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APPLICATION OF TOMOGRAPHICS METHODS FOR DETERMINATION OF THE ZONES OF WEAKNESS BY ELASTIC WAWES

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ABSTRACT

At present the development of knowledge about rockmass is based on using the newest result of fundamental and applied research. Tomographic methods belongs to rapidly developing directions in the area of geophysical data processing. Seismic tomography enable us to evaluate the internal areas of investigated rock massif by using impulsed dynamic methods.

INTRODUCTION

The rock massif represents from the geological point of view very complicated anizotropic area divided by fractures of different size. From this reason, the most important characteristic of rock massif, which influences on rock resistance against its blast disintegration is fracturing. At present there is no generally accepted method of evaluation of fracturing of rock massif.

The evaluation of rock massif is usually conducted visually on the basis of the amount of fractures per unit area. This method has serious disadvantages which cause the mistakes in evaluation of zones of fractured of investigated rock massif.

Seismic and ultrasonic methods are very perspective in the determination of fracturing of rock massif. There are known two wide - spread methods of the rockmass evaluation by using direct waves and the profiling by using refracted and reflected waves. In both cases the results consist from the average value representing the state of area as the whole. The application of computers in seismic and ultrasonic signals processing enables increasing of abilities of this methods in the process of the rockmass evaluation. At present the method of seismic tomography is being introduced in geophysical research. It is based on registration and processing of large amount of data measured in investigated area. Tomography simply means a technique used to obtain an image of a selected plane section of solid objects. By this way it is possible to determine the area of increasid occurence of fractures, their dimension, as well as direction in the area of interest (1).

EXPERIMENTAL PROCEDURE AND DATA ANALYSIS

The method of internal disturbances of rockmass evaluation has been made in laboratory of Technical University Kosice, Department of Extraction of Mineral Deposits and Geotechnics (2,3). It is based on utilizing of tomographic methods of data processing.

Tests were conducted on the granite block with dimensions of 1000 x 1000 x 1000 mm. This modelling block was undergone to blasting. Guns were orientid in the way that the disturbances of models block were created gradually. Measurements were made by ultrasonic instrument Material Tester Model 543 with freguency of 100 kHz. In respect to possibilities in situ conditions, we carried out the measurements by proffiling method, rays-transmission method, and tomography.

In first two methods we divided the walls of the modelling block by sguared grid with the dimension of 50 mm. We made measuremens by transmission of rays through individual grid sguares (fig.1).

We carried out all these measurements before each blasting. By this way it is possible to compare which of used methods better indicates increasing block disturbances. The results were processed by using PC AT 386 computer. In fig.2 (on the left) we can see the results obtained by ray-transmision method where is illustrated the side wall of the undisturbed modelling block and on the right, the top wall of the same block obtained by profiling. Results reached implies that by ray-transmision method we can indicate microfissures which are in fig.2 illustrated by the value of 1. After the blasting the modellig block was remesuared by both methods. In fig. 3 (on the left) we can see the zone of fracturing after the seventh blasting. It is illustrated by values 1,2,3,...,13 where the greatest value represents the greatest amount of fissures and fractures. In the same figure (on the right) we can see the top side of modelling block where the burn cut occurred and it was reflectid on the change of isolines. In fig.4 the top side of the modelling block after the seventh blasting obtained by tomographic method is illustrated. The way of measurements is illustrated on the scheme (fig.5). There were 20 receivers on the top wall and 10 emitters on the side wall.

Result reached by these experiments imply the convenience of using of individual methods. Tomographic method with using of computer data processing indicated with sufficient precision the zones of fracturing of the modeling block. From the measured values it is possible precisely determine the zone of fracturing inside the modelling block after the individual blasting. The profiling method also indicated increasing fracturing but its application for in situ measurements is less suitable.

On the basis of results obtained from the laboratory test the in situ method of determination of fractured zone of the rock massif has been developed. It was based on tomographic procedures. The seismic instrument Bison Model 1580 has been used. The investigated part of the rock massif has been divided on sections as it is illustrated in fig.6. The arrangement of measured points dependeds on given possibilities of the area of interest. The length of seismic profile was 42 m with 2 m geophones spacing. The profile was placed in the distance of 4 m from the crown of the guarry wall in supposed place of the first hole row. The source of the seismic waving was a hammer strike on the least broken part of the massif, gradually on 7 places in mutual distance of 6 m. The strikes were directed in the direction of the seismic profile and were repeated several times at one measurement to gain reguired intensity of the wave field. The evaluated area was in the shape of rectangle with dimensions 36 x 29 m where the first datum is the lengh and the second one is the hight of the evalueted part of the guary wall. The seismic profile was 42 m long and that was the reason to make the results in boundary part of the rectangle more accurate. The results of the measurement were processed in program SEISTOMO (4). At the calculation for each cell values of all seismic rays intersecting given cell are taken into consideration. The fracturing of the guarry wall is expressed by the average velocity of seismic waves propagation in given cell. The graphic output from this calculation is color map showing, by the help of various colours, the spacing of the broken guarry wall in the cross section (fig.8). Another output is the histogram of frequency of velocity for individual clasees.

