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Features of construction of buildings and constructions on loessial the bases in Moldova

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Abstract. Problems of construction and operation of buildings and structures on the basis of loess Moldova, Ukraine Russia. Loess soils are widespread in the territory of the Republic of Moldova and Ukraine, and often serve as the basis for the constructed buildings and structures. Construction on the Loess sequences Type I conditions for subsidence now is no longer a complex engineering problem. However, in the above region are common loess sequences of type II by subsidence from the column drawdown to 1.0 E more. Erected on such grounds is still a fairly serious problem, requiring for their solution increased labor and material costs. The article analyzes the methods of preparation and construction of bases on the loess soils of various regional types and conditions for subsidence in the region. The most effective methods for the preparation of the loessial bases and combat subsidence at housing.

1. Introduction

Construction of buildings and engineering structures on loess collapsible soil holds a special place in the theory and practice of construction. It is explained on the one hand very sensitive reaction subsiding soil to external influences (changing humidity, the added pressure of construction of buildings and structures, etc.), on the other - expanding range of projects under construction (high-rise buildings for residential and public buildings, large factory and factory buildings and building complexes, etc.) and limited land for development with favorable ground conditions.

Choice of rational solutions of a system "base - foundation" in the construction of buildings on the loess subsidence of soils is one of the most important and difficult problems of construction. From the accepted design decisions depend to a large extent the operational reliability of the facility, its cost and specific consumption of materials of the object construction time. Rational solutions for the design of foundations is achieved through joint consideration of the peculiarities of the ground conditions of the site, patterns of development of settlements, design of buildings, their operating conditions, availability of sources of potential soaking.

2. The main problems of design and construction engineering structures on loess soils of the region

Loess soils are among the most common continental Quaternary deposits. Over the long history of the study of loess rocks was proposed more than twenty different hypotheses about their origin. All these hypotheses can be grouped into several groups. This generalization leads to the fact that the origin of loess is mainly due to Eolian (wind) and by water. According to the version of the Eolian origin of loess material transported and deposited in the depressions by the wind, glacial sediments and late vegetation expands. This hypothesis well explained the occurrence of loess cover over large areas and

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is supported by the facts rapid accumulation in arid areas is quite powerful layers of silty precipitation after the passage of strong dust storms. According to the water option education strata of silty deposits occurred as a result of erosion and subsequent redeposition of slope rocks, migration and accumulation of mineral material in the river valleys and lakes, as well as transfer and accumulation of loess sediments in glacial streams. There was also a view that the loess is brought to the dust, but redeposited by water flows. All these hypotheses consider only the process of accumulation of silty sediments, but does not answer the main question: how sediment becomes silty loess with a distinctive set of characteristics and properties. Compilation and analysis of currently available hypotheses of the origin of loess allows to say that the process of the formation of loess rocks consists of two stages: 1. the accumulation of mineral silty sediment, which can occur in different ways; 2. the transformation of the accumulated sediment in typical loess, that is, in the subsiding rock. [1]

On granulometric composition of loess soils belong to silty to sandy loam and loam. For loess soils are characterized by a high degree of pelawatte (contains more than 50% of particles of size 0.05–0.005 mm, while particles smaller than 0.005 mm, usually does not exceed 10-15%); low plasticity index (less than 12); low density of the skeleton of the soil (less than 1.5 g/cm3); there is increased porosity (more than 45%); salinity; low natural humidity; light-colored (mainly from pale yellow to reddish colors); the cyclical structure of the structure of the strata. Yield stress and ductility of loess soils is low, which is typical for clayey silty rocks. When wet they deliquesce, easily melted and eroded. Nature destruction are different from other clay. They are poorly permeable, their permeability changes significantly over time, due to dislodging of the walls of the macropores. Loess soil with moderate humidity moderately deformed, but when soaking their compressibility increases dramatically, so they are to weak rocks.

