STAGES OF OPEN PIT MINING. MINING METHODS AND THEIR PROCESSES

[1]Jumabayeva Guljahon Jaqsilikovna, [2]Allanazarov Bayrambay Rustemovich, [3]Joldasbayeva Aysulu Baxitbay qizi
[1]Nukus Mining Institute "Natural and general professional sciences" intern teacher
[2]Assistant teacher of the "Natural and General Sciences" department
[3]Student of Nukus Mining Institute:

Abstract. *Open pit mining is usually done through a a series of mining steps, commonly known as pushbacks. Metallized in open pit mining, each push considers the mining of one or more benches at the same time, the main operational tasks include: drilling, blasting, loading and transportation. In large open pits, shovels and front end loaders can be used to perform loading operations. Type and number shovels are selected during the planning process and determine their productivity benches, thrust and mining speed. available space for loading is part of the rollback design. This determines its shape and size benches for placing equipment. It is a relevant stage of mine design a description of the location and sequence that the loading equipment must follow finish benching each push. Placement of loading equipment in a mine is usually called exploitation scheme. This term is commonly used in the mining industry, but no often found in literature. The design of a haul road for an open pit mine can have a significant impact on the associated costs with the transport of ore and waste to the surface. This study proposes a new way to design traffic lanes open pits to support efficient trucking operations.It was also changed by the road scheme reflecting the radius of curvature recommended in road design manuals. Finally, three-dimensional a model representing the results of road design is created by combining road layout changes resulting in the slope of the open pit and the design of the bench. The proposed program the way to the area with the gold mines made it possible to design a freight route for the open-pit mines thus, it supported efficient trucking operations; Also, the time required for the truck traffic along the road could be predicted. The proposed method is expected to be useful assist in the improvement of open pit planning and design and road design functions existing mining software applications. The purpose of this article is to learn in the context of the concept of exploitation scheme in open-pit mining strategic mine planning activities. In the first part, the concept is introduced examples where the thrust size is fixed and the number of spades is changed. The second part includes a discussion of motivations and limitations may be taken into account by the mine planner when designing. Multiple paddle and bench configurations in the same push a challenge to design a scheme mainly due to limited space download In such cases, mathematical and optimization tools can be useful; however, models must be able to represent realistic constraints affect the productivity of shovels at different levels. Aggressive in general and expensive schemes are rarely used by highly ambitious mining companies performance and low operating costs. However, choosing an the appropriate operating scheme should be suitable for the main purpose of mine planning activities, ie: value creation through exploitation mineral resource.*

Keywords: *open pit mining, design of the freight route, open pit, calculation of the range of dimensions of movement of mining machines, least cost path analysis,truck transport operation, mine design.*

Introduction

Designing an efficient haulage route for the movement of mining equipment in open pits is important because the cost of transporting ore and waste can vary greatly depending on it road design results. To date, many manuals have been developed for the design of roads in open pit mines. These guidelines describe the design of widths, slopes and curves of haul roads to ensure safety of trucking operations as well as road construction and maintenance procedures. However, one limitation of these manuals is that they do not provide an efficient road design method supporting efficient trucking operations throughout the life of an open pit mine. Surface mining is characterized as a highly capital intensive mining method productivity and lower costs compared to underground methods. Material extraction is usually done in steps or called pushes. Each one pushback includes waste and ore mined through the layers from the mine called benches. Unitary operations in an open mine include: drilling, blasting, loading and transportation. Capital investments in the mine are mainly related to acquisitions equipment for each unit operations. In large metal mines, loading can be done with shovels and mounted front loaders different thrusts of the operation. Planning the use of a mineral deposit is a complex activity. The The main difference from other branches of the industry is the corresponding ore body to the fixed asset of the business, limited and non-renewable. Besides, A mine plan should be developed with uncertain information such as ore body characteristics and economic factors mining project. Strategic mine planning is an activity in which key decisions are made that regulate these activities exploitation of a mineral deposit and the main goal is value Create. These decisions are suitable for choosing: mine method, the processing route, mining sequence, operation volume and intersections variables that separate the valuable part of the ore from step to step cut category in mine. On the other hand, tactical mine planning deals with routine planning activities aimed at actually capturing business value and the like relevance of the mayor during the mining operation. These activities include: strengthening the operation, etc., for example, medium and short term production plans, budget preparation, equipment and production placement monthly, weekly or daily planning. Literature in the field of strategic mine planning has mainly attracted attention key decisions of the mining project. The research in this area was highlighted the complexity of the problem arising from the interdependence that exists among its variables. For example, mining cannot be defined a method without predetermining the mining sequence, intersections, volume operation and processing route. Similarly, there can be no other variables defined without predetermining the remaining variables. A solution requires hence recursive and iterative methods.

Picture 1.

