
# RE-CUTTING BENCHES IN A BLAST-BULLDOZER-BASEMENT COMPLEX DURING THE DEVELOPMENT OF "MOUNTAIN-DEPOSIT" TYPE DEPOSITS

**Mislibaev Ilkhom Tuychibaevich**
Doctor of Technical Sciences, Prof., Navoi Mining and Technology University, Republic of Uzbekistan, Navoi
E-mail: mislibaev65@mail.ru
**Mutavaliev Abduvahab Tolibzhanovich**
Candidate of Technical Sciences, Associate Professor,
Mining and Metallurgical Institute of Tajikistan, Republic of Tajikistan, Chkalov
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**Abstract.**

This article discusses and presents a methodology for cutting benches in a blast-bulldozer-basement system for mining "mountain-deposit" mineral deposits. Experimental studies have demonstrated the feasibility of reducing the volume of rock bypassed by bulldozers in a blast-bulldozer-basement system by enhancing the blast's throwing effect on the discharge. In most cases, when the slope angle is less than or equal to the working wall angle (φ≤γ), steep-slice mining can begin from the bottom up the slope. This increases the quarry wall height with the cutting of new benches until the wall reaches the mountain crest. Subsequently, the wall height will remain constant for a long time (when mining a mountain ridge or plateau) or begin to decrease (when mining a dome-shaped hill). The high efficiency of the blast-dozer-basement system using flat, stepped charges makes it suitable for construction material quarries. This system is particularly effective in newly developed deposits. Switching to this technology at existing quarries using a different system requires minor modifications, such as re-cutting the benches.

**Key words:** technological complex, open-pit mining, blast-dozer dump complex, side height, blast for dumping, minerals of the "mountain-deposit" type, dump.

**Introduction.** The raw material obtained by blasting the rock mass does not, in its entirety, meet consumer requirements. For example, a cement plant requires limestone of the smallest possible grain size, while a concrete plant requires crushed stone of a specific size, with fractions of 10-20 and 20-40 mm. When constructing building foundations and stabilizing dam slopes, rubble stone of 150 mm or larger is used [1]. Consequently, a significant portion of the rock mass must be further crushed, primarily in the quarry's crushing and screening plant and in the cement plant's crushers.

**Materials and Methods.** Experimental studies have demonstrated the feasibility of reducing the volume of rock bypassed by bulldozers in a blast-bulldozer-basement system by enhancing the blast's propelling effect on the discharge. It is now necessary to study and validate the deposit development technology as a whole. This primarily concerns the mining procedure. As is known, steep-layer mining, in most cases where the slope angle is less than or equal to the working wall angle (φ≤γ), can begin from the bottom up the slope [2]. This increases the quarry wall height with the cutting of new benches until the wall reaches the mountain crest. Subsequently, the wall height will remain constant for a long time (when mining a mountain ridge or plateau) or begin to decrease (when mining a dome-shaped hill).

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The high efficiency of the blast-dozer-dump system using flat stepped charges makes it recommended for quarries producing building materials, especially cement raw materials, with a capacity of up to 1 million $m^3$/year, working in "mountain-deposit" deposits [3].

This system is particularly effective in newly developed deposits. Switching to this technology at existing quarries using a different technology system requires minor reconstruction, such as bench re-cutting [2].

At quarries with a truck-mounted system, the reconstruction consists of creating a receiving platform at the foot of the mountain and forming a steep working slope (cutting benches on the slope). The procedure for forming the slope depends on the steepness of the slope: if the slope angle φ is less than the rock roll angle αck, then bench cutting should begin from the bottom (Fig. 1); if φ>αck, then the slope must be formed from the top (Fig. 2). When cutting benches, all cuts are made using a blast-and-bulldozer pit, so a receiving area must first be prepared at the base of the mountain.

Quarries using free-cutting technology already have a receiving area. The transition from this technology to the recommended one involves cutting benches on a smooth, inclined wall with a repose angle of γ = αck.

