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Research Article

The Research of Behavior of Contour Reinforced Sand Blanket with the Curved Floor in a Weak Clay Soils Conditions

Andrey N. Kraev, Aleksey N. Kraev*,

Dmitriy S. Skvortsov and Erkn A. Zhaisambaev

Industrial University of Tyumen, Tyumen, Russia
* kraev_aleksey@list.ru

ABSTRACT:
The research includes the new method of soil strength increasing and reducing of its deformation with the contour reinforced sand blanket with the curved floor. This method makes it possible to reduce sand blanket size through application of the contour reinforcing with curved floor form.

Keywords: sand blanket, contour reinforcing, curved floor.

[I] NTRODUCTION

Nowadays, geosynthetic materials are wide involve for soils reinforcement in civil engineering works. Especially, it is relevant in conditions of weak clay soils.

The basic objectives of the reinforcing are listed below:

- Increasing of soils stability and mechanical strengthening of basis;
- Reducing of deformation processes in soils;
- Elimination of the bottom heave processes.

But, despite the wide use of reinforcing materials, there are a lot of issues in a field of reinforced foundations engineering. It is also relevant in view of its high costs, hard work content and insufficiently exploring. The lack of practical experience and the lack of a regulatory framework are the biggest problems that impeding the full growth in field of reinforced foundations engineering. [1]

[II] SUBJECTS AND METHODS:

Applying of contour reinforced sand blanket with the curved floor is one of the effective ways to increase strength of a weak clay soils [2]. This technology allowed to reduce foundation settlement due to the measures described below:

- Weak soils were replaced with sand;
- Body of sand blanket was contour reinforced;
- Stages of linear foundation work were increased with uniform load transfer on weak soils, including curved floor form of reinforced sand blanket and inclusions of maximal shear zones and plastic collapse in its body.

The above described technology is rational in case of engineering of low-rise buildings based

on strip foundation in a weak clay soils conditions [3].

The experimental field researches were made for studying of the clay base behavior that reinforced with curved floor sand blanket.

The field tests were made at site that located in central district of Tyumen city at Eleckaya street 13/1. In accordance with geomorphology, the testing site located on terrace above the flood-plain of Tura river. The testing site has a smooth relief and from 76.42 to 77.00 m for absolute ground level.

Groundwater conditions of the testing side included ground water level that have been committed from 1.5 to 1.85 above the ground level that corresponds from 74.92 to 75.15 m for absolute ground level. Physicomechanical characteristics of soils in the site set out in table 1.

Preparation stage includes the topsoil stripping and excavating of pit to +75.500 m absolute ground level. Next step of this stage included forming of the curved surface trench for sand blanket. Engineering surveys were made with the geodesic control of set curvature. Size of the sand blanket was set according to ellipse curve with 800 mm depth and 1500 mm width.

Next stage includes drilling of wells for load cells installation [4]. Load cells were set in side wall of the wells with special injection device. Then wells were covered and hard packed with excavated ground.

Woven geotextile Geospan TN-80 was used as reinforcing material. It was laid along the curved outline of the sand blanket after the load cells have been set (Fig. 1).

Then layer-by-layer sand fill work of the sand blanket including the soil packing and load cells installing were made after reinforcing material have been set. Sides of the geotextile were rolled with an overlap in top of the sand blanket and fixed with metal staples after soil had been packed.

Strip foundation on a natural base with similar sizes were performed simultaneously.

Fig. 1: Reinforcing material installation process.

Table 1: Physicomechanical characteristics of soils.

Soil type	Depth, m	*W*,%	I_p, %	I_l, u.f.	γ, kN/m^3	*e*, u.f.	S_r, u.f.	φ, deg.	*c*, kPa	E, MPa
Loam	0-1.1	22	13	0.24	18.1	0.78	0.7	17	17	3.83
	1.1-4.5	28	8	0.58	19.2	0.68	0.88	16	12	4.89
	4.5-7.3	20	8	0.46	20.0	0.58	0.89	23	7	6.15
	7.3-17	35	13	0.56	18.7	0.89	0.98	21	9	3.64

Indicatos as settlement of the foundations, ground movements, general pressure and pore pressure were recorded during the experiment. Vertical movements of the ground layers and sand blanket body were measured with deep screw marks. Movements of the marks were recorded with the deflectometers with 0.01 mm scale gradation.

Soil stresses were measured with general pressures strain-gage indicators and pore pressures strain-gage indicators [5]. Digital converter Field Point (National Instruments) with original virtual instrument was used as a

recording device. As for virtual device, it was created in LabVIEW computer software for PC.

Fig. 2 shows the load cells and ground marks installations scheme.

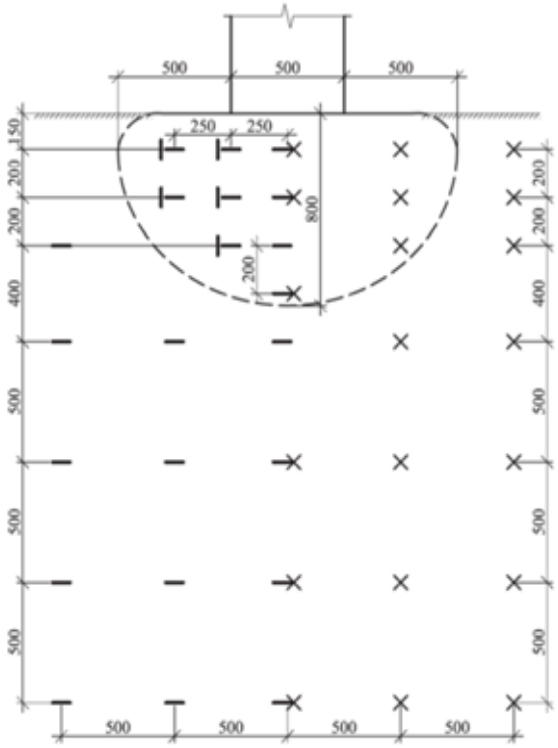

Fig. 2: Load cells (on the left side) and ground marks (on the right side) installations scheme.

