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Influence evaluation of buildings constructed in protected zone on St.Petersburg subway underground structures stress-strain state

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Abstract

Building in protected zones of subway can seriously influence on stress-strain state and operational reliability of underground structures. It should be noted that till nowadays there are no normative documents which regulate the permissible additional load on various types of underground subway constructions, the grade of acceptable approaching of the foundations and piles elements and common attitude to protected area dimensions of different underground constructions and other important factors. There is practical need in developing of criterion of permissibility evaluation of ground construction in the St. Petersburg subway protected zone. The criterion depends on various factors: type of underground structures, geotechnical conditions, the current technical state of underground constructions, the allowed value of additional loads on them and other important factors. The article presents the algorithm for the influence evaluation of ground construction on underground structures as well as the example of its practical realization during developing the design solutions and during construction. There are examples of realization of proposed methodology for influence evaluation of ground construction on various St. Petersburg metro underground constructions.

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1. Introduction

The constant reduction of available land for building construction in St. Petersburg leads to the necessity of using for construction space over the existing subway underground structures. Building in protected zones of subway can seriously influence on stress-strain state of underground structures. This effect may lead to an increase in deformation of underground structures, cracks and other damage of the lining, an increase in water cuttings. In turn, this leads to a reduction of operational reliability of structures, disruption of the safe and uninterrupted operation of subway, considerable unplanned cost of repairs to damaged structures [1, 8-15].

It should be noted that till nowadays there are no normative documents which regulate the permissible additional load on various types of underground subway constructions, the grade of acceptable approaching of the foundations and piles elements and common attitude to protected area dimensions of different underground constructions and other important factors. In particular, this is due to the fact that in the Soviet period, the construction of surface facilities above stations, escalator tunnels, underground vestibules, with rare exceptions, are not allowed. In limited quantities only performed the construction of residential buildings above the tunnels, which are in St. Petersburg, due to a significant depth, minimally affected by ground construction.

2. System of measures for influence evaluation of ground construction on subway facilities

The decision on the admissibility of the construction of the ground object in the protected zone of the St. Petersburg subway should be taken depending on various factors:

- The type of underground facility (deep or shallow station, escalator tunnel, interstation tunnel, ancillary excavations, shafts, wells and etc.)
- Engineering-geological conditions of laying
- Current condition of underground constructions
- The permissible value of additional loads on different types of constructions
- Acceptable approximation of foundations and piles elements to underground constructions
- The permissible degree of uneven loads that arise during the construction of ground objects

If the structure of making decision and construction maintenance should be observed generally, it can be represented by the following flowcharts (see Fig.1).

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