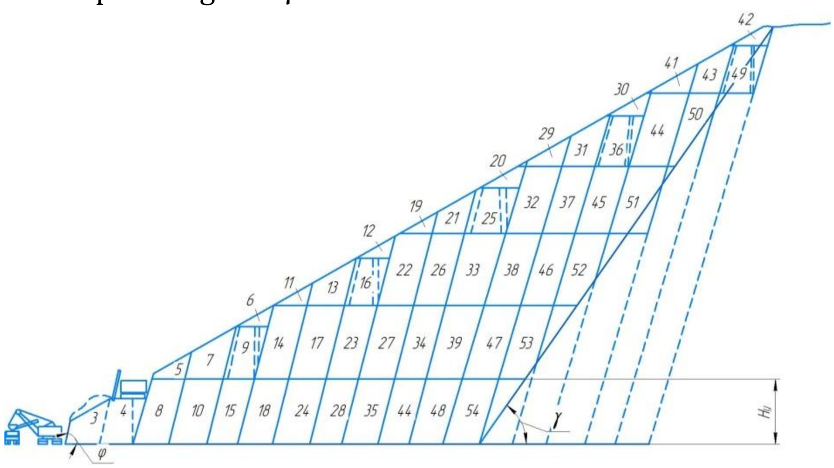

**Fig. 1. Formation of a working side on a gentle slope 1-54 successively processed passes**

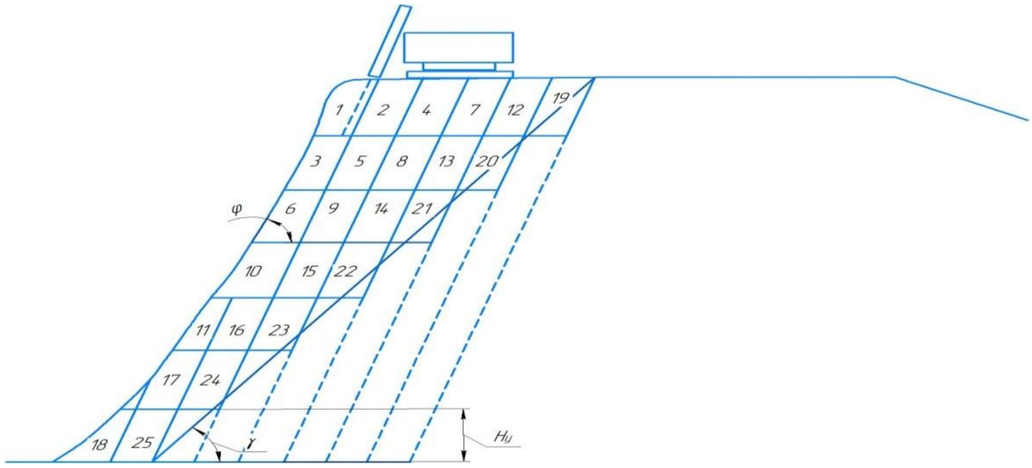

**Fig. 2. Formation of a working side on a steep slope**

As shown in Fig. 3, this operation is recommended to be performed from the top down so that the benches being cut are drilled from the roof rather than from the side slope, using quarry drilling rigs instead of hand-held drills. Drilling rigs can be transported to the upper boundary of the working area via the service road that runs there.

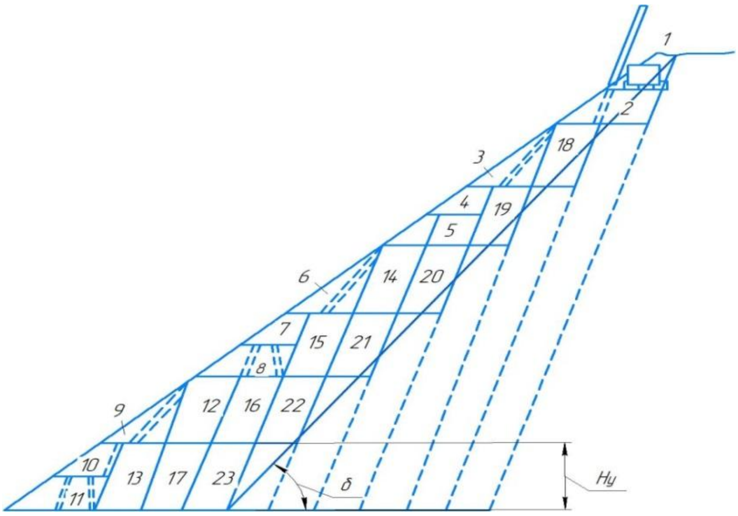


**Fig. 3. Reconstruction of the working side during the transition from the "free excavation" complex to the blast-bulldozer-basement complex.**

The transition from a blast-and-dump system to a blast-and-dump system is also straightforward. Here, cutting benches 10-15 meters high in place of lower benches 3-4 meters high can also be done from the top down using quarry drilling rigs (Fig. 4).

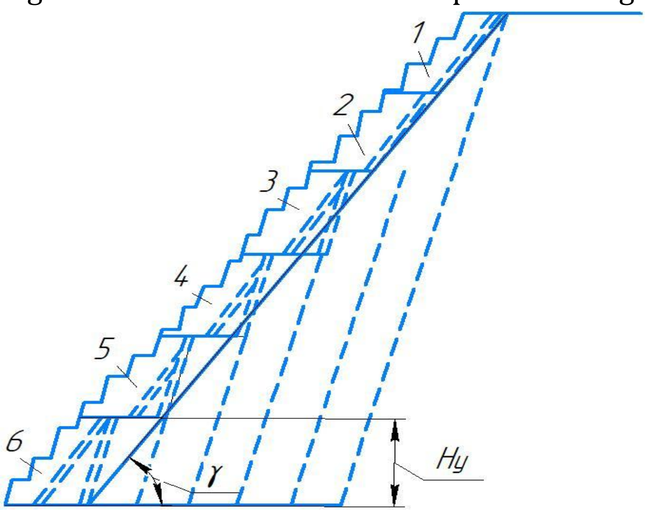


**Fig. 4. Reconstruction of the working side during the transition from the blasting and dumping complex to the blasting, bulldozer and dumping complex**

As follows from the above, replacing previous technologies with the new one requires virtually no additional costs, can be implemented in the shortest possible time (up to one year), and can be done without interruption to mineral production, continuing during the bench cutting process.

The blast-and-bulldozer basement technology is emerging as a promising option for construction material quarries in Tajikistan. The transition to this technology has already been discussed for several quarters in Central Asia.

This technology is also expected to find widespread application in upland quarries worldwide, leading to increased efficiency in open-pit mining.

**Conclusion.**

The proportion of rock (in the volume of one steep layer) subject to removal by bulldozers from the side can be estimated using the dumping coefficient K_(subj.). This proportion (and, accordingly, the coefficient K_(subj.)) decreases according to a power law as the bench height increases from 10 to 20 m.

The possibility of mining a steep layer using several benches and several blocks along the front is limited by the length of the latter and is impractical for organizational reasons. Effective operation of a blast-dozer-dumping system is ensured by mining the steep layer using one bench with one drilling block, which determines the quarry productivity achieved in this system. It is advisable to place and alternately use dumping and reloading zones on different sides of the mountain.

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