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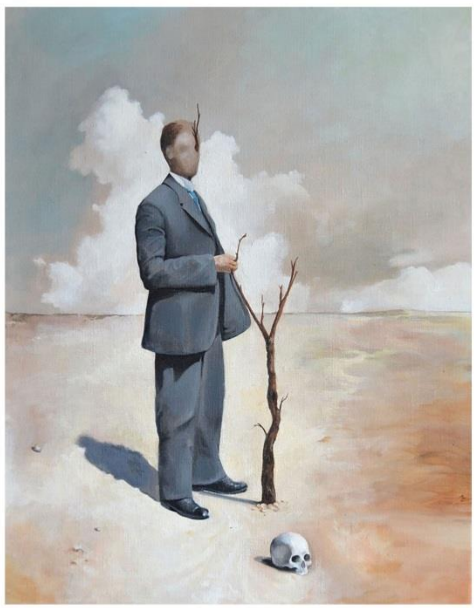

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Open Geotechnology in the development of non-metallic mineral resources during road construction

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Abstract

The study aims to investigate open geotechnology in the development of non-metallic mineral resources during road construction and its R&D support via comparative qualitative research methods. As a result, the broadening of the road causes the rocks to slide, causing dangerous traffic conditions, and the transition to the tunnel version increases the cost to an unthinkable amount. In conclusion, for the purpose of longevity and road safety, the design and construction of roads in mountainous conditions should be accompanied by scientific and technical expertise conducted by research organizations on traffic safety.

Keywords: Side slopes, massive rocks, non-metallic, minerals.

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Geotecnología abierta en el desarrollo de recursos minerales no metálicos durante la construcción de carreteras

Resumen

El estudio tiene como objetivo investigar la geotecnología abierta en el desarrollo de recursos minerales no metálicos durante la construcción de carreteras y su apoyo a la I + D a través de métodos comparativos de investigación cualitativa. Como resultado, la ampliación de la carretera hace que las rocas se deslicen, causando condiciones de tráfico peligrosas, y la transición a la versión del túnel aumenta el costo a una cantidad impensable. En conclusión, a efectos de la longevidad y la seguridad vial, el diseño y la construcción de carreteras en condiciones montañosas debe ir acompañado de experiencia científica y técnica realizada por organizaciones de investigación sobre seguridad vial.

Palabras clave: pendientes laterales, rocas masivas, no metálicas, minerales.

1. INTRODUCTION

When building roads in mountainous areas, the technological working process requires the excavation of massive rocks and soft rocks in the required volumes for arranging the width of the subgrade of the planned category of the road or the number of railway tracks. Developed soils, as a rule, are non-metallic minerals in the form of building materials used to construct embankments and obtain inert materials from them after processing (ZARUBA & METSUL, 1979). Designing an extraction or half- extraction on slopes, with the excavation of non-metallic soils using open Geotechnology, requires knowledge of certain related scientific fields: mining, geology, road building, and other areas, both in theoretical and in practical terms (DOYNO & MANOLOV, 1986).

The task of ensuring the stability of exposed slopes of both soft and massive rocks is a difficult issue for a specialist. To create an efficiently working and safe internal slope of the road excavation, the specialist must possess mining science and, in particular, geotechnology for soil development, taking into account the smallest sliding on the roadway, which is important when operating the road and ensuring safety on mountain roads.

For example, this issue is relevant in domestic practice on Transkama, on the section of the Georgian Military Highway, etc., where retaining walls and fixing slopes with a metal mesh are used. In the conditions of foreign practice on the Carpathian Railways within Bulgaria, it is decided by the installation of facing walls (KORTIEV, 2016). In domestic and foreign practice, the method of applying concrete spraying, which contributes to the weakening of the destructive forces and surface factors of the slopes of the recesses, is still poorly applied. So, geotechnologies of an open method for developing excavations and half-notches are relevant and necessary in the development of road structural elements in mountainous conditions (KORTIEV, KORTIEV, VANEEV, TEDEEV, 2016).

2. METHODOLOGY

The designing engineer draws a slope line structurally without taking into account the processes of future interference of massive or soft rock soils with the atmospheric and climatic conditions of the road laying area. The practically obtained slope from the moment the road was in operation interacts with atmospheric conditions, daily and seasonal temperature fluctuations, rain and wind phenomena, etc. (ZYRYANOV & SAMANOV, 2009).

