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THE INFLUENCE OF THE TUNNEL CONSTRUCTION PROCESS ON THE DEFORMATION OF THE SOIL AROUND THE TUNNEL AND PRECIPITATION OF THE EARTH'S SURFACE

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ABSTRACT

This article presents issues related to the creation of reliable circular cross-sections of tunnels, taking into account the voltages around the artificial spaces located in the grunt massif, and the high speed of tunnel excavation work, as well as the operation of tunnel excavation mechanisms, safe for workers-employees and surface structures, the high-quality processing of the tunnel coating.

Keywords: tunnel, soil, fossil place, tension, deformation, displacement, sediment, Tunnel-tunneling mechanized complex, longitudinal and transverse cuts.

TONNEL ATROFIDAGI GRUNTNING DEFORMATSIYALANISHI VA YER YUZI CHO‘KISHLARINI TONNEL QURISH JARAYONIGA TA’SIRI

ANNOTATSIYA

Ushbu maqolada grunt massivida joylashgan sunьiy bo‘shliqlar atrofidagi kuchlanishlarni hisobga olgan holda tonnellarning ishonchli doirasimon kesimlarini yaratish va tonnel qazish ishlarining yuqori tezligi, shuningdek ishchi-hodimlar va yer usti inshootlar uchun xavfsiz bo‘lgan tonnel qazish mexanizmlarini ekspluatatsiyasi, tonnel qoplamasini sifatli qilib ishlanishi bilan bog‘liq masalalar ko‘rsatilgan.

Kalit so‘zlar: tonnel, grunt, qazilma joy, kuchlanish, deformatsiya, siljish, cho‘kish, mexanizatsiyalashtirilgan tonnel qazish mashinalari, bo‘ylama va ko‘ndalang kesimlar.

INTRODUCTION

Leading positions are occupied by the construction of modern transport tunnels using new innovative solutions of tunnel coating around the world, the improvement of methods for calculating them in strength and durability, as well as the application of Advanced Design Technologies and technical means to them [1].

During the construction of underground metro facilities, there is a violation of the natural stress state of rocks, which leads to deformations of the production contour, covering rocks of the massif and the earth's surface. In conditions of dense development of large cities, entire micro districts with multi-store buildings and engineering communications fall into the zone of influence of mining operations, in which additional efforts arise from the impact of deformation of the earth's surface. Under the influence of these efforts, buildings and structures are subjected to deformations and damage, which in some cases lead to the termination of their operation. The degree of this impact depends on many factors, not the least of which are those

related to the structural features of the underground structure. For example, the mechanism of occurrence and propagation of deformations and displacement in the rock mass during the construction of tunnel workings is peculiar [2].

METHODS

The appearance of any cavity in an array of rocks violates the natural equilibrium determined by the system of gravitational and tectonic loads on the array, arising near the development of displacement, spreading in the array with attenuation, reach the Earth's surface, forming a mulde of displacements [3, 4]. Based on the analysis of scientific papers [5, 6] and the features of the deformation of tunnel workings in the soil mass, the following features of the mechanism of the appearance of deformations can be noted (Figure 1-2): - the construction of tunnel workings causes a change in the stress-strain state of the rock mass; - such a change in the stress-strain state of the array leads to the occurrence of a displacement field in the array around the tunnel; - the propagation of deformations in the array from the source of disturbances of the tunnel workings, occurs in all directions from the workings and has a damping character; - the direction of the displacements is oriented mainly to the center of the production.

