European Scholar Journal (ESJ)
Available Online at: https://www.scholarzest.com
Vol. 3 No.4, April 2022
ISSN: 2660-5562

CALCULATED SPECIFICATIONS OF MACROCLASTIC SOILS OF THE HIGHWAY SOIL BEDS

Kayumov A. D.
The Tashkent State Technical University named after Islam Karimov.
Address: University street №2, Tashkent city, Uzbekistan.
Azimova Sh. N.
The Samarkand State Institute of Architecture and
Civil Engineering named after Mirza Ulugbek.
Lolazor street №73, Samarkand city, Uzbekistan

Article history:

Received: 4th February 2022
Accepted: 6th March 2022
Published: 25th April 2022

Abstract:

The paper presents the results of laboratory and in-situ surveys of the calculated specifications of macroclastic of the highway soil beds used in the design of surfaces (modulus of elasticity *E*, internal friction angle φ, specific cohesion *C*). Also specified the optimal water content and the grade of compaction of such types of soils.

Keywords: soil bed, macroclastic soils, laboratory and in-situ surveys, strength and strain specifications, optimal water content, consolidation ratio.

INTRODUCTION

Macroclastic soils are usually well adopted for the construction of a bed and these types of soils are compressed a little under load. Moreover, macroclastic soils have significant shear resistance and resistance to weather and climatic factors. The results of in-situ tests performed by various researchers show the real properties of macroclastic soils of highway embankments which differ notably from those proposed by the current standards, particular: MKN 44-2008 [1] and MKN 46-2008 [2]. It is applied both to the values of soil water content and density (consolidation ratio) and to the relevant indicators of their mechanical properties used to design of surfaces (internal friction angle φ, cohesion *C* and modulus of elasticity *E*).

Methods. Clarifying the above-mentioned indicators of macroclastic soils, special experimental surveys has been carried out in laboratory and full-scale in-situ conditions on various highways of Uzbekistan.

The analyses of the scientific books by E.M. Dobrov and L.B. Kamenskaya [3] has been carried out by the authors show that to assess the stability of the soil bed of macroclastic soils, strength characteristics are used, determined by the magnitude of the shear resistance. With a content of large fragments up to 65% and argillaceous fine soil, shear resistance is estimated as for clay soils

$$S_{pw}=p\cdot tg\varphi_w+C_w, \qquad (1)$$

and with sand filler with a fragmentation content of more than 65%

$$S_{pn}=p\cdot tg\varphi_n+C_n, \qquad (2)$$

where: p is the normal stress acting in the soil on a given site;
φ_w, C_w are, respectively, the internal friction angle and the cohesion force at the water content of the clay filler W;
φ_n, C_n are, respectively, the internal friction angle and structural cohesion at a given density of macroclastic soil.

Under laboratory conditions, the resistance of model mixtures to shear was determined using the Maslov-Lurie device, depending on the granulometric composition of macroclastic soil at the water content of the clay filler equal to the optimum (W=18%).

The initial materials for the preparation of mixtures were taken fragments of 2-7 mm, loam with a plastic index of 16.38 and sand. The presented materials were subjected to laboratory surveys to characterise them in terms of composition - granulometric composition, specific gravity and plastic index.

RESULTS AND DISCUSSION.

The results of the tests to determine the shear resistance of macroclastic soils by means of the Maslov-Lurie device, depending on their granulometric composition, are summarised in Table 1

Table 1. The internal friction angle and cohesion of model mixtures depending on the granulometric composition with a solid consistency of fine soils (I_L = -0.375)

№	Soil composition, %	Strength indicators of the mixture	
		φ^o	*C*, МПа
1	Clay - 100	14	0.0775
2	Gruss - 100	42	0.005
3	Sand - 100	29°30^I	0.015
4	Loam 33.3%, gruss 66.7%	36	0.0325
5	Loam 33.3%, sand 66.7%	29°50^I	0.030
6	Gruss 33.3%, sand 66.7%	30°30^I	0.017
7	Loam 66.7%, gruss 33.3%	24	0.70
8	Loam 66.7%, sand 33.3%	22	0.067
9	Gruss 66.7%, sand 33.3%	36°30^I	0.0125
10	Loam 33.3%, sand 33.3%, gruss 33.3%	32	0.033
11	Gruss 50%, sand 50%	33°30^I	0.0125

To estimate the grade of consolidation and the mechanical properties of macroclastic soils in-situ conditions, experimental sections has been built on highways in 2018-2021: Reconstruction of the highway 4P-117: Turakurgon - Namangan - Chortok - Keskaner - Sassiksoy - M-41 (0.3-0.5 km) (Fig. 1) - II category; Reconstruction of the highway 4P57 - Kizilkum bypass road: Karmana - Nurota - Boymurod - Utamurod - Mullali - Tomdibulok on the section 22-32 km (Fig. 2) - II category; Highway 4K474A - Kurnos-Arab-Gova (Fig. 3) - V category; Highway - Fergana Yuli in Tashkent.

Figure 1. Reconstruction of the highway 4P-117: Turakurgon - Namangan - Chortok - Keskaner - Sassiksoy - M-41 (0.3-0.5 km)

Figure 2. Reconstruction of the highway 4P57 - Kizilkum bypass road: Karmana - Nurota - Boymurod - Utamurod - Mullali - Tomdibulok on the section 22-32 km

Figure3. Highway 4K474A - Kurnos-Arab-Gova

To recognise the influence of the impact of the own weight of the soil and the load from moving vehicles on the additional consolidation of the macroclastic soil in the experimental areas, in July 2021, the density of the macroclastic soil of the soil bed and the grade of its consolidation have been determined by the method of holes and the PDU-MG4 installation. The water content of macroclastic soil has been determined by the gravimetric method.

