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Geomechanical Stability of Slopes of the Surface Coal Mines of the Main

Idaver Huseini[1,*], Nexhmi Krasniqi[3], Jonuz Memeti[3], Asan Idrizi[2],

[1]*Faculty of Applied Science, State University of Tetovo, Macedonia;* [2]*Faculty of Natural Sciences and Mathematics, State University of Tetovo, Macedonia;* [3]*KEK, Prishtinë, KOSOVË*

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Abstract: The subject of this paper is the analysis of the geo-mechanical stability of slopes of the surface coal mines of the main geometry factors. Its main purpose is to define the interaction between the geological environment and the engineering activity. Therefore, in solving this problem all available documents from the previous researches and examinations for obtaining more credible and relevant data are used. Because of the above mentioned, the thesis shall obtain the following analyses: Description of the existing situation from geological aspect; Application of various numeric and graphical methods; Selection of most optimal geomethric parameters and stability analysis; In general, various methods are used for slope stability analysis. They can roughly be divided into two groups, such as: Border balance methods. In general, the slope stability analysis consists of the following components: Safety Factor Fs; Slope – Geometrical properties; Physical-mechanical properties of tested soil materials; Groundwater. The stability calculation shall be conducted by various methods with the software packages GGU Stability (BISHOP, JANBU). Discovering the right measure and the exact ratio between the advantage and the limitations of a given method is possible only through appropriate methodological approach, where aspects relevant to specific problems in geotechnical engineering shall be analyzed. Following significant results occurred from the work on this doctoral dissertation: 1) Analysis and sensitivity evaluation of the safety factor in the change of the values of certain geo-mechanical parameters. 2) Critical review of the selection of methods for geo-mechanical stability analysis;

Key-words: general bench slope inclination, stability calculation methods, safety factor.

Introduction

General Data For The Investigation Site "Oslomej

The investigation site Surface Mine SM "Oslomej" with the previous designing and investigational works, is divided in two areas: - SM "Oslomej - East" where the coal is completely exploited; SM "Oslomej – West" which is in the phase of regular exploitation.Đukić (1984): " Tuzla, Bosna

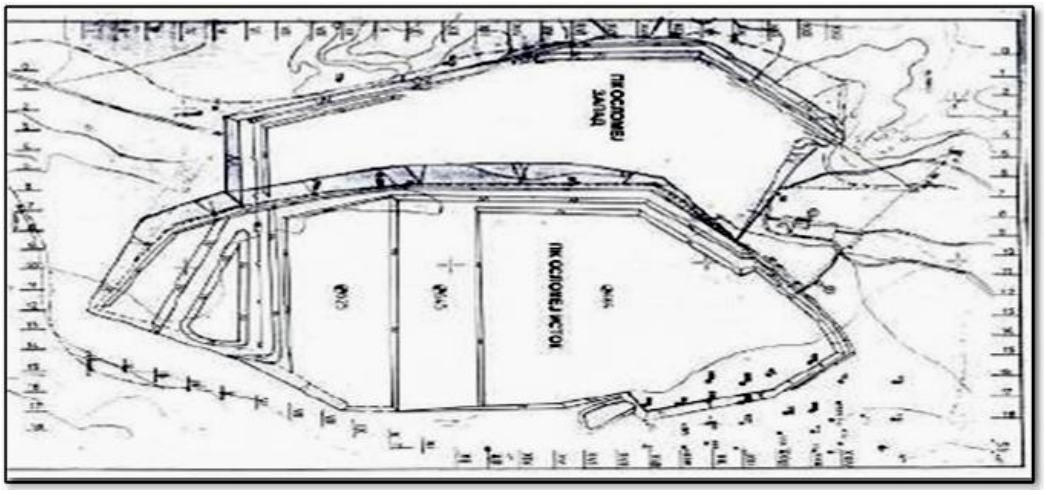

Figure 1. SM "Oslomej East" and "Oslomej West"

Methodology, type and size of the performed hydrological and engineering – geological investigations and testing.Gojković (2008) "Beograd, Srbija.

