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REVIEW ON THE CHANGES IN THE DEFORMATION PROPERTIES OF SALINE SUBSIDENCE GURTS AS A BASIS FOR EMERGENCY STRUCTURES

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Abstract

The main focus of this work of writing is an investigation into how loess-like soils that are under foundations change over time. Different techniques and tools from the field of construction technology have been used in different ways to look into this issue. Also, the article looks at the unique features of the deformation that happened when water got into loess-type soils in the foundations of industrial and civil buildings. Loess-type soils in the foundations of industrial and civil buildings became too wet, which caused the deformation. Since these soils had been put down, a lot of time had passed. Based on the study's findings, relevant ideas and suggestions have been made for discussion.

Keywords: *saline; deformation; Loess-type soils; Deformation*

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1. Introduction

Saline subsidence is a geological phenomenon that occurs when underground salt deposits dissolve due to the presence of water, creating voids that can lead to the collapse of the overlying land. In some cases, this subsidence can occur suddenly, posing a significant risk to structures and human life[1]. To mitigate the risk of subsidence-induced emergencies, engineers have proposed using saline subsidence gurts, which are structures designed to resist subsidence forces and provide a stable foundation for emergency structures. These gurts are typically made of reinforced concrete and are anchored to the stable ground below the subsidence area.

The deformation properties of saline subsidence gurts are crucial in determining their effectiveness in resisting subsidence forces[2]. These properties include the gurt's stiffness, strength, and ductility, which all play a role in how the structure will behave when subjected to subsidence forces. Researchers have conducted numerous studies to investigate the deformation properties of saline subsidence gurts, using both analytical and experimental methods. These studies have shown that the stiffness and strength of the gurts can be significantly influenced by factors such as the size and shape of the gurt, the amount of reinforcement used, and the properties of the surrounding soil[3]. Overall, the design and construction of saline subsidence gurts require careful consideration of the specific geological and environmental conditions of the subsidence area. Engineers must take into account factors such as the expected magnitude and rate of subsidence, the properties of the surrounding soil, and the intended use of the emergency structure to ensure that the gurt will provide the necessary level of protection[4]. the main components that could be included in a block diagram for the changes in the deformation properties of saline subsidence gurts:

a) *Saline subsidence:* The geological phenomenon that causes subsidence due to the dissolution of underground salt deposits.
b) *Subsidence area:* The area where the subsidence is occurring and where the gurts will be installed.
c) *Saline subsidence gurts:* The emergency structures designed to resist subsidence forces and provide a stable foundation for emergency structures.
d) *Deformation properties:* The properties of the gurts that determine how they will behave when subjected to subsidence forces, including stiffness, strength, and ductility.
e) *Design factors:* The factors that influence the deformation properties of the gurts, including gurt size and shape, amount of reinforcement used, and properties of the surrounding soil.
f) *Analytical methods:* The mathematical and computational models used to analyze the behavior of the gurts under different subsidence conditions.
g) *Experimental methods:* The physical tests conducted on the gurts to evaluate their deformation properties under different subsidence conditions.
h) *Geological and environmental factors:* The specific conditions of the subsidence area that must be taken into account when designing and constructing the gurts, including the magnitude and rate of subsidence, the properties of the surrounding soil, and the intended use of the emergency structure.

2. Methods

A block diagram could help visualize the relationships between these components and how they contribute to the changes in the deformation properties of saline subsidence gurts[5]. The characteristics of the saline subsidence's deformation are shown in the diagram's central block. These characteristics are influenced by a number of different factors. The geologic factors and the flow of fluid have the most significant impact on the properties of the deformation. Both mechanical forces and geologic processes can have an effect on the properties of a deformation. Porosity, permeability, and compressibility are all examples of these mechanical characteristics that can be found in the formation. The fluid's physical and chemical characteristics, such as its viscosity, density, and chemical make-up, are included in the list of factors that affect the flow of the fluid[6]. The geologic and fluid flow factors can be subdivided into even more specific aspects. The lithology, grain size, and cementation of a formation all have the potential to have an effect on the mechanical properties of the formation[7]. The salinity of a fluid, the pH of the fluid, and the presence of minerals that have been dissolved in the fluid are all factors that can influence the chemical composition of a fluid.