In 2021, master's student D. Aralov on the Fergana Yuli highway in Tashkent (Fig. 4) determined the modulus of elasticity of macroclastic soil of the lower base layer on the PDU-MG4 device. The tests have been carried out in accordance with the regulations. The test has been carried out on the right side of the traffic lane at 3 points of the cross section: 1.5 m from the edge of the base; into the axis of the right lane and the main axis of the road. The determinations have been carried out at 6 points every 50 m along the longitudinal section, a total of 18 points. The test results are presented in Table 2.

Figure 4. Highway Fergana Yuli in Tashkent

Determination of the maximum density and optimal water content of macroclastic soils is carried out according to GOST-22558 methodology with the following changes and additions: to test macroclastic soils with grain sizes up to 40 mm proposed to use a large Soyuzdornia device; for macroclastic soils with grain sizes of 80-120 mm, we suggest using devices with a diameter and height 1.5 times greater than the largest soil particles. In order to bring the conditions of consolidation as close as possible to the actual conditions of consolidation of the macroclastic soil of the highway, the mixture must be compacted through a rubber gasket [4, 5]

Table 2. Determination of the modulus of elasticity of macroclastic soils

Right side of traffic lane (PK)	Modulus of elasticity in the HPS surface, MPa (PDU-MG4)	Humidity GPS

	To the edge of the base 1.5 m	Axle right lane	Base axle	
PK 34+00	181	184	183	W=4,1%
PK 34+50	183	182	186	
PK 35+00	179	185	182	
PK 35+50	182	187	184	
PK 36+00	184	189	183	
PK 36+50	180	185	187	
Average	**181.5**	**185.33**	**184.17**	

Table 3 shows the results of determining the density of macroclastic soil in section №1 PK 54+64 - PK 55 + 62 and section №2 PK55 + 62 - PK 56 + 65 and the values of the consolidation ratio are calculated.

Table 3. Determination of the density of macroclastic soil in the experimental area by the method of holes

Plot number, PK	Soil sampling depth, h, cm	Natural water content of macroclastic soil, W, %	Maximum density of the soil skeleton, γ_{dmax}, g/cm³	Density of macroclastic soil		Consolidation ratio
				at natural humidity, γ, g/cm³	soil skeleton, γd, g/cm³	
Plot №1 PC 54+64-55+62	0-15	4	2.07	2.06	1.98	0.955
	15-25	4.6	2.07	2.055	1.965	0.948
	30-40	6.3	2.07	2.07	1.945	0.94
Plot №2 55+62-56+65	0-15	6.0	2.04	2.08	1.965	0.96
	20-30	7.6	2.04	2.09	1.94	0.95
	35-45	6.9	2.04	2.06	1.925	0.945

The surveys carried out on various highways in terms of solidity have shown that the specified and required consolidation ratios for macroclastic soils relative to their maximum density are:
On rounded particles
- under capital types of coating K=0.98;
- under lightweight types of coating K=0.96;
- under transitional types of coating K=0.94.
On weakly rounded and non-rounded particles
- under capital types of coating K=1.0;
- under lightweight types of coating K=0.98;
- under transitional types of coating K=0.96.

The optimum water content consolidation of macroclastic soils is set within 1.5 - 8.0% for mixtures of continuous granulometry and 2.2-7.2% for mixtures of discontinuous granulometry. Lower water content values correspond to mixtures with a lower content of silt and clay particles, and higher values correspond to mixtures with a high content of silt and clay particles [6, 7].

CONCLUSIONS

As a result of the study, the following conclusions can be drawn:

1. The strength and deformation specifications of macroclastic soils decrease with an increase in the content of sand and loam.
2. An increase in the content of fragments leads to an increase in the internal friction angle and an elastic modulus, a decrease in the cohesion value of macroclastic soil.
3. With an increase in the volumetric weight of the filler skeleton, an increase in the cohesion of macroclastic soils is observed.
4. With an increase in the content of fragments and sand, the cohesion of macroclastic soils decreases.

REFERENCES

1. MKN 44-2008. Guide to the design of uneven surfaces. ADNII GAK Uzavtoyul. 2008, -97 p.
2. MKN 46-2008. Guidelines for the design of flat road surfaces. ADNII GAK Uzavtoyul 2008, -115 p.
3. Dobrov E.M. and others. Macroclastic soils in road construction. -M.: Transport, 1981. -180 p.
4. Kayumov A.D., Radzhabov U. Clarification of the norms for the density of macroclastic soils of the soil bed and the foundation of highways. International scientific and practical conference on theme of Innovations in the field of construction of transport facilities: formation, problems, prospects. Bulletin 1 (51) 2016, Bishkek, 2016 March 2-4. 407-4012 p.
5. Kayumov A.D., Makhkamov B.R. The use of local low-strength stone materials in the surface of quarry roads. NTiPJournal Mountain Bulletin of Uzbekistan, No. 2. 2017. 112-115 pp.
6. Supplement No. 1 to ICH 84-13 Instructions for clarifying the norms for the density of soils of roads in various regional conditions of Uzbekistan. ADNIIA SJSC Uzavtoyul. 2020, -83 p.
7. Supplement No. 1 to MShN 29-2007 Rules for the control of technological standards for the grade of consolidation of embankments of highways. ADNIIA SJSC Uzavtoyul 2020, -78 p

Prof. Kayumov Abdubaki Jalilovich, Doctor of Technical Sciences, Tashkent State Technical University, Tashkent, Uzbekistan
e-mail: abdubakigmg@mail.ru;
Doctoral Student, Professor's Assistant Azimova Shakhlo Nizomovna, Samarkand State Institute of Architecture and Civil Engineering, Samarkand, Uzbekistan
e-mail: azimovasahlo65@gmail.com.