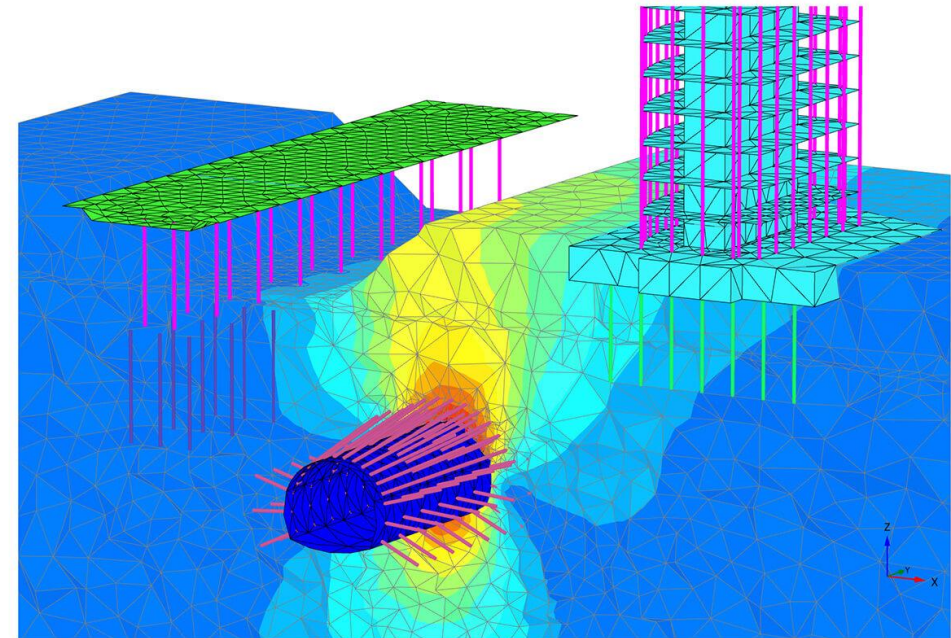
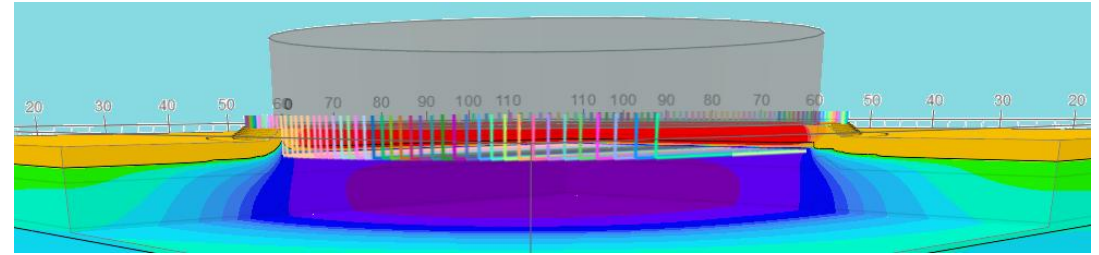


Topic 6. Monitoring of Adjacent Development and Territory



Engineering surveys in dense buildings

Soil structures are among the most ancient, and soil is the most used building material. However, until the middle of the last century, design was based mainly on accumulated experience, and the most important role in the design of structures was played by construction technologies.

Non-rocky and rocky soils are created by nature, not man.

Natural properties are always complex, which entails an increased risk at the design and construction stages. First of all, this refers to the complexity of geotechnical research, design and control, which affects the magnitude of geotechnical risk.