From this histogram as well as from the previous map it is possible to evaluate preliminary quality of the rock in the section. On the purpose of the simplification of the picture analysis it is necesarry to give boundary values for both nonfractured and fractured rocks. Later we will get maps showing the distribution of nonfractured and fractured parts of the rock massif.

CONCLUSION

Results reached by using of tomographic procedures conducted on both the modelling block and in situ show that it is possible to determine the fractured zones for the purpose of projecting and optimilization of the guarry blasting. Tomographic methods of the seismic data processing enable higher effectiveness of the rock massif research. The use of tomographic procedures guarantees not only the operative solution of practical tasks but also enable to clear the unknown rules about rock massif.

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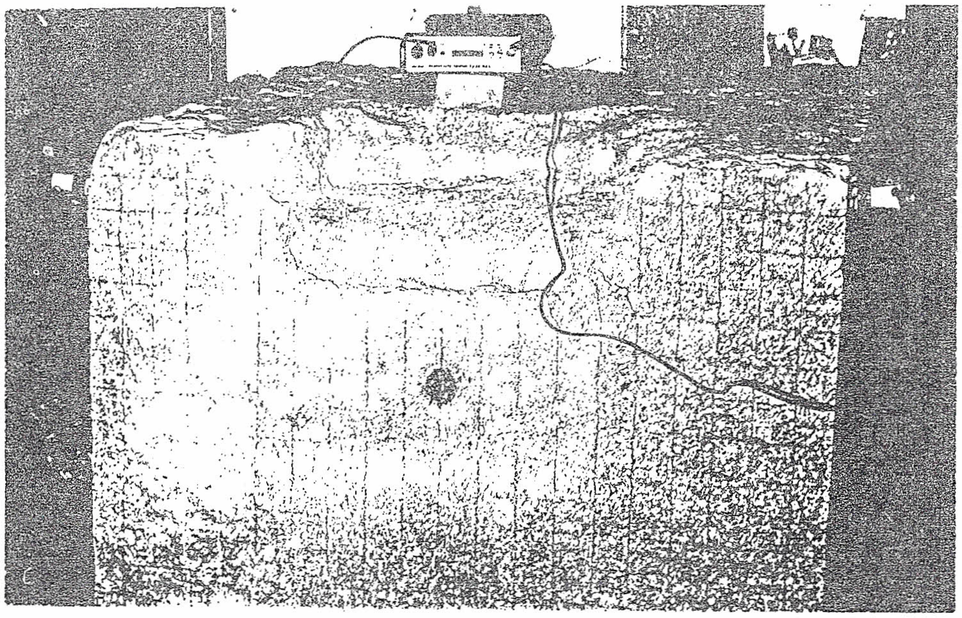

Fig. 1 Measuring of block fracturing by transmission of rays

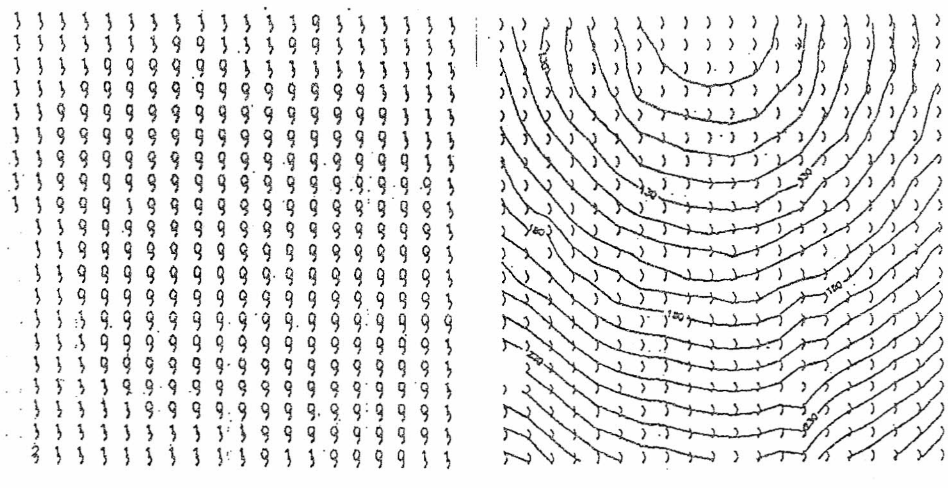

Fig. 2 Results of modelling block fracturing obtained by computers; by transmission of rays (on the left) by profiling method (on the right)

