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Dušan Tašić[*], *Dragan Ignjatović*[*], *Lidija Đurđevac Ignjatović*[*]

DETERMINING THE STRENGTH INDEX OF COAL FROM THE BROD – GNEOTINO DEPOSIT, BITOLA

Abstract

The Point Load Test (PLT) was performed in the geomechanical laboratory of of the MMI Bor, in order to determine the strength index of coal samples from the Brod - Gneotino, Bitola, Republic of Macedonia. On the basis of the obtained results, it is possible to predict the other parameters of the rock mass strength. This paper presents the values of the calculated uniaxial compression strength of coal.

Keywords: *Point Load Test, strength index, coal*

INTRODUCTION

The PLT test represents the fastest and cheapest way to determine the uniaxial compression strength of rocks, primarily in the field, but also in the laboratory conditions. It is possible to examine the samples of irregular shapes, as well as samples selected from the exploration drill holes. Test is carried out by an appropriate apparatus that performs a load on a rock sample, placed between the conical steel plates, until fracture appeared.

The tests were carried out on six coal samples from the core of exploratory drill holes from the site where the PLT tests were performed, according to ASTM D5731-08 standard.

TEST ANALYSIS AND RESULTS

For precise and efficient obtaining of the strength index, coal samples were previously processed and prepared for test on the PLT device (Figure 1). The axial and diametric tests were performed on samples, i.e. the tested strength was normal ($\perp$) and parallel ($\parallel$) on a bedding.

After the test were performed, the uncorrected value of the strength index Is is calculated according to the formula:

$$I_s = P/D_e^2 \text{ (MPa)}$$

where:

P – breaking force [kPa]

D_e – equivalent diameter of core [mm]

$D_e^2 = D^2$ – for diametrical test [mm^2]

$D_e^2 = 4A/\pi$ – for axial test [mm^2]

After that, the corrected values of strength index for $I_{s(50)}$ were calculated, according to the formula:

$$I_{s(50)} = F \times I_s$$

where:

$F = (D_e/50)^{0.45}$ – correction factor

[*] *Mining and Metallurgy Institute Bor, Zeleni bulevar 35, 19210 Bor, Serbia*

Figure 1 *PLT device with prepared samples*

For the conversion factor of strength index in the uniaxial compressive strength, the value of

$K= 21$ ($\sigma_p = K \times I_{s(50)}$)

was taken, which represents a nominal value for this rock type.

Test results are presented in following tables and figures.

Table 1 *Values for index and UCS for sample 9/V_1 (85.20-86.55)*

N^o	Test direction	I_s [MPa]	$I_{s(50)}$ [MPa]	σ_p [MPa]
1	⊥	0.235	0.239	5.023
2	⊥	0.152	0.156	3.277
3	⊥	0.493	0.497	10.445
4	⊥	0.414	0.406	8.535
5	‖	0.112	0.141	2.970
6	‖	0.122	0.154	3.23
7	‖	0.108	0.136	2.864
average value ⊥			0.325	6.05
average value ‖			0.143	3.02

Table 2 *Values for index and UCS for sample 9_1/V_1 (111.05-117.90)*

N^o	Test direction	I_s [MPa]	$I_{s(50)}$ [MPa]	σ_p [MPa]
1	⊥	0.323	0.320	6.727
2	⊥	0.241	0.249	5.239
3	⊥	0.428	0.439	9.227
4	⊥	0.333	0.339	7.118
5	‖	0.105	0.132	2.792
6	‖	0.118	0.149	3.127
7	‖	0.146	0.184	3.869
average value ⊥			0.370	7.070
average value ‖			0.155	3.262

Table 3 *Values for index and UCS for sample 7_1/VI (64.60-67.00)*

N°	Test direction	I_s [MPa]	$I_{s(50)}$ [MPa]	σ_p [MPa]
1	⊥	0.459	0.483	9.725
2	⊥	0.327	0.313	6.592
3	⊥	0.517	0.512	10.789
4	⊥	0.740	0.753	15.816
5	⊥	0.537	0.527	11.072
6	||	0.255	0.321	6.758
7	||	0.208	0.262	5.512
average value ⊥			0.517	10.78
average value ||			0.262	6.135

