MODEL OF HORIZONTAL COAL DEPOSITS EXCAVATION BY BUCKETWHEEL EXCAVATOR

YATAY KÖMÜR YATAĞININ DÖNER KEPÇELİ KAZICI ÎLE KAZI MODELİ

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ABSTRACT

The paper presents a **model of horizontal coal deposits excavation b„ bucketwheel excavator based on the case of "Tamnava" openpit mine. The model can be applied for the concrete deposit conditions and equipment, first of all, for the selection and optimization technological parameters of bucketwheel operations in real time and real space. Bucketwheel excavator type selecting and taking from the data base its operating and constructive characteristics and working environment characteristics, the rule base** of **bucketwheel** excavator technological parameters is **formed.** In the AutoCAD real space surrounding, a graphic interpretation of technological parameters rule base is carried out.

ÖZET

Bu **bildiride, Tamnava açık ocagindaki örneğe dayanarak, yatay kömür yatağının** döner kepçelı kazıcı ile kazı modeli sunulmaktadır. Model, öncelikle bakir yatak şartlan ve ekipman için döner kepçeli kazıcının teknik parametrelerinin, gerçek zaman ve gerçek yer bazında seçimi ve optimizasyonu için uygulanmıştır. Döner kepçeli kazıcı tipi seçimi için, inşa ve çalışma karakteristikleri, çalışma çevresi koşullan ve teknik parametreler arasındaki kurallarla bir veri tabanı oluşturulmuştur. AutoCAD (Bilgisayar Destekli Tasarım) gerçek uzay çerçevesince, teknik parametrelerin yönetim tabanıyla ilgili bir grafik yorumlanmasi yapılmıştır.

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1. INTRODUCTION

The achieved level of opencast mining technic and technology and the need for an ever increasing physical scope of coal production as a strategic raw material in Yugoslavia impose the need for constant updating and modernization of the mining technological process [1].

More and more complicated working environment conditions in lignite deposits (distinct material plasticity, small internal friction angles, load bearing capacity and increased digging resistances) require harmonization of techno-technological parameters with working environment parameters in real space and time.

The authors of this paper developed a simulation model for bucketwheel operation as the dominant equipment unit of continuous mining system on Yugoslav openpit lignite mines.

2. MODEL STRUCTURE

The coal mining model in horizontal deposits is represented in stages. The initial basis consists of a data base of working environment properties and data base of equipment involved in the mining system.

Analysis of bucketwheel excavators according to their kinematic and constructive properties is based on excavator operating parameters and flow-sheet. General bucketwheel excavator parameters (maximum digging height and depth, bucketwheel boom length, digging radius, bucketwheel diameter, free cutting angle, allowed bucketwheel boom angle of incline during elevated and depth operation, discharge angle, excavator delivery boom angle of incline) are taken from bucketwheel excavator data files.

Bucketwheel excavator type selection and retrieval of its operating parameters from the data base represents a starting point for definition of bucketwheel operation technological parameters in the selected flow-sheet.

The simulation model is based on operating flow-sheet decomposition, enabling variation of technological parameters as a function of optimum parameters determination.

Basic bucketwheel operating technological parameters defined by the model are [2]:

- Bench height (h) whose maximum value is limited by the allowed bucketwheel boom angle of incline in vertical plane, being defined as a function of bucketwheel boom length (L_k), bucketwheel boom suspension point height (y) and cut height (h_r);
- Cut height (h_r) corresponds to vertical slice height, and its optimum value ranges between h_r = (0,5 * 0,7) D, where D - bucketwheel diameter. The model allows selection of the number of cuts or height of each cut individually;

