Engineering and environmental surveys of a multifunctional complex of buildings and structures subject to reconstruction

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Abstract. Moscow is the largest metropolis in Russia, therefore environmental problems on its territory are becoming increasingly acute (the increase in the number of vehicles, industrial enterprises and the construction of new facilities has a negative impact on the environmental situation in the city), which requires high-quality engineering and environmental surveys. Engineering and environmental surveys make it possible to assess the impact of the reconstruction of the complex on the environment, identify possible risks and take measures to prevent them. They allow considering factors such as the conservation of natural resources, limiting emissions of harmful substances and other environmental aspects. Conducting engineering and environmental surveys is important for reducing negative impacts on the environment and preserving natural resources. This is especially true in the context of growing environmental problems in the city and increasing control over their solutions by the authorities. The purpose of conducting engineering and environmental surveys of a multifunctional complex of buildings and structures subject to reconstruction is to identify recommendations and proposals aimed at reducing and preventing possible negative consequences on the environment.

1 Introduction

The situation in the center of Moscow has improved due to the removal of industrial enterprises and the construction of new transport interchanges, which reduce emissions of harmful substances into the atmosphere.

With the increase in the pace of construction, the amount of green space lost for the city has also increased, since compensatory planting is not always carried out in full, and sometimes is not carried out at all. Another important problem is the condition of the soil; the center constantly monitors it, including sanitary-chemical, microbiological and

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parasitological indicators. One can often find soils with pollution categories of “hazardous” and “extremely dangerous”.

2 Materials and methods

The site of the designed work is located on the territory of the Central Administrative District of Moscow at the address: Kitaigorodsky proezd, vl. 9/5. In the south it is adjacent to the Moskovskaya embankment, in the west there is the territory of Zaryadye Park. There is no construction or household waste. The vegetation is represented by trees, shrubs and a herbaceous layer [1]. The total area of the site is 110,385 m².

The survey area contains cultural heritage sites that are subject to reconstruction, restoration and restoration. There are no underground sources of drinking water supply and sanitary protection zones, which belong to JSC Mosvodokanal. There is no construction or household waste. The vegetation is represented by trees, shrubs and a herbaceous layer. The total area of the site is 110,385 m². Design stage - PD. A situational plan for the location of the site for engineering and environmental surveys is shown in Figure 1.

![Fig. 1. Situational plan of site location for engineering and environmental surveys.](image)

The construction site is not located in an area prone to emergency situations, natural or man-made, such as floods, landslides, karst, erosion, etc., and is not subject to any resulting consequences. The scope of work performed during the engineering and environmental surveys is given in Table 1.

Table 1. Scope of work performed.

<table>
<thead>
<tr>
<th>No</th>
<th>Names of work</th>
<th>Scope of work</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Radiation survey of the territory</td>
<td>110 385 m²</td>
</tr>
<tr>
<td>2</td>
<td>Determination of the content of heavy metal compounds (lead, cadmium, zinc, copper, nickel, mercury, manganese) and arsenic in soil samples</td>
<td>28 probes</td>
</tr>
<tr>
<td>3</td>
<td>Determination of the content of organic compounds (total petroleum products) in soil samples</td>
<td>28 probes</td>
</tr>
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</table>
3 Results and discussion

The gamma survey did not reveal sources of ionizing radiation or any other areas with increased gamma background levels.

In the examined soils in a layer of 0.0-3.0 m, an excess of the sanitary standards of UEC, MPC for the content of heavy metals and arsenic was found, in the remaining samples in a layer of 3.0-15.0 m there were no excesses. Analysis of the sanitary-chemical and biological state of soils in the study area revealed high concentrations of benzo(a)pyrene in the upper soil layers, significantly exceeding the MPC. The content of benzo(a)pyrene in the studied soil samples exceeds the maximum permissible concentration (0.02 mg/kg) in a layer of 0.0-0.2 m in samples No. 3, 9-1, 10-1 and in layer 0.2-1.0 m in samples No. 9-2, according to the indicator under consideration, the soil corresponds to the “extremely dangerous” pollution category; in a layer of 0.0-0.2 m in samples No. 6, 7, in a layer of 0.2-1.0 m in sample 10-2 and in a layer of 1.0-2.0 m in samples 9-3, 10-3, according to the indicator under consideration, the soil corresponds to the “hazardous” pollution category; in a layer of 0.0-0.2 m in samples 1,2,8, in a layer of 2.0-3.0 m in sample 10-4, in a layer of 2.0-3.0 m in samples 9-4, 10-4, according to the indicator under consideration, the soil corresponds to the “permissible” pollution category; in the remaining samples, according to the indicator under consideration, the soil corresponds to the “clean” pollution category. The content of petroleum products in the studied soil samples is up to 1422 mg/kg in a layer of 0.0-15.0 m. The indicator under consideration is not regulated by sanitary standards. Eggs and larvae of helminths were not identified. No special disinfection is required. According to bacteriological and parasitological indicators, the soil belongs to the category of “clean” pollution. The soil from the site corresponds to at least 4th waste hazard class.

The equivalent and maximum noise levels from vehicles generated on nearby roads during the daytime and at night, respectively, do not exceed the standard value. The results of laboratory tests of water quality correspond to the acceptable level. Levels of background air pollution for all major pollutants do not exceed sanitary and hygienic standards established for atmospheric air in populated areas (<1 MPC).

The results of engineering and environmental surveys of the study area showed that in this area there are excesses of the maximum permissible concentrations of harmful substances. It can be argued that this type of pollution poses a threat to the ecosystem (soil
poisoning, groundwater contamination, biological accumulation) and human health (cancer risk) in the area. Additional measures for sanitary cleaning and monitoring of soil conditions are necessary to minimize risks and ensure habitat safety.

Methods that can be used to clean soil and ground from benzopyrene and heavy metals:

1) Thermal desorption (also known as thermal vacuum desorption) is a method in which soil is heated to high temperatures to vaporize benzopyrene, which is then removed from the soil by vacuum suction.

2) Bioremediation is a method in which living microorganisms (such as bacteria and fungi) are used to break down benzopyrene into less harmful compounds. For example, bacteria can be used to convert benzopyrene into carbon dioxide and water.

3) Chemical oxidative desorption is a method in which an oxidizing agent is applied to the soil, which oxidizes benzopyrene and converts it into less harmful compounds, which can then be removed from the soil.

4) Phytoremediation is a method in which plants are used to remove benzopyrene from the soil through its absorption and metabolism. Plants such as sunflowers or hemp can be used for this purpose. Scientists from Kharkov National University named after V.N. Karazin, with the help of an experiment, they established the most optimal composition of plants, which allows one to obtain representative results on the efficiency of phytoextraction of the studied harmful substances [2, 3, 4, 5].

The results of this study highlight the importance of monitoring environmental pollution, in this case, contamination of soils and soils with carcinogenic substances, and the need to take measures to clean up and minimize future pollution. This is critical to protecting human health and the environment. It should be noted that remediation of contaminated soils is a complex and long-term process that can require significant effort and time. However, measures must be taken to prevent further pollution and protect the environment as a whole.

4 Conclusion

During the survey, comprehensive recommendations and proposals were given to improve the environmental situation and promote the restoration of the natural environment [6, 7]. The results of the survey made it possible to identify negative factors that impact the environment and made it possible to draw up effective measures to eliminate them, which will ensure the protection of the environmental interests of the population and the conservation of natural resources.

References