As a result of the effects of these phenomena, the surface of the slope crumbles to small particles and collapses down onto the carriageway, creating dangerous conditions for movement. If the slope and bedding of the geological formation are parallel and the inclination angles are the same horizontally, then the slope quickly overgrows, and if the first is less than the second, then the slope becomes completely safe. For clarity, we consider Figure 1, where it can be seen that when broadening a road shelf by a unit of distance, the volume of developed soils increases several times (FIRTH, 2012). If the slope line corresponds to the angle of repose of the developed non-metallic rocks (OLESHENKO & LAZAREVA, 2008), then taking into account the geology and soil mechanics (JORDAN, 1984), the negative interaction of the road with the environment becomes minimal and the movement of vehicles is safe.

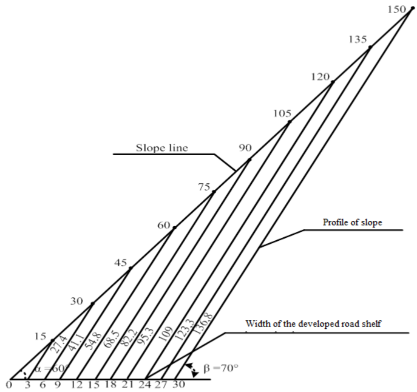

Fig. 1: Graphical arrangement of slope lines and profiles of the slope. (α - the angle of slope to the horizontal; β – slope grade to the horizontal is equal to the angle of the natural slope of the excavated soil.)

Let us have a look at a practically widespread cross-section of a mountain road (Figure 2)

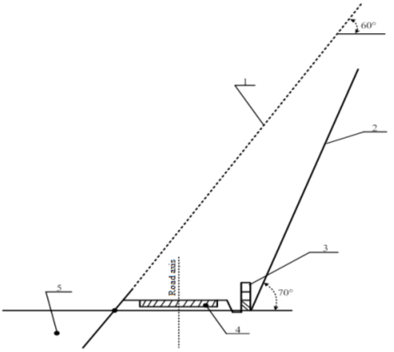

Fig. 2: A cross-section of a mountain road. 1 – slope line; 2 – slope profile; 3 – a protective wall of concrete blocks or solid concrete; 4 – subgrade on bedrock; 5 – deposits of soft massive rock (the avalanche in the development of dredging).

3. RESULTS

The subgrade and protective wall, created structurally, are under the influence of talus phenomena. At the first inevitable discharge of avalanche mass, the sinus of the retaining wall is filled, after which it collapses or stops working (EMBERGER, KENIG & KRPATA, 2013). The roadway is unprotected, and the passage is dangerous, and rock fragments and avalanche-talus dumps not only on the upper structure of the road but also on its lower slope and in the floodplain of the river, polluting the biosphere, destroying forest and grass vegetation. In the floodplain of the river, dams are formed with a violation of the water system and the destruction of ichthyofauna. And in the atmosphere dust spreads. This is the result of the alignment of the interacting forces of the road construction and the environment of modern domestic mountain roads, including the Transcaucasian Highway, the Georgian Military Highway and other mountain roads, replete with countless examples set forth that increase the dangerous traffic conditions (KAGAN, 1973).

To a certain extent, our domestic examples of road safety are lagging behind foreign ones, which should be taken into account in the future in the operation of mountain roads. Figure 3 shows an example of the collapse of the rock mass on the carriageway of the Transkama road, creating catastrophic dangerous conditions for movement. Similar, unsolved and accidentally dangerous sections are enough on our mountain roads, which should be solved by the methods of scientific and technical support and monitoring of the design and construction of the road, using the example of Transkam.

Designing an absolutely safe rail or road in the mountains is difficult, but possible. The geotechnology of the impact of open-pit mining, and in particular half-excavation, in the historical plan has been sufficiently worked out in our Caucasus example. Geotechnology (open) began its development from the end of the 18th century, with the beginning of the construction of the Georgian Military Highway.

Fig. 3: The rockfall on the roadway.

When comparing the theoretically substantiated geometric elements of a safe road with those applied in practice, we find that when implementing a safe road structure, the development of massive rocky soil volumes increases several tens of times (Figure 4), which is impractical for economic reasons and environmental safety. An increase in the developed rocks in an open way is presented in the diagram of dependence on the increase in the width of the road shelf.

