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Research Article

SOME ENGINEERING AND GEOLOGICAL PROPERTIES OF THE SOILS OF THE URBAN AREA OF KARSHI

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ABSTRACT
The authors of the article analyze the results of engineering and geological studies carried out in the framework of solving various tasks of economic activity (planning, design, construction and in some cases monitoring of the operation of structures) on the territory of Karshi. As we move from one stage to another, the conditions of the engineering task change and, consequently, the requirements for engineering and geological information that provides its solution. Based on the results obtained on the geological and geomorphological structure, and hydrogeological conditions, as well as the composition, physical and mechanical properties of soils common in the research area, there are mainly two main groups: connected sedimentary; disconnected sedimentary. The sixth IGE is special, consisting of gray and yellowish-gray, from dusty to gravelly sands in places with the inclusion of small pebbles, dense and medium density, from low-moisture to water-saturated soils. The modulus of the total deformation at water saturation (9.5 to 14.5 MPa) shows a directly proportional relationship between stress and deformation.

Keywords: *Physical and Mechanical Properties, Soils, Connected and Disconnected Sedimentary, Technogenic Soils, Normative Values, Engineering and Geological Element (Ige), Stability of Structures, Deformations, Stress, Modulus of General Deformation*.

INTRODUCTION

Currently, the construction and arrangement of urban areas largely depends on engineering and geological conditions. Engineering geology of cities can be considered as the science of structural-material and physical-mechanical properties of soils. As well as their direction of changes and transformations, which give stability to structures both during construction and during operation. The study of the composition, condition, structure and properties of rocks as foundation soils and the development of methods, programs for forecasting and solving environmental problems in the course of economic development of territories. In such cases, the design of buildings and structures, in the conditions of urban development, it is necessary to solve complex problems associated with changes in the material composition and physical and mechanical properties of soils. Ignoring these changes can lead, at best, to a violation of the conditions of normal operation of engineering structures, and at worst - to emergency situations and human casualties. The transition from standard construction on a free territory to reconstruction and new construction in difficult conditions of dense urban development is an urgent task of the modern urban construction complex. Based on the above, we have set the task of studying some engineering and geological properties of soils of the urbanized urban area of Karshi.

MATERIALS AND METHODS

In solving this goal, the results of research on the compilation of an engineering and geological basis for seismic microdistricting of cities in Uzbekistan (G.A.Mavlyanov, et al.) were used. As well as methodologies developed by G.A.Mavlyanov, V.I.Krieger, V.T.Trofimov, Y.Irgashev, K.P.Pulatov, D.K.Begimkulov and others used in the practice of engineering and geological studies of urban areas, including field, regime observations, laboratory work and modern methods of modeling processes and phenomena.
As is known, construction on subsident soils is one of the main water protection measures that ensure the creation of continuous low-water permeable screens that prevent soaking by underlying groundwater below.

The generalization of the conducted studies used regulatory documents (KMK 2.01.03-96, 1996; KMK 2.02.01-98, 1998; GOST 25100-2011, 2018), and geological and geomorphological structure, hydrogeological conditions, as well as soils developed in the research area (Zakirov et al., 2021). The use of modern research methods developed in soil science and physic-chemical mechanics of dispersed rocks helps to solve many problems associated with such rocks. The use of these methods makes it possible to explain the influence of many factors on soils and predict changes in their properties in a changing environment.

RESULTS AND DISCUSSION

According to regulatory documents (KMK 2.01.03-96, 1996; KMK 2.02.01-98, 1998; GOST 25100-2011, 2018), and geological and geomorphological structure, hydrogeological conditions, as well as soils developed in the research area belong to the dispersed class, in which two main groups are distinguished: cohesive sedimentary; incoherent sedimentary (Begimkulov, 2021; Zakirov et al., 2022).

Cohesive sedimentary soils are polymineral by type, clay by type. According to quantitative indicators of the material composition, properties and structure, the exposed thickness of clay soils is represented by sandy loams, loams and, less often, clays (Agzamova et al., 2020; Zakirov et al., 2021). They are modified from the surface into a soil-vegetation layer – sandy loam and loam with the content of plant roots with a thickness of 0.2–0.5 m.

