EFFECT OF JOINT OPENING ON P-WAVE VELOCITY MEASUREMENT IN ANDESITE ROCK SAMPLES

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Strength of rock mass is greatly affected by the presence of fractures and joints. The rock discontinuities are usually generated during the rock formation where the rock undergone the process of folding and faulting. Joint opening is one of many characters of joint system that directly influences the rock mass strength. Among many methods which can be employed to detect the rock mass strength regarding the joint opening is the ultrasonic wave test. Ultrasonic techniques have been used for many years in geotechnical engineering and mining science. They are employed in the field for geophysical investigations and in the laboratory for the determination of the dynamic properties of rocks (Kahraman, 2002). The method has the advantage to be a non-destructive and very easy to be used in the field and in the laboratory. The derived results can be analysed to evaluate the rock mass strength as well as to determine the dynamic properties of rock mass.

The aim of this study is to enhance the knowledge of p-wave propagation in fractured rocks regarding the joint opening. The result then can be used for interpretation the extent of wave propagation of a rock mass in real dimension of the field. For this purpose, a number of subsurface core samples of Andesite rock from different locations of a dam site project were selected and the petrophysical properties of the sample are determined using various geological measures. The sound samples firstly undergone the ultrasonic wave test measuring the p-wave velocity. Then artificial opening fractures were made in the sample in the direction perpendicular to their axial axis. The dimensions of opening were 0.1, 0.3, 0.5, 1.0, 2.0, 3.0, 5.0, 10, 20, and 30 millimetres. The results of the ultrasonic test which were conducted according to ASTM D 2845-00 (ASTMA 2000), are presented on Table 1.

Table 1. Some data of P-wave velocity measurements

samples (set)	Opening (mm)	No Joint	0	0.1	0.3	0.5	1	2	3	5	10	20	30
1	Vp(m/s)	4278	3960	3872	3875	3913	3268	2786	2465	2425	2181	2152	1876
2		5073	4733	4226	3357	2276	2172	2100	2100	2093	1856	1821	1773
3		5239	4936	4768	4654	4623	4563	4358	2489	2265	1925	1922	1850
4		5235	4791	4379	4354	3692	3655	2919	2240	2192	2009	1761	1505
5		5418	5138	5094	5094	5080	5028	4287	3643	3563	2348	2168	1852

The plots of the test results using statically analysis are shown on Figure 1. The results indicate that the fracture opening directly influence the p-wave velocity and velocity reduction ratio (VRR%)[1]. The results showed that the wave velocity trends for apertures smaller than 5mm were sharper than those of larger apertures. The value of "R^2" indicated that the quadratic ($y = -0.0861x^2 + 4.076x + 9.0336$) and linear ($y = 1.6989x + 13.301$) models were the best fit among the regression models.

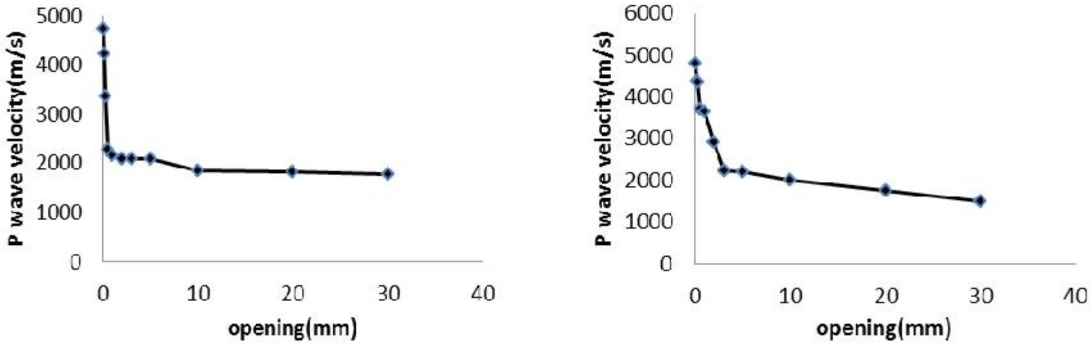

Figure 1. P-wave velocity vs. opening of 2 sets

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1) $VRR\% = \frac{V0 - V1}{V0} \times 100$