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Formation of geological risk upon tunnel construction in water-saturated fine-grained soils

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The main factors of geological risk formation upon the tunnel construction are considered by the example of the Halabyan-Baltic highway tunnel in the north of Moscow. These factors include the engineering geological features of the enclosing rock massif, manifestation of natural and technonatural geological processes, the projected engineering designs, groundwater filtration control and other protective measures, as well as lowering the groundwater level by pumping in the adjacent territory.

The tunnel of about 2 km long connects the Halabyan street and the Baltic street, which gave birth to the name of this engineering structure. The tunnel construction faced numerous difficulties and lasted over 5 years. It is cut mainly in the Quaternary sandy deposits, and in its deepest part in the upper Jurassic sand, sandy loam and loam, somewhere manifesting quicksand properties. Its main part is driven below the groundwater level. The maximal driveway depth is 25 m. The Tarakonovka river channel running in the subsurface pipe overlies the tunnel. In addition, two other highway tunnels and the metro line is located over the deepest part of the Halabyan-Baltic highway tunnel.

Groundwater and water-saturated ground broke through repeatedly into the tunnel in the course of its construction. In 2013, after the end of technological pumping water for construction purposes, the groundwater leakage to the tunnel began. The applied Jet-grouting technology turned out to be ineffective, and the filtration-control curtain of ground-cement piles protecting reinforced concrete walls and floor in the tunnel fail to operate adequately.

Proceeding from the theory on rock massif shear and its pressure on the vertical retaining walls, the boundary of the tunnel influence zone is outlined. The influence area encompasses to a certain degree all buildings damaged noticeably during the tunnel construction.

After the construction termination, the principle negative effect arises from the water inflow to the tunnel and numerous cases of groundwater percolation through the walls, roof, and bottom of the tunnel. Arrangement of permanent drainage appears to be the optimal decision for stopping the water inflow to the tunnel.