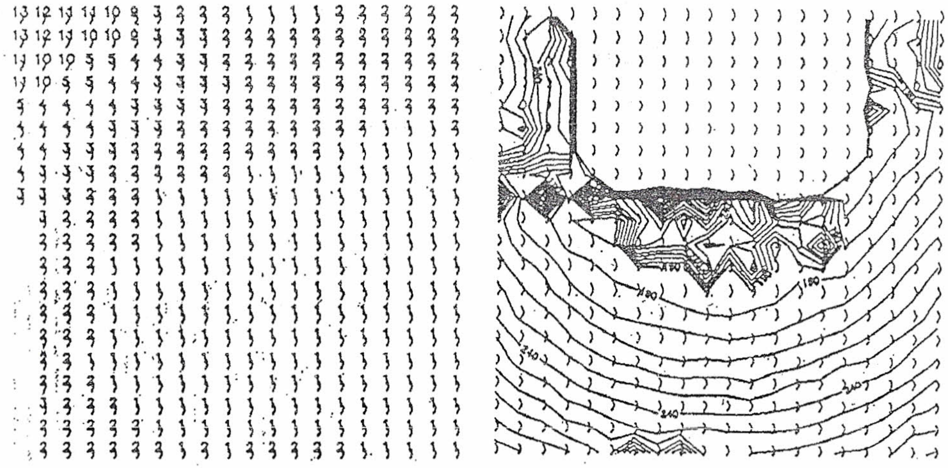

Fig. 3 Results of fractured zoned obtained by computers after seventh blasting

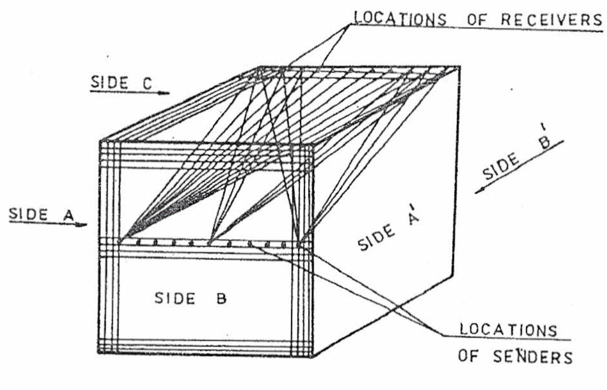

Fig. 4 Results of fractured zones obtained by tomography

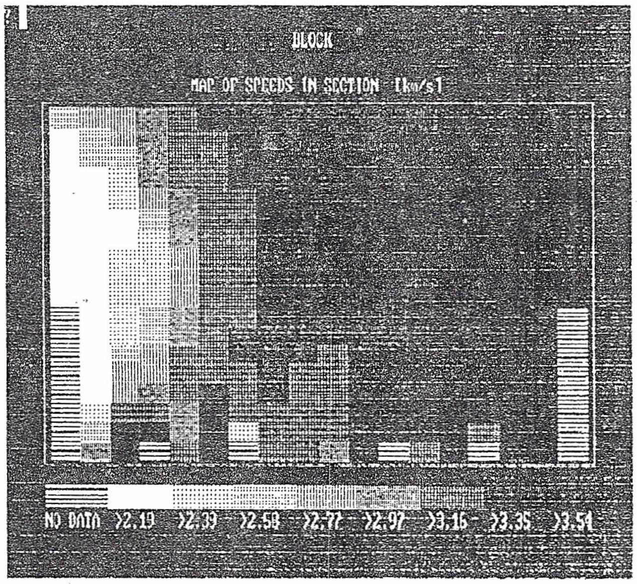

Fig. 5 Measurement scheme for tomographic method on the modelling block

