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CONSTRUCTION OF BUILDINGS ON WEAK MOIST CLAY SOILS IN SEISMICALLY ACTIVE ZONES OF UZBEKISTAN

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Annotation
The article presents the results of laboratory experimental studies on the study of subsidence (deformation) of moist clay soils in static and dynamic (seismic) conditions.

Keywords: clay soil; subsidence; deformation; density; strength; stability; compressibility; seismic deformation; water-saturated soil; humidity; vibration installation.

Introduction

As you know, a significant part of the territory of Uzbekistan is located in difficult engineering and geological conditions. Such territories also include areas of distribution of weak clay soils, where the complexity of engineering and geological conditions is aggravated by high seismicity and the possibility of their moistening during land urbanization. These conditions necessitate the use of such construction techniques that would ensure high reliability and durability of buildings and structures [1].

The design and construction of buildings and structures on clay soils in seismic areas with ensuring their strength, stability and reliable operation is one of the complex problems of modern construction [2].

The study of the causes of deformations of buildings and structures erected on moist clay soils under seismic influence shows that uneven subsidence of the foundation and deformations of erected structures occur even with minimal pressure on the ground, and the nature of the deformation of the structure depends on ground conditions and the intensity of seismic activity [3].

Thus, in the presence of weak water-saturated clay soils capable of transitioning into a dynamically disturbed state, it is not always possible to ensure the strength and stability of the structure by calculating their bases according to the first limit state (bearing capacity) [4].

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One of the main factors determining the magnitude and nature of the manifestation of soil deformation is the degree of its density, humidity and the prevailing type of structural bonds. Humidity plays a significant role among these factors. With an increase in the humidity of clay soils, compressibility increases and this process entails significant deformations of structures. At the same time, clay soil from one variety to another, characterized by completely different properties. Clay soils are capable of producing subsidence measured by several tens of centimeters, and sometimes meters, both from additional moisture and from vibration [5].

Research methodology. To study the effect of humidity on the deformation of moistened clay soil, a series of laboratory experiments were conducted. For laboratory experiments, samples of clay soils were taken from objects located within the city of Tashkent. The experiments were carried out under static and dynamic conditions at a load of P = 0.3 MPa. A dynamic laboratory experiment was carried out on the installation of TASHPI structures (Fig.1).

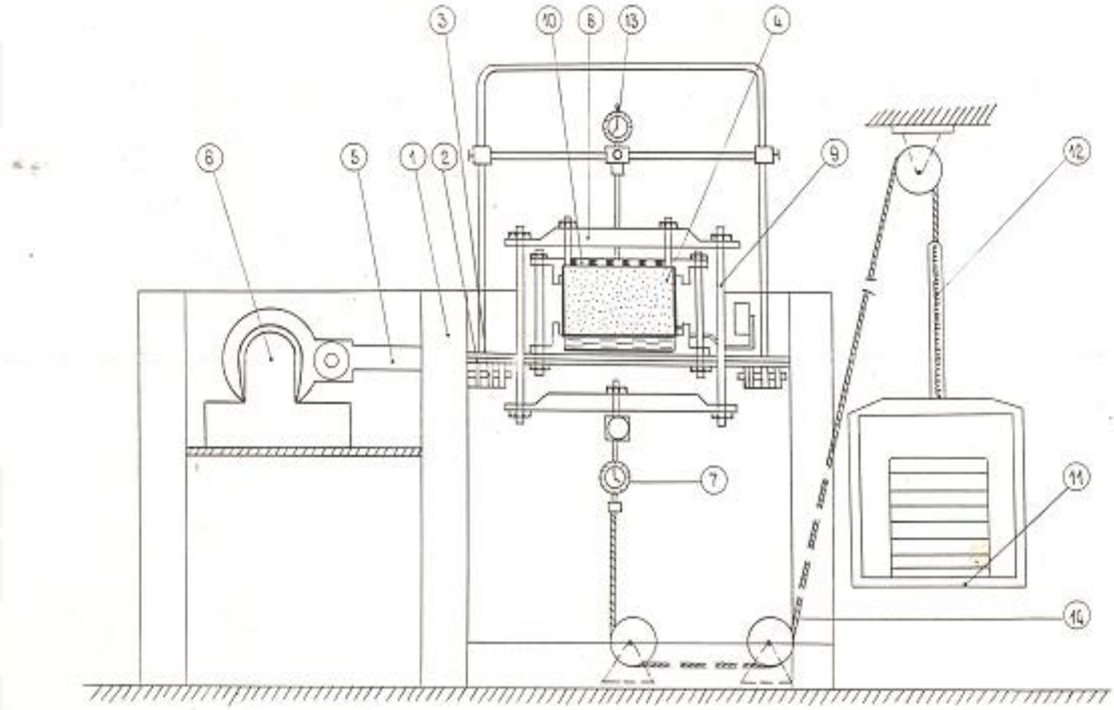

Fig.1 General view of the vibration installation and a loading device for a vibration installation with horizontally directed vibrations:

1-the body of the vibrating installation; 2-the vibrating plate; 3-the four-pin; 4-the test sample of the soil; 5-crank mechanism with an eccentric shaft; 6-DC motor; 7-dinomometer for measuring the amount of priming; 8-device for priming; 9-vertical suspension; 10-stamp with holes; 11-loading platform; 12-spring for damping inertial forces arising from vibration; 13-hour-type indicator; 14-cable for creating a load on the sample

The vibration installation allows you to reproduce harmonic horizontally-forced oscillations with an amplitude from 0.1 to 0.6 mm and a frequency of 1-12 Hz. A load from a given vertical pressure can be applied to the surface of the tested soil sample within a wide range [2].

