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DIMENSION-STONE QUARRYING OPTIMIZATION THROUGH INTERGRATED MODELLING BETWEEN JOINT SETS AND CUTTING GRID: A CASE STUDY AT TAN LONG DIMENSION STONE QUARRY IN SOUTHCENTRAL COASTAL PROVINCE OF BINH DINH

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1. Introduction

Dimension stone is a natural stone made from intact rock groups of magma, sedimentataion, metamorphism without discontinuities and it is quarried and processed to various sizes, shapes, colours and polishes. In stone, there are more joints causing it more difficult to recover more intact blocks. This makes low effectiveness in mining operation due to low recovery ratio and hight cutting rate of dimension stone. Collection on joints in stone has been interested in exploration and extraction stages but there are no applications of the collection into optimizing quarrying operation to impove the mining effectiveness. Recovering blocks in mining operation is significantly important because it also influences to the following stages as processing activities and quarrying technology and processing technology selections suitable with joint sets to increase the recovery ratio and the low cost. Selecting block size and mining direction are dramatically important because they decide the recovery ratio, the mining cost and mining and processing technologies from joint sets at quarries

There have not been papers on optimizing dimension stone quarrying through block size and mining direction to increase the recovery ratio and to reduce the cutting rate. Thereofore, the study begins with ranging block sizes from joint sets, cutting area, mining equipment and processing machines. After that, the paper establishes an integrated modelling by combinating joint set modelling with cutting grid modelling. An optimal block size which has the highest recovery ratio and the lowest cutting rate will be selected. The paper did experiment at Tan Long dimension stone quarry in Binh Dinh province, contributing to selecting an optimal block size and specific mining direction for the quarry

2. Method

In dimension-stone extraction, determining recovered block sizes and mining directions is significantly important to suit to the joint network so that the recovery ratio of intact blocks could get the highest as well as the cutting cost reduces to the lowest level. Therefore, it is necessary to considerabout block-size optimization so that the lateral cutting area will be the smallest and the size will be suitable for cutting machines, processing machines and market-required products. The flow chart to determine the most suitable block size is represented in Fig. 1.

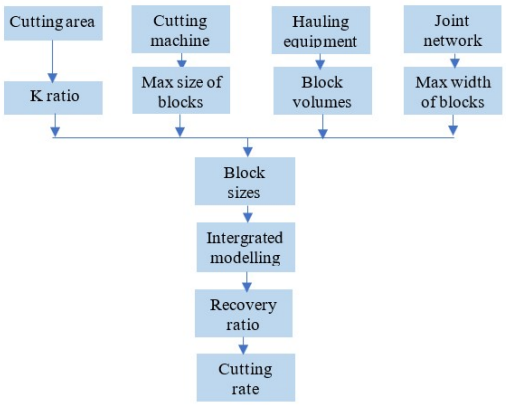

Fig 1. Flow chart to calculate suitable size for dimension stone

3. Case study

The study was carried out at Tan Long dimension stone quarry in Southcentral coastal province of Binh Dinh.

Joints was included into three major joint sets with the dip direction and the dip of $70^0 \angle 80^0$, $190^0 \angle 80^0$ và $35^0 \angle 80^0$, respectively. .

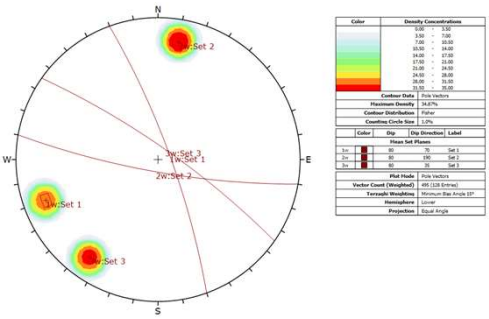

Fig .2. Analysizing and representing joint sets for Tan Long dimension stone quarry in Binh Dinh Province

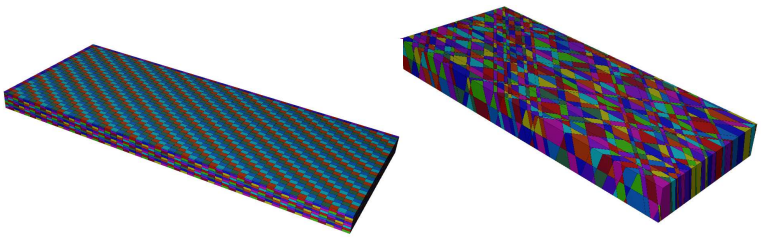

Fig. 3. Three-dimensional joint sets modelling and cutting-grid modelling for Tan Long dimension stone quarry, Binh Dinh Province.

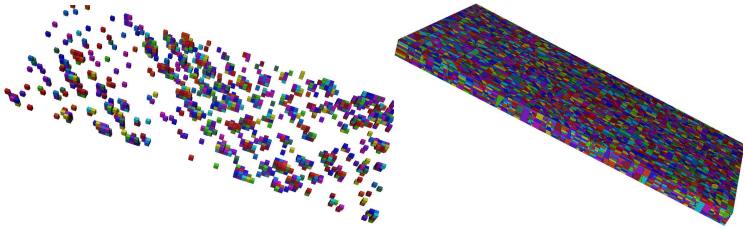

Fig. 4. Three-dimensional integrated modelling and after applying filter algorithm for intact block at Tan Long dimension stone quarry, Binh Dinh Province.

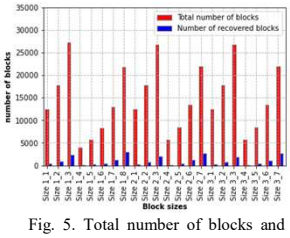

Fig. 5. Total number of blocks and recovered blocks for each block size.

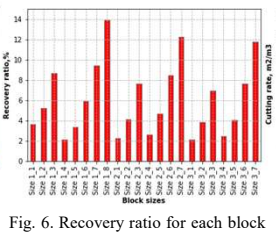

Fig. 6. Recovery ratio for each block size.

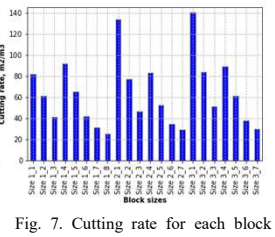

Fig. 7. Cutting rate for each block size

4. Conclusions

- Integrated modellings selected play an important role in calculating the volume and the size of minable blocks because the modelling is interested in dips, dip directions, spacings of joints and cutting grids.
- Optimizing block size plays an important role in decreasing block-cutting area. Optimization size is square, but short edge being more than 80 percent of long edge still ensures and suits with cutting machines. Minable-block size has a significant meaning in calculating recovery ratio, depending on joint-set parameters. The optimizing size in cutting grid must ensure the highest recovery ratio and the lowest cutting rate.
- Mining direction for dimension stone is hozirontal length of block size chosen to parallel to one of the strikes of joint sets.