Table 4 *Values for index and UCS for sample 7_1/VII (85.25-86.80)*

N°	Test direction	I_s [MPa]	$I_{s(50)}$ [MPa]	σ_p [MPa]
1	⊥	0.597	0.595	12.513
2	⊥	1.074	1.044	21.935
3	⊥	0.240	0.244	5.130
4	||	0.007	0.009	0.189
5	||	0.007	0.009	0.189
6	||	0.007	0.009	0.189
average value ⊥			0.627	13.19
average value ||			0.009	0.189

Table 5 *Values for index and UCS for sample 7_1/VII (94.60-96.20)*

N°	Test direction	I_s [MPa]	$I_{s(50)}$ [MPa]	σ_p [MPa]
1	⊥	0.297	0.304	6.40
2	⊥	0.624	0.618	12.985
3	⊥	0.448	0.446	9.576
4	||	0.014	0.017	0.353
5	||	0.010	0.012	0.265
6	||	0.012	0.015	0.318
average value ⊥			0.456	9.653
average value ||			0.014	0.312

Table 6 *Values for index and UCS for sample 8/VII_1 (55.50-58.25)*

N°	Test direction	I_s [MPa]	$I_{s(50)}$ [MPa]	σ_p [MPa]
1	⊥	0.693	0.625	13.13
2	⊥	1.042	0.021	21.44
3	⊥	0.829	0.895	18.80
4	||	0.007	0.009	0.189
5	||	0.007	0.009	0.189
6	||	0.007	0.009	0.189
average value ⊥			0.514	17.79
average value ||			0.009	0.189

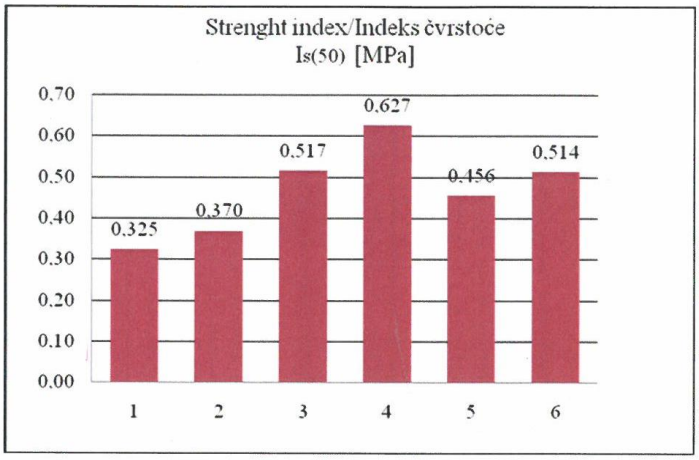

Figure 2 *Average values $I_{s(50)}$ of coal samples – tests were carried out normal on bedding*

The strength index of tested coal samples, ranges from $I_{s(50)}$ = 0.325-0.627 MPa, measured normally on a bedding, i.e. $I_{s(50)}$ = 0.009-0.155 MPa for measurements performed parallel to a bedding. The values of the obtained index strength of performed PLT and calculated value of the uniaxial compression strength for coal are mainly found in the range of previous laboratory results of testing the strength of coal in the area of this deposit showing that similar geomechanical parameters of the rock mass are obtained using a much cheaper method of determining. The results can be used in further assessment the parameters and classification the wall mass.

CONCLUSION

In the framework of geomechanical testing the coal samples from the Brod - Gneotino Bitola, determining the strength parameters using the PLT apparatus was carried out. The results of the obtained index strength are the values that can be used to estimate the intact strength of coal, as well as the other parameters for numerical geotechnical classification of the wall mass.

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