Published in Proc. Intl. Conf. on Innovations in Civil Engineering 2021 (ICICE – '21)

COMPARISON OF BEHAVIOUR OF SAND AND CLAY WITH WOVEN AND NON- WOVEN GEOTEXTILE – A NUMERICAL STUDY

Amrutha Mohanan T[1], Maria Seby[2], Mikhil Antony[3], Rosemary P A[4], Haritha C R[5]

[1,2,3,4] B tech Student, Department of Civil Engineering, Sahrdaya College of Engineering and Technology, Kodakara, Kerala

[5] Faculty, Department of Civil Engineering, Sahrdaya College of Engineering and Technology, Kodakara, Kerala

amruthamohanant@gmail.com

Abstract

Soil is a weak structural material in tension. Geotextiles act as a reinforcing element to the soil matrix helping to provide a stronger structural material. Two main types of geo-textiles woven and non-woven geotextiles; woven geotextiles are made by weaving together polypropylene or polyester fibers whereas non-woven geotextiles are needle punched and heat set. The effectiveness of these geotextiles to enhance the strength properties of the sand and clay were numerically analyzed using PLAXIS 2D software. The CBR and BCR values in drained, undrained and partially drained conditions were found out from the load penetration graphs. The experiments were conducted to identify the basic soil properties which must be given to the software as input parameters of the soil samples. The properties of the soils are listed below in Table I. The properties of the Geotextiles are directly available from the manufacturing company, and it is listed in Table II.

Table 1 Soil Properties

Properties	**Clay**	**Sand**
Material Model	Mohr-Coulomb	Mohr-Coulomb
Material Type	Undrained	Undrained
Unit Weight (unsat)	16.6 kN/m^3	18 kN/m^3
Unit Weight (sat)	17.31 kN/m^3	23 kN/m^3
Permeability, K_x	1.15x10^{-8}m/s	1.15x10-8m/s
Permeability, K_y	3.31 X 10-^{10}m/s	2.8 x 10^{-5}m/s
Elastic Modulus, E_{ref}	2000 kN/m^2	30000 kN/m^2
Poisson's Ratio	0.23	0.333
Cohesion, c_{ref}	0.54 kg/cm^2	0.01 kg/cm^2
Angle of Internal Friction	1°	33°
Dilatancy Angle	0°	3°

Table 2 Properties of Geotextile

Properties	**Woven Geotextile**	**Non-Woven Geotextile**
Material Type	Elastic	Elastic
Weight (g)	400	150
Poisson's Ratio	0	0.35
Modulus of Elasticity E(MPa)	80	20
Tensile Strength (KN/m)	30	13

ISBN:978-93-5493-852-8

The CBR test is numerically analyzed in PLAXIS 2D software by developing a finite element model. Test sample is modelled according to the CBR test. Here, sand and clay are used as samples; different cases of each sample with and without geotextile (woven and non-woven) are considered. Drained, undrained and partially drained conditions of the soil are also considered. The CBR model obtained from the analysis produce a load-penetration curve. The load required for 12.5 mm depth of penetration and CBR value of the modelled soil is calculated from this load-penetration curve. Two different cases were considered (i) Model without mould and annular disk (ii) Model with mould and annular disk. The test is conducted for the samples at drained partially drained and undrained conditions with the different layers of geotextiles and spacings: (i)CBR model with soil, CBR model with geotextile reinforced soil at centre, (ii) CBR model with geotextile reinforced soil at 1/3rd distance from bottom, (iii) CBR model with geotextile reinforced soil at 2/3rd distance from bottom, (iv) CBR model with 2 geotextile reinforced soil at centre and 1/3rd from bottom, (v) CBR model with 2 geotextile reinforced soil at centre and 2/3rd from bottom,(vi) CBR model with 2 geotextile reinforced soil at 1/3rd and 2/3rd distance from bottom , (vii) CBR model with 3 geotextile reinforce soil at centre, 1/3rd and 2/3rd distance from bottom. The load penetration graphs for sand and clay with non-woven geotextiles given below. Similar graphs were obtained with woven geotextiles too.

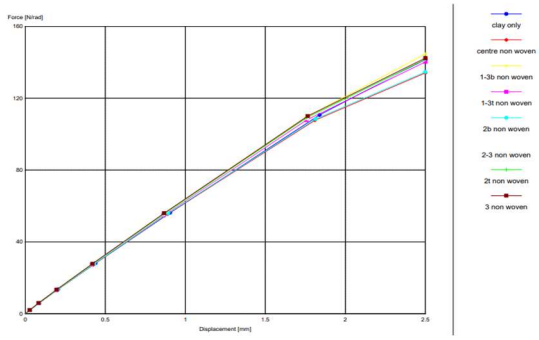

Fig. 1. Clay with non-woven geotextile

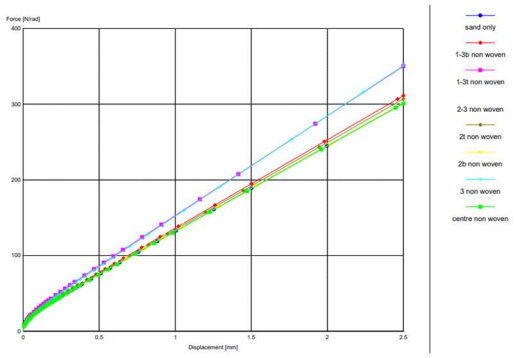

Fig. 2. Sand with woven geotextile

The CBR values were found out using the load obtained from the graphs. The woven and non-woven geotextiles are placed at different locations within the soil samples, and it was found that maximum CBR value was obtained for woven geotextile, when it is placed as three layers. The BCR value obtained for clay as 1.005 and for sand as 1.0039 shows that there is sufficient improvement in the strength characteristics with the usage of geotextiles. When effect of water table and pore-pressure was considered, the variations in the strength characteristics goes on changing but the CBR values were increased. Geotextile reinforcement is an effective method to improve the CBR of soils.

Keywords: Plaxis 2D, California Bearing Ratio, Bearing capacity ratio.

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