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SPECIAL CONDITIONS OF TRANSPORTING ROUTES CONSTRUCTION IN UNDERMINED AREAS IN CZECH REPUBLIC

In undermined areas some changes of geological-geotechnical proportions, mainly hydrogeological ones, may occur and through its effects it can cause temporary or permanent malfunction of the transportation routes and related structures, such as subsidence (continuous or discontinuous), shifts, inclination etc. Such changes and deformations are evoked by mining activities (all interventions into earth crust done for reaching mining deposits) and also by activities done by mining techniques (all interventions into earth crust for technical purposes – underground spaces of old municipal development, collectors etc.). Mining gases also appear in areas with black coal mining. The main component of the mining gas is "methane". Its occurrence was noticed around old mining works, which are not ventilated, where mining gases penetrate to surface as a result of leakage.

В регионах, где существуют подземные горные выработки, могут происходить некоторые изменения геологических и геотехнических соотношений, в основном гидрогеологического характера, что может стать причиной временных или постоянных нарушений транспортных дорог, а также проседаний грунта (постоянных и дискретных), сдвигов грунта, образования уклонов и пр. Такие изменения и деформация являются результатом горно-добывающей и геолого-разведочной деятельности или применения горных технологий (любое вмешательство в земную кору для технических целей – подземное пространство старых городов, коллекторы и пр.). В регионах, где ведется добыча черного угля, также наблюдаются проявления рудничного газа. Основным компонентом рудничного газа является метан. Его присутствие было зафиксировано на территории старых невентилируемых горных выработок, где рудничные газы проникают на поверхность в результате просачивания.

Characteristics of undermined areas

The largest area with the highest occurrence of mining works in the Czech Republic is the Ostrava-Karviná region. About 400 old mining pits and adits can be found there. In the past liquidation of old mining works was usually carried out by filling them with gauge or various construction spoil up to their opening, without closing the pit by the closing stall board. Location of old mining works, where the survey hasn't been done yet, is nowadays determined only theoretically, based on preserved mine-metrical documents. Theoretical coordinates of old mining works locations are burdened by a mistake of transformation of coordinates and often also by inexact registration of the location during excavation, esp. liquidation of pits. Their optical localization in terrain is usually impossible, but in some cases they are signalled by terrain depressions, which are however nothing extraordinary in this area.

Risk factors of areas of old mining works:

- By consequent depression and washing fine-grained fractions of pit fillings during rain falls, empty spaces of different sizes appear (from units up to tens of cubic meters), which as a result endanger stability proportions in mining works surrounding (most frequently there are roads, engineering networks etc.);
- Potential instability of materials forming the pit filling;
- Methane exhalation that locally ranges in limits of explosiveness, non-controlled accumulation in construction objects etc.

All such factors have effect on transportation routes, such as roads, motorways, local communications including rail transport, railways and work sidings, static transport devices, pipe systems and mutual crossing of the components above. To the category of related structures we include bridges, culverts, subways and tunnels, mutual crossing of traffic roads, crossings, traction lines, signal, communication and safety devices.

Effect of mining activities on terrain deformation

The size of effects depends on so called foundation conditions (geology, hydrogeology of the deposit, i.e. deposit depth, deposit thickness, deposit inclination, properties of the massive rocks, the amount, direction and speed of groundwater stream etc.).

The figures show the course of deformation (continuous deformation with small thickness of coal seams and big deposit depth is typical for Ostrava's part of the coal colliery). Those basic parameters are characteristic for the undermining effects. For the sake of clarity it should be pointed out that a reverse value of curvature, the so-called radius of curvature, is used. The continuous deformation means that structural changes (surface cracks) are not created in the foundation soil.

Effects of undermining are characterized by subsidence, horizontal shift (horizontal part of spatial shift of the subsidence trough point), inclination, radius of curvature and horizontal relative deformation – expansion or compression of the terrain. It implies that the effects of undermining influence construction of transportation routes and related structures, inclusive electric tractions, communication and safety devices, signalization etc.

Effects of mining activities on roads

Continuous deformations appear on roads (in sites with a rather big excavation depth).
Interrupted deformations (diagonal or vertical landscape levels, landscape waves, cracks, local depressions) appear on roads. They appear only when the continuous deformation of the landscape is present.

Related structures, in particular drainage systems (catch drains, blind shafts, gutter bridges) and bridge structures loose their reliable performance.

The ground water level in the subsidence trough changes and deteriorates the load-carrying capacity of the territory.

Foundations of traction mains masts (for trolleybuses), signalling equipment, or cabling can be damaged.

Effects of mining activities of rail tracks

- malfunctions in spatial layout of tracks – directional and vertical;
- tracks, rail switches, track fastenings become worn too early;
- fasteners and sleepers (esp. timber ones) become too worn;
- the ground water level in the subsidence trough changes and deteriorates the load-carrying capacity of the territory;
- change of the transport building body profile;
- danger of loss of the body stability;
- decrease of the bearing capacity of the ground level, gradual mixing of layers (impress of the gravel ballast into the ground level);
- loss of function of related structures, mainly drainage systems (blind drains, shafts, culverts), including bridge objects etc.;
- possible breakdowns of electric traction posts (trolleybus transport), signal devices, cable distribution system etc.

The issue of mining gas outlets

The issue of uncontrolled mining gas outlets has been very urgent in regions of Ostrava and Karviná lately, in connection with termination of mining and liquidation of some of the mining works.

The problem is that the mixture of the methane and air may create an explosive or flammable concentration. The explosive concentration of the methane ranges between 4.4 and 17 %, depending on the contents of the gas

in the air mixture. However methane is flammable at other concentrations too.

Locations with mining gas outlet can be divided into following categories:

A – location with possible random outlet,
B – location endangered by outlets,
C – location dangerous by outlets,
D – carbon out crops,
E – location near the old mining work of liquidated main mining work of drill.

Constructions can be divided into following categories due to degree of endangerment by mining gas outlets:

level 1 – the construction is **safe** when the concentration of methane in all rooms is lower than 0,1 %,

level 2 – the construction is **endangered** when the concentration of methane in all rooms is higher than 0,1 % but lower than 0,5 %,

level 3 – the construction is **dangerous** when the concentration of methane in any room is higher than 0,5 %.

Factors that influence outlet and concentration of methane from subsoil:

- barometric pressure;
- fluctuation of groundwater level;
- structure of superstrata (their gas permeability);
- depth of mining beds locations under the surface;
- difference in temperatures on surface and underground.

The carbon cover is pervaded with many discontinuities created by undermining, tectonic disturbances, artificially created mining works and drills, exposed "carboniferous windows", where coal measure gets to the surface, but also with sites in the superincumbent layer, where sewerage system, collectors etc. were made by antropogenous impacts (human activity). Thus, vast and hardly identifiable network of locations, where mining gas can easily migrate and uncontrollably penetrate to the surface, was developed.

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