

RESEARCH TO QUANTIFY THE LIGNITE EXTRACTION POTENTIAL ACCORDING TO BENCHES AND BENCH SYSTEM SLOPE ANGLES FOR OPEN PIT MINES IN OLTENIA

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Abstract

In the lignite mining activities in open pit mines, the recovery of larger quantities of coal is based usually on "the temptation to force the slope angles" of the benches and bench systems. An important element to take this decision is the knowledge of the amount of coal that can be recovered.

1. Introduction

One of the main conditions to improve the efficiency of lignite extraction by re-designing benches and bench system slope angles is the exact knowledge of the quantity of coal (tons) that can be capitalized at a time. Knowing the exact amount of coal that can be recovered is in fact the main key in the relationship "economic efficiency - safety

factor", i.e. both a larger quantity of exploited coal in a shorter time, and fulfilled stability conditions.

2. Coal extraction potential for working benches

Passive reserve definition. According to the Figure 1 the "active reserve" is defined as the quantity of coal currently operated under the conditions of the designed angle "u1" to a certain career, and "passive reserve" as the quantity of coal that could be additional extracted in the case of an angle "u2", larger than u1, but satisfying the stability conditions.

In order to establish the "passive reserve" we count on the fact that the usually height of the working benches varies between 5.0 m and 20.0 m, the bench slope angle is usually 45° and the minimum thickness of a coal layer must be 1.0 m (condition imposed by the extraction equipment).

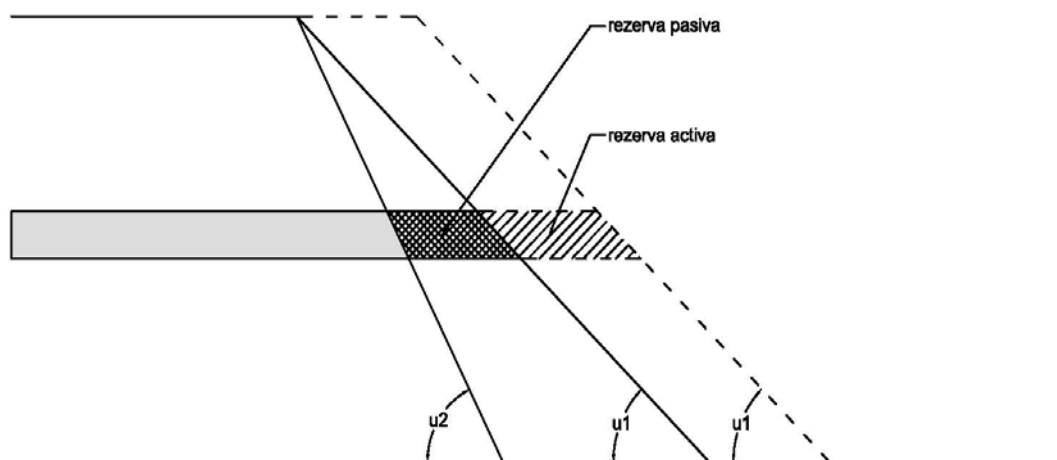


Fig. 1 – Working bench "Active reserve" / "passive reserve"

Construction of the mathematical model. The model, scaled 1 : 1, was realized by AutoCAD and defined for a bench 20.0 m height. The reference system of coordinates was chosen on the top of the bench. Thus, the model reference system is suitable for all benches less than 20.0 m height, respectively for any bench multiple of 1.0 m height in the interval [1.0, 20.0] m.

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Figure 2 presents in detail the model having on the vertical axis the bench height and the position of a coal layer 1.0 m height and on the horizontal axis the variation of the slope angle (from 45° to 80°).

The interval of 5° of the slope angle was chosen thus to have both economic (amount of coal) and "practical" (values of the angle that can be worked by mining) relevance.

Therewith, for practical use of this model, the variation intervals were defined using the "chess board" principle.

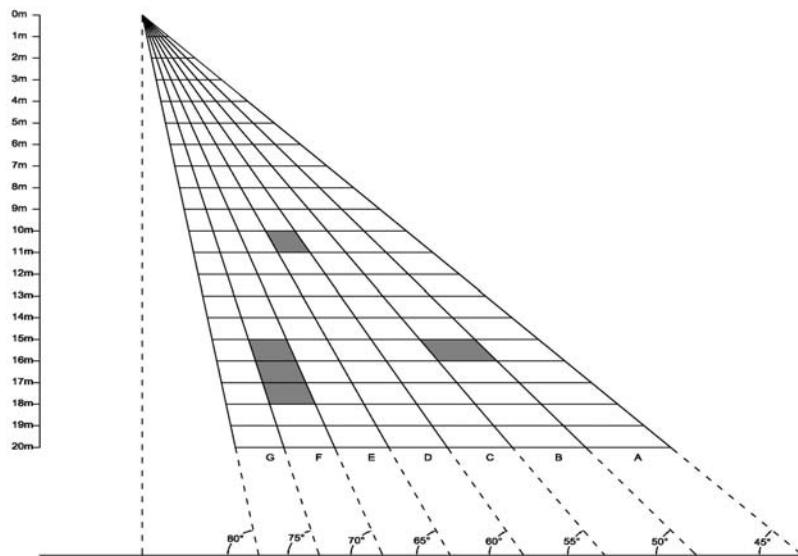


Fig. 2 – Working bench Mathematical model of "passive reserve" determination

3. Results

Considering the coal layers perfectly horizontal (as shown in the Figure 2), the areas of the parallelograms drawn by the coal layers lines and the slope angles lines were determined by AutoCAD.

The resulting "passive reserve" (in tons) for the model set is presented graphically in the Figure 4 for different slopes height and angle and for an average volumetric weight of coal of $12.5 \text{ kN} / \text{m}^3$.

