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# Investigation of the Quarry Transfer Points Influence on Reduction of Mining Operations

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**Abstract:** The paper considers the effect of rock mass overloading within excavation warehouses on the intensity of mining operations. A scheme of ore overload with horizon alternating concentration on adjacent bench allowing limiting the depth distribution temporarily nonworking pillar in the work area has been offered.

**Key words:** Concentration level · Temporarily nonworking pillar · The intensity of deposit development

## INTRODUCTION

In recent years the depths of pits, mining unit capacities as well as traffic engineering have been increased. At the same time, significant parameters warehouses require worksites in the pit of a width of 100-150 m [2, 8]. Increased intensity of mining operations accelerates the process of moving and rebuilding of transport communications and, respectively, the relocation of transshipment points. Their number within the pit field can range from 1-2 to 6-8, existing on one place from one to three years [3, 7, 9].

The object of study. Semi-stationary transfer points within the quarries limits obstructs the requirement achievement of commensurate mining on adjacent horizons at a certain rate in an intended direction [1]:

$$\upsilon_n \geq \upsilon_{n+1} - \frac{1}{T}(B_n - B_o),$$

where,

$\upsilon_n$ - The horizontal velocity advancing of overlying bench, meter per year;

$\upsilon_{n+1}$ - Horizontal velocity advancing of underlying bench, meter per year;

$B_n$ - The actual width of a working platform on the horizon, *n*, meter;

$B_o$ - Minimum width of the working area, meter;

$T$ - The period under review, years.

There are two solutions of this problem [1, 4, 6]. The first is creation of sites which lead to mining on the level transfer points needed to compensate for the mismatch between continuous advanced working side and cyclical movement of transfer point. Advancing site is created by accelerated overlying bench. In the second case, underneath the transfer point a temporary pillar with its subsequent open pit is formed.

However, while the quarry depth is increased, the implementation of these schemes becomes more difficult. In the first case, the volumes of extracted overlying rocks are increasing. In the second case the pillar is lowered into the ore zone that leads to pit productivity reduction.

Due to the conditions it is needed to reduce the capacity of warehouses located in the ore zone, so it leads to increasing in their number and reducing the transfer step.

Research results. To balance the above mentioned unfavorable factors a scheme within quarry ore overload limits with alternating concentration on adjacent ledges used to limit the depth distribution of the pillar has been developed. This technology can be implemented using a hydraulic excavator with backhoe in warehouses that are a combination of the mining bench and receiving the trench, which is temporarily stored in the pit of overloaded ore [10].

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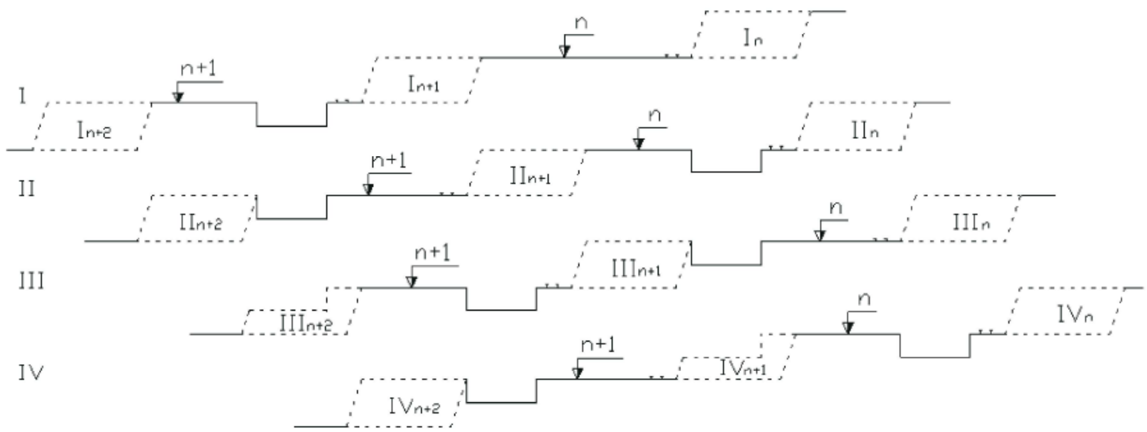


Fig. 1: Scheme of pit wall advance at the location of transfer point with receiving trench

Hydraulic excavators, backhoes in recent decades are widely used in mining enterprises at the quarries of building materials as well as at the coal mines [5].

Fig. 1 shows a diagram of advancing pit edge within quarry limits location of transfer point with the receiving trench. Two adjacent mining levels, developed by railway transport have been presented on the diagram. Stage 1 corresponds to the beginning of warehouse employment on the level $n + 1$. During this period, the overlying levels $n$ are carried away and ready mining stocks on the level $n + 2$ are extracted.

At the second stage the point is transferred to the upper level $n$ that permits to eliminate the formation of non-working pillar.

After extension of the work site on the level $n + 1$, there is an opportunity to locate warehouse on this level (Step 3).

On the fourth stage point on the level $n$ is used.

Time of transfer point relocation should be functionally linked with an average speed advancing pit wall [5]. The latter, in turn, is determined by the required rate reduction of mining operations and according to the law of lowering mining activity, advancing ledges are:

$$\upsilon_{\min} \geq h_y \cdot (ctg\varphi \pm ctg\beta),$$

where,

- $h_y$ - The rate of reduction of mining operations, meter per a year;
- $\varphi$ - Slope angle of the pit, degree;
- $\beta$ - The angle of incidence of mineral deposits, degree.

Its maximum possible value can be calculated by the formula:

$$\upsilon_{\phi\ \max} = \frac{Q_{\max}}{H \cdot L},$$

where,

- $Q_{\max}$ - Maximum productivity of mining equipment, cubic meter per year;
- $H$ - Bench height, meter;
- $L$ - Length of amount of work on the levels of transfer point, meter.

Taking the width of the stocks recess equal to the width of the stope mining excavator, the time of their mining, which will be the lifetime of transfer point operation, will be defined as follows:

$$T_{\max} = \frac{A}{h_y \cdot (ctg\varphi \pm ctg\beta)}$$

$$T_{\min} = \frac{A \cdot H \cdot L}{Q_{\max}}$$

where $A$ – stope width, meter.

Obviously, during mining operations in the mode that provides the minimum dimensions of site, operating time of transfer point in one place will tend to $T_{\max}$.

## CONCLUSION

Scheme with alternating concentration level on adjacent benches allows restricting the depth pillar distribution on the transshipment point area, which will be of two ledges and keep the high intensity of the field development.

Fig. 2 shows comparative characteristics of excavation warehouses. The main parameter determining efficiency of capital costs is the amount of additional recoverable rock mass.

Fig. 2: The main parameters of transfer points

| Parameter | Warehouse type<br>Bench face | Buried | Complex |
|---|---|---|---|
| Total width of operating site | 75 m | 80 m | 58 m (80 m taken into account mining face) |
| Warehouse capacity | 12500 $m^3$ | 15000 $m^3$ | 12800 $m^3$ (without taken into account mining face) |
| Volume of additional rock (depth 100 m) | 1 285 000 $m^3$ | 1 385 000 $m^3$ | 930 000 $m^3$ |
| Transfer point facilities | Mining tracked excavator-8 | Mining tracked excavator -8 | Komatsu PC 1800-6 |

As the Figure 2 presents, transfer warehouse capacity is almost the same and permits to identify the most cost-effective storage type – it is complex. In fact width enlargement of the site on the level of overload point location, in this case, is determined by the site width of dump truck maneuvering for unloading, as well as the width of the trench receiving warehouse.

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