Smooth adjustment of the motor speed by changing the voltage in the motor circuit using a laboratory autotransformer, allows you to create vibration effects of different intensity, taking into account the amplitude and frequency of the oscillation.

The installation can be used to examine soils, both disturbed and undisturbed structures at various accelerations of vibration. When testing soils of undisturbed structure, the sample was mixed into a compression device, which is rigidly fixed on a vibrating plate (Fig.2).

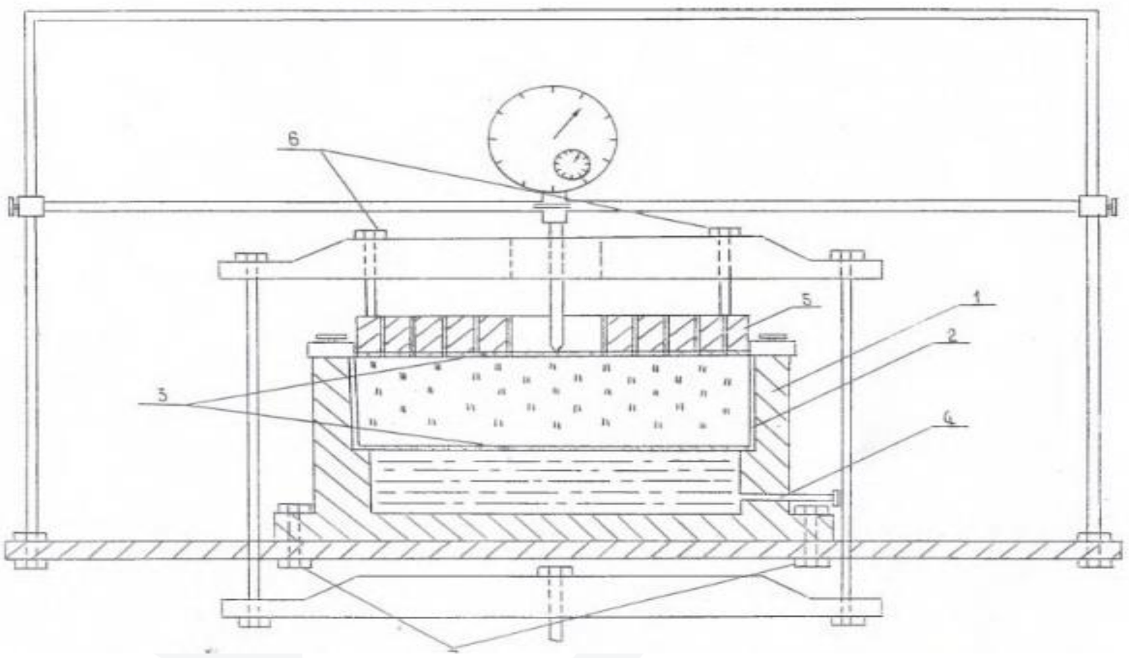

Fig.2 Schematic section of the vibration compression device:
1-special chamber; 2-cutting rings; 3-discs with holes; 4-nozzles; 5-upper clamping rings; 6-upper clamping bolts; 7- lower clamping bolts

The compression device consists of a special chamber, a cutting ring
(D = 90mm, h = 30mm), disks with holes (water and air are squeezed out through the upper disk when the sample is deformed, and the soil is soaked through the lower one), a branch pipe through which the soil is soaked. A rubber pipe (hose) of the

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required length is put on the nozzle. The device is equipped with an upper pressure ring, pressure bolts. With the help of bolts, the device is attached to the vibrating plate. With the help of a cutting ring, twin samples were cut out of a monolith of soil for conducting a series of tests. After preliminary compaction, the ground was soaked in the device. The soil was soaked to various degrees of water saturation (up to S_t = 0.8-1.0). After stabilization of the deformations from the lock, the sample was subjected to vibration on a vibration unit in the acceleration range from 100 to 10000 mm / s ^ 2 with an oscillation frequency from 1 to 12 Hz and an amplitude of 0.2-4.0 mm. The experiments were carried out at a constant vertical load P = 0.3 MPa and at different oscillation durations.

The vertical deformation of the sample was recorded by hour-type indicators with an accuracy of 0.01 mm.

The test sample placed in the compression device was fixed rigidly on the vibrating plate of the installation. A certain amount of oscillation acceleration was applied to the surface of the sample, if necessary.