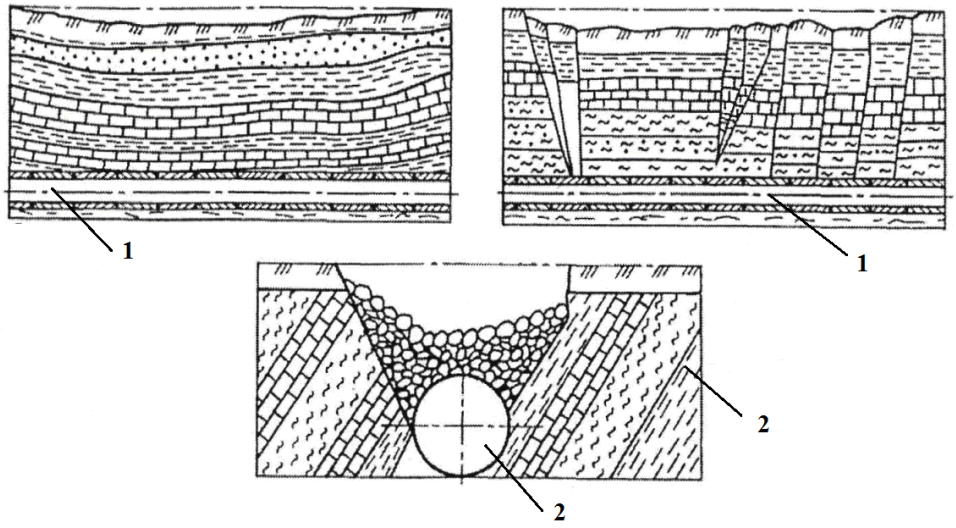

Figure 1. Deformation of the soil around the tunnel
1- tunnel, 2 – grunt array

Figure 2. Subsidence of the surface of the Earth over shallow-located tunnels

Also, a review of the work made it possible to note the general features of the manifestation of displacement on the Earth's surface characteristic of tunneling (Figure 3):
- the maximum subsidence of the surface is localized above the axis of the tunnel;
- the boundaries of the movement zone in the direction perpendicular to the axis of the tunnel are symmetrical to the axis of the tunnel, and the lengths of the half-mouldes are approximately equal to the depth of the tunnel;
- the process of moving the surface in the longitudinal direction begins even before the approach of the mine face, is sharply intensified when the face passes under the point and fades when the face is removed;
- the boundary of the displacement zone in the longitudinal direction increases when the face is stopped.

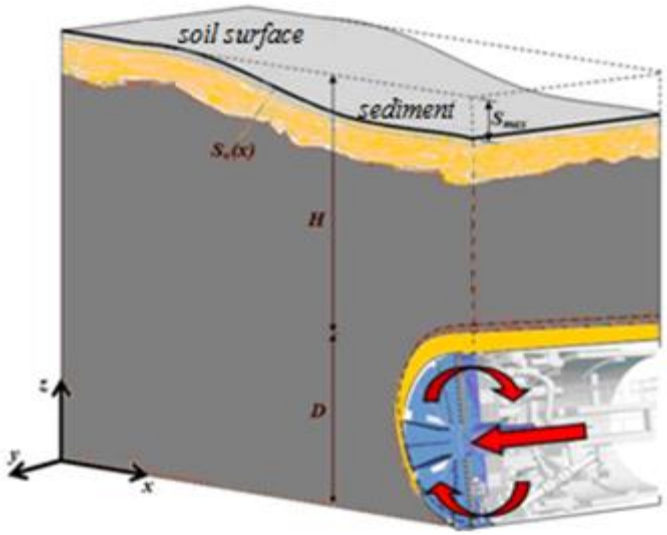

Figure 3. Scheme of propagation of sediments over the artificial cavity

The period of dangerous deformations is considered to be the period of displacement of the earth's surface over horizontal tunnel workings, in which deformations occur at a settling rate of at least 50 mm per month [5, 6, 7]. Thus, the maximum subsidence of the earth's surface during the construction of distillation tunnels made by the Tunnel-Tunneling mechanized complex and fixed with precast reinforced concrete lining in Proterozoic clays is calculated only in units of centimeters (and as established by research, subsidence of the earth's surface up to 3 mm does not have a harmful effect on buildings and structures at all) [8, 9].
The process of displacement begins in front of the moving face at a distance of 15-20 m, thus, the dynamic angle of influence is on the order of 70-75 °. The subsidence of the earth's surface above the face plane reaches 5 mm. After passing the observation point by the face, the earth's surface undergoes further subsidence, while the active period lasts about 10 days, and the maximum subsidence reaches 15-20 mm.
The process of shifting the earth's surface at this stage is associated with the deformation of the permanent lining of the workings and the reduction of the construction gap between the lining and the array before the production of grouting works.

