



**INFLUENCE OF SOME GEOTECHNICAL PARAMETERS IN DESIGNING AND EXPLOITATION OF THE  
COAL UNDERGROUND SERIES (UCS)  
IN MINE SUVODOL BITOLA**

**Dr.Sci. Risto Dambov, PhD,**

University "Goce Delcev", FPTN, Institute of Mining, Stip, R. Macedonia E-mail:dambov2004@ugd.edu.mk

**Blagoja Gorgievski, MSc.,**

grad. min. eng., REK Suvodol Mine, Bitola, Email:domabt@gmail.com

**Dr. Sci. Orce Spasovski, PhD,**

University "Goce Delcev", FPTN, Institute of Geology, Stip,  
R. Macedonia, E-mail: orce.spasovski@yahoo.com

**ABSTRACT**

*During previous exploitation of the main coal seam in the "Suvodol" mine, several micro locations are defined which because of the specificity of the geo-morphological characteristics, resulted with landslides with different sizes and on more micro locations.*

*The necessity in the process of planning and the technological process of the coal exploitation itself, was imposed, with geotechnical researches to find out the lithological structure of the deposit, and the condition of the underground waters.*

*Also the morphological characteristics and the seismic-dynamic models of the terrain were defined, and with adequate geostatic calculations in the following period it is necessary to define the concrete geotechnical conditions for the further exploitation of coal of this floor seam.*

**Key words:** geomechanics, stability, seismic-dynamic models, coal

**1.0 INTRODUCTION**

During exploitation of the main coal seam in the mine "Suvodol", are defined several micro locations which because of the specificity of the geo-morphological characteristics, resulted with landslides with different sizes. About the under ground coal series (UCS), of importance is the existence of the landslide in the NE part of the excavation site, more exactly in the area of the micro locations 3, 4 and 5. (Fig.1)

The previous conducted methodology of geo-mechanical researched works and laboratory tests is in conformity with the technical regulations and standards. Special accent of these researched works is put on defining of the geo mechanical and hydro geo-logical characteristics of the terrain and that is:

- Physical mechanical characteristics of the lithological members, and by possibility of their contacts too
- Forecasting of possible changes of the characteristics and the condition of the materials, especially those that impact the stability of the operating and final inclinations of the mine of the UCS
- Hydro geological function of all the lithologic members (h.g. collectors, h.g. insulators and h.g. complexes etc)
- Conditions for forming and existence of well waters zones by the structure of porosity, their power, mutual hydraulic relations and connections with the surface waters
- Piezo-metric surfaces and magnitude of pressures in the inter-seams and underground coal parts of the productive series, as one of the most important parameters in the analysis of the inclinations stability, their impact on the possible raising of the leveling instrument of the excavation, penetration of underground waters etc.
- Defining of the filtering characteristics of the represented materials in natural conditions, and also directions and speed of movement of the well water and other types of underground waters.

Knowledge of the above mentioned parameters of all aspects is of special importance because of the fact that it is in question opening and operating of a new mine (Underground Coal Series).