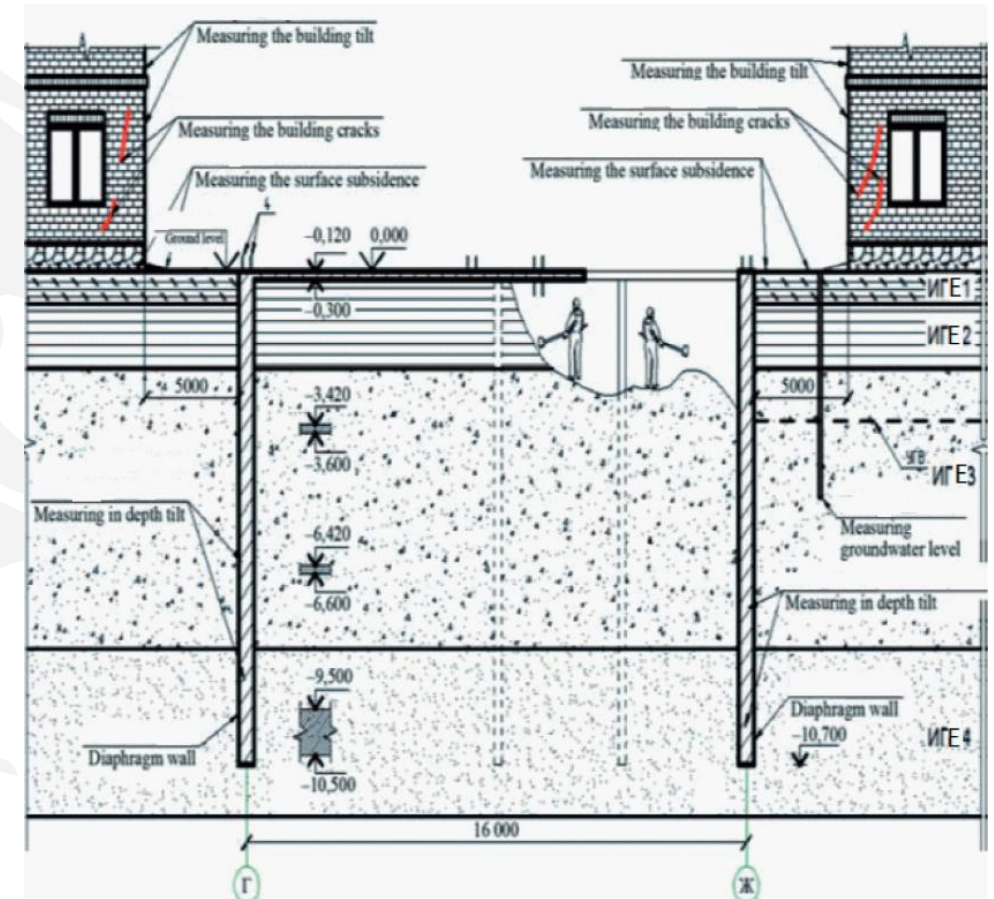
The main causes of emergencies during construction in difficult engineering and geological conditions are:

- incorrect assessment of engineering and geological conditions of the construction site;
- a decrease in the technical level of design, construction of buildings and structures;
- failure to provide scientific and technical support at the stages of design and construction of the facility, including monitoring of the construction facility at all stages of its life cycle;
- violation (non-compliance) of the rules for the operation of buildings and structures;
- combining together the above-mentioned factors, which is a chain effect of a combination of these factors;
- other additional factors.



Engineering surveys in dense buildings

The main difference between soil and other geotechnical structures is related to the control stage. For foundation structures, during monitoring, the quality of the underlying soil surface is monitored, and deviations from the expected ones in the physical and mechanical properties (hereinafter referred to as PMV) of the soil (in relation to the geological model and partially to the geotechnical one), which may lead to corresponding changes in the design. Similarly, monitoring should be applied to underground structures and pits, since when excavating the soil, the geological model is checked for compliance with the actual data.



Engineering surveys in dense buildings



At the stage of pre-design work and/or adjustment of project documentation, the following features are taken into account:

- placement of local facilities in territories that previously require a comprehensive urban planning solution;
- selection of an architectural and planning solution (architectural project) and the optimal option for the location of the object, its volumetric and spatial solution, clarification of the boundaries of the territory, interconnection with the surrounding buildings;
- assessment of the size of the zone of impact of earthworks on the surrounding buildings and the need to establish the technical condition by inspection of buildings and structures within this zone;
- composition and scope of additional engineering-geological, hydrogeological, environmental and other surveys.

During the development (adjustment) of the design task taking into account the conditions of dense buildings, when determining the scope of the survey, special attention is paid to underground structures and engineering networks (collectors, communications, etc.). For the inspection of structures of underground structures / networks, foundations and soils of the foundations of adjacent buildings, special survey methods are provided, including pits in an amount sufficient for calculations.

In the areas of historical development, the presence and placement of existing underground structures, basements, foundations of demolished buildings, wells, reservoirs, underground workings, etc., are revealed.

Engineering surveys for the design of new buildings are carried out in the volumes necessary to calculate the mutual influence of the new building and adjacent buildings. To design measures to reduce the impact of a new building on nearby objects, engineering surveys provide for both determining the engineering and geological conditions of the construction site of a new building, and obtaining complete data on the surrounding buildings.