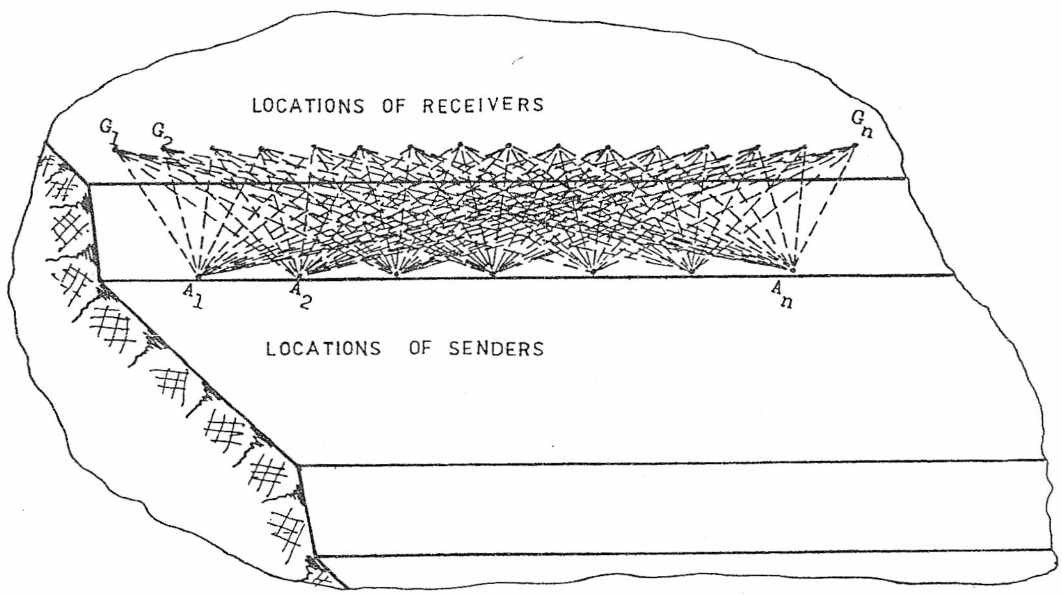

Fig. 6 Scheme for in situ measurements based on seismic tomography

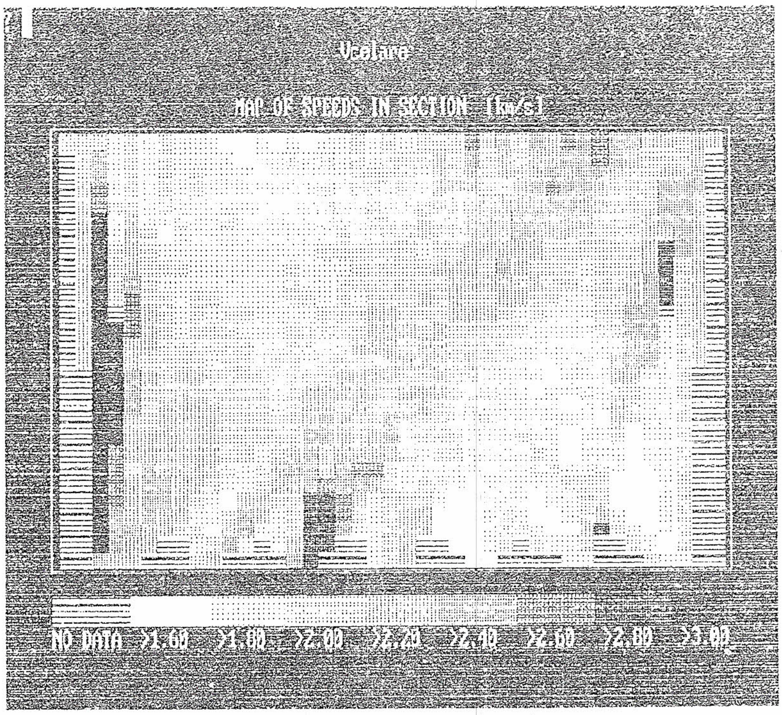

Fig. 7 Results reached in limestone opencast quarry by seismic tomography

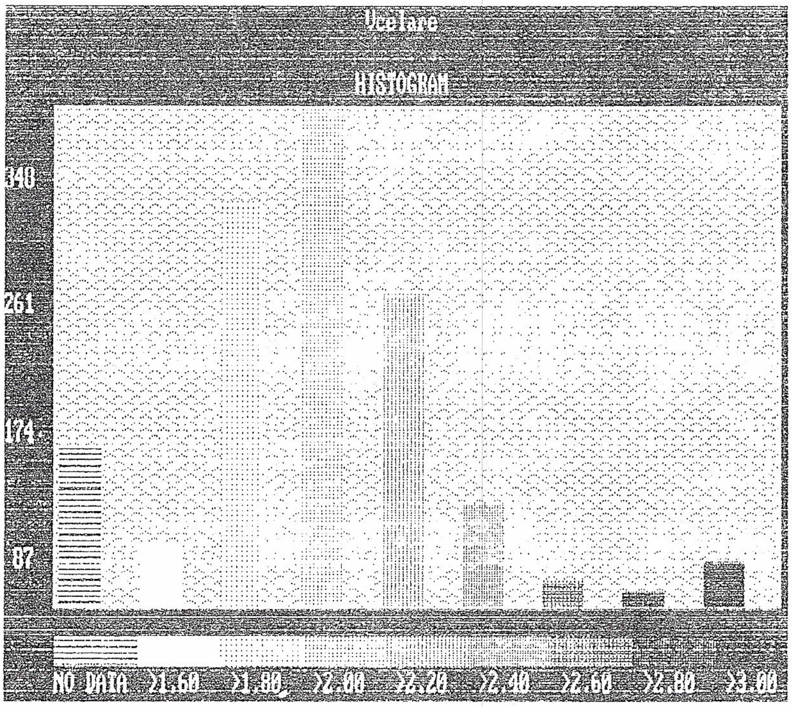

Fig. 8 Velocity frequency histogram