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Determination Of Deformation Of Buildings And Structures And Their Geodetic Observation Works

Docent: Juraeva Xusnora Davronovna
xusnoragk@gmail.com
Senior Lecturer: Yuldashev Akmal Olimovich
gkk304@gmail.com
Senior Lecturer: Kenjaev Ulug'Bek Abdulakimovich
ulugbekkenjayev@gmail.com
Tashkent university of architecture civil engineering

Аннотация: контроль просадок и деформаций зданий и сооружений является основной целью геодезических наблюдений. Здания и сооружения требуют постоянных геодезических наблюдений. Большое значение имеет вопрос определения наилучшего результата осадки, смещения, отклонения и деформации по результатам геодезических наблюдений. Важно и неотложно решать такие проблемы, как отклонение, деформация, проседание и горизонтальное смещение зданий и сооружений.

Annotatsiya: Bino va inshootlarning cho'kishi va deformatsiyasini kuzatish geodezik kuzatishlarning asosiy maqsadi hisoblanadi. Bino va inshootlar doimiy geodezik kuzatishlarni talab qiladi. Geodezik kuzatish natijalari bo'yicha cho'kish, siljish, og'ish va deformatsiyasini aniqlashning eng yaxshi natijada baholash masalasi muhim axamiyatga ega. Bino va inshootlarning og'ishi, deformatsiyasi, cho'kishi va gorizontal siljishi kabi muammolarni hal etish muhim va dolzarb hisoblanadi.

Annotation: monitoring the subsidence and deformation of buildings and structures is the main goal of geodetic observations. Buildings and structures require constant geodetic observations. The issue of determining the best result of subsidence, displacement, deviation and deformation according to the results of geodetic observation is of great importance. It is important and urgent to

solve problems such as deviation, deformation, subsidence and horizontal displacement of buildings and structures.

Ключевые слова: деформация, просадка, смещение, отклонение зданий и сооружений, нивелирная сетка, уровень, электронный тахеометр, контрольные отметки, пространственное смещение, собственный вес конструкции, осадка грунта

Kalit so‘zlar: bino va inshootlarningning deformatsiyasi, cho‘kishi, siljishi, og‘ishi, nivelirlash to‘ri, nivelir, elektron taxeometr, nazorat markalari, fazoli siljish, inshootning o‘z og‘irligi, tuproqning shibbalanishi

Keywords: deformation, subsidence, shift, deviation of buildings and structures, leveling grid, level, electronic total station, control marks, spatial displacement, own weight of the structure, soil settlement

Introduction. Modern buildings are distinguished by their multi-storey construction in a small area. A large number of control marks are installed on the individual elements of multi-story buildings. Control marks are measured by geodetic method in a certain period of time, and its deformation value is determined. In practice, when determining the deformation of the structure, the maximum accuracy of the measurement and the closeness of the deformation value to the measurement error is the most important and necessary task of geodetic observation.

It is known that there are many types of natural disasters on earth. They consist of strong earthquakes, catastrophic floods, floods, hurricanes, tsunamis, volcanic eruptions, large landslides, wide spread of various epidemiological diseases, etc., and cause incalculable damage to humanity and nature. A strong earthquake is the most damaging natural disaster. Usually, strong earthquakes do not kill people, but anti-seismic buildings and structures built by them individually, wrong actions can cause a tragedy. It is known from historical sources that deadly and strong earthquakes can cause the death of hundreds of thousands of people, the destruction of buildings and structures, tsunamis, large landslides, fires and various man-made accidents. According to statistics, several thousand to ten thousand people are killed every year in countries located in different regions of the globe as a result of strong earthquakes.

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Main part: Buildings and structures built on the basis of the project change over time, that is, under the influence of various reasons, they can move and sink. In general, the structure undergoes spatial displacement [1].

Deformation is derived from the Latin word deformatio, which means to deform. That is, it is understood that the constructions lying on the same plane change the points of mutual location under the influence of the external environment. Deformation is divided into two types: elastic and plastic. If the load acting on the building returns to its original state, this is called elastic deformation. And if it's the other way around, it's called plastic deformation.

Buildings and structures may deform, sag, deviate, and cracks may appear on the surface of the structure. The subsidence caused by the structure's own weight gradually stops depending on the soil compaction. In this case, if the foundation of the structure is sandy, subsidence occurs at a high speed and stops quickly. But in clay soils, the opposite happens.

Monitoring of deformation is carried out regularly, for several years, by geodetic methods. This is determined by observing the displacement and settlement values of the structure. To carry out these observations, special geodetic network points and high-precision geodetic instruments are used on site. For this, control signs are installed in the structures and their condition is monitored. Observations are carried out according to a separate program for each facility. Compilation of this program is considered a complex, scientific and technical issue, and the author of the construction project, geodesists, constructors, and geologists are involved in order to solve it [2].