The collection and analysis of archival materials of surveys is carried out not only for the site of new construction, but also for nearby objects. They also collect information on the planning, engineering preparation and improvement of the site, documents on the production of earthworks. On the basis of comparison of new research materials with archival data, changes in engineering, geological and hydrogeological conditions that occurred during the period of operation of existing buildings are established.

Assessment of the impact of a new building on the adjacent buildings is carried out taking into account the forecast of changes in the hydrogeological conditions of the site, the condition of existing buildings, their dimensions and structural features.

The data obtained, if necessary, are used to design a water reduction system.

Engineering surveys in dense buildings



A complex of survey works using field and laboratory methods should ensure the receipt of all soil characteristics necessary for the calculation and design of the foundations and foundations of a new building, as well as checking the risk of deformations and ensuring the stability of nearby objects.

The results of survey work are used to develop compensatory measures to prevent and/or reduce man-made impact on adjacent buildings. Determine the characteristics of the soils required for the calculation of the main design solutions to reduce the impact of a new building on the adjacent buildings in the form of retaining or enclosing walls, which are made using the "walls in the ground" technology, sheet pile fencing made of metal sheet piles or piles, which simultaneously perform the functions of an anti-seepage curtain.

For construction sites, where the manifestation of dangerous natural and man-made influences on buildings (karst, sufosis, erosion, heaving, flooding, dynamic actions, electrical, magnetic and thermal fields, man-made actions), in order to assess possible changes in their properties as a result of these processes, special studies are provided to ensure the obtaining of characteristics of soils and groundwater, which are used to perform design work.

To clarify the heterogeneity of the structure of the soil thickness, their composition and condition, to identify karst and man-made zones, erosion erosion zones, and groundwater conditions, it is recommended to provide for geophysical studies.

The project for the protection of nearby objects is carried out on the basis of the following initial data:

- report on engineering-geological, engineering and geodetic surveys for nearby objects;
- a report on the results of the survey of nearby objects located in the zone of influence of the new building;
- the results of the analysis of the adopted method of construction of a new building and assessment of its impact on possible deformations of buildings of adjacent objects for the period of construction and the next period of operation. The analysis materials contain predicted additional deformations of the foundations of the surrounding buildings and their unevenness (differences in subsidence and rolls of building sections). These data are given for each object separately.

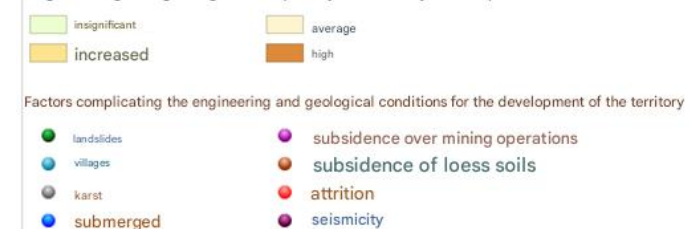
Destructive processes in the soils of the construction site

Construction and operation of buildings and structures on the territory of Ukraine, in most cases, is carried out in difficult engineering and geological conditions. The categories of difficult soil conditions include territories where, as a result of the development of deformation or dynamic processes in soils, there is a danger of damage or destruction of buildings. More than 80% of the territory of Ukraine is represented by complex engineering and geological conditions. Difficult conditions include areas of soil occurrence with special properties (subsiding – 70% of the territory, swollen, biogenic, silt, eluvial, saline, bulk); with the possible development of dangerous geological processes (landslides – more than 130 thousand landslides were recorded, karst – 60% of the territory covers the process of karst formation); territories that are forged, flooded, etc. territories, as well as seismic areas with an area of more than 120 thousand km² or 20% of the territory.