- Face slope angle (w_c) is formed, during excavator operation, being limited by slope stability safety factor at a specific height, yielding the maximum allowed angle of incline. Minimum face slope incline occurs in the case when crawlers approach the minimum distance from bench bottom edge during excavation of the highest first cut;
- Lateral slope incline (w_b) is defined in line with mined material physico-mechanical properties in dependence on bench height. As a rule, both for face and lateral slopes the largest allowed angle of incline is adopted since it yields the most favorable technological and in turn production effects;
- Block width (S_b) directly depends on the digging radius and angles of bucketwheel boom movement towards the massif and mined-out area in a horizontal plane. Maximum internal block width is defined by the angle of bucketwheel movement towards the massif in the highest panel $w_{ug} = 90°$, while the minimum internal block width is limited by the free cutting angle a_s. Block external width is limited by bucketwheel boom movement angle towards the mined-out area in a horizontal plane, being $w_{s4} = 35 - 40°$;
- Block depth (D_b) depends on the possibility of excavator travel mechanism approach to block face slope bottom edge, i.e. bucketwheel boom to the face slope upper edge. Maximum block depth equals the lower value of above two limits, being presented on Figure 1 [3].

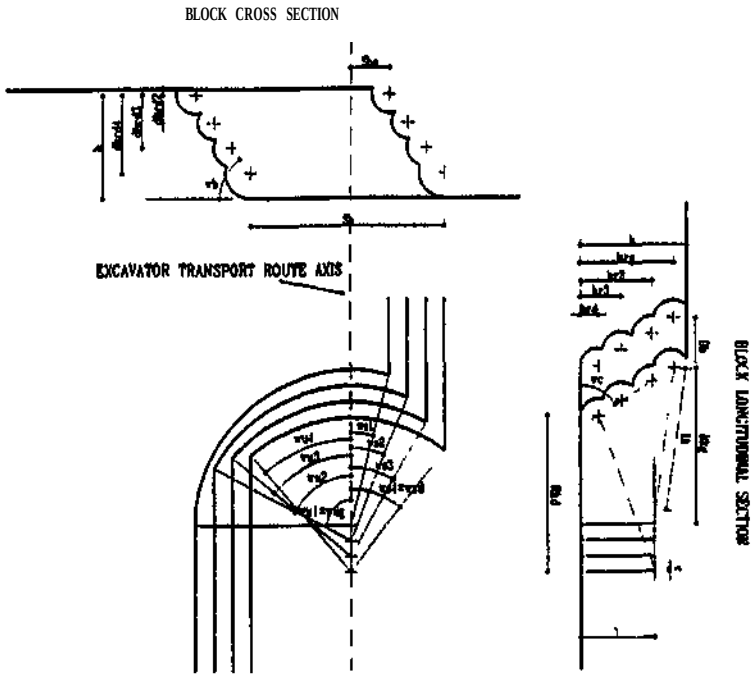


Figure 1 - Bucketwheel excavator operating parameters

Retrieval of necessary data from sequential datafiles allows calculation of bucketwheel excavator mining techno-technological parameters. Obtained results form a results base [4], Results base represents a basis for graphic interpretation of bucketwheel excavator operating flow-sheet within the AutoCAD environment.

Openpit mine graphic interpretation technological procedure requires definition and introduction of standard procedures based primarily on AutoLISP programming language programs.

Data bases on geological exploration works taken from another programming environment are adopted to AutoCAD data base structure. Retrieval of these data and their graphic interpretation or digitalization of existing backgrounds with the aid of a graphic board and digitizing program yield bases for design in an AutoCAD environment.

The procedure of handling data bases in this environment requires vertical division in layers, which must be a function of designers needs for successful manipulation of the set of data on the grade (hangingwall and footwall isolines, valuable and harmful component contents, deposit division into miniblocks), land isolines, geological and technological profiles, existing objects, etc.

3. SIMULATION MODEL CASE STUDY

Simulation was applied on an actual case in lignite Openpit Mine "Tamnava - East Field".

On a digitized openpit mine situation plan bucketwheel excavator operation was simulated for concrete working environment and mining equipment conditions. Simulation procedure is shown on Figure 2.