RESULTS

Tunnels traversed by the Tunneling Mechanized complex with the use of prefabricated railway lining cause large deformations of the earth's surface, and the maximum subsidence can increase by 10-15 mm, reaching values of the order of 30-35 mm [10, 11]. Also, the construction of two distillation tunnels can cause a change in the natural stress-strain state of the soil mass, in which violations of soils and foundations of nearby buildings, underground utilities, etc. may occur. Violations of the soil massif during the construction of two distillation tunnels by the shield method are characterized by the formation of a displacement mold, which is a part of the earth's surface. The slide can be represented by two main sections - along and across the axis of the tunnels [10, 11].

In [11], interesting observations were made on the subsidence of rocks during the passage of distillation tunnels. Observations were carried out using deep reference points embedded in various layers of rocks. As a result, the values of displacement of various rocks under the influence of mining operations and the rate of their subsidence were obtained: 7 mm/day during the penetration of the left tunnel and 10-1-28 mm / day. from the right, the angles of influence are about 40°. The following factors influence the process of displacement and deformation of the soil mass:

- engineering-geological and hydrogeological conditions;
- features of the layout and development of this urban area;
- the shape and dimensions of the tunnels under construction, the depth of their laying, the distance between them;
- availability of underground utilities and structures;
- space-planning and design solutions of tunnels;
- organization and technology of tunnel construction, etc.

Factors related to engineering-geological and hydrogeological conditions include the physical and mechanical properties of soils, the nature of their occurrence, and the regime of groundwater. During the construction of tunnels by the Tunnel-Tunneling mechanized complex, both short-term and long-term precipitation of the soil massif occurs.

In disconnected moistened soils, precipitation values can be very significant. In clay soils, due to their connectivity, the amount of sediment is significantly less than in disconnected soils. In plastic soils, precipitation values increase gradually over several months, and their attenuation lasts for a very long time, sometimes for two to three years or more. The influence of the features of the layout and development of the urban area site, as well as underground utilities or other tunnels on the process of moving the earth's surface over the tunnels under construction is mainly reduced to the manifestation of initial violations of the soil mass caused by tunneling [10-11].

DISCUSSION

The depth of the tunnels affects the development of movements and deformations of the earth's surface. With shallow laying of tunnels, precipitation of the earth's surface appears quickly and their value decreases with increasing depth of tunnel laying. With deep laying of tunnels, the opposite pattern is observed: the values of the precipitation of the earth's surface increase approximately in proportion to the increase in the depth of the laying, and the rate of increase

of the precipitation of the earth's surface decreases almost linearly with depth [11, 12]. The type of tunnel construction also affects the precipitation of the earth's surface. For example, if an insufficiently rigid lining is applied in soft soils, then its deformations can cause movements of the soil mass, which will entail precipitation of the earth's surface.

On the contrary, in dense soils with elastic properties, the use of flexible prefabricated or monolithic-pressed linings compressed into the ground helps to prevent violations of the soil mass and sediment of the earth's surface. The precipitation of the earth's surface during the construction of tunnels by the Tunnel-tunneling mechanized complex method is usually less, compared with the mining method [13, 14, 15]. When tunneling in soft and weakly resistant soils, the main reasons for the appearance of precipitation of the earth's surface were the "loss" of soil in the bottom of the shield and the presence of a gap between the lining of the tunnel and the contour of the development of the tail shell of the shield. The level of precipitation of the earth's surface: due to the "loss" of soils in the bottom was 10-20%; due to the gap between the lining of the tunnel and the contour of the workings - 40-50%; after the passage of the shield - 30-50% [15] (Figure 4).

