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BEARING CAPACITY OF STRIP FOUNDATION ON SOFT SOIL REINFORCED BY GEOTEXTILE
PORTANCE DE FONDATION SUR SEMELLE SUR SOL MOU RENFORCE PAR DES GEOTEXTILES
TRAGFÄHIGKEIT VON STREIFENFUNDAMENTEN AUF GEOTEXTILVERSTÄRKTEM, WEICHEM BODEN

This paper concerns tests of rigid strip foundation on subsoil reinforced by horizontally placed geotextile. The two-layer subsoil was used ie.mud covered by sand. The experimental results for two types of geotextile in relation to the case without geotextile are presented, for different inclination and eccentricity of load and two different lengths of geotextile anchorage.

Die Ergebnisse von Laborversuchen eines streifen Fundamentes auf zweischichtigem Boden mit waagerechter Geotextile Armierung sind vorgestellt. Die untere Schicht ist Schlamm, auf welchem das Geotextil aufgelegt ist und mit einer Sandschicht bedeckt wird. Die Versuche betrafen zwei Geotextilarten, verschiedene Neigungen und Exzenter der Krafte sowie zwei Verankerungslängen.

INTRODUCTION

The dynamic developement of geotextille application in civil engineering results from their uneque features as a flexible, two dimensional material made from synthetic fibres. Synthetic fibres allow to manufacture very useful and practical products.

An increasing amount of their applications is followed by technical criteria and standarts not always sufficiently precise, for example in the care of two-layer subsoil separated and reinforced by geotextile. The model tests of the influence of geotextile on the soil bearing capacity have been carried out in the Geotechnical Department of Technical University of Gdańsk since 1984. Our research enclosed the tests for one - layer subsoil /sand/ and two - layer soil /sand over mud/, but only the latter ones will be presented here.

EXPERIMENTAL LABORATORY MODEL

The general view of model stand is shown in fig. 1.

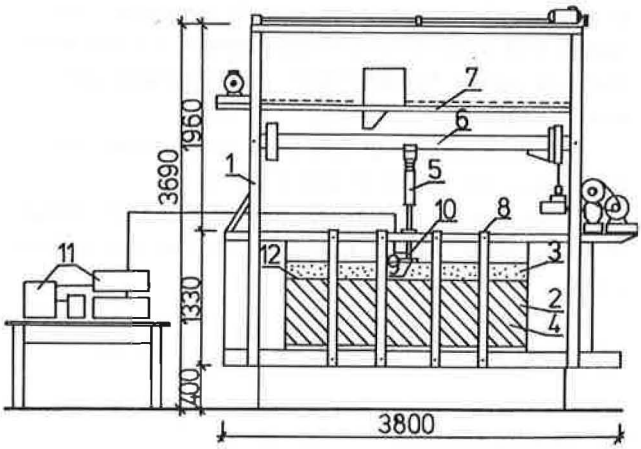

Fig. 1. Model set up for natural soil

1. steel frame, 2. Test box, 3. sand, 4. mud; 5. screw jack, 6. frame, 7. roil track and soil cherging box, 8. beams for glass protection, 9. strip foundation model; 10. tensometric dynamometer, 11. amplifiers and rocorders; 12. geotextile.

The box for sand had an utilitary length of 2,65 m width - 0,5 m and height - 1,07 m. The front wall was made of 35 mm thick glass that allowed photografical documentation of soil

displacements. In each test the same types of soil were used ie.mud covered by a layer of sand. Their properties are given in table 1.

Property	Unit	Sand layer	mud
Unit weight,	kN/m^3	16,72	20,90
grain diameter D_{10}	m	$1,8 \cdot 10^{-4}$	$1,5.10^{-6}$
grain diameter D_{60}	m	$2,5 \cdot 10^{-4}$	$1,1.10^{-4}$
water content	%	0,1	16,5
effective angle of friction ø	o	30	9,0
cohesion c	kPa	-	5,5
density or plasticity index		/densified/ $I_D = 0,69$	/soft-plastic/ $I_L = 0,59$

Table 1. Soil properties

A plate used to simulate the strip foundation /for example a caterpillar/ has width B = 0,2 m and length L = 0,5 m
The load was exerted by a screw jack with constant displacement rate v = 7,5 mm/min. The loads and displacements were measured electronically using tensometric dynamometers and dial ganges.

