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Methods of Complex Testing of Multiple Soil Properties in Laboratory and Field Conditions

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Abstract. The paper covers the problem of the lardier estimation of such properties as relative swelling, relative shrinkage and appearance of ground pressures, which can be observed in laboratory conditions in swelling pressures.

Keywords. Swelling soils, relative swelling, relative shrinkage, swelling pressures.

Soils of the territory of Uzbekistan are mainly sedimentary and highly sedimentary soils. However, there are such areas where water affects the soil and increases its size, i.e. increases. We call these homogeneous soils volatile soils.

The processes of moisture-induced soil in the soil consisting of extensible soils are somewhat more complicated than those of sedimentary soils, i.e., if the soil increases with moisture, the soil expands, and when the moisture decreases, the reverse process is observed - compaction - volume reduction. The amount of expansion pressure in the expansion process is known from experiments.

It can reach 10-15 kg/cm^2. Such effects not only deform any structures and building structures, but also lead to their destruction.

P_{sw} is proliferative pressure in porous soils;

W_{sw} is expansion moisture;

ε_{sw} is relative expansion at a given pressure;

ε_{sh} is relative shrinkage at expansion;

They are the main indicators.

In the design of buildings and structures on soils with swelling soil, it is important to know the amount of relative swelling (ε_{sw}) of the soil, that is, it will be possible to estimate the impact of the deformations on the building or structure in advance.

There are several ways to experimentally determine the amount of relative abundance, of which we will focus on the following two methods, that is:

1. Determining the free expansion of the soil under the influence of moisture only without the influence of external load on the soil in the Vasiliev device (PNG) method.
2. Determining the amount of relative expansion of the soil under the influence of moisture and external load and under the influence of the compression device - odometer.

Taking into account the probability of soil mass expansion, it is important to determine the relative expansion amounts of the base under the influence of different loads, i.e., ε_{sw}=f(P) using the method of one and two curves in the compression device.

In the single curve method, the sample is compacted from the same load, and then the ε_{sw} =f(P) graph is constructed from the moisture effect, and the same process is repeated from the next load.

In the method of two curves, one sample is exposed to water, and after the deformation is stabilized, the load is increased step by step, and the load is increased to 4-5 kg/cm^2 on the second sample without the influence of moisture, and the connection graph ε_{sw}=f(P) is constructed. The amount of relative expansion and the amount of expansion pressure determined in laboratory conditions using these two methods are presented in Tables 1, 2 and 3.

Table 1
Test characteristics of the soil sample

Sample No.	Soil sample structure	Porosity coefficient, e	Moisture W, (%)	Plasticity number I_P

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1	Intact	0,73	21,20	34,90
2	Intact	0,65	20,30	29,50
3	Broken	0,95	4,10	33,40
4	Broken	0,95	3,80	29,10

Table 2

One and two curves, a table of correlation of the amount of relative increase of the soil using the method (in %)

P, kg/cm^2	Sample 1			Sample 2			Sample 3			Sample 4		
	ε^1_{sw}	ε^2_{sw}	$\frac{\varepsilon^2_{sw}}{\varepsilon^1_{sw}}$	ε^1_{sw}	ε^2_{sw}	$\frac{\varepsilon^2_{sw}}{\varepsilon^1_{sw}}$	ε^1_{sw}	ε^2_{sw}	$\frac{\varepsilon^2_{sw}}{\varepsilon^1_{sw}}$	ε^1_{sw}	ε^2_{sw}	$\frac{\varepsilon^2_{sw}}{\varepsilon^1_{sw}}$
0	10	10	1	15,4	15,4	1	20,5	20,5	1	26	26	1
0,5	3.8	7,6	2	-	-	-	6,2	17,4	2,8	8,5	22	2,6
1	1,5	5,9	3,9	5,8	9,7	1,7	5,2	14,5	5,8	5,7	18,1	3,2
1,5	-	-	-	-	-	-	-	-	-	3	15	5
2	1,2	3,2	2,7	4,6	7,3	1,6	1,3	9,3	7,7	1,1	13	12
2,5	-	-	-	-	-	-	0,1	7,2	7,2	0,1	10,5	-
3	1,4	2,2	1,6	2,4	6	2,5	1,1	5,1	-	1,4	9,8	-
4	-	-	-	2,2	5	2.3	-	-	-	-	-	-
5	-	-	-	2,7	4,1	1,5	-	-	-	-	-	-

Note: ε^1_{sw} (ε^2_{sw}) is a relative increase determined by one (two) curve method.