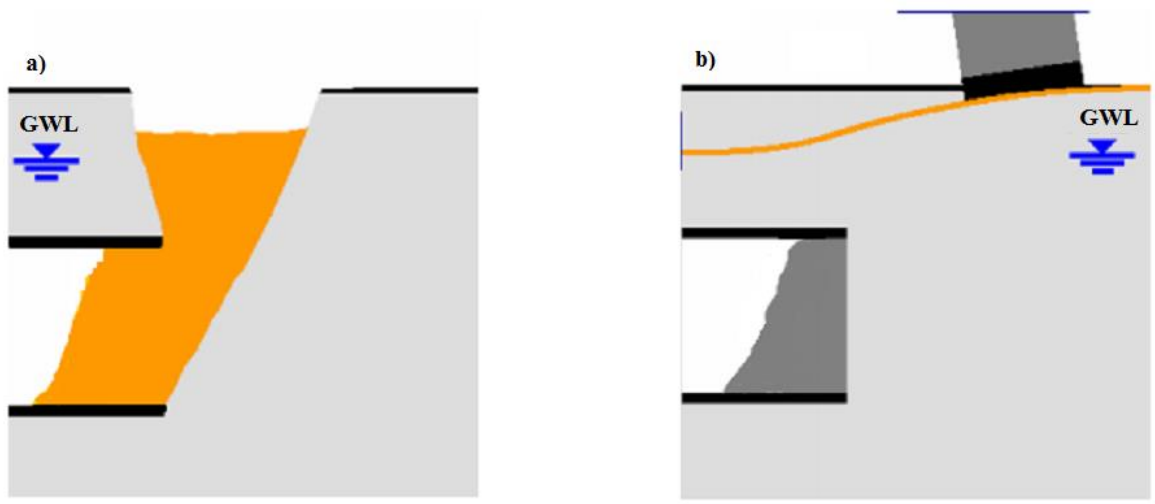

Figure 4. Precipitation of the earth's surface during the construction of tunnels by the shield method:
a) In the case of unstable face; b) due to the "loss" of soils

CONCLUSION

The appearance of a cavity in an array of soils violates the natural equilibrium determined by the system of gravitational and tectonic loads on the array, arising near the development of displacement, spreading in the array with attenuation, reach the earth's surface, forming a mulde of displacements, the parameters of which affect the behavior of the tunnel structure.

Traditional design methods used in engineering practice to assess such impacts are based on the results of measuring deformations and oscillation amplitudes of the free surface in the field. To date, when designing tunnel linings, fairly simple approximate engineering methods of calculating loads using the apparatus of structural mechanics are used. At the same time, all active loads acting on the lining are first determined, and why calculate it as a core system, taking into account or without taking into account the elastic resistance of the soil. The main

disadvantage of calculation methods for given loads is that they do not fully take into account the actual conditions of interaction of the lining with the surrounding soil mass.

However, with this approach, the mechanisms of interaction between the tunnel lining and the surrounding soil mass remain unclear.

At the moment, three main directions have been formed for determining the deformations of the soil mass and the sediment of the Earth's surface during closed tunneling: analytical methods, empirical methods and numerical methods. The disadvantage of analytical and empirical methods and formulas is the possibility of their application only for strictly defined engineering-geological conditions and methods of tunnel construction. This circumstance limits, and in some cases excludes, the possibility of using solutions for calculating the parameters of the sludge over the tunnel. These methods do not allow us to take into account such factors as the physical and mechanical characteristics of rocks and the features of the engineering and geological conditions of tunnel construction.

Numerical methods allow us to obtain information about the distribution of stresses and displacements of soil at different depths for different soils. Using numerical solutions, it is possible to obtain movements of the soil surface and taking into account the impact of the weights of the soil layers for tunnel lining.

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