Mine Experimental Research of the Power Options of Mechanized Fastening Sections Based on Lithological Structure Coefficient

R.O. Dychkovskyi, V.S. Falshtynskyi, P.B. Saik, V.S. Lozynskyi

SUMMARY: The results of simulation systems of the rock-mass using the new mathematical approaches and modern information software are introduced. The contacts of rock mass strata are presented as the curves in the simulation model. In such way, it is forming the specific zones with different strengthening characteristics. Authors propose to define the deformations of roof rocks and loadings on mechanized complex according to the values of the lithological structure coefficient. This parameter also is used for the correcting the technological parameters of the mining in wallfaces.

KEYWORDS: Coal seams, simulation, lithological coefficient, mining technology

INTRODUCTION

Priority factors in energy are safety, competitive ability and economic relevancy of obtaining energy raw material. In the applying modern technologies, the coal should become the main source of energy generating in Ukraine [1, 2]. This fuel raw is a warranty of the energy independency of our country. Its share in equivalent fuel near 95.4%. For comparison, the share of oil exceeds 2% and the natural gas is at the level of 2.6% [3].

Therefore, the development of increasing coal mining volumes, what provides improvement of technology and introduction of advanced level techniques, is extremely important problem, solving of which is actual and necessary. It enables to perform mining works and control mining pressure effectively.

Due to the complicated political situation, the special attention should be paid to the Eastern Region of our country. There are two coal mining companies: the State Company “L’viv-vugillya” and the State Company “Volyn’vugillya”. It is necessary to take into account all negative phenomena which influence justification of parameters of working out reserves in mines of these companies. It especially concerns natural and anthropogenic zones of high rock pressure, what is ordinary for working out of reserves in zones of weakly metamorphosed mine rocks.

Solving the set tasks is also necessary due to depreciation of mechanized complexes in the Region and the fact that reserves of coal seams are worked out significantly. This work is impossible without accounting for different kinds of dynamic phenomena, studying reasons and results of formation of strain-stress state, comprehension analysis of existing technology solutions at mines of Ukraine and abroad.

MAIN PART

To achieve the set goal on the example of wallface № 309 of the seam $n^7_в$ of the mine "Zarichna" the SC "L'vivvugillya" proposes to create an appropriate simulation model, what characterize geometric parameters and physical properties of the rock array. Forecasting of technical and technological situation in the well pillar of this wallface is proposed to be performed through the set lithological structure factor [4] on the bases of analysis of geo-structural changes of over-the-coal thickness.

Analysis of mining and geological conditions

At the wallface area № 309 seam $n^7_в$ of simple structure, sustained by the thickness, geological thickness is 0.7 m, extracted thickness is 1m, average is 0.7 m. Coal from the seam is related to the mark Zh, strength is 1.5. Coal is humus, black, with inclusions of flux, fragile, weak and light. Coal seam contacts with included rocks are clear, straight. Coal seam is not prone to spontaneous combustion, unsafe by dust emissions.

Direct covering of the seam with a series of exploration wells of surface drilling is represented by clay shale of dark gray color, medium strength and stability, with thickness 1.64 - 3.75 m. The main seam covering is gray siltstone, horizontally-layered, dense, like micas. Thickness is up to 5.5 m.

Caving step of the direct covering: primary (lb_0) – 1.5 m;
following (lb_i) – 0.6 m.

Caving step of the main covering: primary ($l\kappa_0$) – 15–20 m;
following ($l\kappa_i$) – 8–12 m.

Direct footing is represented by siltstone, in the top part by the "kucheryavchyk" type of medium strength and stability (P2), when moisturized tends to lift. Thickness is 0.5 - 4.7 m. The sandstone lies below it.

The lower part of the direct covering is presented by carbonaceous-clay shale, which caves during coal extraction. In tectonic disturbance areas the layer of carbonaceous-clay shale may reach up to 1 m. Along the top edge of the clay shale and carbonaceous-clay shale there are sliding mirrors. Clay shale of the direct covering is fractured.