It is possible to obtain ε_{sw} and P_{sw} connections of various processes that appear in the soil in the experiment, that is, in the first method, expansion is observed as a result of the solid phases of the soil absorbing water, and in the second method, only moisture is applied to the sample, and after the relative expansion is stabilized, the density graph of the sample (soil consolidation) is applied after the load is applied was built.

Table 3 shows the amount of pressure obtained by the method of one and two curves.

Table 3

Sample №	P^1_{sw}, kg/cm^2	P^2_{sw}, kg/cm^2	P^2_{sw}/P^1_{sw}	Sample №	P^1_{sw}, kg/cm^2	P^2_{sw}, kg/cm^2	P^2_{sw}/P^1_{sw}
1	4,0	5,3	1,3	3	2,5	5,1	2,0
2	5,7	8,7	1,5	4	2,5	6,9	2,8

Note: P^1_{sw} and P^2_{sw} are one- and two-curve expansion pressures.

In addition to the above-mentioned methods, the connection ε_{sw}=f(P) can also be determined using the following third method created in the laboratory.

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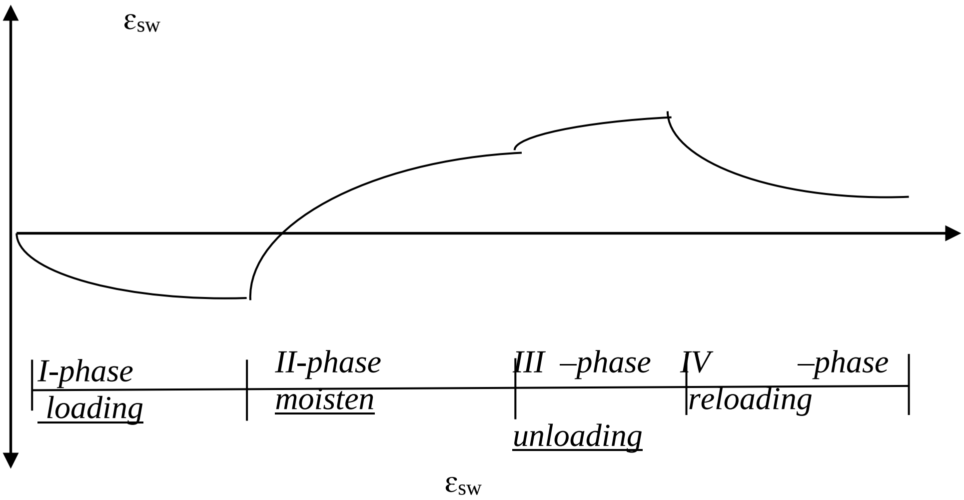

Figure 1. The graph of deformation phases of permeable soils.

The essence of the method created in the laboratory is that the soil sample is increased to a certain value of the load and the connection graph ε_{sw}=f(P) is built for the soil in its natural state (Fig. 1, phase 1), then the sample is exposed to moisture and deformation is observed (swelling or densification) and after the process stabilizes (Fig. 1, phase II) final porosity coefficient $e'_{к}$ of the sample is determined. After stabilization of the deformation, it is observed that a certain amount of additional deformation occurred when the sample was gradually released from the load (Fig. 1, phase III). If this process is continued and the sample is reloaded, the process in phase IV of the connection graph ε_{sw}=f(P) is observed in the soil.

Such deformation processes in elastic soils are relevant for all settling soils in a certain sense, and their study is of great importance in the study of deformations and their effects in soil foundations in construction practice.

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