[*]*Corresponding: E-Mail: idaver_edi@yahoo.com; Mr.eng_edi@hotmail.com.; Tel: 0038970830711*

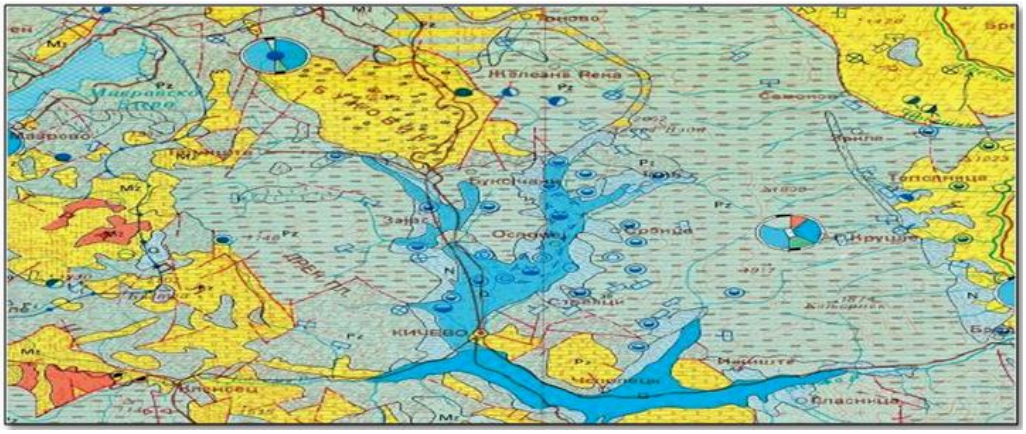

Figure 2. Hydrogeological map if the Kicevo ravine

Geo-mechanical parameter values of the materials.

The conclusion is indisputable for the choice of the geo-mechanical parameter values of the materials as one of the most complex and most sensitive tasks during stability analysis. Therefore during the solvation of this problem, all the disposable layers are used up to the current investigations and testing in order to obtain the most relevant data, and the adopted geo-mechanical parameters are shown in the Table 1.

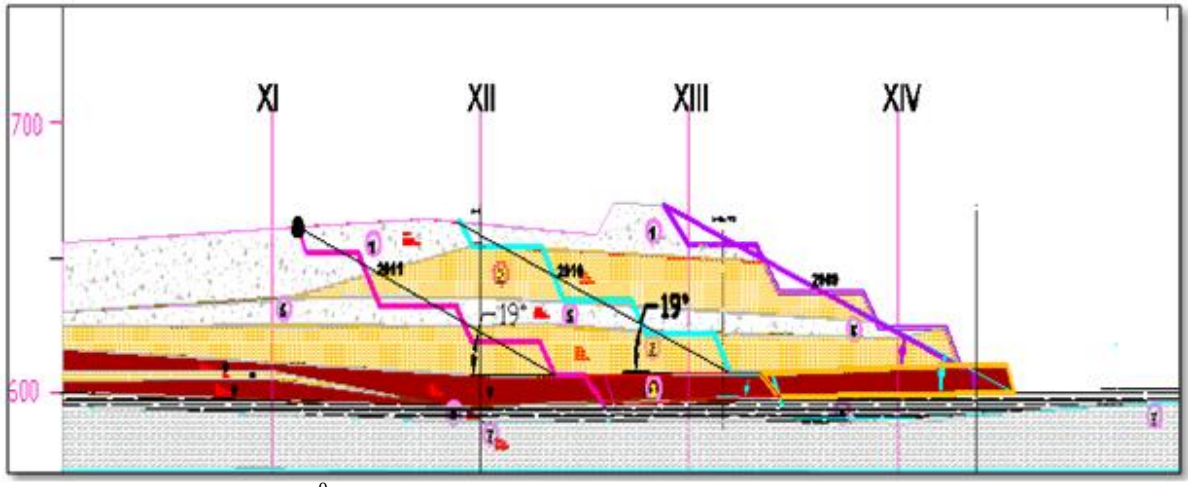

Figure 3. profile 4-4' ($\beta=19^0$)

Table 1. Adopted geo-mechanical parameters for the profile 4-4'

