Drainage of Buildings and Territories in Conditions of Low Permeable Soils

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Abstract

This article shows specialty of the substantiation for optimum parameters of drainage systems in the low permeable soil for buildings and territories. This paper lists significant factors of a choice of the key parameters which defines the efficiency of drainage systems. It is being given their role in decision-making for geotechnical conditions of the Northwest region of Russia. The analysis is made for the drainage servicing objects with burying of the exploited volumes in limits of 6-7 meters. This article describes various features of the drainage of territories and buildings with a big area of the equipped permeable surfaces. It investigates significant factors for the choice of effective system of drainage: water drawdown power, texture of a geologic profile, structural-spatial concept of buildings, technological and environmental requirements, and safety regulations. This article shows dependence between each factor and parameters of drainage: constructional type, situation in the plan, an overhang confining layer, and water handling construction. The report notes that practice testifies to the requirement of the use of the complicated schemes and the drainage construction of drainage without pipe. This is in connection with increase in safety requirements and ecology.

Keywords: Drainage, optimum parameters, choice of effective systems

Introduction

Nowadays, the design of the drainage systems has met new challenges related to the choice of the optimal concepts. First of all, they appear in the course of the selection of significant factors for particular building conditions. However, this is a territory with a big area of the equipped permeable surfaces in the composite geotechnical conditions.

In particular, the existence of bedded formation of the nonuniform helps to structure the low permeable soil clay soils with anisotropic filtration properties. Flooding happens because of the existence of a temporary perched ground water. This type of groundwater is formed at an infiltration of an atmospheric precipitation. Also, the emergence of a perched ground water does not always have a seasonal nature because of climate pattern of the territory and a lowland relief. The described geotechnical conditions are the characteristic of the Northwest region of Russia. They are of interest to the experts that develops design decisions in similar natural and geological conditions.

Subsequently, the author tried to reveal significant factors and to show their role in the choice of the essential parameters by defining the effectiveness of drainage systems. Furthermore, the author spoke about drainages and the servicing of objects with the burying of the exploited volumes in limits of 6-7 meters. The results of the analysis and the drawn conclusions are based on many years of experience in design. It includes successfully realized decisions checked by time in construction engineering. Also, we used our expert reviews in the work process. This served as justification for the updating of the projects which originally contains unsuccessful decisions.

I.

The main parameters of drainage include structural-spatial type, situation in the plan, an overhang confining layer, and water hauling construction. Thus, we will consider these factors sequentially: Structural-spatial type - horizontal gravity drainage in two options depth of drainage. The first – near surface, and the second – deep within 6-7 meters. The following important parameter is a drainage arrangement with respect to protected object. However, this parameter of drainage is known as the scheme or system. Contour and linear systems of drainage exist in Russia. Furthermore, parameter is the degree of hydrodynamic perfection. It characterizes the place of the provision of drainage with regards to a confining layer. Drainage located on a confining layer is regarded as perfect (sovershenny). If the drainage is located above a confining layer, then it is called drainage above water table (nesovershenny). At last, important parameter is a water hauling construction. In addition, it can have a pipe or might not have a pipe.

Consequently, there are significant factors that define the choice of the parameters of drainage without their priority subordination. It, however, include the water drawdown power, texture of a geologic profile, structural-spatial concept of buildings, technological and environmental requirements, and safety regulations. They significantly influence the choice of parameters

of drainage and its effectiveness. In addition, we will talk explicitly about the roles of these factors.

Originally, we estimate the potential water drawdown decrease on the basis of information on the protected objects and geotechnical features of the construction site.

Power or Depth of Water Drawdown

It is defined considering drainage rate and the actual deepening of substructure or subsurface infrastructure of the urban environment. In this environment, water regulation is necessary. Also, we can determine the type of efficient system of drainage by this characteristic. If it is about subsurface infrastructure, then we make use of drainage and storm elements. Thus, such elements solve some problem of the organization of the surface and underground drain. In case the protected object is burying the exploited volumes, then we use a drainage of a deep underlay of horizontal type. Also, the selection of an optimum design of the transportation of water will depend also on other significant factors (Kliorina, 2017). The use of both types of drainage is urgent when protecting against the flooding of buildings. Also, the territory is required. Therefore, their interference on change of the water mode of the territory has to be predicted beforehand.