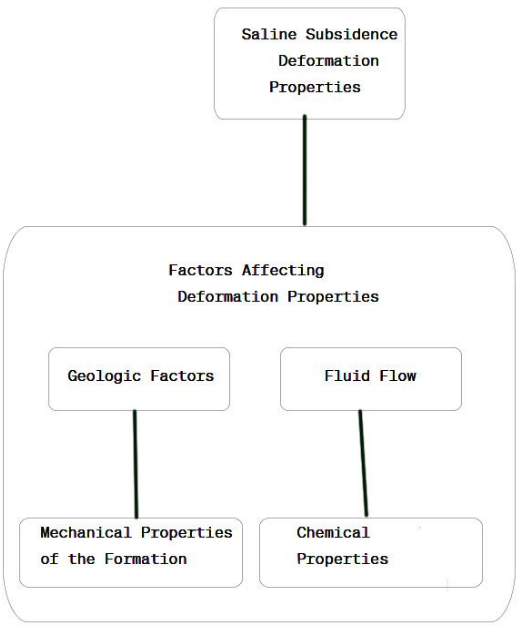

Fig. 1. Block diagram of deformation properties of saline subsidence

The interaction of these various factors ultimately determines the deformation properties of saline subsidence. This interaction can have far-reaching implications not only for the stability of the subsurface but also for the planning and execution of subsurface engineering projects[8]. The peculiarity of the properties of saline subsidence soils makes it very careful to assess their subsidence, errors in the determination of which can entail not only significant deformations, but also the complete destruction of structures. Among the physical factors, porosity, humidity, and the degree of humidity have the greatest impact. There is a certain relationship between porosity and subsidence. In the general case, an increase in subsidence with an increase in porosity and load is noted.

According to the data of Dwiyati, S. T et al.[9], the maximum value of Sse is observed at loads of 0.2-0.3 MPa. Their research notes the maximum Sse value of about 0.5 MPa. With porosity of less than 0.41, soils generally do not have additive properties. Sagging is also not observed for soils with high natural humidity exceeding 0.20. The closest correlation of subsidence is recorded with the degree of humidity. With a degree of moisture Sg = 0.6-0.7, soils are superfluous with subsidence properties. Currently, there are two methods for determining soil subsidence determined using the “one” lithot curve and “two” curves. Comparative tests of soil subsidence determined using the “one” and “two” curves differ 1.2–2.3 times. This is confirmed by the research of N.Ya. Denisov, A.K. Larinov, V.P. Ananyva.

As a result of the analysis of a large number of experiments, it was concluded that with an increase in the content of clay particles and an increase in the number of plasticity, the difference in the results of relative subsidence by the two methods increases[10]. With relatively small loads (0.05-0.15 MPa), this discrepancy is significant, and when the loads increase to

0.2-0.3 MPa, the discrepancy decreases. The experimental object. The study of the changes in the physico-mechanical properties of the soils of the foundations of the emergency building was carried out by the PNIIIS laboratory[11]. Due to water seeping through the foundation over a period of twenty-one years after the infrastructure had been initially commissioned, it was in a state of disrepair. It was necessary to travel through the excavations in order to select the monoliths. In the laboratory, the testing of the soils adhered to the protocols that had been established. Here, we discussed the strategy that would be used for the endeavour. The goal of this study was to evaluate the relative merits of composites consisting of zircon sand, boron carbide powder, and an aluminium matrix in terms of their overall performance. The ongoing investigation has yielded significant findings, which have made it possible for us to arrive at the following significant inferences and conclusions[12]: A comprehensive literature review on hybrid metal matrix composites was carried out so that problems could be identified and goals could be established. The mechanical properties of adhesives, as well as their wear characteristics, have been investigated by researchers. Now that the equipment selection and testing procedures have been finalised, the sample fabrication process can begin. Using the stir casting method, a sample needs to be prepared before it can be used. The condition of the exterior of the sample will be evaluated. In this test, the tensile strength, compressive strength, and hardness of the material will all be evaluated[13]. In order to image the microstructure evaluations of the samples that were tested, we will be using SEM analysis.