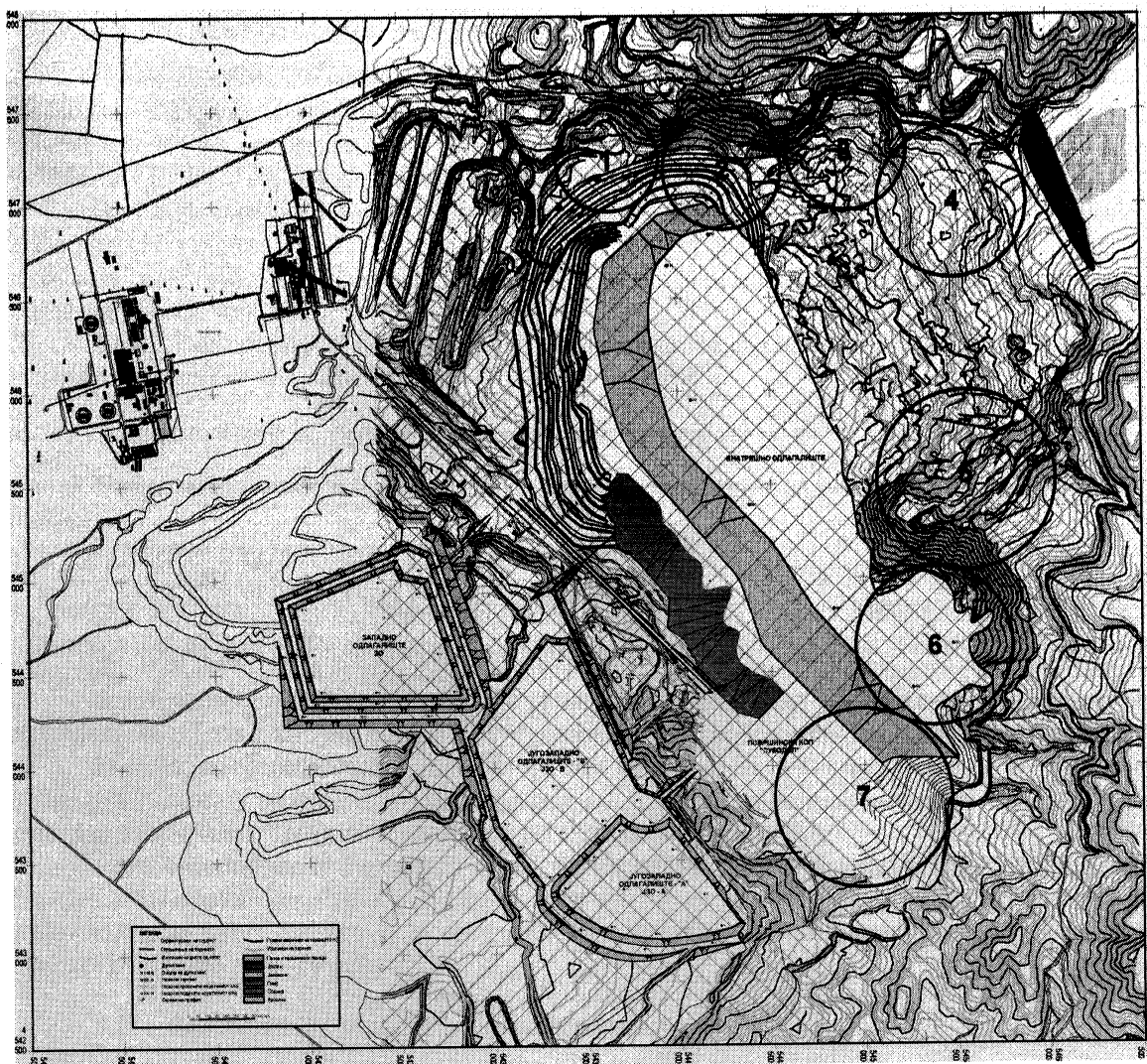


Fig. 1 – Defined micro locations in the contours of the mine “Suvodol”

## 2.0. GENERAL DATA ABOUT THE DEPOSIT

Underground coal series spatially is found in the scope of confined field of the main productive seam, that is already in exploitation in the mine “Suvodol”. In the mine “Suvodol”, continually is performed excavation of coal for the providing of the thermal power plants with coal for undisturbed production of electricity.

The wider area of the UCS, belongs to the end south west part of the hillsides of the Selechka mountain that contact with the Pelagonian valley. In geological sense, the deposit itself is located in the frames of the former Pliocene lake basin (part that is called Suvodol bay), that enters deep in the hillsides of the Selechka mountain. Because of that, the deposit “Suvodol” from the north, east, south and south west side is confined with rocky masses of meta-morph complex. From the geo-morphological aspect, as a noticeable forms in the deposit itself and the close surrounding are outstanding some hillsides mutually confined with horsts, that enter deep into the deposit, i.e. the basin.



### **3.0 PRESENT GEOLOGIC AND ENGINEERING GEOLOGIC PROCESSES AND PHENOMENONS**

Presently (before the opening of the UCS), the zone of the excavation site that is influenced by the researches, characteristic are only the constant current (present) phenomenon and phenomenon that are hereditary during the exploitation of the MCS (major coal series). Of most importance is the existence of the landslide in NE part of the deposit, that with its base is in nearness of the next zone for excavation of the UCS.

Beside the mentioned landslide, presently in the zone of Micro 6 are noticed phenomenon of crevices in the area of the profiles 21 – 25. Their presence is a result of the closeness of the underground horst, so this represents confirmation about the importance of the slope of the paleo-relief for the situation of the stability, that should have in mind during the further activities.

Except these geological processes and phenomenon in the rest part of the zone of UCS, other more important phenomenon are not noticed.

