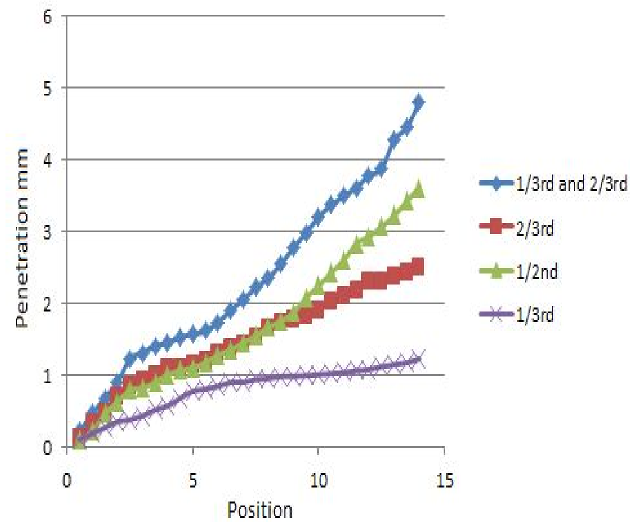


CBR value at 2.5mm penetration
= ( 1.233/13.44)x 100
= 9.17 %
CBR value at 5mm penetration
= ( 1.5755/20.16)x 100
= 7.82 %
CBR value is 9.17 %

## CBR VALUE FOR CLAY SAMPLE WITH NON-WOVEN GEOTEXTILE :

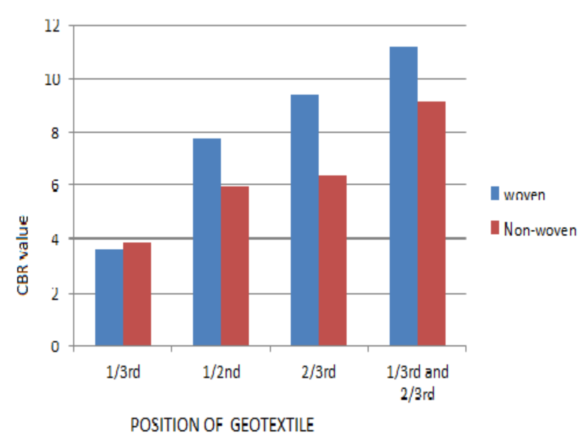
CBR VALUE AFTER PLACING NON-WOVEN GEOTEXTILE

The Woven Geotextile is placed at the one-third, middle, two-third and both one-third and
two-third position. The strength is found to be increased from 2.49 % to 11.12 %. The maximum CBR value attains at 1/3rd and 2/3rd position.




## COMPARISON OF RESULTS BETWEEN CLAY SAMPLE WITH WOVEN AND NON-WOVEN GEOTEXTILES:

| TYPE OF SOIL | MATERIAL USED | POSITION | CBR VALUE |
|---|---|---|---|
| CLAY SAMPLE | GEOTEXTILE (WOVEN) | 1/3rd | 3.58 |
| | | 1/2nd | 7.76 |
| | | 2/3rd | 9.39 |
| | | 1/3rd and 2/3rd | 11.12 |
| | GEOTEXTILE (NON-WOVEN) | 1/3rd | 3.90 |
| | | 1/2nd | 5.91 |
| | | 2/3rd | 6.43 |
| | | 1/3rd and 2/3rd | 9.17 |




The Geotextile is added to the soil sample in one-third, middle, two-third and both one-third & two-third position. The strength is found to be increased from 2.49% to 11.12% by adding the Woven Geotextile and from 2.49% to 9.17% by adding the Non-

Woven Geotextile.The maximum CBR value attains at the 1/3 rd and 2/3rd position. Woven Geotextiles shows better improvement of the strength than Non-woven Geotextiles.

## 5. CONCLUSION

Natural clay is tested for its index properties. CBR test is conducted to find its strength parameters . Two types of Geotextiles are used. The Geotextile is added to the soil sample in one-third, middle, two-third and both one-third & two-third position. The strength is found to be increased from 2.49% to 11.12% by adding the Woven Geotextile and from 2.49% to 9.17% by adding the Non-Woven Geotextile. The maximum CBR value attains at the 1/3 rd and 2/3rd position. Woven Geotextiles shows better improvement of the strength than Non-woven Geotextiles.

## REFERENCES:

1) Haeri, S.M., R. Nourzad, A.M. Oskrouch (2000) –"Effect of geotextile reinforcement on the mechanical behavior of sands. Geotextiles and Geomembranes" 18 (6), 385–402.
2) Latha, G.M, V. S. Murthy (2007) -"Effects of reinforcement form on the behavior of geosynthetic reinforced sand. Geotextiles and Geomembranes" 25, 23–32.
3) Michalowski, R.L. (2004) "Limit loads on reinforced foundation soils." Journal of Geotechnical and Geoenvironmental Engineering 130 (4),381–390.
4) Romesh Chander Khanna - "Soil testing for engineers" , Khanna publishers, Delhi.
5) C.Venkatramaian –" Geotechnical engineering", Wiley eastern publishers, Delhi
6) E.Saibaba reddy, K.Ramasastri - New Age International limited publishers, Delhi.
7) B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain- "Soil Mechanics And Foundation Engineering", Lakshmi Publications.
8) IS 2720 (Part -3/section 1) – 1980, Determination of Specific Gravity of Soil.
9) IS 2720 (Part 8) - 1985, Determination of Plastic Limit And Liquid Limit.
10) IS 2720 (Part 9) – 1985, Determination of Grain Size Analysis of Soil
11) IS 2720(Part 29) – 1985, Determination of Dry Density of Soil in-place by Core cutter Method.
12) IS 2720 (Part 16) – 1985, Laboratory Determination of CBR.
13) P.Senthil kumar and S.Pandiammai Devi- Dept of Civil Engineering, PSG college of Technology
14) S.A.Naeini and M.Mirzakhanlari- "The effect of Geotextile and Grading on the Bearing Ratio of Granular soils" ( volume 13-2008)