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A GOAL FOR GEOTEXTILES
UN BUT POUR LES GEOTEXTILES
ZIELSETZUNG FÜR GEOTEXTILIEN

The use of geotextile as a reinforcing material is not new. The concepts of using various types of fabrics and geotextiles as reinforcing materials have been reported at first and second international conferences on geotextiles in Paris and Las Vegas (U.S.A) respectively. But available information on basic physical properties like strength and deformation behaviour of woven geotextile materials is not adequate. Therefore, the purpose of this present investigation is to ascertain the stress-strain relationships of geotextile reinforced earth samples under different confining pressures. It is found from the experiments that the addition of geotextile materials to earth causes considerable amount of improvement. Moreover, the geotextile reinforced sample is much better in strength than the corresponding geotextile unreinforced sample. The configurations and placing of geotextile materials and the results obtained from the tests are reported and discussed in this paper.

Die Verwendung von Geotextilen als Verstärkungsmaterial ist nicht neu. Die Konzepte verschiedener Typen von Geweben und Geotextilien als Verstärkungsmaterial zu gebrauchen, wurden im ersten und zweiten Geotextil-Kongressen in Paris bzw. in Las Vegas (U.S.A) erörtert. Jedoch sind Angaben über die grundlegenden physikalischen Eigenschaften gewebter Geotextilien, wie ihre Festigkeit und ihr Deformations-Verhalten, nur ungenügend vorhanden. Das Ziel vorliegender Untersuchung ist deshalb, die Spannungs-Dehnung Verhältnisse von, mit Geotextilen verstärkten, Erdproben unter verschiedenen allseitigen Druckspannungen festzustellen. Die Versuchsergebnisse zeigen, dass das Hinzufügen von Geotextilien zum Boden eine beträchtliche Verbesserung bewirkt. Eine von Geotextilien verstärkte Probe ist druckfester als die entsprechende nicht verstärkte Probe. In dieser Arbeit wird über die Art und Anordnung der Geotextilien sowie die Versuchsergebnisse berichtet und diskutiert.

INTRODUCTION

Geotextiles

Use of polymers and manmade synthetic materials as geotextiles have proved to be very beneficial for agriculture, water conservation, water pollution control etc. Their chemical and biological performances, physical and mechanical properties are very advantageous in geotechnical engineering (2). Geotextile material generally perform three main functions : (i) layer sepration, (ii) filtration/drainage boundary and (iii) reinforcement (5). Today geotextiles can be used for the construction of roads, reservoirs, sports ground, fabric retaining walls, bridges, dams, railroads, drainage, erosion control, garden construction, shore lining and pipe wrappings, high rise buildings, drainage and foundations (1,3). The mechanism of geotextile reinforcement is also germane to the behaviour, function and reliability of geotextiles. The various aspects of geotextiles material properties, functions, applications etc. have been reported by Giroud (14). A practical design procedure for unpaved roads reinforced with geotextiles was proposed by Giroud and Noiruy (11).

The growth of geotextiles have been sudden and headed for even better prospects in the future. There is an ample scope for innovation in the choice, design of geotextiles in variety of civil engineering applications. The property requirements of geotextiles are yet to be established (3).

Fibers

The development of man-made fibers is an event of profound significance. Today, woven textiles and their end products constitute the world's second largest industry. The use of woven textiles in geotechnical engineering which of recent origin have further broaden field of their application. Very recently, a team of Japanese researchers has won a patent for a hollow man-made fibre which, when prepared in membrane form, is suitable for fractinating blood components (3). Their use in pollution control may not be a far-reaching thing. Aramide fibres have a chance of substituting asbestos in some fields like friction linings, seals and heat protective clothing (5). A system using hollow nylon fibers provides pure water from sea. Today polyester and polyamides are increasingly used for ropes and fishing nets. The term advance fibres includes aramide, carbon silicon carbide, aluminium oxide and boron fibres. These are characterised by high stiffness, high rupture modulus and excellent tensile strength. The applications of these fibres were triggered by several factors : First, the oil crisis of 1973 - 74 and 1978 - 79, increasing popularity of sports, awarness of health hazard characterized by increased terroist activities. Besides the introduction of composite fibre materials in aircraft was set by the Boeing 767 project and followed by others. Because composite fibre material offered excellent rigidity and strength and reduces the operating cost by about 35%. The organic fibres degrade so rapidly, it is the development of man-made fabrics that ushered in the age of geotextiles, which include fabrics for stabilisation (37%); fabrics for coastal erosion and erosion control (12%); drainage fabrics (18%); asphalt and moisture proofing (18%) and exotic high performance requirements (15%) (3). The commercial success of an invention by Mercer was ensured when engineers discovered that his types of open mesh fabric were better suited than steel wire mesh for specific ground engineering applications (6).