Loess soils meet on the territory of Ukraine, Belarus, Moldova, Central Asian States and abroad. On the territory of the Russian Federation, they occupied the vast expanses of Siberia, the non-Chernozem zone of the European part of Russia, for example, in the Lower Volga and the North Caucasus. In this work we show the experience of the study of loess soils in the Republic of Moldova, which is no less relevant in our country. The loess soils of Moldavia (between the rivers Prut – Nistru) are mainly subaerial sediments with a predominance of loess-like loams of medium composition. The capacity of loess soils varies and ranges from 2.0 - 3.0 m up to 20,0 - 30,0 m Capacity collapsible soil thicknesses generally do not exceed 12,0 15,0 Prevails...M. I type of conditions for subsidence. In large cities: Kishinev, Bendery, Tiraspol are quite frequent loess soils of type II conditions of the subsidence with the subsidence of its own weight to 25.0 cm and more. The initial pressure of the subsidence of soil, mostly exceeding 0,10 MPa, and in Kishinev, in is 0.12 MPa [2]. In the Northern part of the Republic mostly occur loess-similar soils are of small capacity with an initial pressure of the subsidence of about 0.20 MPa..

Until 1962 in Moldova on collapsible soils the construction was carried out without their seals. For protection from soaking loess soils in the project envisaged the following water activities: planning of the territory, the pans, manholes and pavings. The trays fit the inputs and outputs of the networks. So was built on subsiding foundations and strip foundations 5 – storey residential building series I-SS in Chisinau, Balti, Bender and some other cities of the Republic. [3]

Some time after the commissioning of the buildings because of failures of engineering networks began to soak the soil of their foundations. Water activities have proved effective, and some of the buildings began to deform. In load-bearing engineering structures have cracks, in some cases reaching a considerable size. For example: significant deformation was observed in the houses on the street Dimitrova and Karmanova, at school, on the street Dovatora in Chisinau, in the house of Soviets in Tiraspol and some other objects.

Since 1962 in Moldova on collapsible soils during construction of steel compacted soils in the pits of heavy rammers. It is possible to create a permeable screen of loess rocks and reduce the load on underlying unconsolidated loess soil to values smaller than the initial subsidence pressure. Because it was constructed of large buildings the I-464C-6 in Botanica district of Chisinau. Due to the fact that this series of houses intended to be built on unsettled ground, the pressure on the compacted layer was

made smaller the initial pressure of the subsidence of loess soil in the soles of compacted layer, which is in Chisinau for the soils exceeded a value of 0.10 MPa. In subsequent years, due to faulty networking technical underground flooded with water and soaked the Foundation soil, no deformation of buildings was observed. The reason is that the load of Foundation in collapsible soil did not exceed the initial pressure of the subsidence. The weight applied in rammer was up to 3T. and more. Power compacted loess layer, scattering the load of the weight of the structure to a pressure less than the initial subsidence was 1.5 m. It is important to note that in the constrained conditions of city building, heavy compaction rammers are able to provide on located close to the buildings negative impact, transferring dynamic effects on them.

Since the 80-ies in the city of Chisinau, Tiraspol, Bender began a massive construction of the sleeping districts 9 and 12 – storeys residential buildings large-panel series. On all construction sites overlain by loess collapsible soils predominant type II conditions for subsidence. With capacity collapsible soil thicknesses reaches a 12.0 - 15.0 m, with a projected drawdown to 25,0 - 30,0 sm.

For the construction of such geotechnical conditions of the Moldavian designers was borrowed from "Guidelines for planning" developed by the Kyiv research Institute of building constructions (NIISK) for 9-story large-panel residential buildings of Ukraine in collapsible soil type II with application complex events (ZSR 270-74 and RSN 297-78). During the preparation of loess subsidence of the reason these Guidelines recommended that the same method developed in Dnepropetrovsk specialists for the city of Zaporozhye and Dnepropetrovsk. The gist of it was that the subsidence properties of loess thickness were eliminated only in the upper and middle parts of the surface compaction by heavy rammers and backfilling of soil with subsequent layer-by-layer compacted. In this way, under the shallow foundations were created layer waterproof unsettled loess soil with a capacity of 5,0 - 6,0 m, rarely more. As a result, achieved the elimination of up to 70 - 80% of the subsidence of loess foundation. In combination with other planned events (waterproof and constructive) it would ensure the stability of the structure for the entire period of its operation.