4. Coal extraction potential for final bench systems

For an accurate assessment of the quantity of coal to be over-extracted in the case of designing of new

general slope of the bench system, we proposed an "ideal" bench system consisting on four benches. Each bench is 20.0 m height and the slope angle 30° . The general angle of the bench system is 8° . The "passive reserve" (hachured zones) has been calculated in the case of increasing of the slope angle from 8° to 15° . In figure 3 the hachures represent the "passive reserve" by increasing the slope angle in the interval 8° - 10° .

It is noted that the "passive reserve" together with the width of the benches increase from the upper part to the lower part of the bench system of the open pit mine.

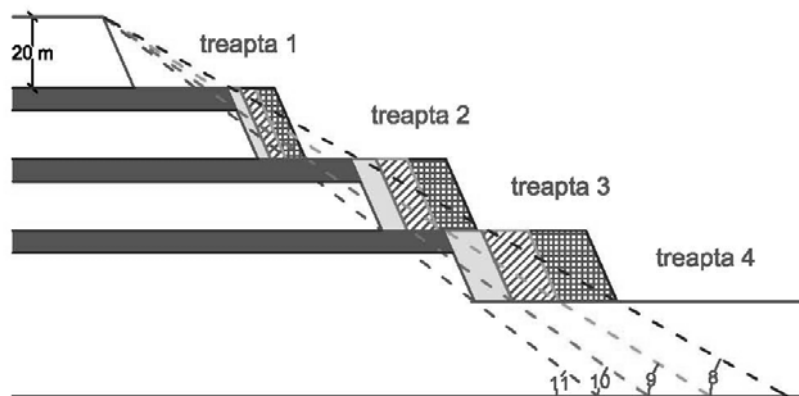


Fig. 3 – Bench system Mathematical determination of the "passive reserve"

5. Conclusions

By re-designing the slope angles of the working benches, considering an average volumetric weight of coal, additional amounts of coal can be extracted (tens of tons per linear meter of bench).

Re-designing the slope angles of the bench system (final slope) leads as well to the recovering

of important amounts of coal (thousands of tons per linear meter of slope). The recovered amount of coal by re-designing the general angle of the open pit mine is much more important than the amount of coal recovered by re-designing of the slope angle of the final individual benches.

In this direction, a special attention should be given to develop this extraction potential.

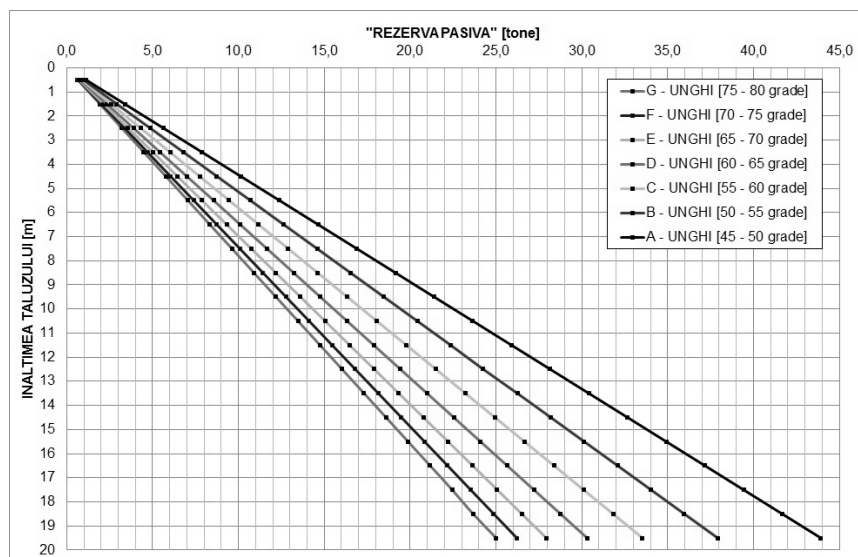


Fig. 4 – Working bench. „Passive reserve” for different slope heights and angles

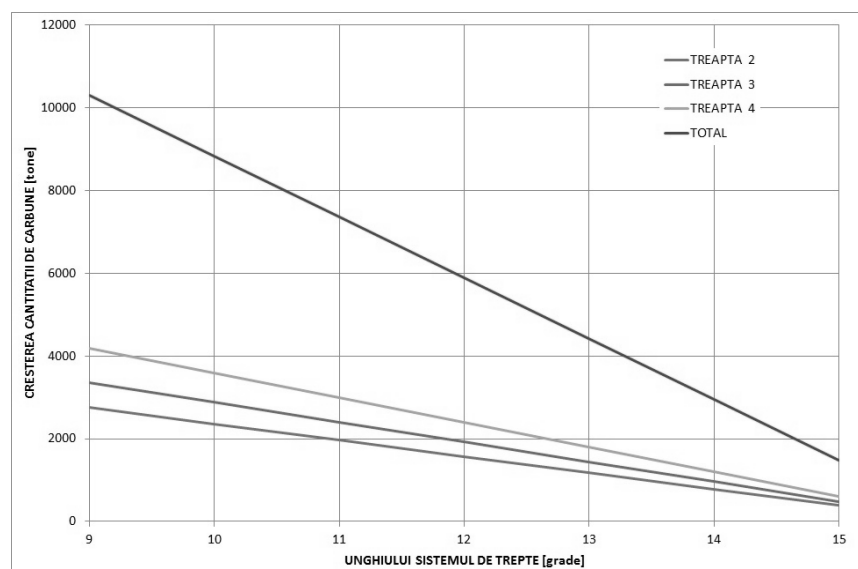


Fig. 5 – Bench system. „Passive reserve” for different bench and bench system slope angles

References

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