Zoning by complexity of engineering and geological conditions



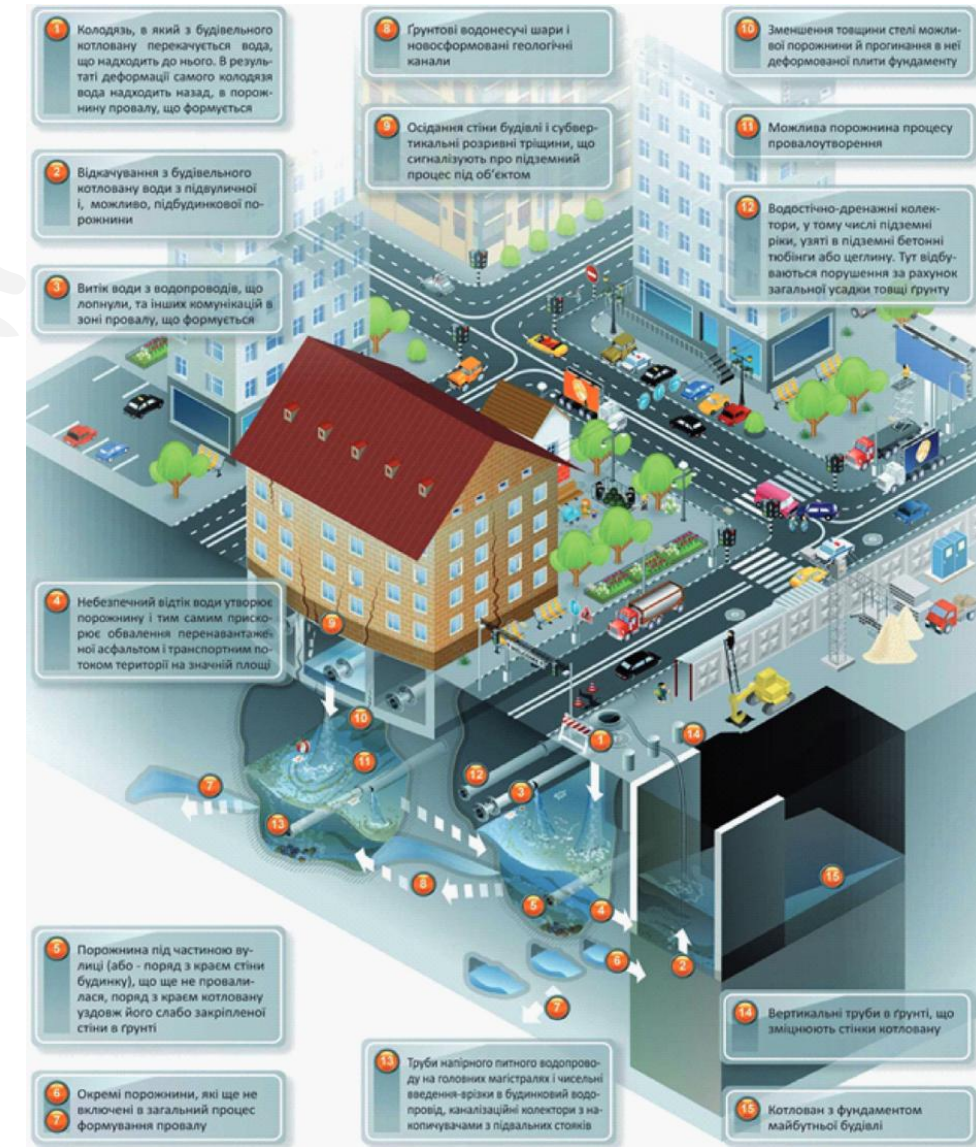
Engineering and geological complexity of territory development



Destructive processes in the soils of the construction site

Existing dense buildings in each case of new construction can create a risk of damage or disruption of the normal operation of existing buildings, due to the influence of the following factors:

- I. Violation of the soils of the foundation during the work on the construction of the pit.
- II. Additional stresses in the core of the base due to additional loads.
- III. Dynamic loads on the base of houses due to the installation of pit enclosing structures (sheet piles, piles).
- IV. Destructive processes in soils: erosion, suffosion, freezing, subsidence, changes in hydrogeological conditions, etc.).
- V. Vibration and dynamic loads from the operation of construction and transport equipment.
- VI. Impact of construction and transport equipment, and especially lifting equipment.
- VII. Violation of normal conditions of insolation, ventilation, engineering support, improvement of existing buildings.



Geotechnical monitoring

The objects of geotechnical monitoring are the foundations of foundations, soils located in the construction zone, as well as structures for fastening the walls of pits of buildings and structures.