### **4.0 GEOTECHNICAL CONDITIONS FOR EXPLOITATION OF UCS**

Geotechnical conditions that in smaller or bigger measure impact on the process of exploitation of the masses are:

- Conditions for protection of surface waters
- Conditions for protection of underground waters

#### **4.1. Conditions for protection of the surface waters**

Successful solving of the issue of seizing of the surface waters (from the temporary water currents and atmosphere waters), could be much helpful toward improvement of the conditions for excavation in the zone of UCS.

In principle, about the actual zone, for efficient solving of the issue with protection of the surface waters it is necessary application of usual solutions with planned located floor surface canals and flanged protective canals, with purpose to reduce the impact of the atmosphere waters.

About dimensioning of the surface canals, the data about the intensity of the rainfall could be used. Because of the expected depth that would be obtained with the excavation of the UCS, and with that also the great manometer height that should be overcome, the waters that gravitate toward the working excavation blocks of UCS, have to be pre-pumped.

#### **4.2. Conditions for protection of underground waters**

About protection of the impact of the underground waters, indispensable is necessary to have certain parameters connected with the water flow in eventual water intake installations.

From other side, with their performance it would go in contribution of the solving of the problem with reduction of the action of the artesks and sub-artesks pressures, and of course of successful solving of these problems, in great measure would depend the conditions for exploitation of UCS (especially of the state of stability)

### **5.0 INFLUENCE OF THE GEOMECHANICAL CHARACTERISTICS ON THE DESIGNING TECHNOLOGY OF UCS**

Seen from the geotechnical aspect, the influence of the geo-mechanical characteristics on the designing technology of the mine is given on the basis of performed analysis of the stability and derived conclusions and recommendations referring with it.

From the analysis of the working slopes performed on profiles that are chosen as representative, and on the basis of the geo-mechanical, geological and hydrological researching, it came to the following ascertainments:

- The performance of working inclinations of the coal is not representing a problem of geotechnical aspect, which means that the performance have to be adjusted to the optimal conditions dictated by the available equipment for excavation

- The performance of working inclinations of sandy- dusty sediments, during inclination of  $\alpha = 56^\circ$  should not be with greater inclinations of  $H = 11 - 12$  (m) which mean that it could appear a necessity of

sublevel excavation or previous reduction of load.

The analysis about the stability of the inclinations is performed on a characteristic profiles (Fig. 2 and 3), on which is performed analysis of stability of inclinations, with all potential possible positions of the sliding planes (sub-base, base and over-base). At (Fig 2 and 3) are represented only sliding planes about the calculated lowest factors of safety.

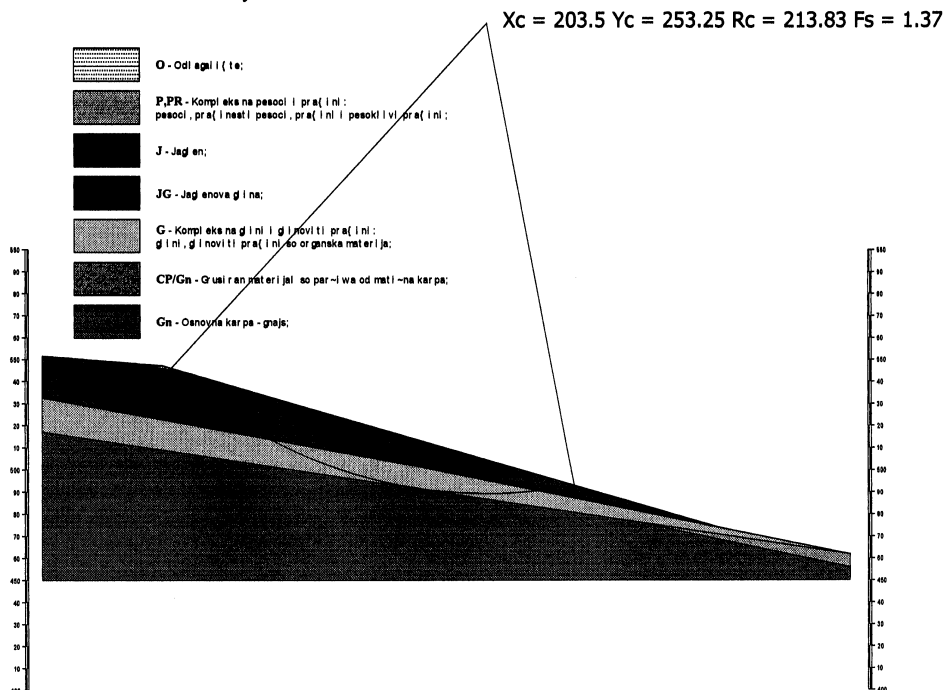


Fig. 2. – Analysis of stability of the north inclination, profile 37 - 37'

