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THE INVESTIGATION OF ANISOTROPIC BEHAVIOR OF SHELL LIMESTONE BY MODELS OF AUGER PILE IN LABORATORY-LIKE ENVIROMENTS

Novskyi Aleksandr, Novskyi Vasilyi, Vivcharuk Vladislav

Odessa State Academy of Civil Engineering and Architecture

The methods and results of the investigation of anisotropic behavior of shell limestone by models of auger pile in laboratory-like environments are described.

Key words: shell limestone, anisotropy, lamination, strength in shear, structural strength.

1. Introduction

The widespread use of shell limestone as the base of foundations, including auger pile, allots a new task for researchers, the solution of which will allow to investigate these subsoil, which possess special characteristics.

Sawn limestone is organogenic rock, which possess anisotropic behavior. Its thickness consisting of mussels – skeleton remainders of shellfishes, which are located horizontal and cemented on their contacts of strong crystallizational bonding. Collapsing strength is dependent on the direction of effort. The meaning of maximum load applied vertically to the flatness of their savings (through-the-lamination) is lower than in horizontal direction (alongside the lamination). This may explain the different indicator values of nonrigid and structural behaviors properties in horizontal and vertically directions.

In the normative literature is adopted anisotropy coefficient k_a for evaluation criterion for anisotropic properties of rock and half-rock solids, and his value is determined by the ratio of indicator of maximum strength on unixial compression in horizontal direction R_{ca}, to its value at the vertical vector of the load application Rc.[1,2].

It should be noted that a similar relation between another ratios of mechanical characteristic of shell limestone (structural strength, strength in shear) is considerably different from the coefficient of anisotropyby amount of strength on unixial compression, and that because you must use the corresponding coefficients of anisotropy in the calculations that use the structural strength and strength in shear, including alongside the side face of auger piles.

The purpose of research, the results of which are presented in this paper, is further definition of anisotropic properties of shell limestone - shell rock of Odessa region determining the strength in shear alongside the side face of models of auger piles, which are located across, alongside and at an angle 45^0 to the lamination.

2. The results of the investigation.

The shell limestone has a high porosity (60%). Has an appreciable quantity of interstices of generous size. Drilled formation wall of auger pile have a high porosity. Cement slurry at concrete pouring of pile is permeating to the large blowing spaces of interstices and forming a rough blending surface between the trunk of the pile and the surrounding rock. The shearing resilience is determined not by friction, but durability of limestone, which is situated outside surface of pile shaft, impregnated with consolidated non-shrink grout. Consequently, the destruction at “frustration” occurs on limestone.

The investigation of shell limestone by pales of minor diameter in a laboratory environment are made in compliance with the basic requirements of ДСТУ Б В.2.1-1-95 “Soils. Field test method by pales”. Investigations were carried out to determine shearing resilience at side face surface auger piles. For this, their production was carried out with preservation of below vesicle bottom that promoted the furnish of load transmission on the shell limestone at the contact of side face of stem with internal surface of down hole. We bored down hole with diameter 21mm to the full height of the sample. We filled with sand on the required height the lower part, whereupon, the down hole was filed by non-shrink grout. We performed shaft equipment by cane of iron wire of Ø 3 mm, and the head top we strengthened by snipping of the pipe Ø1 / 2 inches by a height of 6 sm. The vesicle, which is below bottom of bore, was out of sand after achieving the design strength.

Investigations were carried out on a laboratory bench posed a hand-power press, its circuit design and physical configuration are showed on the picture 1.

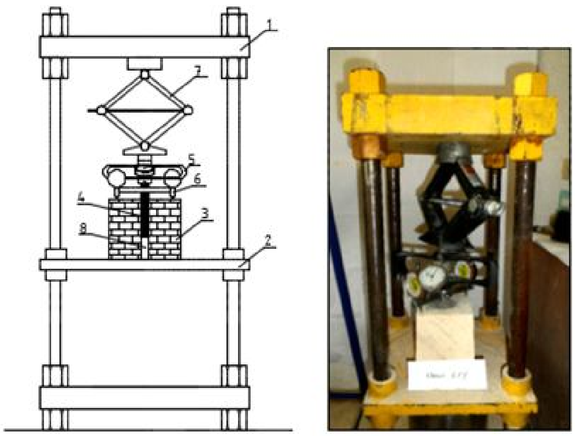

Fig.1. Scheme appearance and propulsion test coquina limestone models of bored piles

1-2 - fixed plates; 3 – sample of shell limestone; 4 – model of auger pile; 5 – dynamometer; 6 - dial test indicator; 7 - adjustable jack; 8 – cavity under the pile toe.

The loading of pile was carried out by degrees at 0,5кН. Each grade of load was maintained until the advent of conventional stabilization of displacement, adopted 0.01 mm in the last 10 minutes of observation. For maximum take the load at which the displacement of the pile does not die out. After the “frustration” repeated investigations of piles were carried out to determine the shearing resilience alongside the side face after the destruction of the structural bonds.

Amount of the load at each stage was determined by a dynamometer, which was installed on the head of pile, with support on the upper stationary plate. The exertion in dynamometer measured dial test indicator with a measuring sensitivity of 0.01 mm. Vertical displacement of piles during theinvestigations measured by two dial test indicators with a measuring sensitivity of 0.01 mm, which were fixed by the clamping console (reference system) on the metal head of pile. According to sample results the dependency diagramsof displacement of piles from load were plotted.

Table 1

The ratio of the shear resistance of shell limestone on the lateral surface of bored piles up and down bedding

№ ser,	Number of tests	Value indicators MPa		Factor aniso-tropy k_{af}
		across bedding f_c	along bedding $f_{c,a}$	
1	4	0,78	0,83	1,06
2	4	0,45	0,37	0,92
3	4	0,38	0,24	0,63
4	4	0,41	0,40	0,98
5	4	0,44	0,31	0,70
6	4	0,52	0,46	0,88
Average		**0,50**	**0,43**	**0,86**

The above-described method of determining the shearing resilience at the contact side face of auger piles and shell limestone was used in the investigations of shell limestone by piles across, alongside and at an angle 45^0 to the lamination, which allowed to establish the variation of this characteristic with the anisotropic properties of the rock.

The value limit of shearing resilience is determined by the results of theinvestigations of limestone by simulative piles across, alongside and at an angle 45^0 to the lamination. The results are shown in Table. 1 and 2.

Table 2

The ratio of the shearing resilience of shell limestone on the side face of auger piles across, alongside and at an angle 45^0 to the lamination.

№ ser.	Number of tests	Value indicators MPa		Factor aniso-tropy $k_{a,f}$
		across bedding f_c	under 45° to bedding $f_{c,45}$	
1	4	0,83	1,02	1,23
2	4	0,55	0,60	1,09
3	4	0,50	0,48	0,96
4	4	0,43	0,40	0,93
5	4	0,46	0,54	1,17
6	4	0,55	0,60	1,09
Average		**0,56**	**0,61**	**1,08**

3. Conclusions

In such a manner, the results of conducted investigations, the shearing resilience alongside the side of auger piles is lower, than across, and at an angle 45^0 to the lamination. is slightly higher. At that, anisotropy coefficients respectively equal to 86 and 1.08.

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