Scale limit for ensuring the movement of mining machines when calculating the dimensions of the mine
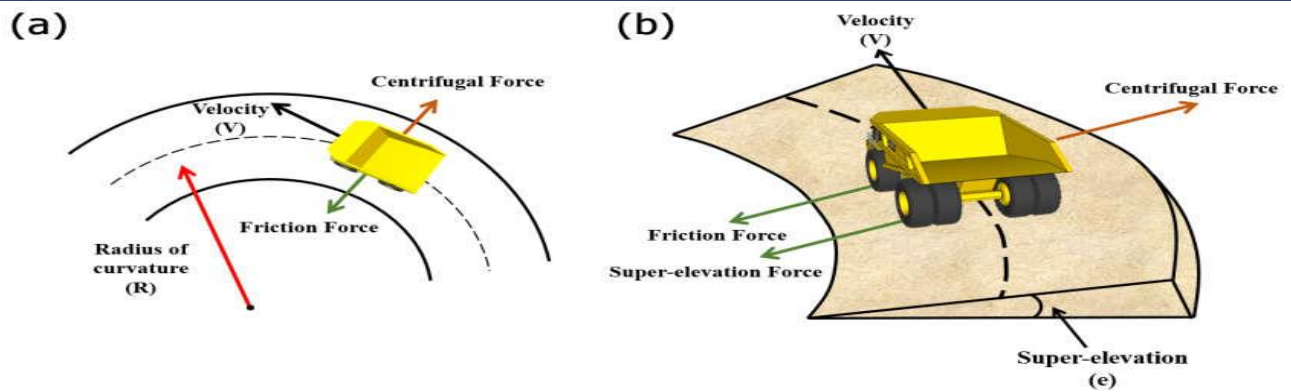
The radius of curvature should be taken into account when determining the horizontal arrangement of cargo the way. Failure to allow sufficient curve radius may increase travel time and cost due to reduced performance stability of the truck. If a sufficient radius of curvature is obtained, it is possible to maintain a stable speed of the truck and reduce the wear of the truck wheels, which efficient shipping operation. The radius of curvature must be designed in such a way that the centrifugal force acts on the truck during rotation and the friction between the truck tires and the road surface is balanced (see Picture 1a).

Equation for the minimum radius of curvature to be considered in road design as follows:

$$R = \frac{V^2}{127(e+f)}$$

Here R is the radius of curvature (m), V is the speed of the vehicle (km/h), e is the degree of elevation (m/m) and f is the coefficient of friction between the tire and the road surface. Means the speed of the car maximum speed when the truck is operating on a downhill slope without load. Super high is implied bank level at one end of the road (see Picture 1b). Applying the height difference reduces and allows the truck to exert centrifugal force when turning on either side of the road for the truck to rotate stably. The top elevation should not exceed 6%-7% (approx. $5°$–$6°$). proposed a super-height in the freight path according to the radius. curvature and vehicle speed. The coefficient of friction varies depending on the road surface and 0.13 if the surface is sandy and soft or muddy, or 0.453 if it is partially paved. Pushback design and loading equipment selection are two activities of the mayor about planning activities. Pushback design involves sizing and each push form and its seating and access features routes. On the other hand, the choice of loading equipment takes definition into account type and number of shovels or front loaders used for loading activity. Various options considered in selecting the final thrust design included in the final pit definition and mining sequence. On on the other hand, the choice of loading equipment is mainly determined at the time of operation the measuring stage in which the size of the mill and mine is determined. Both activities are available has been extensively studied in the strategic mine planning literature. Location and sequence of loading during the mine design phase it is determined that the equipment must be followed to finish the machines. placement of The loading equipment on different benches of each push is called a exploitation scheme. Although this concept is widely used in the mining industry less covered in the literature. Scheme of operation suitable for placement of loading equipment during completion of benches for each push. This will change with the development of mining and therefore it defines the extraction sequence of the machines. Utilization design schemes are part of the mine design phase and therefore part of strategic and tactical mine planning activities. from a strategic point of view, definition of

exploitation schemes, mining design and loading equipment selection are interrelated activities. Their definition directly affects the mining speed of the mine. For example, a particular recoil design may have the same loading equipment giving different extraction rates as a result of different exploitation schemes. Therefore, exploitation schemes play a crucial role in the evaluation of production rate and other key variables of the strategic mine planning process.

Content and essence of the article

The purpose of this article is to explore the concept of exploitation scheme open pit mining. The idea is to introduce the concept and discuss the goals and the constraints that govern its proper design. The scope of this paper is metallurgical open pit mining with electric shovels development of loading activities. It is a part of operational design schemes strategic and tactical mine planning. However, the focus will be strategic point of view. Nevertheless, conclusions and discussions can be extrapolated tactical mine planning activities. The article describes the processes of opening a mine, and as the main task, the sequential execution of mining processes in the mine is of great importance.

Conclusions

Finally, the shipping lane An open pit mine is designed using a terrain model of the mine along with the transport route layout as input for AutoCAD 3D and rendered in three dimensions. application of the proposed method made it possible to determine the slope limit for the area with gold deposits $10°$ (16-18%) as proposed open pit haulage route scheme. It was also possible estimate the approximate working time, travel distance and speed associated with road transport designed for trucks. The proposed method can solve the problems that arise when the layout of the traffic path is determined only the traditional mining method. Designing exploitation schemes is a complex activity involving depth knowing the parameters that govern the operation. Experience and the creativity of the mine planner is key to creating schemes that solve problems the ultimate goal of value creation and respect for constraints operation. This paper explored the concept of exploitation scheme, proposed a discussion of the formal definition and relevant considerations design. Support for complex scenarios with multiple shovels in a reduced area Mathematical and optimization tools can be useful for dealing with circuit design. However, optimization models must be able to represent the design purpose and operational constraints. Further research may be warranted search for existing and new mathematical methods that can be useful for optimization design schemes for use in open pit mining. As a result, our method allows not only analysis optimal route for trucks traveling along the existing road in open pit mines during the production phase their life cycle as well as the design of the haulage route for the open pit mine which is still being planned and the project step and the path for it do not exist. Open mines have many obstacles such as trees, rocks or other equipment. reduces the visibility of drivers. Reduced visibility often creates dangerous situations for the truck drivers. Therefore, it will be interesting to develop an extended method to consider in future work stopping and sight distances when designing the radius of curvature.

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