Texture of a Geologic Profile

According to these characteristics, we allocate several usually met options which influence the choice of the effective system of drainage. First option presents soils with low anisotropic filtration properties, and it has a low power in the top section. They are spread by conditionally waterproof soils within the deepening of the bases of buildings. Here, we call waterproof soils with a coefficient of permeability that is less than 0.005 m/days in the design practice of Russia. In this case, we choose a perfect drainage of the territory of subsurface type. The scheme of drainage is multilinear. Also, we determine distance between lines by calculation. The extent of drainage will depend on a configuration and the area of water-permeable surfaces. The choice of a design of drainage will be influenced by production requirements to the territory. They, in turn, depend on the purpose of the town-planning environment. The buried parts of buildings will require various type of drainage of a deep level. However, it is near a base drainage of preventive appointment with the contour scheme in the plan. The drainage should be brought closer as much as possible to a structure of the base. Also, it should be laid with a minimum bias. However, it is economically expedient. Construction of drainage will be defined by technical capabilities and convenience execution of work. In the second option, soils of a stratified superposition have low anisotropic filtration characteristics. Big strength of

layer with the provision of the conditional confining layer are much deeper than the required zone of drainage or water regulation. Unlike the first option, it is necessary to use drainage above the water table of the subsurface and deeply put type. Consequently, it is here too important to predict their interference on the water regime. Besides, it is necessary to carefully prove calculations of the definition of the expenses of a drainage drain. They always surpass various expenses of the perfect type of drainage. Contour scheme of drainage of buildings. Drainage distance on the base and its construction depend on safety requirements. Calculation needs to be executed if the drainage lower than the base is buried. In the third option, soils are of a stratified superposition with the coefficient of permeability of layers, differing from each other more than 20 times. Usually, lamination is formed by layers of sandy pockets in almost confining layer. Also, there can also be a technogenic layer which is poured out on a soil surface. Flooding is usually caused by a perched ground water, subsoil waters in sandy pockets, and in permeable technogenic layer. In bore hole surveying, we often note the existence of local pressures because of the opening of sandy pockets. Here, decisions of the texture of a geologic profile similar to the first option will be required. When calculating the expenses of drainage drain, it is necessary to be guided by the coefficient of permeability of sandy aqueous pockets or a technogenic layer.

Structural-Spatial Concept of Buildings

To choose efficient system of drainage, two main characteristics are important. The first is a structure of the base. The second is the existence of the standard or individual structural-spatial concept of the protected building and plane constructions. Therefore, these characteristics influence the scheme of a drainage and its construction. At the big area of the protected object, the contour scheme of drainage becomes more complicated at the expense of underground internal lines (Kliorina, 2003, 2017). We surely have to consider safety regulations. When deepening drainage below a sole of the base of the building, it is necessary to provide protective measures against a suffosion. They can be solved by the application of a construction of drainage without pipe. The similar constructions are timely. This happens when the building has a facade of ladder and ramps with the characteristic base. As Structural-spatial concept of buildings is continuously improved, it is important to correlate the decisions made on drainage to the quality of the environment and the objects which needs protection.

Safety Regulations

Level subordination of a drainage concerning a foundation base of the building or a construction matters. If the drainage is below the foundation

base, the requirement is timely for the protected object which is located nearby. We speak about the new buildings and the buildings exploited as well as the building services systems. In this case, the scheme of drainage is defined by calculated clearance distance. Therefore, the contour near a base drainage was removed from the foundation base of the building or applied to the construction of drainage without pipe. Today, we prefer the option of the construction of drainage without pipe that is explained by the size of construction site and the larger deepening of drainage.

Technological and Environmental Requirements

Consequently, such requirements affect the choice of all parameters of drainage. The modern feature of buildings is the need for individual decisions of schemes and the construction of drainage. It is promoted by new materials and building method. An important aspect of the considered requirements refers to the compensation of the consequences of water drawdown. Therefore, it is solved by the modern technologies and by methods of the forecast. In various zones of water-permeable surfaces, the drainage solves the general problem – creation of optimum moisture conditions of the exploited subsurface structure (Kliorina & Lapshina, 2004). In addition, the general problem depends on particular demand. This demand, however, is defined by the use of the exploited subsurface structure and geotechnical conditions.

Conclusion

1. In the paper, we considered difficulties of the choice of significant factors for the justification of the optimal solution of drainage. This is defined much by the differing specific conditions of construction.
2. We revealed significant factors for the choice of efficient system of drainage. These include: water drawdown power, texture of a geologic profile, structural-spatial concept of buildings, technological and environmental requirements, and safety regulations.
3. We investigated significant factors which determine parameters of efficient system of drainage of the territories and buildings. Also, we showed dependence between each significant factor and the main parameters of drainage are its structural-spatial type, situation in the plan, an overhang confining layer, and water hauling construction.
4. Experience shows the necessity of using complicated schemes and the construction of drainage without pipe due to increased safety and environmental requirements.

Recommendations

The data provided in this article can be useful to the experts in developing design solutions in similar natural and geological conditions.

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