Factors causing deformation of buildings and structures are presented in the following diagram. (Scheme 1).

Scheme 1. Factors causing deformation

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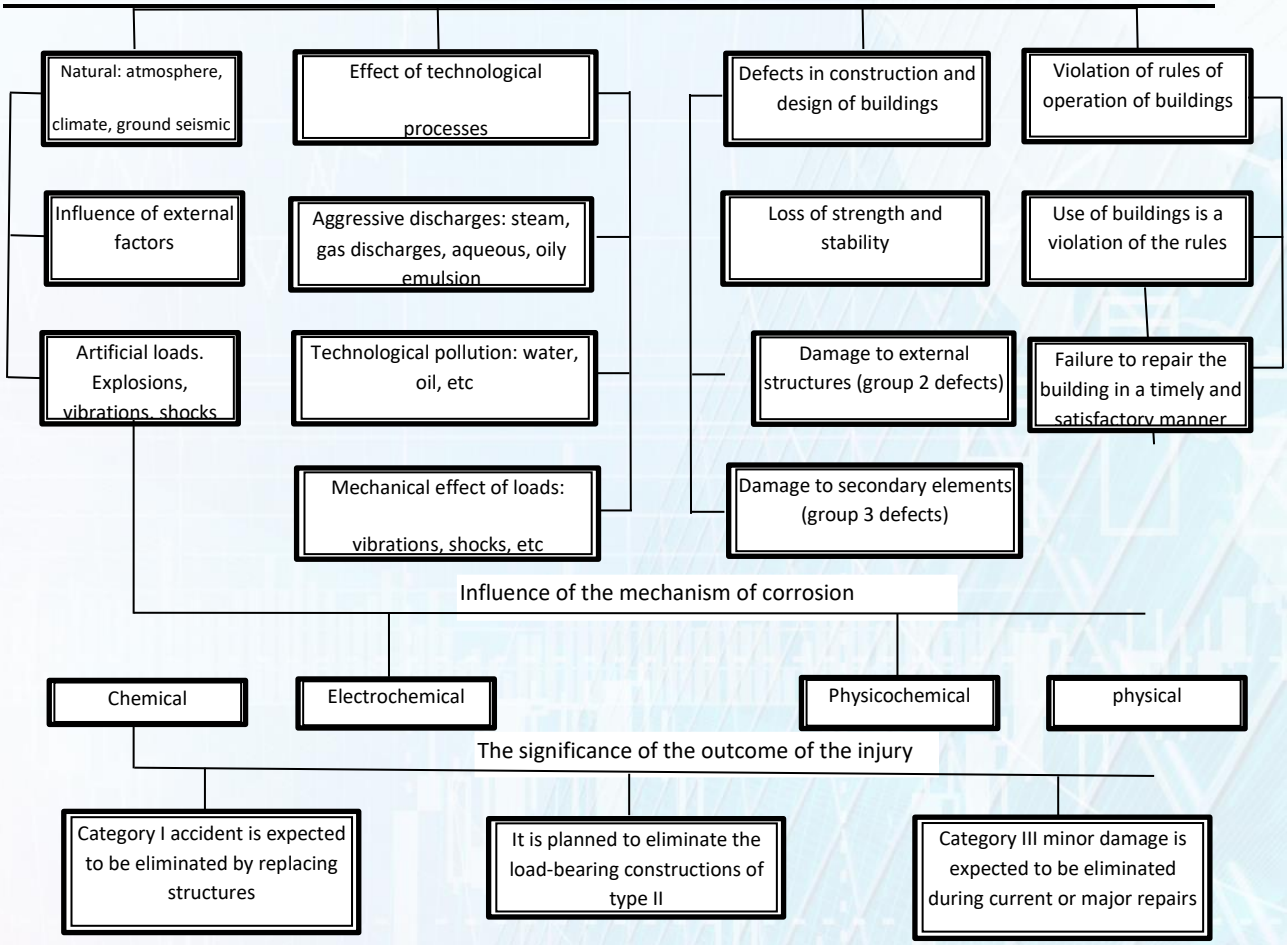

The simplest forms of deformation are: stretching, compression, bending and twisting. In general, as a result of deformation, the building changes its shape.

If the foundation sinks flat, the building will also sink flat. If the foundation sinks unevenly, the building will also sink unevenly, which in turn will make the building unusable.

Materials and methods:

The position of the marks to be placed to monitor the vertical settlement of the building and structure depends on the adopted measurement method. The method of geometric leveling with a short sight line (up to 25 m) is used to monitor the subsidence of the foundations of buildings and structures.