Incoherent sedimentary soils are polymineral by type, sandy by type. Sandy soils are represented by multi–grained sands - from powdery to gravelly. According to the analysis of the initial results, the lithological structure and physico-mechanical properties of soils within a 26-meter thickness are divided into six engineering-geological elements (EGE).

The first EGE with a capacity from 0.5 to 2.0 rarely 3.5 m, includes man-made soils, re-deposited sandy loams and loams with the inclusion of household and construction debris, irrigation deposits with re-deposited loams and sandy loams silty, thickened, heterogeneous in composition and density of addition, from low-moisture to moist, from hard to soft plastic (Zakirov et al., 2020; Zakirov et al., 2022). These soils lie in the upper part of the section, above the groundwater level. The soils are highly porous, with low strength and deformation properties. The extreme and normative values of indicators of physical and mechanical properties of soils are given in Table 1.

Table 1: Extreme values of soil characteristics of the first EGE

Name of the characteristic	Unit of measurement	Number of definitions	Extreme values	Normative values
Density of soil particles	t/m³	11	2,67-2,71	2,68
Soil density	t/m³	11	1,48-1,72	1,77
Density of dry soil	t/m³	11	1,30-1,70	1,51
Specific gravity of the soil	kH/m³	-	14,8-17,2	16,7
Porosity coefficient	w/m	11	0,914-1,084	1,012
Natural humidity	fr. of a unit	11	0,113-0,255	0,183
Degree of humidity	w/m	11	0,29-0,71	0,52
Humidity at the yield point	fr. of a unit	11	0,270-0,383	0,316
Humidity at the rolling boundary	fr. of a unit	11	0,179-0,288	0,187
Plasticity number	fr. of a unit	11	0,070-0,111	0,096
Turnover rate	fr. of a unit	11	< 0 – 0,55	< 0
Specific coupling	kPa	11	5,0-8,0	6,4
Internal friction angle	degree	11	24-27	25
The modulus of its total deformation in the load range P = 0.0-0.3 MPa at natural humidity	MPa	11	4,5-8,0	6,8

The second EGE combines such soils as sandy loam and loam, grayish-brown, light brown and brown colors. Mainly loess-like, macroporous, with the inclusion of carbonate nodules, with veins of gypsum up to 10%, with single inclusions of pebbles, with traces of tinning, moist and moist, from hard to plastic (Khudoyberdiyev et al., 2022). According to the results of the analyses, it was established that the soils are subsident under additional loads, and non-subsident under natural conditions under natural pressure. The soils of the second EGE lie in the upper part of the section above the groundwater level and have. Table 2 shows all the extreme and normative values of indicators of physical and mechanical properties of soils.

Table 2: Extreme and normative values of physical and mechanical properties of soils of the second EGE

Name of the characteristic	Unit of measurement	Number of definitions	Extreme values	Normative values
Density of soil particles	t/m³	470	2,65-2,73	2,68
Soil density	t/m³	457	1,38-1,99	1,77
Density of dry soil	t/m³	457	1,30-1,70	1,51
Specific gravity of the soil	kH/m³	-	13,8-19,9	17,7
Porosity coefficient	w/m	462	0,517-1,068	0,782
Natural humidity	fr. of a unit	471	0,014-0,285	0,171
Humidity corresponding to full water saturation	fr. of a unit	-	-	0,292
Degree of humidity	w/m	468	0,06-0,80	0,59
Humidity at the yield point	fr. of a unit	475	0,178-0,339	0,263
Humidity at the rolling boundary	fr. of a unit	475	0,136-0,284	0,187
Plasticity number	fr. of a unit	475	0,016-0,129	0,076
Turnover rate	fr. of a unit	471	< 0 – 0,91	< 0
Specific coupling	kPa	316	1,8-28,9	10,4
Internal friction angle	degree	316	20-30	25
The modulus of its total deformation in the load range P = 0.0-0.3 MPa	MPa	342	1,6-13,1	6,8
Modulus of total deformation at water saturation E_{sat}	MPa	45	1,3-10,7	3,6
Relative drawdown:				
at P=0,1 MPa	fr. of a unit	283	0,001-0,047	0,012
at P=0,2 MPa		283	0,001-0,090	0,020
at P=0,3 MPa		346	0,002-0,096	0,026
Initial drawdown pressure	MPa	280	0,02 - > 0,3	0,09