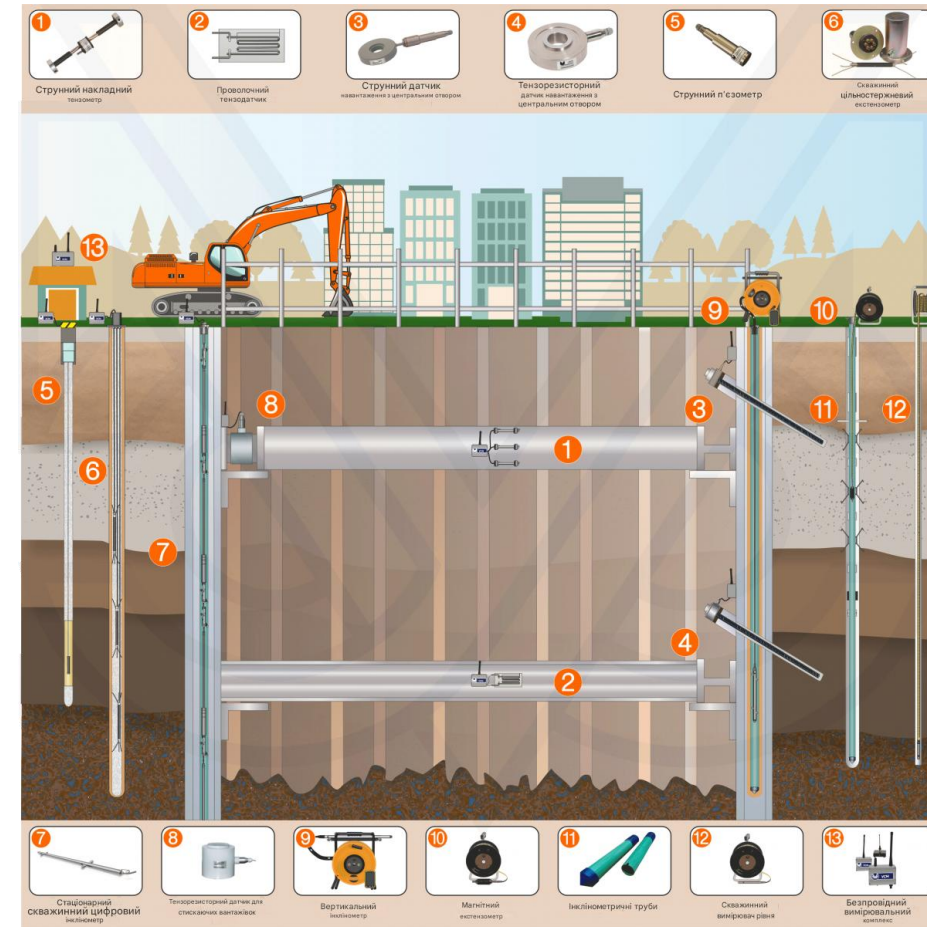
The task of geotechnical monitoring is:

timely detection of deviations in individual components of the geological environment of the base of the object under construction and the zone of influence of construction and systematic control over the development of these deviations;

systematic control over the condition of structures, fences (fasteners) of the pit;- adjustment or development of new technical solutions that provide the characteristics of the state of soils, foundations and soil masses adjacent to the building or structure specified by the project;

adjustment or development of new technical solutions for stabilization of deformations of pit walls;

systematic control over the parameters of radiation and other types of environmental safety.



Geotechnical monitoring

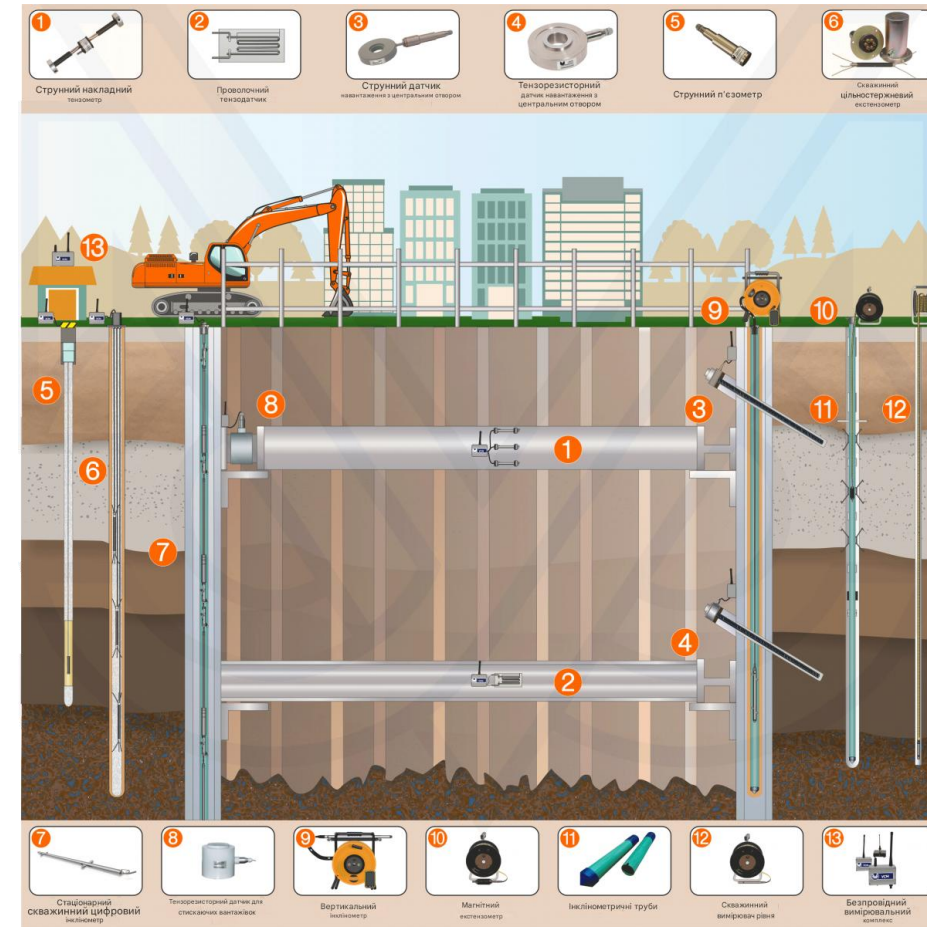
Methods for obtaining information:

