ISSN NO: 2770-4491
November 2025

Development Of Technological Schemes For Transporting Rock Mass And Management Of The Working Area Of A Deep Quarry

Ravshanova M. H. [1]
[1] Navoi State Mining and Technological University

Abstract: The operating conditions of modern industrial vehicles are determined by the increasing depth of mining operations. This trend results in the predominant use of vehicles (over 60%) as assembly units, concentrating vehicle traffic in the working area of deep quarries with their limited space of the Muruntau deep quarry is characterized by a high concentration of traffic, heterogeneity of the transported rock mass, and instability of key parameters. During a shift, 10-15 working faces and 5-10 transfer points are in operation, forming over 100 routes with an average length of 3.73 km. The maximum freight traffic intensity on individual routes reaches over 35,000 m³ of ^{rock} mass per shift. The share of face roads along the traffic routes is 15-30%. Up to 80% of the roads have a service life of up to one year. The complexity of operating conditions is exacerbated by the high concentration of mining equipment and minimal excavation space.

Key words:

The operating conditions of modern industrial vehicles are determined by the increasing depth of mining operations. This trend results in the predominant use of vehicles (over 60%) as assembly units, concentrating vehicle traffic in the working area of deep quarries with their limited space of the Muruntau deep quarry is characterized by a high concentration of traffic, heterogeneity of the transported rock mass, and instability of key parameters. During a shift, 10-15 working faces and 5-10 transfer points are in operation, forming over 100 routes with an average length of 3.73 km. The maximum freight traffic intensity on individual routes reaches over 35,000 m³ of ^{rock} mass per shift. The share of face roads along the traffic routes is 15-30%. Up to 80% of the roads have a service life of up to one year. The complexity of operating conditions is exacerbated by the high concentration of mining equipment and minimal excavation space.

The Muruntau quarry is being developed in stages. Mining operations are currently underway within the fourth stage of development to a depth of 630 meters, where the Muruntau quarry will merge with the Myutenbai quarry (design depth: 300 meters) to become a single quarry (Fig. 1).