The pits passed along the deformed load-bearing wall of the living house in the immediate vicinity of the foundation. Monoliths of soil of undisturbed structure were selected from pits[14]. Shear tests were also performed by preliminary compaction, consolidated during water saturation at loads of 0.1 - 0.2 and 0.3 MPa. The 2-curve technique was used for the compression tests. The research was carried out on naturally moist soils with matric potentials (P) ranging from 0.0 to 0.3 MPa in one of the divisions. At P = 0.3 MPa, full saturation was attained. Saturation was reached at Tvyt on the other branch, and loads were then applied to increase the matric potential to 0.3 MPa. At Trench, monoliths recovered from a depth of 10 metres were subjected to compression tests using a lock to determine their global subsidence value. Only the weight of the soil itself can account for the sinking ground in this area[15].

Physics - mechanical properties of soils. Loess soils are heterogeneous in the density of addition within the entire studied thickness[16]. The density of dry soil varies from 1.35 to 1.63 t / m3. The most porous subsidence loesslike soils are noted in pit No. 3, where highly porous soils are developed at the base of the foundations to a depth of 7.4 m. In pit No. 1, these soils are also marked in the upper 3-meter zone, and pit No. 2 is found in the form of a layer deeper, in the range of 6.4-8.5 m. From a depth of about 9.5-10.4 m, low-porous, less subsidence soils have been discovered everywhere. The natural moisture content of loess soils according to the data of previous years and present studies on the residential building site is 7-13%. The degree of humidity does not exceed 0.42-0.45. At present, loesslike soils at the base of a residential building, in its middle part (Sh-1 and partial Sh-2), as a result of soaking, have high humidity reaching a moisture content of 18-19% and a degree of humidity of up to 0.65. In direct proportion to the density and moisture of the soil are their subsidence properties.

The greatest subsidence was noted in pit No. 3, where low-moisture under-compacted soils of increased porosity were discovered in the intervals of 2-6 m. The drawdown from the own weight of the soil reaches 0.074-0.097 (see. 1). In pits No. 1

and No. 2 at the base of the foundations to a depth of 6-7 m, subsidence from the own weight of the soil does not occur. it was partially eliminated as a result of soil soaking and the influence of the additional load from the building, which caused the building to fall and its uneven deformation.

In general, according to the building parameter, the total value of the remaining subsidence from the own weight of the soil is in pit No. 1-16.9 cm, in pit No. 2-27.2 cm and in pit No. 3-45.6 cm (see Fig. 2). According to SNiP 1.12.03-83. Type of soil conditions by subsidence in the area of residential building No. 45-II. The first engineering-geological element (IGE-I) combines highly porous (RH = 0.874), low-moisture (SГH = 0.41) loess-like loams, which occur in the upper part of the studied thickness, i.e., at the base of the foundations. Uncompacted soils, density of dry soil Pd = 1.35-1.48 t / m3. When water is saturated, the soil exhibits strong subsidence properties. The initial subsidence pressure is Pse = 0.03 MPa. At domestic pressure from non-subsidence to very subsidence. The relative subsidence at P = 0.2 MPa reaches 0.093-0.128. According to the deformation index, the soils of IGE-1 are compressible. The compression module is the total deformation in the load intervals of 0.0-0.3 MPa, at natural humidity is 5.1 MPa. With water saturation, the value of the module decreases to 1.9 MPa. The degree of compressibility variability.

$$d_E = \frac{5{,}1}{1{,}9} = 2{,}7 \qquad -1$$

The main indicators of the physico-mechanical properties of the soils of IGE-1 are given. The second engineering - geological element (IGE-2) is represented by loess-like loams of medium density (LH-0.801), weakly moist and moist (SГH = 0.48) lying both at the base of the foundations (Ш-1-2) and in the middle part of the thickness under study. Soils are more dense than IGE-1. The density of dry soil Pd = 1.40-1.57 t / m3. The soils of IGE-2 were subject to artificial soaking to a greater extent; therefore, their subsidence properties were partially eliminated. The initial filler pressure is Pse = 0.14 MPa. At domestic pressure, soils are mostly non-subsiding.