geodetic - with the use of theodolites, levels, total stations, electronic scanners, space navigation systems (fixation of deformations and changes in the location of monitoring objects in space);

geophysical - to solve a wide range of problems, especially in the absence of direct access to soils and the impossibility of drilling at a given point (including vibroseismometry and radiometry);

engineering and geological - by direct selection and analysis of samples from drilled wells, as well as regime observations in equipped wells and posts;

physical - based on the use of a complex of strain and stress sensors (including automated complexes).



Geodetic and geological monitoring

The geodetic system of observations (monitoring) consists of several blocks:

a system of observations of the state of the surrounding soil mass outside the enclosing structures of a building or structure;

a system of observations of deformations of structures of the object under construction;

a system of observations of existing objects located in the zone of influence of construction.

Geological monitoring is carried out in order to control the geotechnical and hydrological parameters of the foundations of buildings and structures to identify changes in the engineering and geological environment, the development of which can affect the structural safety of the object in the process of construction and operation.

The main controlled parameters of the engineering and geological environment include:

groundwater level, their temperature and chemical composition, aggressiveness to structural materials, changes in the characteristics of materials over time;

parameters of soils in the natural state - density, speed of elastic waves (longitudinal and transverse), porosity, moisture; changes in these parameters over time, including before the start of construction, construction of the facility and operation, are determined;