The third EGE is represented by sandy loams and loams with the inclusion of carbonate nodules and gypsum in the range of up to 10%. Water-saturated, from solid to fluid state, lie below the groundwater level and in the zone of variable humidification, non-sedimentary.
According to static sounding data, the soils of the second EGE are weak and are characterized by the immersion resistance of the cone Pqc = 6.7-19.0 kgc/ cm^2 (0,67-1,9 MPa). The standard value of Pq_c = 13 kgc/cm^2 (1,3 MPa). Table 3 shows all the extreme and normative values of the indicators of the physical and mechanical properties of the EGE soils.

Table 3: Extreme and normative values of physical and mechanical properties of soils of the third EGE

Name of the characteristic	Unit of measurement	Number of definitions	Extreme values	Normative values
Density of soil particles	t/m³	664	2,65-2,73	2,68
Soil density	t/m³	634	1,66-2,10	1,95
Density of dry soil	t/m³	634	1,30-1,83	1,56
Specific gravity of the soil	kH/m³	-	16,6-21,0	19,5
Specific gravity of the soil taking into account the weighing action of water	kH/m³	-	6,6-11,0	9,5
Porosity coefficient	w/m	634	0,595-1,062	0,718
Natural humidity	fr. of a unit	694	0,149-0,372	0,246
Humidity corresponding to full water saturation	fr. of a unit	-	-	0,268
Degree of humidity	w/m	658	0,81-1,0	0,93
Humidity at the yield point	fr. of a unit	697	0,170-0,371	0,266
Humidity at the rolling boundary	fr. of a unit	697	0,114-0,265	0,196
Plasticity number	fr. of a unit	697	0,019-0,129	0,069
Turnover rate	fr. of a unit	694	< 0 - > 1	1,0
Specific coupling	kPa	399	4,3-38,9	12,0
Internal friction angle	degree	399	22-33	26
Modulus of total deformation at water saturation E_{sat}	MPa	451	2,0-12,5	5,4

Table 4: Extreme and normative values of physical and mechanical properties of soils of the fourth EGE

Name of the characteristic	Unit of measurement	Number of definitions	Extreme values	Normative values
Density of soil particles	t/m³	37	2,71-2,75	2,73
Soil density	t/m³	37	1,46-1,95	1,82
Density of dry soil	t/m³	37	1,31-1,71	1,56
Specific gravity of the soil	kH/m³	-	14,6-19,5	18,2
Porosity coefficient	w/m	37	0,596-1,075	0,758
Natural humidity	fr. of a unit	37	0,014-0,237	0,169
Humidity corresponding to full water saturation	fr. of a unit	-	-	0,278
Degree of humidity	w/m	37	0,04-0,79	0,62
Humidity at the yield point	fr. of a unit	37	0,264-0,433	0,329
Humidity at the rolling boundary	fr. of a unit	37	0,150-0,273	0,184
Plasticity number	fr. of a unit	37	0,130-0,205	0,148
Turnover rate	fr. of a unit	37	< 0 – 0,29	< 0
Specific coupling	Pa	22	7,0-48,3	17,7
Internal friction angle	degree	22	20-28	25
The modulus of its total deformation in the load range P = 0,0-0,3 MPa	MPa	22	3,8-10,5	7,0
Modulus of total deformation at water saturation E_{sat}	MPa	6	2,0-4,0	2,9
Relative drawdown:	fr. of a unit			
at P=0,1 MPa		19	0,004-0,038	0,010
at P=0,2 MPa		19	0,007-0,056	0,016
at P=0,3 MPa		23	0,008-0,072	0,022
Initial drawdown pressure	MPa	19	0,03 - 0,27	0,10

The fourth EGE includes heavy loams and loess-like clays, macroporous, with the inclusion of carbonate nodules, with veins of gypsum up to 10%, moist and moist, from hard to refractory, subsidence under additional loads and non–subsidence - under natural pressure. Table 4 shows all the extreme and normative values of the physical and mechanical properties of the fourth EGE soils.
The fifth EGE combines heavy loams and loess-like clays, low porous with the inclusion of carbonate nodules and gypsum up to 10%, water-saturated, from solid to fluidly plastic, lying below the groundwater level and in the zone of variable humidification, non-sedimentary. Table 5 shows all the extreme and normative values of indicators of physical and mechanical properties of soils of the fifth EGE.