Item number	Material Description	Geo-mechanical Tag	c (kPa)	φ (°)	γ (kN/m^3)	r_u
1	Quarter	SFc/GW	10.00	16.70	20.40	0.00 0.20 0.30
2	Organic, medium to high plastic clay	OH/OI	10.00	16.40	17.00	0.00 0.20 0.30
3	Coal	L	50	25	13.5	0.00
5	In-clayed sands	SFc	20.37	21.71	21.41	0.00 0.20 0.30
7	Medium plastic clay	CI	18.00	18.00	19.90	0.00
8	Coal with coal clay	L/OH	20.00	17.80	17.90	0.00

Method applied for stability of the analysis

The geo-mechanical analyses for the stability are made taking into consideration the weight and the specifics of the stability problem. The calculation of the stability is made according to the methods of Bishop,Yanbu in the software packages GGU Stability.

Table2 β=19°,Stability analyses for the profile 4-4' (in the year of 2011)

4-4'2011	ru=0		ru=0,20		ru=0,30		ru=0	ru=0,20	ru=0,20
	Bishop	Janbu	Bishop	Janbu	Bishop	Janbu	J/B	J/B	J/B
1	0.97	0.99	0.8	0.8	0.71	0.71	1.020619	1	1
2	1.22	1.22	0.98	0.99	0.87	0.88	1	1.010204	1.011494
3	1.34	1.42	1.13	1.24	1.02	1.15	1.059701	1.097345	1.127451
4	1.44	1.46	1.36	1.33	1.31	1.26	1.013889	0.977941	0.961832

Table 3 Difference between the achieved Fs for the sliding surfaces according to Bishop and Yanbu depending on the ru for the profile 4-4' for the year of 2011

$B_{0,2}$-$B_{0,3}$	B_0-$B_{0,3}$	B_0-$B_{0,2}$	$J_{0,2}$-$J_{0,3}$	J_0-$J_{0,3}$	J_0-$J_{0,2}$
0.09	0.26	0.17	0.09	0.28	0.19
0.11	0.35	0.24	0.11	0.34	0.23
0.11	0.32	0.21	0.09	0.27	0.18
0.05	0.13	0.08	0.07	0.20	0.13

Table 4 The ratio between the obtained Fs for defined sliding surfaces according to Bishop and Yanbu depending on the ru for the profile 4-4' for the year of 2011.

$B_{0,2}/B_{0,3}$	$B_0/B_{0,3}$	$B_0/B_{0,2}$	$J_{0,2}/J_{0,3}$	$J_0/J_{0,3}$	$J_0/J_{0,2}$
0.89	0.73	0.82	0.89	0.71	0.80
0.89	0.71	0.80	0.89	0.72	0.81
0.90	0.76	0.84	0.92	0.80	0.87
0.96	0.90	0.94	0.94	0.86	0.91

Impact of the ru and β on the Fs

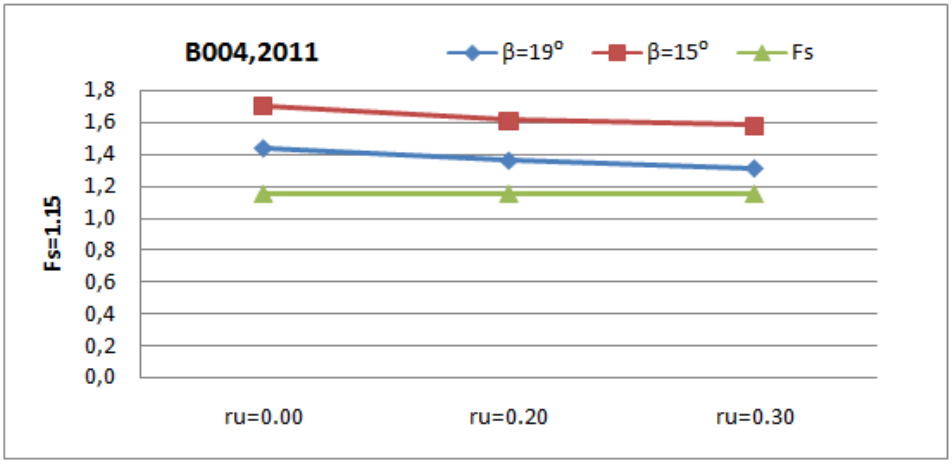

Figure 4. Diagram of the impact of the ru and β on the Fs.