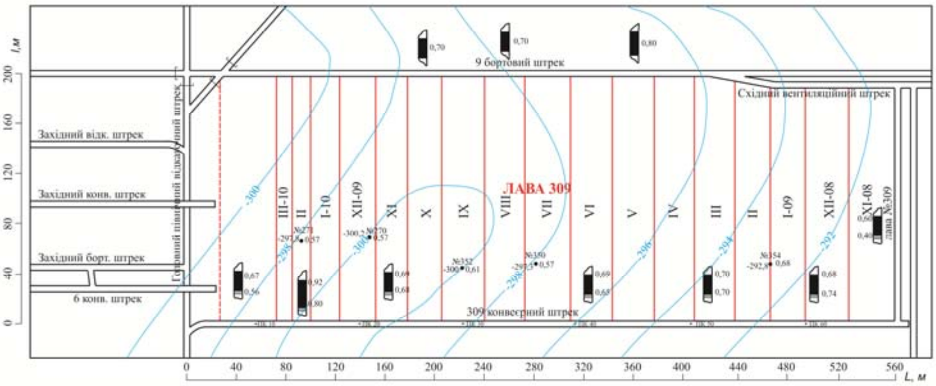
The seam footing is represented by sandy shale, which is sometimes mixed-layered with sandstone. Dark gray siltstone at the top of lumpy texture of the type "kucheryavchyk" with remains of charred flora. Below, along the section it is layered, like micas. Seam thickness is up to 5.65 m.

In regard to tectonic, the area of wallface No 309 is characterized by an average complexity. The intensity of fracturing of direct covering rocks is 4 - 7 fractures/ m (units/m), cracking strike timed to two systems: the North-East (basic) and North-West directions.

Methods of mechanization of mining operations

Mechanized complex 1KD90 with sections 1KD80 and combine 1KD101 are accepted for mechanization of sewage treatment works. Transportation reflected from the array coal is made with scraper conveyor SP253. To supply the working fluid in the system and its support in operating pressure of emulsion it should be used the oil station SNT32.

The well pillar of the wallface No 309 of the mine "Zarichna" is outline with 309 conveyor and 9 board drifts. Obtaining a copy of the wallface plan No 309 of the mine "Zarichna" of SC "L'vivvugillya" is shown in the Picture 1.



Pic. 1. Copying from the plan of mining works in 309 wallface
of the mine “Zarichna” of the SC “L’vivvugillya”

Imitation system of reflecting lithological structure

Analysis of the strength characteristics of lithological structure of the covering rocks shows that the direct covering layer of sufficiently unstable rocks which will cave right after shifting of the purgative stope. Based on the set deformation characteristics of mine rocks [4] siltstones, representing the main cover, changes tensile strength to the uniaxial compression within 22.2 - 29.1 MPa. Above the main covering the layer of “weak” clay shale (argillite) lies with the limit of strength on uniaxial compression within the characteristics in the range of 21.0 - 23.4 MPa. Since the deformation characteristics of this rock layer are compared to the main covering rocks, this layer deforms with the main cover. Its thickness ranges from 3.2 m on the picket PC 0 + 5 to blowout on the PC 30 + 6. Accordingly, at the maximum thickness the caving step reaches 10 - 15 m. This layer of rocks can hung or completely caves at different speeds of the stope. In the last case, this situation will form a zone of high rock pressure and will make a significant uploading of sections of mechanized complex.

Above this rocks the layer of rigidity lies with stratification of sandstone and mudstone rocks. Step of caving of these rocks exceeds 50 meters. The deformations of this layer at the same time will have elastic-plastic nature and almost will not upload powered mechanized fastening of the stope.

Problem area of extraction pillar will be the distance from PK 0+3 to PK 10+7, where it can be stratification of these rocks by creation of additional uploading of sections of mechanized fastening.

Analysis of lithological difference shows that on the extraction pillar area PK 0 – PK 30 + + 6 is described by the following inequality:

$$Rst1 < Rst2 < Rst3 > Rst4 < Rst5,$$

where:

Rst1 – limit of strength on the uniaxial compression of coal seam $n^7_в$;

Rst2 – limit of strength on the uniaxial compression of direct covering;

Rst3 – limit of strength on the uniaxial compression of main covering;

Rst4 – limit of strength on the uniaxial compression of rock stratum of mudstone;

Rst5 – limit of strength on the uniaxial compression of sandstone.

Basic load on fastening of mechanized complex will occur on the bases of the movements of the main covering in form of siltstone with uploaded mudstone rocks. Relationship of over-coal thickness to extracted thickness of the coal seam $n^7_в$ which is taken to the calculation of loads on section, makes 3.3 - 5.3. This condition corresponds to accepted norms of determining of the power parameters of mechanical fastenings.

