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The Experimental Research of Foundation Behavior on Weak Clay with Reinforced Sand Blanket with Curved Floor

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Abstract

The article reports results of research of the foundation behavior on weak clay soils with strengthening of the foundation with the sand blanket that all around reinforced with the geosynthetic material. Author proposed the structure of sand blanket with curved floor that all around reinforced with the geosynthetic material. Reinforcing element of the sand blanket press the transversal strain of the sand soil then so that to reduce the deflection of the press-tool. Curved floor of the sand blanket makes the pressure in a weak clay foundation more uniform. Moreover, it increases the using soil volume and makes more effective behavior of the reinforcing element. The curved bearing surface of the sand blanket allow to increase the range of the line soil foundation behavior and reduce the settlement of the press-tool by 2.5 times.

Keywords: Foundation, weak clay soil, sand blanket reinforced with the geogrid.

INTRODUCTION

Tyumen region territories characterized as territories with a weak clay soils. It makes difficult to build of the low-rise buildings and increase the cost of the construction. Therefore, it is necessary to invent new technologies of soil bearing capacity increasing.

Author suggests the system of the sand blanket with the curved floor that all around reinforced with the geosynthetic material. Reinforcing element of the sand blanket press the transversal strain of the sand soil then so that to reduce the deflection of the press-tool. Curved floor of the sand blanket makes the pressure in a weak clay foundation more uniform. Moreover, it increases the using soil's volume and makes more effective behavior of the reinforcing element.

SUBJECTS AND METHOD

For research of deformation characteristics of the foundation bed was used the photofixation method. The principle of method in forming of the grid of marks on the backside of the soil behind the transparent wall. Next step is to fix the initial positions of the marks with the photo shooting and then marking photo every next pressing step. After the experiment obtained photos processed in pairs in image editor software. The result of these manipulations is a value of the soil particle displacement.

The experimental device is a soil tray in clipped center plane of half of cylinder form. The diametric wall made from transparent acrylic plastic. It allows to make instrumental and visual monitoring of foundation's deformation. The height of the tray is 800 mm, the diameter is 980 mm.

The loading was made with step static load and console-lever system (Fig. 1).

Figure 1: The experimental device.

The disturbed loam sample was used as foundation. It was loaded in the tray layer-by-layer .The physical mechanical properties of the soil presented in Table I.

Table 1: The physical mechanical properties of the soil

Modulus of deformation E, MPa	Soil plasticity number I_p, unit fraction	Flow index I_l, unit fraction	Soil consistency,ρ, g/cm^3	Phi/porosity (fractions) e, unit fraction	Soil moisture level S_r, unit fraction	Natural moisture content w, unit fraction	Angle of shear resistance, φ,°	Specific cohesion c, MPa
4.3-5.7	0.16	0.63-0.69	1.76-1.84	0.8-0.89	0.9-0.96	0.29-0.30	15.2-19	0.017-0.020

The press tools in scheme presented as a rectangular with the 100 mm width and 250 mm length.

The researches were made in an unfortified soil samples and with strengthening of reinforced sand blanket with the curved floor. The sand blanket formed as clipped ellipse form with depth that equal the width of press-tool (100 mm).The width of the sand blanket formed proceeding from the 70 mm behind press-tool condition.

The scheme of the models presented in the Fig. 2

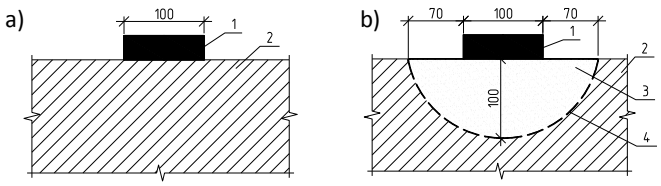

Figure 2: The models of soil foundations: a – for the clay foundation press-tool; b – for the reinforced sand blanket with curved floor press-tool; 1 – for the hard and flat press-tool; 2 – for the weak clay foundation; 3 – for the medium coarse sand; 4 – for the geogrid.

The geosynthetic material SSP 30/30 (geogrid) was used as a reinforced material. The physical mechanical properties of the geogrid presented in Table II.