To determine the absolute value of the subsidence, leveling is carried out from the reference taken as the starting point. Relative subsidence is obtained from the difference in measurements between points of the structure. The most

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commonly used method for subsidence monitoring is high-precision geometric leveling. Leveling is carried out along the marks, which are considered as subsidence marks. These marks are placed on the foundation of the structure and they move with the structure, so by observing them we can determine if individual parts of the structure are sinking. Sinking marks are determined relative to a network of rappers located at a certain distance from the monitored structure, on the edge of the sink funnel. The stability of the height conditions of these rafters should be maintained during subsidence monitoring [3].

Placement of subsidence marks and geodetic base marks is one of the main tasks in determining the vertical and horizontal displacement of individual points of structures. The quality and detail of displacement detection depends on the correct placement and number of characters. As much as possible, sink marks are placed at the same level, at the corners of buildings. For residential and public buildings with brick walls, settlement marks are placed along the perimeter of the foundation at intervals of 10-15 m.

Figure 2 shows an example of installing sink marks on walls and columns.

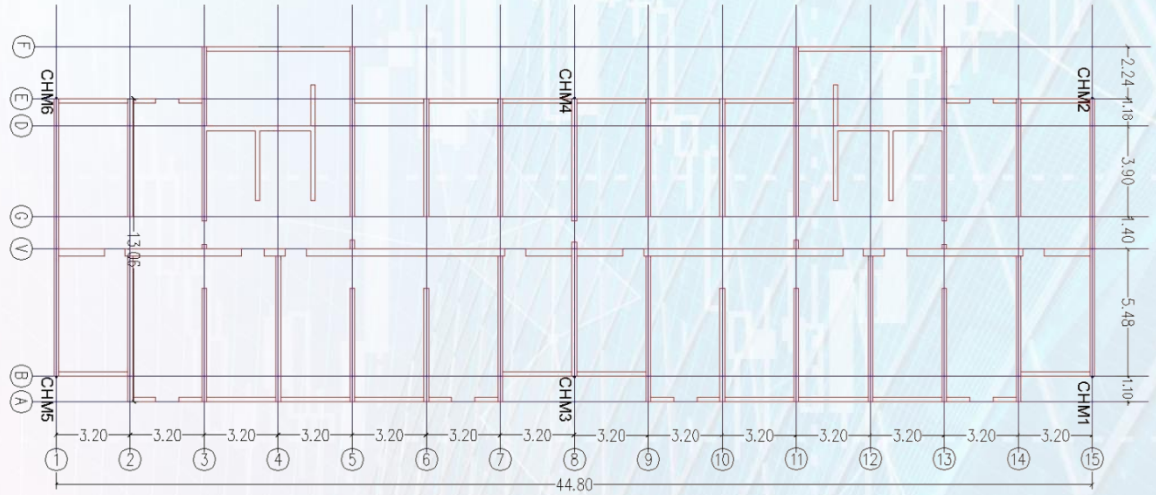

Figure 2. The scheme of placement of sink marks on the walls of the building

The arrangement scheme of stamps is designed in the plan of foundations of buildings and structures. Each stamp is numbered. A typical brand consists of a 15 cm long rebar or piece of iron.

Depending on the requirement and tracking accuracy, the rappers are as follows:

1. fundamental - deep rappers - installed on a solid, stable layer of the earth;

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2. earth grunt rappers - installed below the freezing layer of the earth;

3. wall signs - are installed on the walls of buildings and structures whose foundation subsidence has ended.

The 44.80 m long structure has 6 sink marks installed. They are placed horizontally along the structure at a distance of 20-25 meters. The scheme of the leveling path when transferring the absolute heights of the structure to the heads of the subsidence marks is shown in Figure 3.