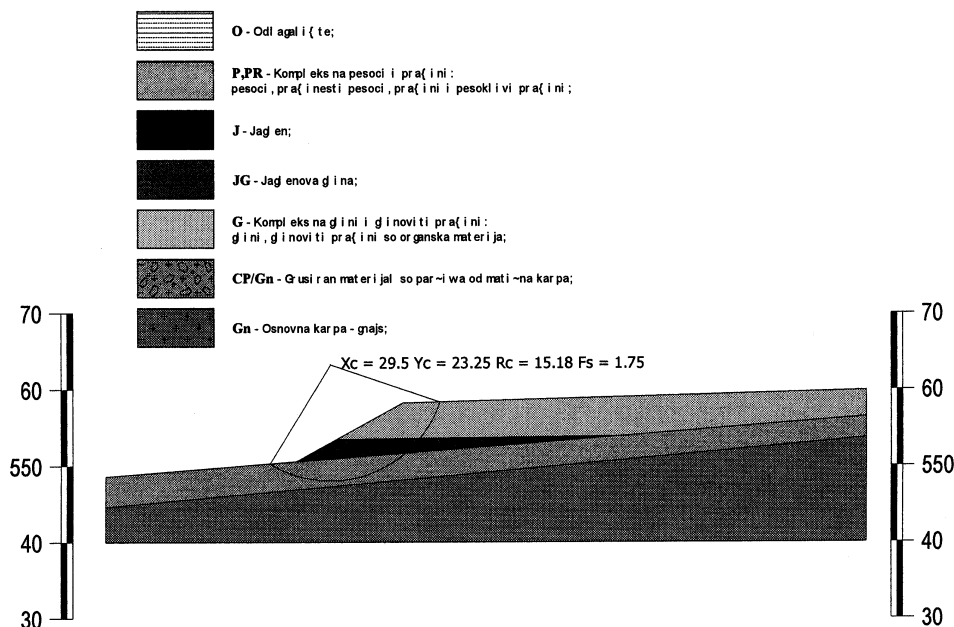


Fig. 3. – Analysis of stability of the south slope, profile 37 - 37'



Angles of inclination of the slopes are determined with the factor of safety  $F_s \geq 1,13$  about the final slopes, with  $F_s \geq 1,15$  about the slopes of the opening working trench and with  $F_s \geq 1,10$  about the working slopes. During the stability analysis of the final slopes the value of the coefficient of the pore pressure  $r_u = 0,20$  is taken, while at analysis of the working slopes that coefficient is  $r_u = 0,10$

## **6.0 CONCLUSION**

Having in mind the fact that in the previous exploitation of the coal in the mine "Suvodol" there were appearance of significant sliding of slopes, but also activation of landslides, then the necessity of geotechnical monitoring of the technology of the opening and exploitation of UCS is quite real. That is from aspect of real expectations during the course of exploitation of UCS, these problems shall be more expressed.

It is necessary in the course of the exploitation, on the questions of geotechnical nature to dedicate more influence. Of the complicated geological conditions as generally for the whole mine "Suvodol", and also for the UCS, the relevancy of the geo-mechanical data get with standard laboratory tests is more expressed.

With purpose maximally to seize the reserves of coal, the final slopes are set at the foot of the geological border of the deposit toward the external surrounding in the flange zone for which there are no geological and geo-mechanical research works.

The underground waters, as it is known, impact the stability of the slopes, with active forces (hydrostatic and hydrodynamic) and lower the parameters of hardness of the "material" that build up the slopes. In principle there is no sliding without impact of water. Therefore exclusively is important with dewatering of the surface and underground waters, to bring down their negative influence to the supposed level during the calculations of the stability of the slopes.

## **7.0 LITERATURE**

- [1] PROPOSAL about geo-mechanical research works and examinations of UCS (GIM, institute about geotechnique – Skopje 2005)
- [2] Settlement of single piles, (Department of Civil Engineering, Monash University)
- [3] M-r Gjorgjievski Blagoj, Master paper "Systems for protection of UCS of underground and surface waters with implementation of information system for monitoring " University "Goce Delchev", FPTN, Shtip – 2011.
- [4] By Joel O. Kimrey and Larry D. Fayrad "GEOHYROLOGIC RECONNAISSANCE OF DRAINAGE WELLS IN FLORIDA" Tallahassee, Florida, USA, 1984