However, an important feature of the engineering-geological conditions of Moldova is that loess thickness here almost everywhere is underlain by underlain by Sarmatian clays of high power. Consequently, in the early 80-ies of the whole territory of the large cities of the Republic has undergone man-made flooding with the rise of the groundwater level to a height of 10,0...15,0 m [4]. This led to the soaking of the lower horizons of unconsolidated loess grounds of high-rise buildings and structures. Some of them have undergone serious deformation. Such deformations are registered in the city Bender (two 9-storey series I - III 464MCB in the neighborhood), in Chisinau (9-storey house of 135 series in the neighborhood Budesti, houses on the street Aleshin). The survey showed that in all cases, subsiding strata were soaked. The reason for soaking was leakage from water-bearing communications and the rise of the groundwater level in the impoundment. The houses in the town of Bender in wall panels cracked and stopped working elevators. The maximum drawdown of one of the corners of the house was 29.6 cm differential settlement - 6.9 cm [5].

The most severe deformation was observed in Chisinau on 9-storey panel residential building on the street Aleshin. The building consists of 7 sections, separated by expansion joints with a width of 30 cm on a single partition banked 180 - 200 mm, some - at the level of the parapets faced. Stopped the elevators, this caused many complaints from tenants. After consultations with specialists of the Dnepropetrovsk branch of the NIISP, it was decided to eliminate roll, and stabilize the precipitation method, controlled soaking. Work continued within 1 year. Stabilization sediment of the building was achieved, however, align partitions failed. It is noteworthy that some of the individual sections are dipped for controlled soaking for 45 - 55 cm, almost twice the maximum calculated drawdown values defined experimentally in laboratory conditions based on the characteristics of loess soil.

The research of soil Foundation of the house on street Aleshina and other deformable buildings of Chisinau is made by experts of laboratory of physical-mechanical properties of rocks, Academy of Sciences of Moldova was established that the loess soils in Chisinau belong to the slowly – subsiding type. For the study of the subsidence properties not applicable method recommended by GOST 23161-78 involving soaking the loess sample by capillary method. It's not the actual real work of the soil

under the building, where it is filtered groundwater. Differences in the assessment of subsidence taking into account water filtration and metering can achieve 100% or more [6]. However, soaking is still recommended normative documents of the Russian Federation, for example, SP 21.13330.2012 "Buildings and structures on undermined territories and collapsible soils". [7].

Numerous deformation houses, built in flooded areas of Chisinau confirmed the findings of the staff of the Academy of Sciences of Moldova. In consequence, it has become obvious that mechanical transfer of the experience of building on collapsible soils one region to another without considering the differences in geological conditions of territories and of physical-mechanical properties of loess soils is futile. As a result, designers focused attention on other more effective methods of preparing loess grounds, taking into account the specific geotechnical conditions and properties of loess soil of the Republic. This: device tamped pits for the strata of type I conditions of the subsidence, compaction subsidence strata at full capacity bored piles, construction of pile foundations of bored piles in thickness of type II by the subsidence [8].

3. Rational methods of foundations on loess strata

On loess soils of type I of the terms of settlement for industrial, residential, civil, agricultural buildings with loads on the individual foundations to 1500 - 1800 kN and frameless buildings with bearing walls with loads of up to 400 - 600 kN per 1 linear m the most effective are the foundations in stamped pits. Developed and can be successfully applied foundations in stamped pits: no extended base for loads of them up to 800 - 1000 kN; with the widened base, obtained by ramming in the bottom of pit of hard soil material (crushed stone, gravel, sand-gravel mixture, etc.) - for loads up to 1500 - 1800 kN; tape intermittent foundation for frameless buildings up to 5 floors. In addition, developed new designs and methods of installation of foundations in stamped pits: prefabricated precast hollow blocks with the widened sole for frame buildings; ribbed and arched with widen base for seismic conditions, the bearing layer of Foundation load up to 2500 - 3000 kN, which will significantly expand the scope and volume of use of basements in stamped pits.

