SELECTION OF APPROPRIATE METHOD FOR EXTRACTION OF BUILDING STONES USING LINEAR ASSIGNMENT TECHNIQUE

Mohammad Hayati 1, Reza Baghbani 2, Reza Rajabzadeh 3

1 Assistant Professor, Department of Mining, Faculty of Engineering, Lorestan University, Khorramabad, Iran; 2, 3 Mining Engineering Graduate Student, Lorestan University, Khorramabad (IRAN)

*Corresponding author: Mohammad_Hayaty@yahoo.com

DOI: 10.7813/jmt.2015/6-1/76

Received: 04 Feb, 2015
Accepted: 05 Mar, 2015

ABSTRACT

Choosing the appropriate method for mining is of particular importance because if a suitable extraction method is not selected, several difficulties arise in mining operations, additional costs will be imposed on the project and the quality and quantity of the mineral products may be reduced. Several methods have been developed for extraction of decorative and facade stones. Advancement of technology and the use of machinery have abolished primary methods in which human resources somehow played a significant role. Choosing the right method from among the available methods is a multi-criteria decision-making problem in which the criteria must be first identified and then the appropriate method should be selected according to these criteria. In this paper, conventional methods for extraction of building stone, including diamond wire saw, blasting, barking and wedge as well as expansive chemical materials (Katrock & Fract) were analyzed using linear assessment method according to various criteria such as increased gross profit, safety, quality and reduction of the adverse environmental effects, waste, productivity, block size, topography of mine, energy consumption (electricity and water) and finally reduced extraction time. In conclusion, the diamond wire saw method was proposed as the most suitable alternative for extraction of building stones.

Key words: Extraction Method, Building Stone, MCDM, Linear Assignment Method

1. INTRODUCTION

Nowadays, building stones play an important role in the field of non-oil exports and mineral source revenues. Iran is in second rank as regards the quarries but is in the first place in terms of beauty and diversity of colored stones; therefore, it is important to pay due attention to this section of mining activities [1]. Several methods have been used for the extraction of building stones. The conventional methods used in extraction of these stones in the majority of Iranian mines include barking and wedge, diamond wire saw, blasting (using weak explosives) as well as expansive chemical materials (Katrock & Fract). As each mining method has a number of advantages and disadvantages over other methods, it is not possible to choose the more appropriate method by only relying on engineering judgment without using a scientific and efficient approach. The use of multi-criteria decision-making (MCDM) methods is therefore helpful in this respect. In this context, a range of criteria including gross profit, quality, safety and so forth should be considered for selection of an appropriate extraction method, and each method should be evaluated relative to these criteria. In this paper, we introduce each of the considered methods, assess the effective standards for extraction of building stone for each method and finally suggest the best alternative (extraction method) using linear assignment. Review of literature suggests that a number of multi-criteria decision-making methods such as analytical hierarchy process (AHP) and technique for order-preference by similarity to ideal solution (TOPSIS), etc. have been used by themselves or combined with fuzzy logic to select the appropriate alternative (such as proper mining method, transport, loading-trucking, proper drilling, suitable location, good maintenance system, etc.) in problems related to mining, tunneling and underground spaces [2-12]. However, so far no research has been conducted for selection of suitable extraction method using linear assignment approach.

2. QUARRY MINING METHODS (EXTRACTION OF BUILDING STONES)

There is a variety of methods to isolate stone blocks from mountains. Barking and wedge, diamond wire saw, blasting and expansive chemical materials (Katrock & Fract) are common methods for extraction of building stones in the majority of quarries in Iran [1]. Below we briefly explain each of these methods.

2.1. Barking and wedge method

Barking and wedge method is among the oldest methods applied to extract the stone blocks. In this method, first a number of holes are drilled along the line where the crack or cut is to be dug. Diameter, number and depth of holes depends on the variety and type of rock. The closer and deeper the holes, the more comfortable and easier the separation of stone blocks. After digging the holes, first barking and then the wedge is placed inside them. After the impact of hammer blows on wedges, the desired crack is created in the stone, and the stone blocks are separated with the expansion of these cracks [1].

2.2. Blasting method

In block extraction method by blasting, vertical and horizontal holes are first drilled in specific intervals. Using special explosives and explosive fuses, blasting is done and the block is separated from stone bulk. The main difference between blasting in quarries and normal blasting procedures is that the stone should be left cracked and loose, and the crack should only be created in the desired direction and the surrounding stones should be left intact. Fine dynamite is the most suitable explosive material produced in Iran, which is used in this procedure with a weaker explosive power relative to ordinary dynamos [13].