Research results. The results obtained (Fig.3) showed that with an increase in the moisture content of clay soils, an increase in their subsidence modulus is observed. At the same time, it was also possible to trace an increase in the compressibility of the soil under these conditions. It should be noted that in some varieties of soils (for example, No. 4), compressibility is insignificant at a pressure on the soil of up to 0.3 MPa, even with an increase in humidity to full water saturation. This is apparently due to the very high density (the density of dry soil is more than 1.55 t/m ^ 3) and their strength (Fig.3).

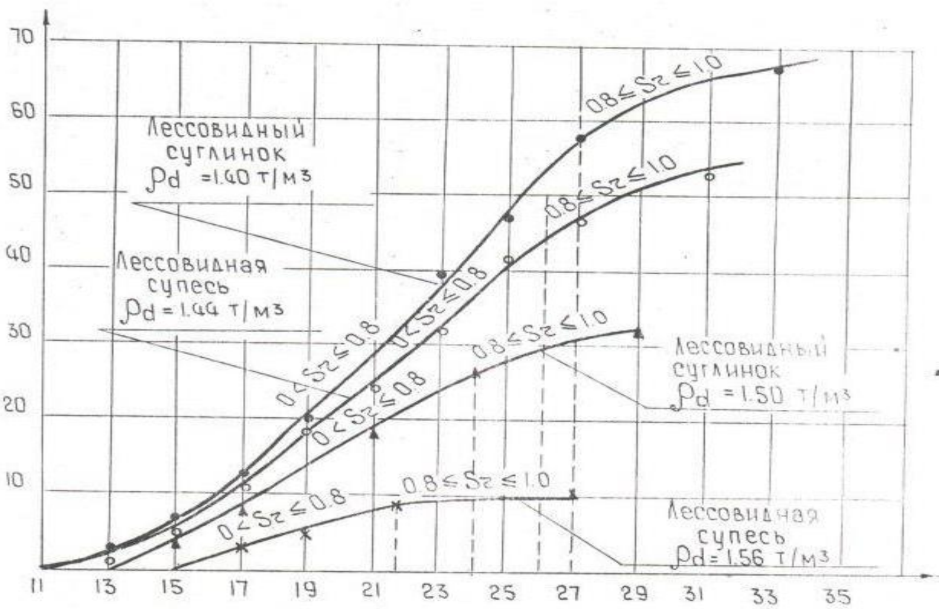

Fig.3 Change in deformation of clay soils with varying degrees of moisture

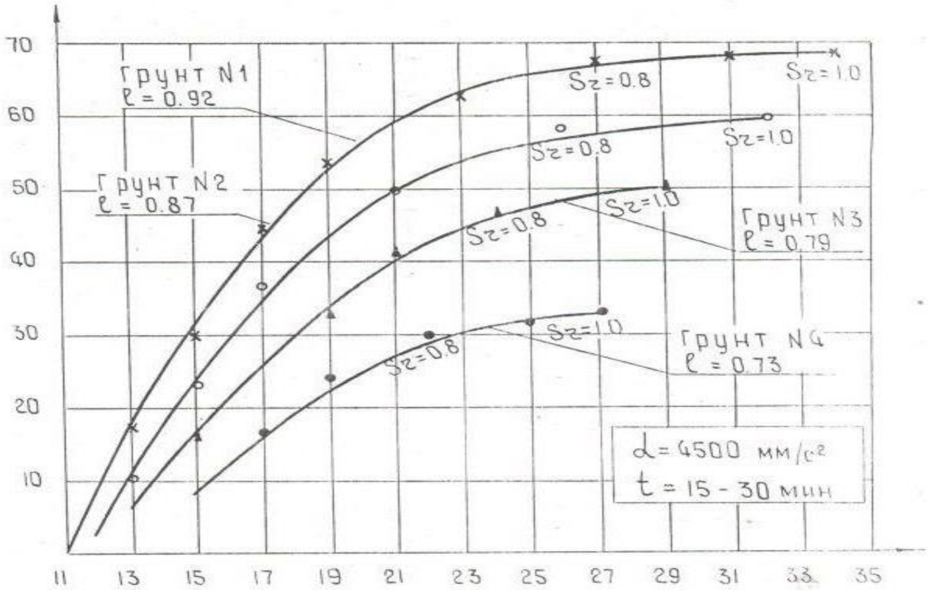

Fig.4 Changes in seismic deformation of clay soils with increasing humidity

It follows from this that the higher the degree of density, as well as the lower the pressure on the clay soil, the greater its humidity is needed to begin the destruction of the existing soil structure. This circumstance is clearly seen from Fig.4, where graphs of the dependence of additional seismic deformation of clay soil on its humidity are shown. Additional deformation (seismic subsidence) during an earthquake can have a significant magnitude exceeding 2-3 times the usual subsidence [2,3]. These circumstances, along with other factors, lead to catastrophic phenomena associated with the death of a large number of people during earthquakes.

Conclusions

As a result, it can be concluded that for the occurrence of compaction (subsidence) of clay rocks, it is not at all necessary to moisten them to full water saturation. The results obtained can be taken into account when designing and constructing buildings and structures on moist clay soils in seismic areas.

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