Recent Studies

In most of the recent numerical investigations the soil-reinforcements was represented by an equivalent homogeneous or a discrete finite element method. e.g. Herrmann (8). Hausmann and Vagneron (9), McGown etal (10), Mandal and Char (13). An analytical model for soil-membrane (geotextile) interaction was presented by Bourdean etal (12). The primary influence of the geotextile-reinforced embankments on soft foundations were reported by Boutrup and Holtz (12). The behaviour of fabric is more pronounced with higher modulus geotextiles and for undrained response of foundation. Ingold (4) reported that there is a significant difference between results from shear box tests, either fixed or free, and pull-out tests. There is general agreement that the often large disparity between shear box and pull-out test results arises question of the effect of geotextile extensively requires much more research, both from the point of view of testing and its effect on the degree to which the reinforcing mode is actually mobilised in the field. Keeping this view in mind a goal for geotextiles reinforced earth structures has been taken up into consideration. The main purpose of the present study is to ascertain the response of strength and deformation behaviour of woven geotextiles. It was observed that the stress-strain response of sand are considerably improved by the introduction of geotextiles.

SAND AND GEOTEXTILES

The sand is locally known as Toyoura. The soil was an oven dried. The properties of sand are shown in Table - 1.

TABLE 1.- PROPERTIES OF SAND

D_{10}	0.162
C_u	1.467
G_s	2.644
ϕ_{triax}	40^o
e_{max}	0.84
e_{min}	0.42

Two woven geotextiles were selected for the purpose of this testing. The physical properties of woven fabric are given in Table-2.

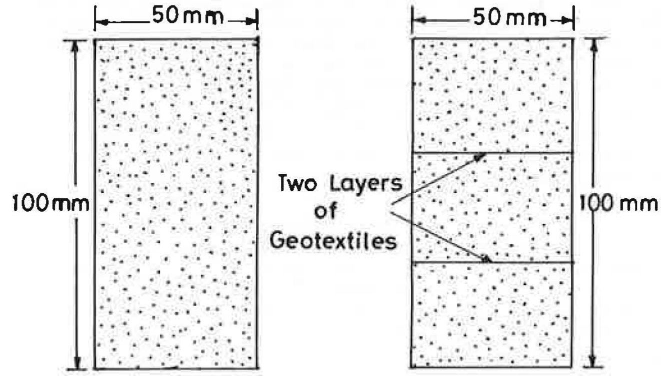
TABLE 2.-PHYSICAL PROPERTIES OF WOVEN FABRICS

Type	1030	1020
Thickness(mm)	0.51	0.33
Weight (g/m^2)	308	230
Tensile strength(Kg/cm^2)	285	187
Elongation (%)	24	21
Tearing strength (kg)	78	60
Water permeability	3.1×10^{-4}	1.3×10^{-3}

N.B : 1 Kg/cm^2 = 97.84 KPa, 1 Kg = 9.81 N

TRIAXIAL TESTS

The conventional triaxial tests were carried out on dry samples reinforced with horizontal circular strips of woven geotextiles. Samples were typically 50 mm in diameter and 100 mm in height. The samples in the mould were always compacted in three equal layers. The strips were kept horizontally in two layers as shown in Fig. 1.



(a) UNREINFORCED SAMPLE (b) REINFORCED WITH GEOTEXTILE

FIG.1.-ARRANGEMENT OF GEOTEXTILES

The diameter of the strips were the same as the triaxial samples. Compaction in three layers in the mould assembly gave a uniform dry density and corresponded to approximately85% relative density by tamping. Confining pressures of 97.84 KPa, 146.76 KPa and 195.68 KPa were taken. Strain controlled tests were used for all the undrained triaxial tests. A deformation rate of 3 mm/min was used for all tests.

RESULTS

The triaxial compression tests were performed to determine the stress-strain relationships of woven fabrics. The stress-strain relationships for unreinforced and reinforced with fabric are shown in Figs. 2, 3 and 4. The results of tests are given in Table -3.

The initial tangent modulus and maximum principal stress difference are substantially improved by the introduction of geotextiles. Moreover, the geotextiles reinforced samples showed a smaller axial strain at failure than corresponding to unreinforced samples. For smaller strain levels, the deformation moduli are very much improved by the presence of geotextiles. A slight bulging of samples observed between the reinforcing layers during the experiment.