Table II: The physical mechanical properties of the geogrid

Geogrid model	Breaking strength, kN/m		Cell size, mm	Roll width, cm	Roll length, m
	Along (warp)	*Across (weft)*			
SSP 30/30-2.5(150)	30	30	2.5	150	100

RESULTS

The settlement-loading graphs for the both type of foundations presented in Fig. 3.

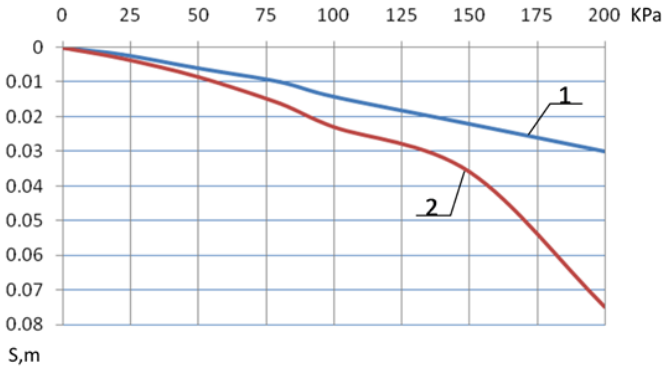

Figure 3: The settlement-loading graphs: 1 – for the press-tool on a clay foundation strengthening with reinforced sand blanket with curved floor; 2 – for the press-tool on a clay foundation.

Analysis of the graphs shows that settlement of the press-tool on the unfortified foundation increases much faster than on a reinforced sand blanket with curved floor foundation.

The difference between settlements in the first steps is 10%. At 50 KPa pressure perceptible increased the difference of the settlements between the press-tools. It shows that reinforcing element works.

The contour lines of vertical and horizontal movements were ploted at 150 KPa pressure. These contour lines based on experimental research data (Fig. 4).

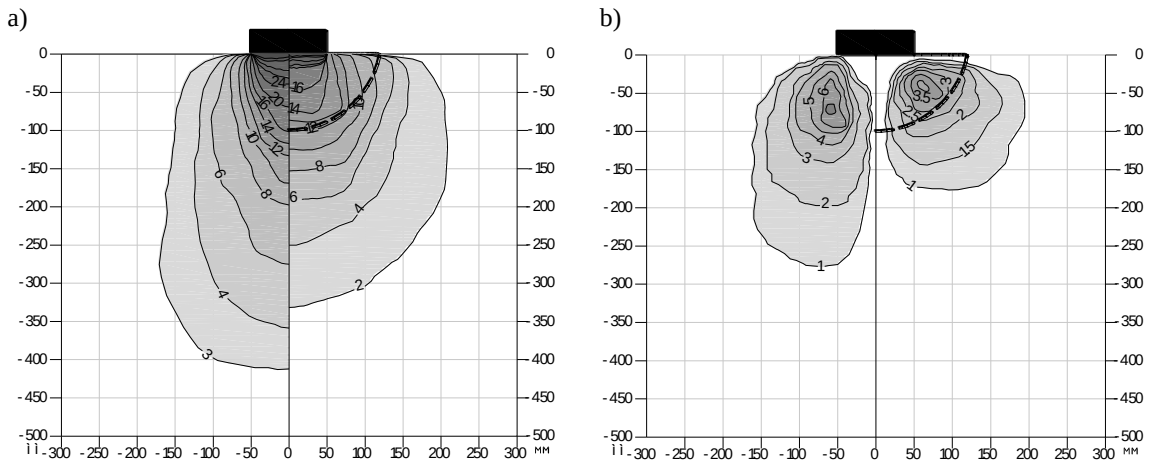

Figure 4: The contour lines of the movement; a - for vertical, b - for horizontal (left parts – for unfortified foundation, right parts for reinforced foundation).

CONCLUSIONS

1) The range zone of the vertical movement on a reinforced foundation takes the «onion» form. This suggests about including in behaviour of the foundation all around the curved floor of the sand blanket;

2) The press tool on a reinforced foundation has maximum horizontal movements in body of the reinforced sand blanket, that leads to a decreasing of it's absolute value;

3) The horizontal deformations areas spread's depth for the press tool on unfortified foundation is 2.8b and for reinforced foundation is 1.7b;

4) The curved base floor of the sand blanket allow to increase range of the line behavior and to reduce the settlement of the press tool in 2.5 times.

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