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## Methodology of prediction stress-strain state deep foundation structures of subway station’s taking into account stages of its construction

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### Abstract

The paper presents a methodology for predicting the stress-strain state of deep foundation constructions of subway stations. The methodology is based on an open dynamic system «rock mass - construction technology - subway station». This system takes into consideration the structural features of the stations and stages of their construction, that influence on the course of geomechanical processes. The proposed approach provides a complete picture about the stress-strain state of subway stations structures and basin subsidence of surfaces (мульды оседания поверхности) and can be used to justify the rational space-planning, constructional and technological solutions. Using of the open dynamic system "rock mass - construction technology - subway station" allow entry structural and technological changes in the developed base model for its adjustment in the process of construction and exploitation of subway station, in an emergency or other newly emerged factors that allows to quickly solve problems.

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## **1. Introduction**

Conditions of subway stations construction are characterized by a variety of interconnected natural, technological and man-made factors. These factors reflect specificity requirements to methods and techniques of subway stations construction. During designing and building rock mass, technology of construction and the subway station must be considered as elements of the dynamic natural-technical geosystem.

Field investigations show significant effects of construction technology (the sequence of tunneling, the gradual opening of tunnel's sections, advance of tunnel's face, etc.) on the magnitude and nature of the load distribution on the lining of deep foundation subway stations.

Existing methods of calculation of deep foundation underground station's structures, as a rule, based on the scheme given loads. As a consequence, these methods do not consider the complex space-planning scheme of stations and main stages of the technology of their construction, as well as other conditions and factors that have a significant impact on the development of geomechanical processes and the state of stress and, therefore, does not fully reflect the characteristics of their work.

Calculation of complex construction of subway stations in the form of a rod systems on the basis of structural mechanic requires using of significant assumptions, which is a serious problem especially in the development of fundamentally new constructions, technological solutions and types of stations because of the impossibility of accurate estimates of the changes impact to the existing design scheme.

To develop an adequate design scheme, at this approach, we need to build the subway station with a large margin of solidity, with the further conduct of field studies on it that requires a significant investment in material resources and time for developing a rational design. Further improvement of the stations will be carried out consistently for a long time with the gradual adjustment of the design scheme and constructions in accordance with the results obtained in the newly built stations. Thus, currently used approaches to the calculation and design of subway stations are very time-consuming and do not provide a complete picture of the formation of its stress-strain state.

## **2. Methodology of investigation**

With modern positions geomechanics and geotechnology, rock mass, construction technology and the station are considered as an open subsystem of dynamic geo-system (0). The system «rock mass - construction technology - subway station» displays the interaction of factors and their combinations, affecting on the efficiency of the construction and operation of the subway stations.

Subsystem «soils» forms the background information about the parameters of surrounding rock mass that defines the requirements for the construction technology of the subway station. The subsystem «subway station» contains the characteristics of a functional purpose of the object and, in turn, formulates requirements to the characteristics of surrounding rock mass. Subsystem «technology of construction» includes technological solutions that meet the requirements of the subsystems «soils» and «subway station». The subsystem «preparing and influence of soils» changes the characteristics of the natural stress field and contains the technology solutions that meet the requirements of the subsystems «soils» and «technology of construction».

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