CONCLUSIONS

Due to the introduction of geotextiles, the angle of internal frictions, initial tangent moduli and the ultimate strength

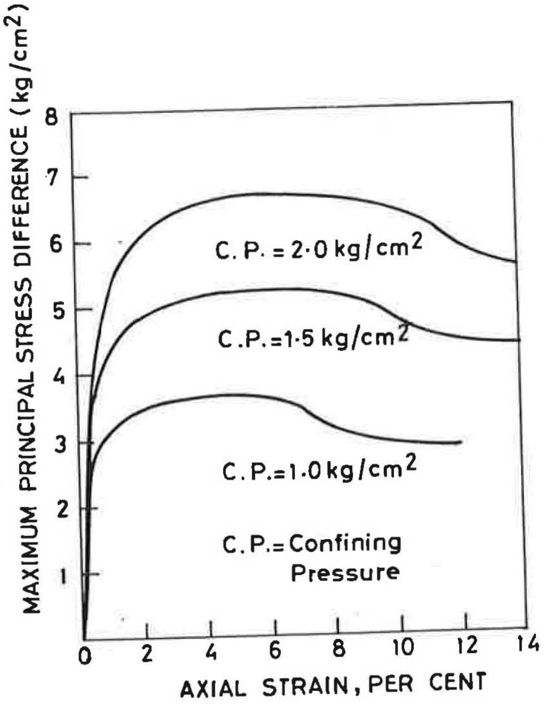


FIG.2.-STRESS-STRAIN RELATIONSHIPS FOR UNREINFORCED SAMPLES (1 Kg/cm^2=97.84 KPa)

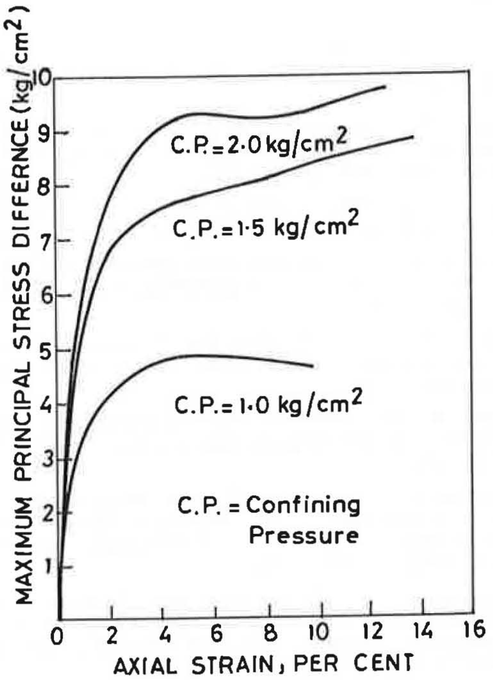


FIG.4.-STRESS-STRAIN RELATIONSHIPS FOR WOVEN.FABRIC, TYPE.1020 (1 Kg/cm^2 = 97.84 KPa)

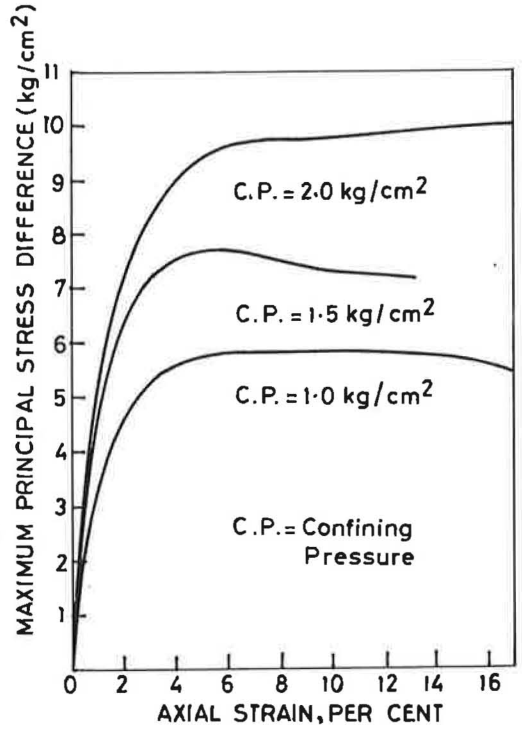


Fig.3.-STRESS-STRAIN RELATIONSHIPS FOR WOVEN FABRIC, TYPE. 1030 (1 Kg/cm^2=97.84 KPa)

TABLE 3.-TRIAXIAL TEST RESULTS FOR WOVEN FABRICS

Reinforcement	Type	Confining pressure (Kg/cm^2)	Maximun principal stress difference (Kg/cm^2)	Axial strain (%)	Initial tangent modulus (Kg/cm^2)
Unreinforced	-	1.0	3.60	6.0	-
		1.5	5.20	7.0	-
		2.0	6.70	7.0	777.78
Woven	1020	1.0	4.90	5.0	-
		1.5	7.10	7.0	-
		2.0	9.25	6.0	1166.67
Woven	1030	1.0	5.80	5.0	-
		1.5	7.70	5.0	-
		2.0	9.75	7.0	1250.00

N.B : 1 Kg/cm^2 = 97.84 KPa

of triaxial samples improved substantially. Deformation moduli are very much improved at lower strain levels. The geotextile reinforced sand showed a smaller strain at failure than corresponding unreinforced samples.

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