The mechanical properties of geotextiles are shown in table 2 and fig. 2.
The wide range of values was assumed to observe precisely their influence on the soil behaviour.

LABORATORY TESTS AND RESULTS

The test were carried out in 3 basic schemes, see fig. 3 a-c. Following 5 parameters

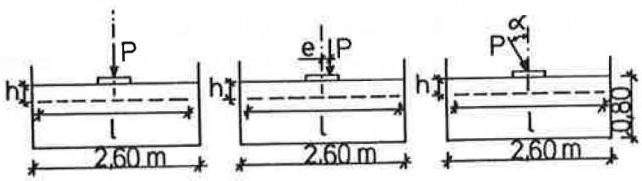

Fig. 3. The basic schemes of tests

L.p	Manufacturer	Trade name	Structure	Tickness mm	Tensile strenght kN/5cm
1.	Zakłady Włókien Chemicznych Chemitex-Elana Toruń	Geo włóknina	Nonwoven punched sewn	3	243
2.	Zakłady Wyrobów Dywanowych Zielona Góra	Novita	Nonwoven punched thermally bounded	4	325

Table 2. Properties of geotextiles

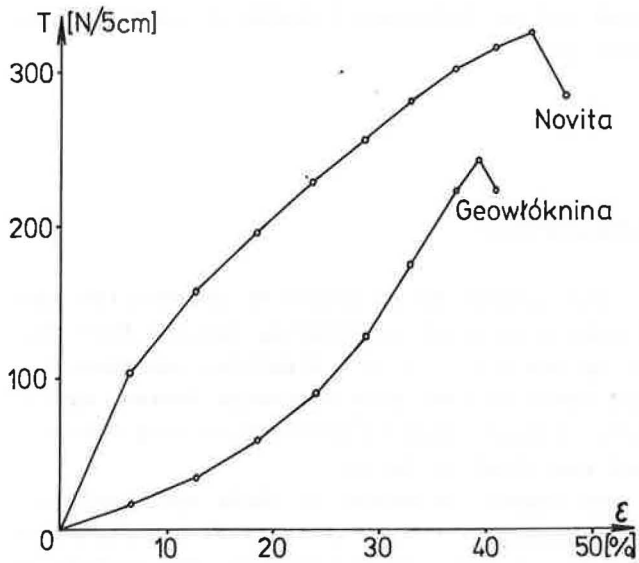

Fig. 2. Results of uniaxial tension strenght tests for two types of geotextile

influenced independently the bearing capacity of plate :
1/ thickness of sand layer equal to depth of geotextile - h,
2/ length of geotextile band l,
3/ type of geotextile,
4/ inclination of load α ,
5/ eccentricity of load e,

from which the first was emphasized. None of 75 carried out tests caused failure of geotextile and in all test a satisfactory recurrence of results was observed. The load was exerted until the settlement of plate reached 0,10 m. According to /1/ the results were related to the results of analogical tests, where no geotextile layer was used. A dimensionless bearing capacity ratio was defined as :

$$BCR = q_o/q$$

where :

q_o - bearing pressure for the unreinforced soil at settlement s = 0,05 m

q - bearing pressure for the reinforced soil at the settlement s = 0,05 m.

The influence of geotextile on ultimate bearing capacity appeared at relatively big settlements, which started to mobilize tension stresses in fabric. Hence s = 0,05 m was used as a representative value.

A significant influence on the behaviour of soil reinforced by geotextile has the length of anchorage of the fabric band /2 nd parameter/. The total lengths of fabric l_1 = 1 m and l_2 = 2,65 m were tried out /no additional anchorage was made at the end of geotextile/. A comparison between these two series of tests can be extracted from figures 4a, 4b and fig. 5. The length l_1 = 1 m was not sufficient because in oposition to l_2 = 2,65 m the slip of fabric could be distinctly observed /confirming results in /4/. The influence of the depth of geotextile was observed by varying it from 0,05 m to 0,2 m at different load conditions and using two konds of fabric. In fig. 4a the pressure - settlement curves are presented for centrical and vertical loads ; in fig. 6 - at angle of inclination of load α = 20° and in fig. 7 - at eccentricity of load e = B/6.