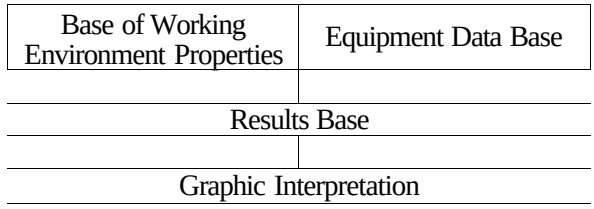


Figure 2 - Simulation Procedure

Graphic interpretation implies taking over data from results base, their graphic interpretation, as well as presentation of obtained results including both technological parameters (block width, block height, working front depth) and technical properties (mining output in real mining time).

Realization of the TechnoCad program for bucketwheel excavator SchRs 630 operation flow-sheet graphic interpretation exemplified by Openpit Mine "Tamnava - East Field" with the results is presented on Figures 3,4 and 5.

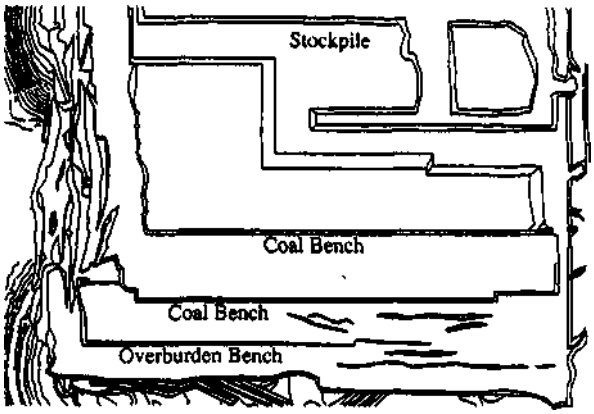
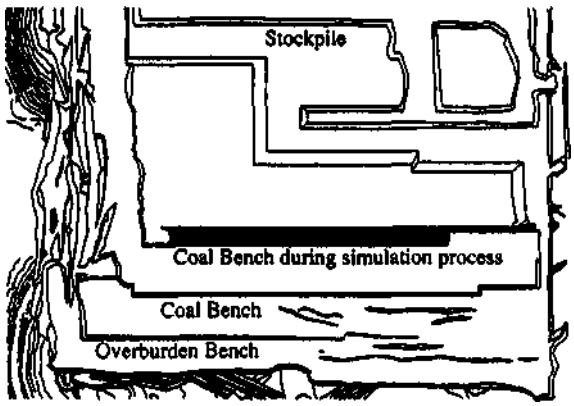


Figure 3 - "Tamnava - East field" situation plan



Block width»48.5m **Bench height«20 m** **Block depth-5.4 m**
Front l«nght-1242m **Qapacity-2133m3/h** **Exc. time-564.81 h**

Figure 4 • An overview of coal bench during simulation process

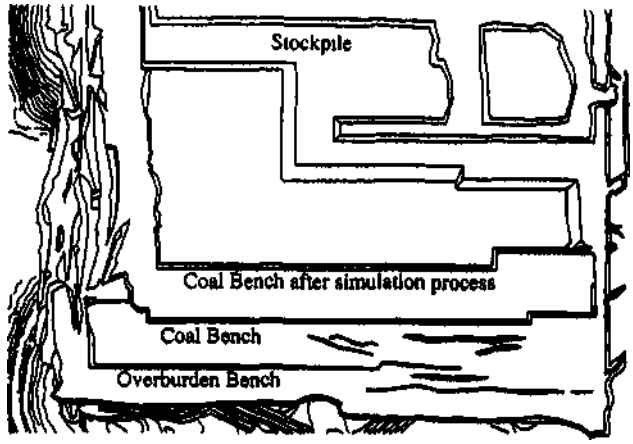


Figure 5 • An overview of coal bench after simulation process

4. CONCLUSION

Model of the horizontal coal deposits excavation by bucketwheel excavator is developed in Basic and AutoLISP program languages for AutoCAD graphic surrounding. It is configured for simulation of bucketwheel excavator working in function of working environment characteristics and equipment operating and constructive characteristics in real space and real time. Model is applied on "Tamnava East Field" openpit. It is adopted for interactive communication through data base control and optimization methods implementation possibility. In this paper bucketwheel excavator simulation on the coal bench is presented.

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