ISSN NO: 2770-4491
November 2025

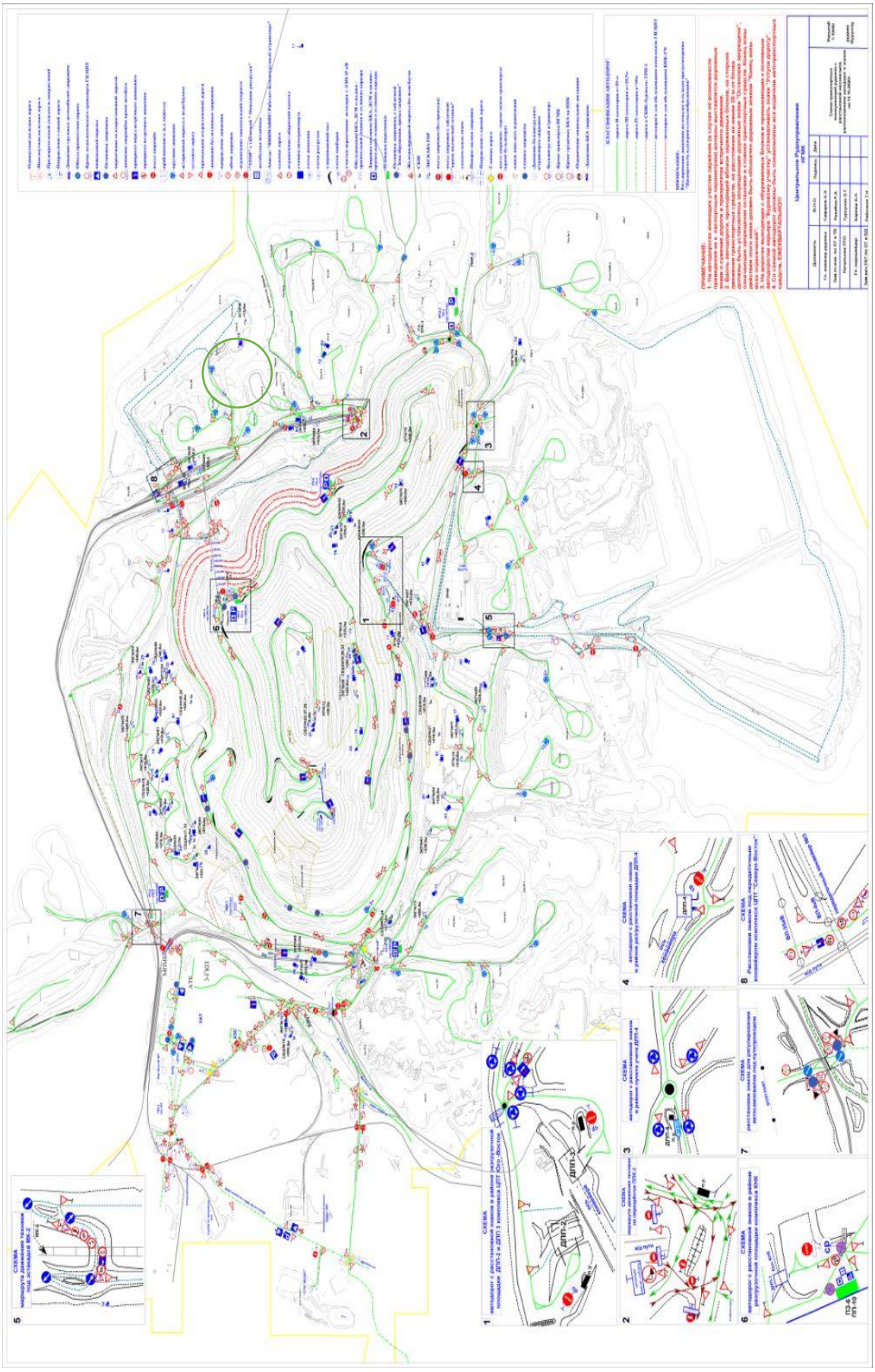

Рис.1. Транспортная схема карьера Мурунтау

ISSN NO: 2770-4491
November 2025

At the Muruntau-Myutenbai quarry , a cyclic-flow technology for transporting rock mass is used. Transportation of rock mass within the quarry to the loading units of the concentration horizons (from the surface to the +285 m horizon for ore and to the +405 m horizon for waste) and from the upper horizons to the surface is carried out by road transport [32; p. 90]. Ore from the +285 m horizon is delivered by a steeply inclined conveyor KNK-270 to the loading and storage complex located on the eastern side of the quarry (VPPK-3), with subsequent transportation of the ore by rail to the processing plant.

Overburden rocks are delivered to the surface via an inclined conveyor with a crushing and transfer station located on the south-eastern side of the quarry, then via a main conveyor to external dumps and are stored in dumps using an OSHS-4000/125 walking stacker .

With increasing depth, the transition to the introduction of dump trucks with a carrying capacity of 170-200 tons, with the technical re-equipment of the excavator-truck complex, will allow for the improvement of its control system.

Thus, the operating conditions for modern industrial vehicles at the Muruntau gold mine are determined by the ever-increasing depth of mining operations. This trend dictates the predominant use of road transport (over 60%) as an assembly line, concentrating road freight traffic within the deep quarry's confined space. To meet these requirements, it is necessary:

- study of the distance of transportation of rock mass with the lifting height and average weighted slope;
- comparison of the operation of heavy-duty dump trucks when carrying out work at lower levels, which predetermines the development of a rational technological scheme for a deep quarry;
- application of a technological method through the use of compact hydraulic excavators and dump trucks with smaller parameters (dump truck width).

Currently, open-pit mining technology involves working zones for dump trucks that differ in the distance of transportation and the height of the rock mass lifted.

In deep quarries, the main indicator characterizing the labor intensity of transport work performed by dump trucks is the average weighted slope, the value of which allows for taking into account complex sections of the route (horizontal, gently sloping, and steep).

$$i_{\text{ср}} = \frac{\text{Нп}}{L}. 100\%, (1)$$

where H_p is the height of the rock mass lift, m;

L – distance of transportation of rock mass, m.

The rapid expansion of open-pit mining at the Muruntau deep quarry necessitated a study of the impact of quarry conditions on the performance of industrial vehicles. Existing regulatory documents insufficiently address this impact, focusing primarily on haulage distances, which is one of the reasons for the discrepancy between design and actual performance.