For high-rise buildings and mass is a very effective surface compaction and subsidence of ground in the pit heavy rammers with a base diameter of d = 1.8 m - 2.0 m and a mass of 5.5 - 6.0 t with a conventional tape device, freestanding or slab base accept for constructional reasons. When a single-layer compaction depth of soil compaction is usually 2.5 - 3.5 m, while a double layer can increase 5 - 6 m. In the construction of heavy buildings and other structures sensitive to unequal subsidence and deformation of soil masses, the reason it is advisable to use bored concrete piles in punched wells with extended sole. Their particularity and main difference from conventional bored piles is that the wells are not drilling, punching and ramming the projectile at the base of the excavator, resulting in soil compaction around the pile at its base and create a widened soles by ramming at its bottom to the refusal of certain portions of the hard concrete, dry concrete mix or other material. All of this provides increased bearing capacity of Foundation is 1.5-3.0 times and reducing the cost and complexity of its construction.

On loess soils of type II conditions of subsidence for residential, civil and industrial buildings with bearing walls up to 9 - 12 floors, as well as the relatively rigid frame buildings up to 6 - 8 storeys the most efficient is the use of a complex of actions, including:

- preparing grounds by surface compaction to eliminate its subsidence of properties within the deformable zone of the load of the foundation and creating solid waterproof screen;
- waterproof activities, precluding the possibility of soaking the soil at the base;
- structural measures rely on possible subsidence at the base and aimed at ensuring the strength, stability and normal operation of constructed buildings and structures.

For relative flexible, and high-rise buildings and mass when frequent location of supporting structures and foundations for effective deep compaction and subsidence of ground in the whole of the amount of their boarding thickness by punching wells with subsequent filling them with dredge material.

The feature of the method of deep compaction is that in accordance with the cumulative plot of distribution over depth of the pressure from the load of foundations, the self-weight of soil and load from the forces of friction arising from the subsidence of the surrounding soil, the following changes occur in the loess massif in its depth: a) at the bottom of the compacted array is created bearing layer by ramming down to the bottom of the punched wells of a rigid material (gravel, slag, sand and gravel, etc.) to individual portions with a height of 0,8 - 1,2 d (d — diameter of the ramming of the projectile); b) the middle part is formed a zone of increased strength by filling the wells of a rigid material with a seal each portion, from - rolling height of 1.5 - 2.0 d; C) in the upper part of the compacted zone is created by filling the punched wells of the local loess soil compaction. Deep compaction by this method is performed via the attachment to the excavator ensuring the perforation of wells with diameter of 0.6 - 1.0 m, the energy of one shot of 30 - 40 t/m, i.e. 10 to 13 times higher than that used in recent machines of shock-cable drilling of BS-I to M.

For flexible and long-span buildings it is advisable to use:

- driven and bored piles in elastic shells, excluding the transfer to pile additional loads from the forces of the load friction arising from the subsidence of the surrounding soil;
- built-in-place piles in the shell of compacted soil produced through the punching hole, base layer height of 2 - 4 m created by ramming punched in the bottom of the well to the loss of a hard material;
- bored piles with extended base and with the base layer obtained by fixing the underlying loess and other soils.

Along with this, for heavy buildings with heavy loads on floors in many cases are extremely effective is the combination of deep seal with the device in printed or driven piles, where deep compaction is used to eliminate the subsidence of the soil under the internal structures, foundations for process equipment, floors, removing the biasing forces of friction on piles and piles designed to transfer the load from the load-bearing structures on the underlying, more solid layers of soil. [9].

4. Conclusions

The use of conventional pile foundations of driven piles and bored piles in appropriate only in cases of occurrence at the base of the subsiding strata underlying soils with high bearing capacity: the Sands of large and medium size, solid Sarmatian clays or rocky soils;

Adjustable steeping risky to use under the soil type II of the subsidence;

Research should be continued to develop variants of the constructive measures aimed at ensuring the strength, stability and normal operation of buildings and structures;

Because of the wide distribution of loess rocks should be given as much attention to the features of the training grounds and the implementation of constructive interventions in the development of building codes.

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