Basement load pressures were transferred with foundation blocks (FBS 24.6.6) via 4 steel flanged beams (40 SH1) that was laid on a model of strip foundation with 0.5x5m sizes in plan. Total pressure was 1200 kN (60 blocks), that corresponds to 240 kPa of medium pressure under the foundation floor of the strip foundation.

Fig. 3: The experimental research site.

[III] RESULTS

The settlement-pressure graphs were based on the results of experimental research (Fig. 4). In addition, study shows pattern of vertical strains and vertical movements (Fig. 5) in body of the contour reinforced sand blanket with the curved floor and the weak sub-base.

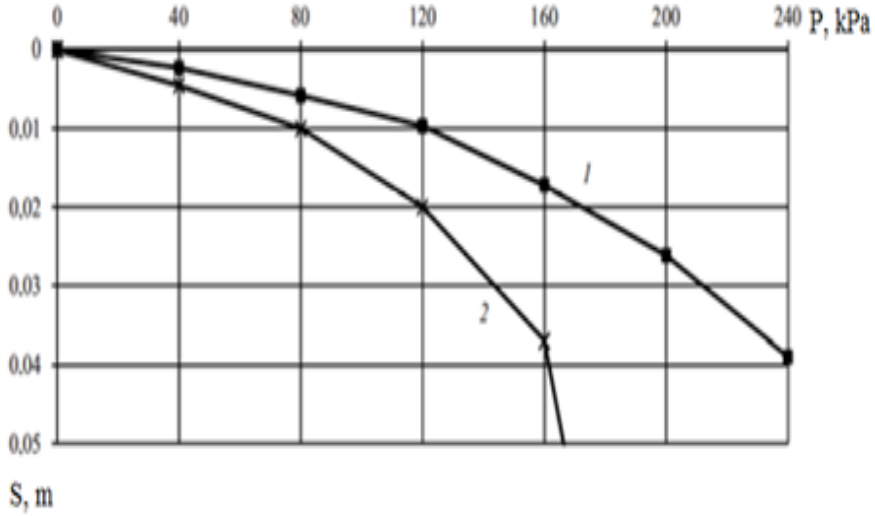

Fig. 4: Experimental graphs “settlement-pressure”: 1 is for foundation with contour reinforced sand blanket with the curved floor; 2 is for natural ground.

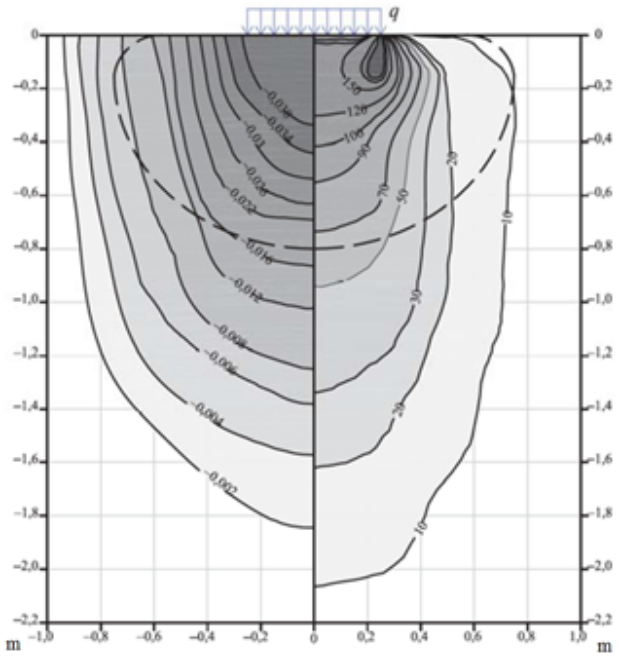

Fig. 5: The experimental contour line of the vertical movements (left side, in m) and vertical strains (right side, in kPa).

The graphs analysis shows that settlement of the press tool on a natural ground increasing much faster than settlement on a ground with contour reinforced sand blanket with the curved floor. Press tool lost the bearing capacity on a clay foundation at 160 kPa pressure. Ground settlement in a reinforced foundation with same pressure was twice less. A further increase of strain shows the linear behavior of reinforced foundation until the end of the experiment.

Contour lines that based on research results show the developments of vertical movements in body of reinforced sand blanket with curved floor and pressure distribution. Contour lines show developments of vertical movements and pressures distribution at 80, 160 and 240 kPa. Fig. 5 shows the contour lines of movements and stresses at 240 kPa average pressure.

Analysis of contour lines of vertical movements in soil body that armored with sand blanket with curved floor shows that settlement of press-tool at 80 kPa is a results of deformation of body of sand blanket. There are vertical movements in all sections of the reinforced sand blanket at 160 kPa. This indicates that a whole sand mass in reinforced geotextile block included in ground work. The increasing of pressure to 240 mPa shows that vertical movements were relocated to weak soils basement in a whole curved side of sand blanket.

[IV] CONCLUSION

The following conclusions were made and based on results of the experiments:

- Applying of contour reinforced sand blanket instead the weak soils localizes zone with the highest development of shearing stresses and shear deformations in a solid sand ground under the strip load. All this allows to increase linear zone of ground work and reduce its deformability.
- Contour reinforcing of the sand blanket with curved floor, that close to contour lines of the major principal compression are considerably reduce settlement of the foundation (more than twice).

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