To assess the impact of quarry mining conditions on the operation of motor vehicles, the equivalent transportation distance indicator was adopted, taking into account the labor costs for horizontal movement and lifting of rock mass from the quarry and determined by the formula:

$$L_{np} = L + \frac{h}{0.05}, (2)$$

where L_{pr}, L – respectively, the reduced (equivalent) and horizontal transportation distance, km;

h – height of lifting of rock mass from quarry, km.

Fig. 2 shows changes in the performance indicators of motor transport during the transportation of rock mass over time at a depth of 560 m.

ISSN NO: 2770-4491
November 2025

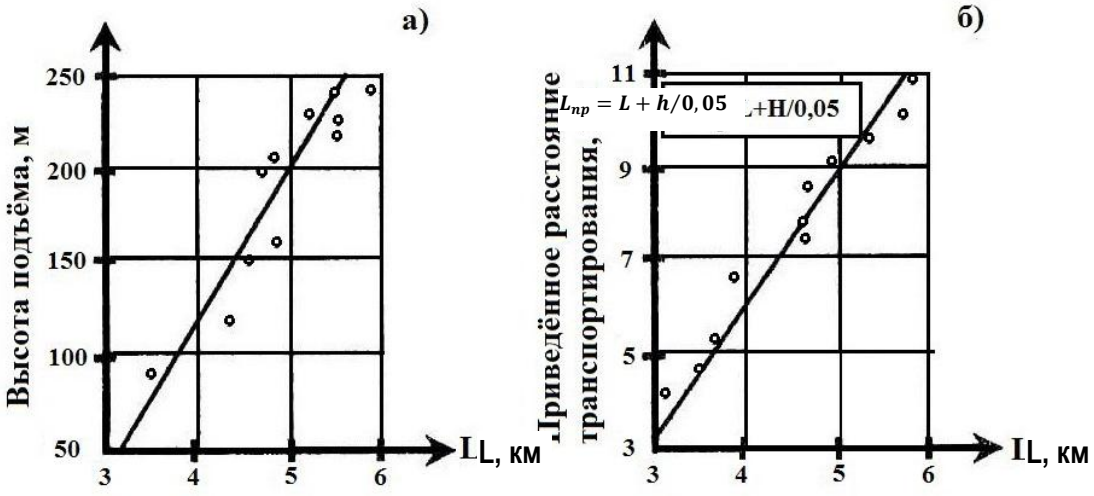

Fig. 2. Dependence of lifting height and reduced distance on horizontal transportation distance

It has been established that there are direct relationships between the horizontal transportation distance, lifting height and the reduced transportation distance (see Fig. 2) with a correlation coefficient of r = 0.82 ÷0.87.

If the influence of the given transportation distance on the productivity of a dump truck is obvious, then the relationship between this distance and the time the vehicles are on duty is manifested indirectly through the duration of their stay in repair and maintenance, since with an increase in the lifting height of the rock mass, the duration of the vehicle's operation in extreme modes increases.

Thus, when developing technological schemes for transporting rock mass using heavy-duty quarry dump trucks, it was established that in the deep part of the quarry, the introduction of an excavator-truck complex allows for the improvement of their operation and increases their productivity, when comparing their geometric and energy-power parameters.

Literature

1. Mariev P. L., Kuleshov A. A., Egorov A. N., Zyryanov I. V. (2004). *Career motor transport: status and prospects* . Science.
2. Napadailo V. A., Matveev A. S., Panchenko V. V. (1976). *Operational planning and management of mining production in quarries.* Nedra.
3. Uniform production standards for open-pit mining operations for mining industry enterprises. Part IV. *Excavation and transportation of rock mass by dump trucks.* (1989). Moscow:.
4. Fainblit M. A., Ilbuldin D. Kh., Ivanchenko N. M. (1996). *Standardization of vehicle productivity at kimberlite quarries of JSC "Diamonds of Russia - Sakha".* Mining Journal, 7, 20–21.
5. Vashlaev I. I., Selivanov A. V. (1997) *Determination of the horizontal equivalent of the movement of rock mass by motor transport using the energy criterion when moving on slopes.* News of universities. Mining journal, 10, 78–80.
6. Vashlaev I. I., Selivanov A. V. (2003). *Determination of the horizontal equivalent of a motorway in a quarry using the energy criterion.* Mining Information and Analytical Bulletin, 8, 175–177.
7. Bakhturin Yu. A. (2005). *Current state of quarry transport* . Catalogue-reference "Mining Equipment - 2005". P. 123–133.