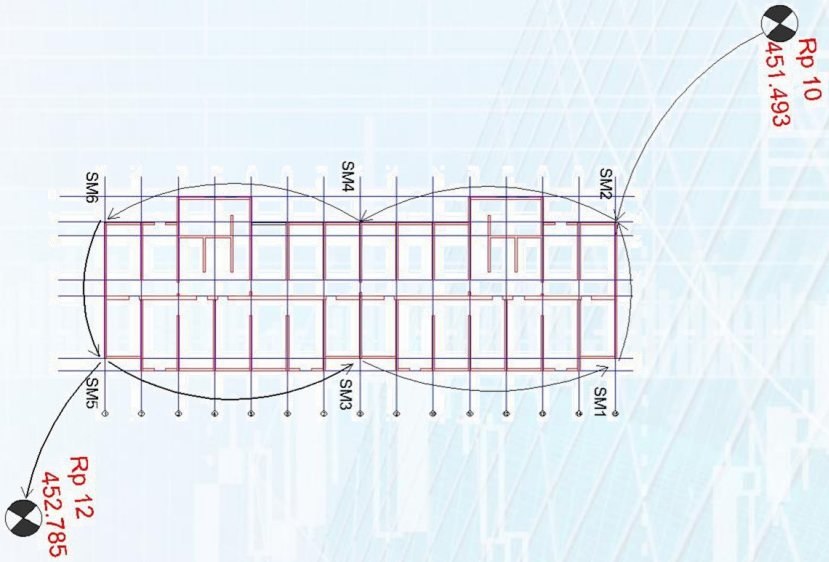

Figure 3. Scheme of the leveling way

The leveling way is carried out by the technical leveling method, and the mean square error of leveling is determined according to the following formula:

$$f_{\text{discrepancy}} = \pm 50\sqrt{L}\ \text{mm} \qquad (1)$$

here, L – is the length of the leveling way, km.

Results. The points located in the building were used as starting points. The absolute heights of these points are determined by the result of the 1st degree leveling. The measurement results are processed on a computer, and table 1 shows the value of absolute heights.

Table 1. Changes in absolute heights in buildings and structures

№	Location	1–cycle	2–cycle	3–cycle	Difference, mm (1-2 cycle)	Difference, mm	Difference, mm
		Absolute heights, m	Absolute heights, m	Absolute heights, m			

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		11.02.2023 year	15.06.2023 year	17.12.2023 year		(2-3 cycle)	(1-3 cycle)
1	SM 1	451,270	451,261	451,254	9	7	16
2	SM 2	451,270	451,264	451,253	6	11	17
3	SM 3	451,270	451,258	451,243	12	15	27
4	SM4	451,270	451,257	451,245	13	12	25
5	SM5	451,270	451,248	451,239	22	9	31
6	SM6	451,270	451,253	451,240	17	13	30

Figure 4. When monitoring the deformation of the building and structure used digital levels

During the geodetic inspection, defects and deformations are detected not only in some structures, but also in the building as a whole. Deformations that cause damage to buildings, which must be removed during technical operation, as a result of loss of strength and damage to the building structure, that is, moisture under the foundation and underground communications (water conduit, sewage, heat supply networks) caused by failure, digging trenches and underground water pressure in basements etc. First of all, it is necessary to eliminate the causes of defects. Strengthening of the base of buildings, foundations, walls and other load-bearing structures is used to eliminate defects. There are several methods of troubleshooting.

Factors causing deformation of the building

Exploitation of buildings, violations of rules, their description and complexity are different districts, and they can be divided into two groups:

• Violation of building maintenance and use rules;

• timely and unsatisfactory performance of repair work.

The first group includes improper storage of floors and foundations, which is a dangerous violation of the rules of building operation. Especially in loess soils, waterlogging of the soil causes a large uneven settlement in the foundation. This situation may be related to errors in the vertical planning of the land around the building, earthworks, malfunctions of underground communications, etc. The occurrence of such conditions around the building leads to the freezing of the ground, as a result of which the bearing capacity decreases while the volume expands.

There is another situation that often occurs in the process of operation, which is related to the correct operation of the roof covering. This is often the correct choice of covering structures, the correct arrangement of ventilation and heat regime in attic coverings, etc. is related to

The second group includes errors related to the violation of the technology of carrying out repair work on floors and foundations, eaves, walls and roof coverings.

It is necessary to study and determine the deformations in the structure in order to visualize the state of strength of the structure. Deformation in the structural element appears in different ways, it can be a parallel shift of the cross-sectional surface, compression or stretching.

There are two types of deformation in building structures: local or general. Local deformation includes twisting, shifting, compression or stretching of elements occurring at structural nodes. General deformation can include displacement or deformation of the structure [4].

As a result of geodetic observation, the general condition of buildings and structures that have been operated for a certain period of time is determined. It should be noted that one of the main issues of diagnosis is to determine the deformations of buildings and structures. It is carried out by identifying existing deformations, defects and damages during the inspection process and analyzing them.

Conclusion/Recommendations**:** It occurs as a result of excessive movement of the ground or an error in determining its load-bearing capacity during the design process, or violation of the standard operating conditions provided for in the project. Often, this situation is manifested in the wetting of sedimentary soils, the melting of ice sheets, and in the event of an emergency in the water and heat supply system. Measurement of the

subsidence of buildings and structures is carried out by comparing the marks of the rapier and subsidence marks. Base rappers are measured with a level. The deviation of the structure is measured with a theodolite or an electronic total station. Measurement of displacement of constructions and structures is also performed using a theodolite or electronic total station, where the lateral displacement of an object or structure is measured by a straight line drawn along the structure.

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