At a load of P = 0.2 MPa, the relative subsidence is small and reaches 0.037. The deformation indicators of IGE-2 soils are slightly higher than IGE-1. The compression module for the total deformation of naturally moist soil is 8.3 MPa. With water saturation, the value of the module decreases Esqt = 0.3.3 MPa.

The degree of variability of compressibility.

$$d_E = \frac{E_e}{E_{Sat}} = \frac{8{,}3}{3{,}3} = 2{,}5 \qquad - \qquad 2$$

Strength indicators of ITE-2 soils are similar to soils (IGE-1). The basic indicators of physical and mechanical soils (IGE-2) are given. The third engineering - geological element (IGE-3) combines loesslike loams, which occur from a depth of more than 9.5-10.4 m and are represented by low porous (Lн = 0.775), low-moisture soils (ShH = 0.44).

Low subsidence soils. Initial subsidence pressure Pse = 0.2-0.3 MPa and more than 0.3 MPa. At domestic pressure, the soils within the thickness are mostly subsidence because they lie at great depths and were less susceptible to wetting. The deformation indices are characterized by a module of the total deformation of the naturally moist hurt equal to 6.2 MPa. With water saturation, the value of the module decreases almost widow Esqt = 3.3 MPa.
The degree of compressibility variability

$$d_E = \frac{E_e}{E_в} = \frac{6{,}2}{3{,}3} = 2{,}5 \quad - 3$$

The main indicators of the physico-mechanical properties of the soils of IGE-3 are given. Primers contain water-soluble salts. The dry residue reaches 1.775%, the content of SO4II-ions is up to 1.150. According to SNiP 2.03.11-85, soils are slightly aggressive to Wb concrete on sulfate-resistant cements in accordance with GOST 22266-76. When determining the angle of internal friction and specific adhesion as a result of the inspection of the emergency building, it is also noted that with increasing load on the sample, the soil's ability to moisturize decreases and, at the same time, the moisture content of the soil samples during water saturation does not reach humidity values under the emergency foundation facilities. Consequently, soil samples water-saturated at various loads end up in nonequilibrium states, which introduces the determination of the error in the experimental results.

3. Findings

As a result of the studies, it was found that the thickness of the loess-like soils lying at the base of the deformed apartment building is heterogeneous in terms of humidity, density, composition and the degree of manifestation of subsidence properties. The reason for the uneven deformation of the apartment building was the soaking of loesslike subsidence soils lying at the base of the foundations of the apartment building, as a result of which their subsidence properties were partially realized (sh-1 and sh-2). Sources of soaking loesslike subsidence soils were abundant watering of flower beds and a garden around the house, as well as a possible leak from the pipes of the water supply and sewer network during the long-term operation of a residential building. The gradual accumulation of moisture and led to the manifestation of subsidence in loess soils. The drawdown for explored fraud (20 m) of loess-like subsidence soils is w-1-16.9 cm, w-2-27.2 cm, w-3-45.7 cm. The unconsolidated state of loess-like soils at the base of a residential building is currently preserved. A possible repetition of moistening and soaking loesslike soils can cause additional subsidence, settlement and deformation of the residential building.

4. Conclusion

The loess-like soils beneath the crooked apartment block differ in moisture, density, composition and sinkability, according to the research. The apartment building's crooked shape is caused by saturated loess-like subsidence soils under its foundations. This revealed several properties, including sinking-related sh-1 and sh-2. The saturated loess-like subsidence soils were thought to be caused by overwatering the flower beds and garden around the house for a long time, as well as water supply and sewer network leaks over the house's lifetime. Loess soils are sinking due to moisture accumulation. The scam's 20-metre drawdown values were w-1-16.9 cm, w-2-27.2 cm, and w-3-45.7 cm. Drawdown values for loess-like soils. At the base of a residential building, loess-like soils are kept loose. If loess-like soils are saturated and moist, home structures may sink, settle, and deform.

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