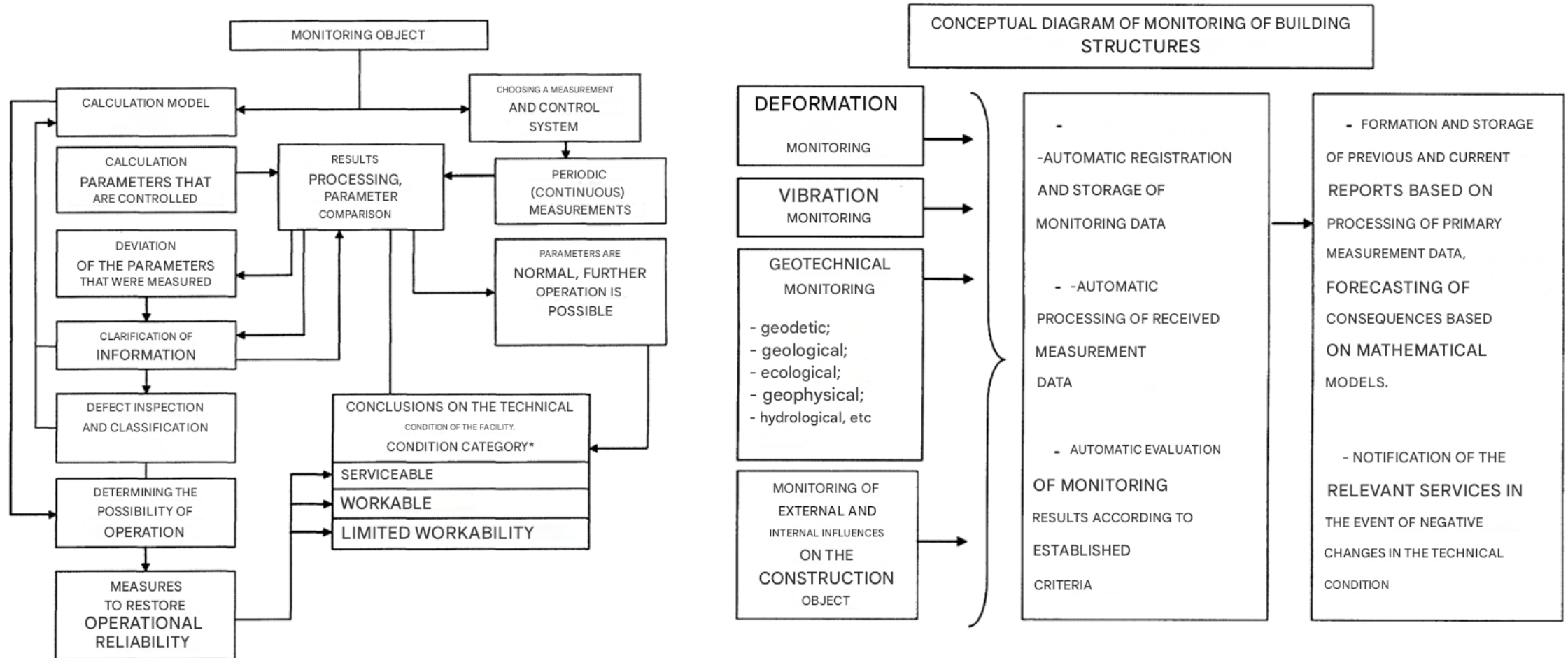
soil surface marks at reference points, rise and fall of the earth's surface, soil displacement, changes in slope slopes, etc.

To predict the state of soils in the foundations of buildings and structures, a mathematical model of the engineering and geological environment is used. The software is selected so that it is possible to adjust the model in the process of obtaining information.

Model verification is carried out by solving test problems and comparing the results with information from monitoring networks.

On the basis of the computational mathematical model and based on the results of full-scale observations, forecasts of changes in the physical and mechanical properties of soils, stress-strain state of the soil mass and hydrogeological regime, activation and development of dangerous hydrological and engineering-geological processes are performed.

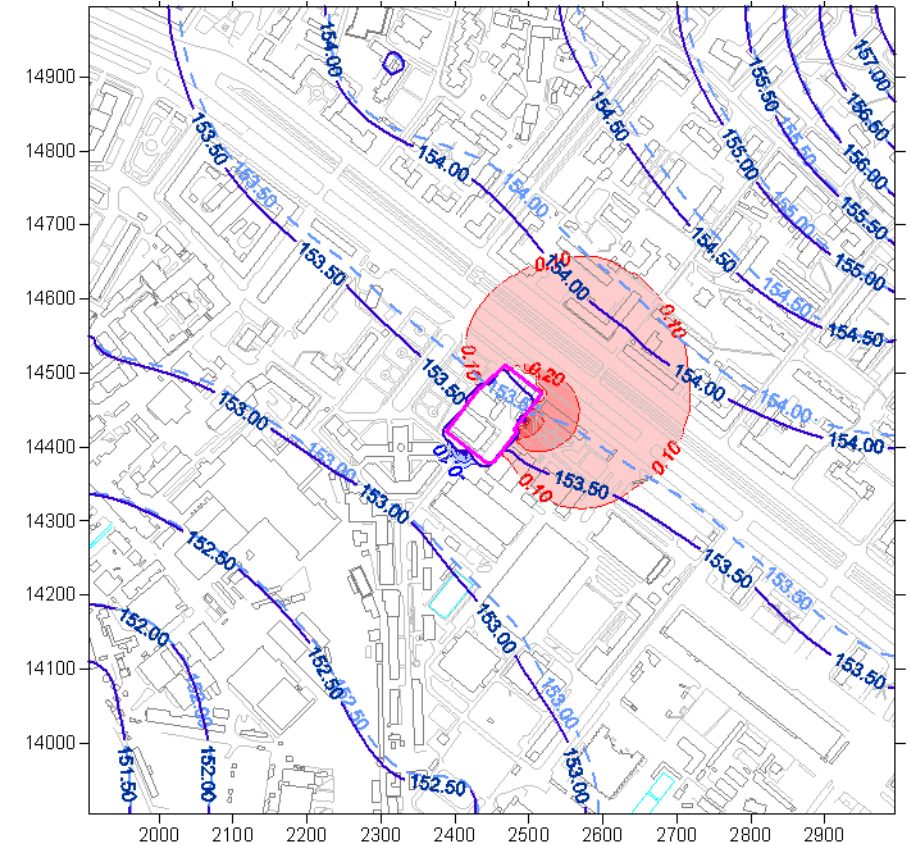
Structural diagram of technical condition monitoring



