A Transportation Model to Optimize Road Location in Open Pit Mining Method

Ali Parhizkar*
Lahijan Azad Unversity
Ali.parhizkar@gmail.com

Afshar Ziazarifi
Lahijan Azad Univrsity
Email Address

Alireza Mardookhpour
Lahijan Azad University
Email Address

Majid Abrari
Lahijan Azad University
Email Address

Amir Hossein Bangian
Tehran South branch of Azad University
Email Address

ABSTRACT

The road is an important design factor in mine planning and design which influences the pit slope, stripping ratio and mineable ore quantity. The road position in open pit wall is a function of the volume of material which must be transported from pit (mine) to different destinations such as waste dump, stock pile, mill and leach dump. In this paper we presented a model to optimize the road location. This model gives the most optimum possible location of road which has the minimum transportation cost. As a case study the model was implemented in a copper mine in Iran and the optimum position of road in pit wall was determined. The results indicated that this position gives the most suitable design parameter and presents the minimum cost.

Keywords: road, open pit mining, location theory, transportation

INTRODUCTION

After determination of final pit limits we have to exert road characteristics in ultimate pit to achieve the practical or actual or optimum pit such as: road position, road gradient, road shape (Spiral or Zigzag), etc (Crawford & Hustrulid; 1979).

The most important characteristic which must be determined is the road location. All points on the pit perimeter can be a candidate for road location. Pit perimeter is too wide and can be spread even to several kilometers. In this research we will present a model to optimize road location using location theory. The fundament of this theory is minimizing the transportation cost function. This theory was introduced by Alfred Weber. Alfred Weber's work (1909) is considered to have established the foundations of modern location theories. One of his core assumptions is that firms will chose a location in view to minimize their costs. A set of simplifications are also considered, namely that location takes place in an isolated region (no external influences) composed of one market, that space is isotropic (no variations in transport costs except a simple function of distance) and that markets are located in a specific number of centers. Weber's location theory explains well the location of heavy industries, particularly from the industrial revolution until the mid twentieth century (Donnelly & Smith; 2003).

In this paper at first we investigate the destinations of materials which are exploited from pit then we model the problem for an open pit mine with 4 destinations for mined materials. After that the model will implemented in a copper mine as a case study and finally we will mention an overview and discussion of the paper subject.

MINED MATERIALS DESTINATIONS

Mined materials are transported from pit to different locations. These destinations are determined based on cut off grade criteria (Hustrulid & Kuchta; 2006). The potential of future economic value of mined materials in addition to new advances in mineral processing technique have increased the destinations of exploited materials from two locations to four ones. Milling and waste dump were only two locations in past but now the destinations of mined materials have developed because of mentioned reasons. So four destinations are common in open pit mines: Mill or crusher; Stockpile; Waste dump and Leach dump.

Figure 1 shows a schematic of this subject. These locations are effective on the road location in the pit wall.

LOCATION THEORY AND MINING PROBLEM FORMULATION

Consider 1,2,…,m presented facilities in different points $P_1, P_2, \ldots, P_m$. New facility must be located in X point. Transportation costs have direct proportion with distance between new facility and old existent facilities.

Assume that $d(X, P_i)$ is the transported distance between X and P_i and w_i is the result of multiplying transportation cost