Geotechnology for the development of non-metallic rocks is practically considered expedient with a road stick width of up to 12m, which meets the standards of a motor road of the III technical category or the width of the subgrade of a double-track railway. Further broadening is neither economically, environmentally, nor geotechnologically feasible. In the compiled diagram (Fig. 4), the developed area with a road width of 10m is category IV, with $\alpha = 60$ and $\beta = 70$ is 258 m^2, which exceeds the tunnel section for the same technical category

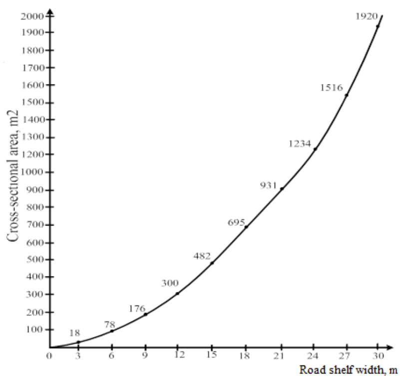

Fig. 4: Growth area diagram of the developed excavation of the mountain road.

Replacing an open excavation with a tunnel option in transport, hydraulic and other types of construction is decided: a) when the excavation device is more expensive than the tunnel; b) the road crosses a steep slope on which are avalanches, mudflows, talus, rockfalls, avalanches, etc. are possible, which complicate the operation of the road, which should be taken into account when designing the object. But the cost of the object at the same time increases by almost 15 times, which leads to in-depth research and analysis of the task.

The broadening of the road causes the rocks to slide, causing dangerous traffic conditions, and the transition to the tunnel version increases the cost to an unthinkable amount; the construction of a retaining wall at the base of the slope is not an effective cost. But the young scientists of NCIMS (North Caucasus Institute of mining and smelting) are obsessed and reflect on the solution of the issue by shifting the axis of the road to the outside with the device of the accumulating recess instead of the retaining wall at the base of the internal slope. The strategy for improving this issue should be directed to the likeness of improving urban public transport both in Russia and abroad. Purposeful promotion and solution of safety strategies on roads and in general in the problem of protecting the lives of people and territories should be solved in a complex taking into account dangerous natural processes.

4. CONCLUSION

1. The solution to the issue of traffic safety from the destructive processes of the slope phenomena of avalanches, detrital slope and avalanches should be solved by the same methods of open geotechnology - by digging a trench (accumulating excavation) instead

of an ineffective retaining wall with the road axis shifting to the outside (if necessary).

2. Failure to build unreasonable retaining walls will save 1/3 of the budget spent on the construction of mountain roads.

3. For the purpose of longevity and road safety, the design and construction of roads in mountainous conditions should be accompanied by scientific and technical expertise conducted by research organizations on traffic safety.

REFERENCES

DOYNO, A., & MANOLOV, A. (1986). "Moved off and offsets in transport". **Sofia, darstvo publishing house technic**. P. 429. Russia.

EMBERGER, G., KENIG, I., & KRPATA, R. (2013). "Public Transport for (Disabled) People - The Vienna Experience". **13th World Conference of Transport Research.** P. 26. **Rio de Janeiro**. Brazil.

FIRTH, D. (2012). "Urban Mobility Strategy". **The City of Stockholm Traffic Administration**. P. 72. Sweden.

JORDAN, P. (1984). "Iron and iron lines". **Sofia**. P. 197. Russia.

KAGAN, A. (1973). "Estimated indicators of physical and mechanical properties of soils". **L.: Stroyizdat.** P. 144. Russia.

KORTIEV, A., VESKREBENETS, A., CHOCHIEV, R., & TEDEEV, V. (2015). "Monitoring the processes of exogenous (slope) phenomena on the roads to the mining enterprises of Ossetia with a view to the sustainable conservation of slopes". **Sustainable development of mountain areas.** Vol. 1, Nº 23: 29-34. Vladikavkaz. Russia.

KORTIEV, L. (2016). "Protection of mountain roads and territories from slope phenomena". **Vladikavkaz, NCIMS (North Caucasus Institute of mining and smelting). Publishing house Terek**. P. 215. Russia.

KORTIEV, L., KORTIEV, A., VANEEV, S., TEDEEV, V. (2016). "Retaining walls and their use to ensure traffic safety on the development of mountainous areas". **Sustainable development of mountain areas.** Vol. 8, Nº 3: 231–237. Vladikavkaz. Russia.

OLESHENKO, E., & LAZAREVA, E. (2008). "Foreign experience in road safety: priority low-cost measures". **Collection of reports of the eighth International Conference Organization and Road Safety in Large Cities**. pp. 194-199. St. Petersburg. Russia.

ZARUBA, K., & METSUL, V. (1979). "Engineering geology/ Transl". **From English. M.: Mir**. P. 409. Russia.

ZYRYANOV, V., & SAMANOV, R. (2009). "Improving Urban Public Transport Operation: Experience of Rostov-on-Don (Russia)". **International Journal of Transport Economics.** Vol. 36, Nº 1: 83–96. Italy.

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