Change in the established groundwater level

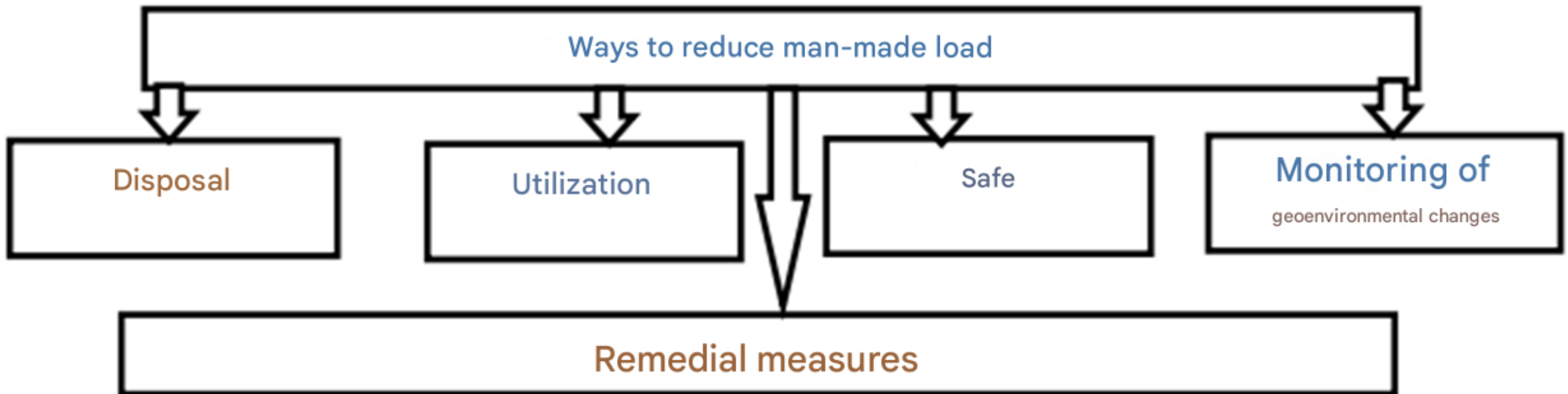
Active development of underground urban space (construction of parking lots, subway and other industrial and social facilities underground) violates the natural hydrogeological regime. Artificial obstacles to the movement of groundwater cause a rise in the groundwater level, including flooding. As a result, basements are flooded, corrosion of reinforcement of concrete structures is accelerated, and the service life of houses in which sanitary standards for their operation are not provided is reduced. This is a common phenomenon in Ukraine.

A separate aspect is the delay in schedule or delay in construction and installation work after the construction of the pit. As a result, the soils on which the foundation is erected are repeatedly frozen, which reduces their building properties. But the structures were designed for the initial, higher physical and mechanical indicators of soils, so frozen and degraded soils may not withstand the required load.



Soil, surface and groundwater pollution

In the modern conditions of the formation of a globalized society in many countries of the world, there is a deepening of geoecological problems that affect the development of cities. It should be noted that the growth of city territories, the level of use of their lands leads to an aggravation of environmental problems. Therefore, in recent years, the importance of geoecology as "a science that studies natural and man-made factors that affect biota and biological species, including humans, in Earth conditions has been growing." The development of geocology is due to the need to solve environmental problems, which is influenced by natural economic factors. In the context of the implementation of the directions of formation and use of geoecology in the field of land relations of cities, geoecological monitoring is used.



Afterword

«When I published the book "Structural Mechanics of Soils", I was not yet aware of the uncertainty associated with the interpretation of drilling results, and my test methods were still very primitive. Therefore, I myself went through a period that can be described as "abuse of soil mechanics". I am still surprised when I remember the bold conclusions that I then made on the basis of experiments carried out on primitive instruments, with a small number of disturbed samples. It was only later that I realized the great influence of sampling and testing techniques on the results obtained.»

Karl Terzaghi (1883–1963)