Table 5: Extreme and normative values of physical mechanical properties of soils of the sixth EGE

Name of the characteristic	Unit of measurement	Number of definitions	Extreme values	Normative values
Density of soil particles	t/m³	37	2,71-2,75	2,73
Soil density	t/m³	37	1,81-2,07	1,95
Density of dry soil	t/m³	37	1,42-1,69	1,56
Specific gravity of the soil	kH/m³	-	18,1-20,7	19,5
Specific gravity of the soil taking into account the weighing action of water	kH/m³	-	8,1-10,7	9,5
Porosity coefficient	w/m	37	0,616-0,923	0,751
Natural humidity	fr. of a unit	38	0,152-0,331	0,248
Degree of humidity	w/m	37	0,81-1,0	0,92
Humidity at the yield point	fr. of a unit	38	0,268-0,420	0,346
Humidity at the rolling boundary	fr. of a unit	38	0,137-0,238	0,190
Plasticity number	fr. of a unit	38	0,130-0,217	0,156
Turnover rate	fr. of a unit	38	< 0 – 0,89	0,38
Specific coupling	kPa	26	9,0-32,5	15,7
Internal friction angle	degree	26	21-26	25
Modulus of total deformation at water saturation E_{sat}	MPa	29	2,2-5,5	4,6

Table 6: Extreme and normative values of physical and mechanical properties of soils of the sixth EGE

Name of the characteristic	Unit of measurement	Number of definitions	Extreme values
Density of soil particles	t/m³	11	2,65–2,66
Soil density	t/m³	11	1,92–2,13
Density of dry soil	t/m³	11	1,58–1,80
Specific gravity of the soil	kH/m³	-	19,2–21,3
Porosity coefficient	w/m	11	0,473–0,678
Natural humidity	fr. of a unit	13	0,051–0,239
Humidity corresponding to full water saturation	fr. of a unit	11	0,184–0,256
Degree of humidity	w/m	11	0,55–1,00
Specific coupling	kPa	10	0,0–3,0
Internal friction angle	degree	10	32–38
Modulus of total deformation at water saturation E_{sat}	MPa	10	9,5–14,5

The sixth EGE combines gray and yellowish-gray sands, from dusty to gravelly, in places with the inclusion of small pebbles, dense and medium density, from low-moisture to water-saturated. The exposed capacity of the sands is 0.4–5.8 m, and in some workings – 6.1–9.0 m

The granulometric composition is dominated by medium–sized sands with a fraction content of more than 0,25 mm – 51,1-68,2% and pulverized with a fraction content larger than 0.1 mm – 33,6-68,4%. The main indicators characterizing the physical and mechanical properties of sandy soils of the sixth EGE are given in Table 6.

CONCLUSION

Thus, the article considers only some features of the composition, structure and properties of clay rocks. Nevertheless, even from this brief message it is clear that the nature of the soil properties of the urban area of Karshi is extremely diverse and complex. According to the results obtained, it can be stated that six IGE have been identified in the research area. The first two IGES are subsident, they lie above the level of groundwater. Soils with additional both under loads and in natural conditions under natural pressure are subsident. Other IGES that lie below the groundwater level and in the zone of variable humidification are non-sedimentary. The sixth IGE is special, consisting of gray and yellowish-gray, from dusty to gravelly sands in places with the inclusion of small pebbles, dense and medium density, from low-moisture to water-saturated soils. The modulus of the total deformation at water saturation (9.5 to 14.5 MPa) shows a directly proportional relationship between stress and deformation. To understand the essence of the indicator, you need to know what kind of soil deformations are and what they depend on. These are our further studies, we will talk about them in the next section of the article.

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