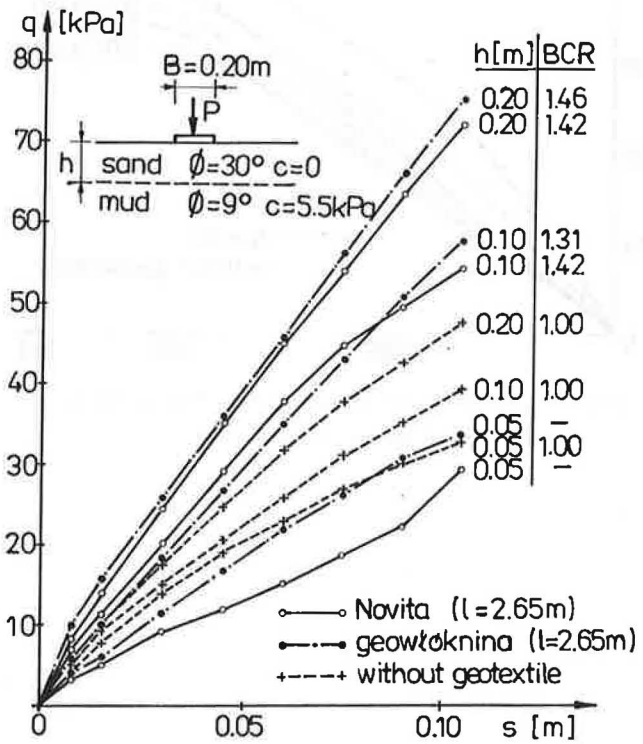

Fig.4a. Influence of upper layer thickness and type of geotextiles /lenght l = 2,65 m/ on bearing capacity of subsoil.

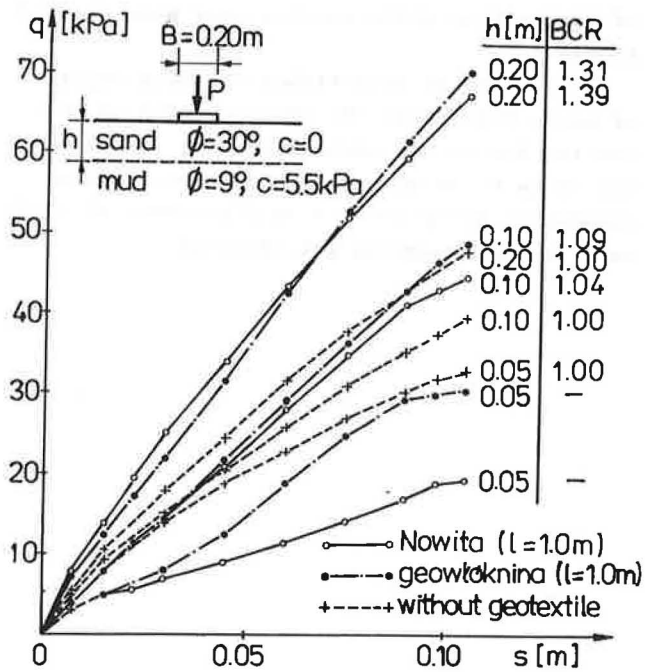

Fig. 4b. Influence of upper layer thickness and type of geotextiles /lenght l = 1,0 m/ on bearing capacity of subsoil.