Table 5. Impact of the ru on the (Fs) ; for (β=19o, β=15o) year 2011.

2011,4-4'			2011,4-4'		
Bishop β=19^0			Bishop β=15^0		
condition	ru	F	condition	ru	F
	0.00	0.97		**0.00**	1.74
B001	**0.20**	0.8	B001	**0.20**	1.44
	0.30	0.71		**0.30**	1.24
	0.00	1.22		**0.00**	1.79
B002	**0.20**	0.98	B002	**0.20**	1.46
	0.30	0.87		**0.30**	1.29
	0.00	1.34		**0.00**	1.60
B003	**0.20**	1.13	B003	**0.20**	1.32
	0.30	1.02		**0.30**	1.19
	0.00	1.44		**0.00**	1.70
B004	**0.20**	1.36	B004	**0.20**	1.61
	0.30	1.31		**0.30**	1.58

Table 6. Impact of the β on the (Fs); for sliding surface B003, year of 2011

4-4'-B003	β=15^0	β=16^0	β=17^0	β=18^0	β=19^0	β=20^0	β=21^0
r_u=0.00	1.6	1.53	1.47	1.4	1.34	1.26	1.19
r_u=0.20	1.32	1.27	1.22	1.17	1.13	1.08	1.02
r_u=0.30	1.19	1.14	1.1	1.05	1.02	0.97	0.92
Fs	1.15	1.15	1.15	1.15	1.15	1.15	1.15

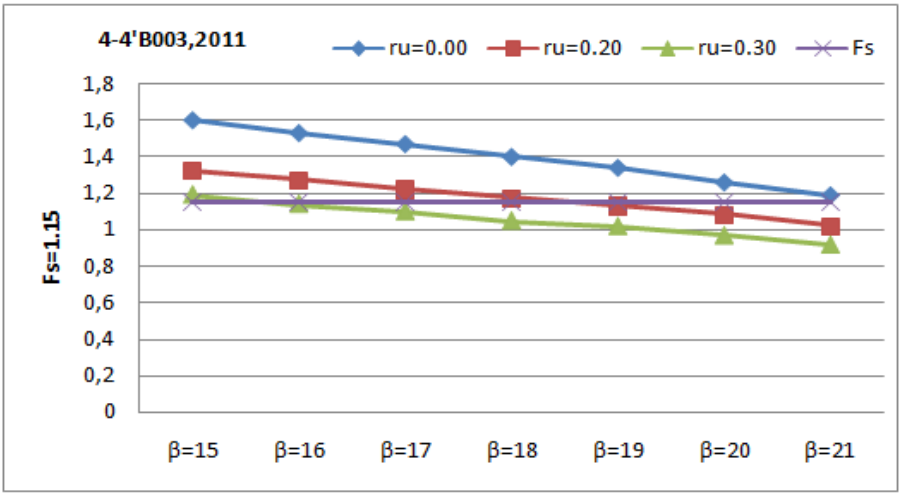

Figure 5. Diagram of the sensitivity of Fs from β and ru in the profile of 4-4′ B003

Establishments, conclusions and recommendations

- The following additional important results are highlighted in this paper:
- Impact of the coefficient of the pore pressure over the stability;
- Analyses and assessment of the sensitivity on the Fs from the change of the angle of the working slope;
- Critical review on the selection of analytic methods of the geo-mechanical stability;

- From the shown tables 3 , 4.from the calculations in GGU Stability, the obtained values from the safety factor according to the method of Yanbu are around 5-15% lower from the ones according to the method of Bishop, for the year of 2011.
- This represents linear declination of the coefficient of safety and that can be observed as well as at the rest of the analyzed sliding surfaces but with different intensity.
- It is established that with increasing the angle of the working slope of the excavation from $\beta=15^0$up to $\beta=19^O$ the financial effect is getting better, but from the other side, the value of the safety factor is decreasing for 10-20% for the profile 4-4′ (in the year of 2011), independent which method is applied.

Recommendations

- The analyses in this paper give the possibilities for many analyses and scientific researches in the future, such as in the fields of the following investigations, the following aspects are recommended:
- Variation of the amount of the input parameters in order to determine the probability amount of Fs (the safety factor).
- Analyses of the seismic aspects

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