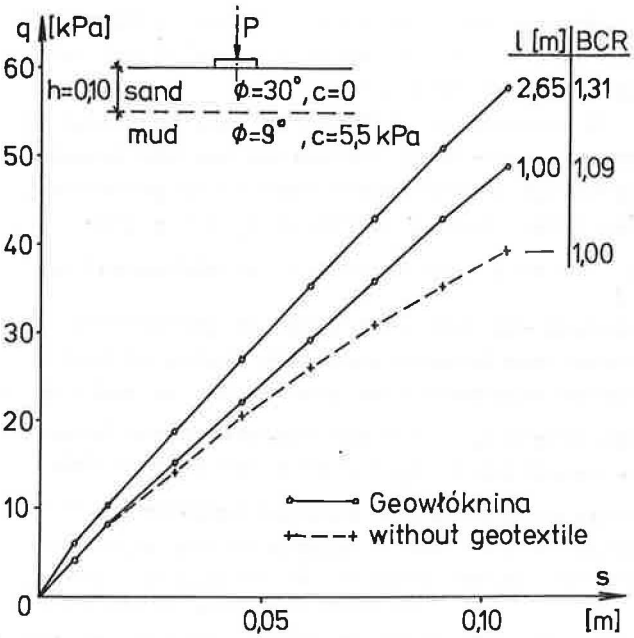

Fig. 5. Influence of geotextile lenght on bearing capacity of subsoil.

A particular case was observed for the 5 cm thickness of sand layer, that gives BCR < 1.

It could be a result of elastic reflection of sand grains while pouring sand onto elastic fabric.

This would be significant for thin layers of sand. Concerning the optimal depth of geotextile due to the maximum bearing capacity q the value h 20 cm seems to be a reasonable assumption since for h = 30 a decrease of ultimate bearing capacity was observed.

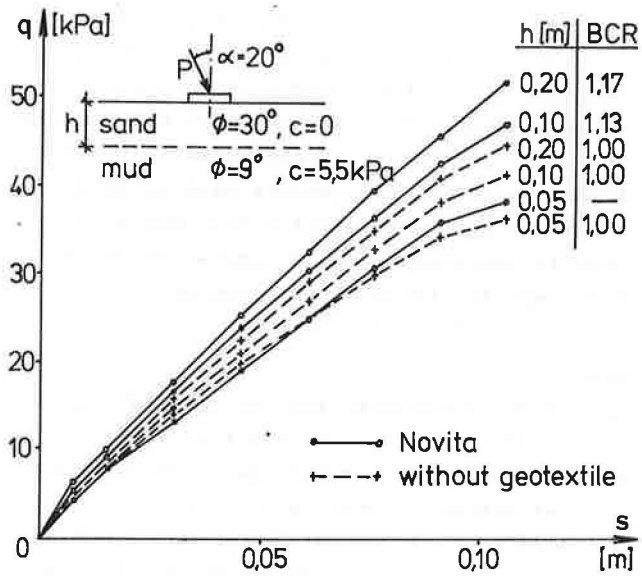

Fig. 6. Results of model tests for inclined load of strip foundation

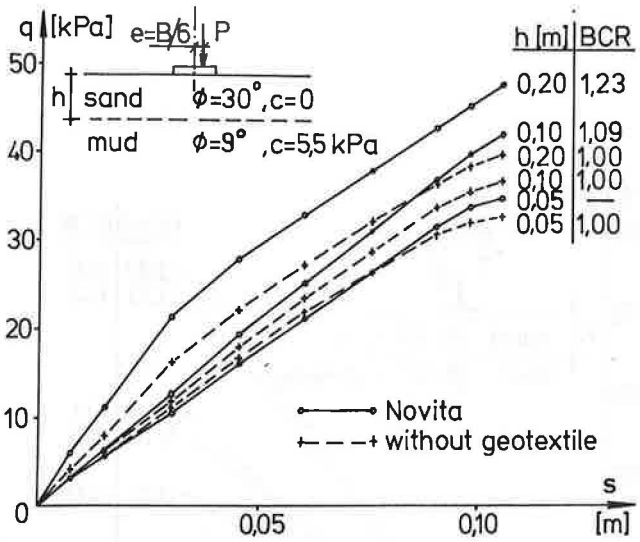

Fig. 7. Results of model tests for eccentric load of strip foundation

CONCLUSION

From the results presented the influence of 5 parameters can be extracted and analysed separately for the similar soil conditions. They are :

1. Thickness of sand layer h,
2. Length of geotextile band l
3. Type of geotextile,
4. Inclination of load α,
5. eccentricity of load e.

The effect of reinforcement is observed at big deformations only, with maximum influence on settlements s /reduction/ at $B/2 < S < B$.

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