For simulation display of lithological and structural features of rock structure, it were imposed three-dimensional Cartesian coordinates, respectively, in the horizontal plane: the length of extracted pillar and the length of the wallface, in the vertical – lithological structure of the coal thickness of rocks. To set the features of the coal containing thickness structure after lithological structure it was used a numerical reproduction system (Table. 1 and 2) and computer software of data processing in the system of tables Excel - 2003 and OriginPro 8.5.1. These software were also used for setting numerical values of obtained squares of the layers of lithological structure.

The complexity of the structure requires a significant variation of data, thus to display lines of a contact for individual polling station drifts it were used polynomials of the 6th degree.

As a result of the approximation it had been obtained the following mathematical dependences to display lines of lithological difference of 9 board drift:

1. $y_1 = 0,12211 - 6,34E - 0,4x + 6,27E - 0,5x^2 - 2,65E - 0,7x^3 +$
$+ 1,13E - 9x^4 - 2,81E - 12x^5 + 2,39E - 15x^6$, authenticity $R^2 = 0,9928$;
2. $y_2 = 0,80158 + 0,00421x - 1,95E - 0,5x^2 - 1,16E - 07x^3 +$
$+ 8,81E - 10x^4 - 2,61E - 12x^5 - 2,32E - 15x^6$, authenticity $R^2 = 0,9935$
3. $y_3 = 0,57513 + 0,0489x - 4,02E - 04x^2 +1,33E - 0,6x^3 - 9,93E -$
$- 10x^4 - 2,37E - 12x^5 + 3,12E - 15x^6$, authenticity $R^2 = 0,9861$;
4. $y_4 = 4,19105 - 0,03021x + 8,50E - 0,4x^2 - 6,44E - 0,6x^3 + 2,24E -$
$- 0,3x^4 - 3,59E - 11x^5 + 2,15E - 14x^6$, authenticity $R^2 = 0,9717$;
5. $y_5 = 5,17867 - 0,00933x + 7,52E - 05x^2 + 4,63E - 0,4x^3 + 1,10E -$
$- 0,8x^4 - 1,62E - 11x^5 + 8,80E - 15x^6$, authenticity $R^2 = 0,9745$.

To reflect lines of lithological difference 0f 309 conveyor drift:

1. $y_1 = 2,28833 - 0,08444x + 0,00131x^2 - 8,86E - 0,6x^3 + 2,93E - 0,8x^4 -$
$- 4,61E - 11x^5 + 2,74E - 14x^6$, authenticity $R^2 = 0,9941$;
2. $y_2 = 2,94141 - 0,07629x + 0,00121x^2 - 8,32E - 06x^3 + 2,8E - 0,8x^4 -$
$- 4,47E - 11x^5 + 2,68E - 14x^6$, authenticity $R^2 = 0,9815$;
3. $y_3 = 2,71477 - 0,02301x + 5,64E - 0,4x^2 - 5,01E - 0,6x^3 + 1,95E -$
$- 8x^4 - 3,37E - 11x^5 + 2,13E - 14x^6$, authenticity $R^2 = 0,9932$;
4. $y_4 = 5,97342 - 0,1097x + 0,00205x^2 - 1,46E - 0,5x^3 + 4,93E - 0,8x^4 -$
$- 7,76E - 11x^5 + 4,59E - 14x^6$, authenticity $R^2 = 0,9842$;
5. $y_5 = 7,38545 - 0,02667x + 4,84E - 0,4x^2 - 3,65E - 0,6x^3 + 1,29E -$
$- 0,8x^4 - 2,07E - 11x^5 + 1,22E - 14x^6$, authenticity $R^2 = 0,9854$.

The value “x” shows an approximation of the contact line by length of extraction pillar, numerical value - factor that takes into account features of geological structure under 9 board and 309 conveyor drifts.

Visualization of contact lines of lithological structure of rock array of 309 wallface by sections of 9 board and 309 conveyor drifts is shown in the Picture 2.

The square of individual layers of lithological differences within the extraction pillar of 309 wallface may be defined by the following mathematical expressions:

$$P_1 = \int_0^{560} f(y_2 - y_1)dx \qquad P_1 = \int_0^{560} f(y_2 - y_1)dx \; ;$$

$$P_2 = \int_0^{560} f(y_3 - y_2)dx \qquad P_2 = \int_0^{560} f(y_3 - y_2)dx \; ;$$

$$P_3 = \int_0^{560} f(y_4 - y_3)dx \qquad P_3 = \int_0^{560} f(y_4 - y_3)dx \; ;$$

$$P_4 = \int_0^{560} f(y_5 - y_4)dx \qquad P_4 = \int_0^{560} f(y_5 - y_4)dx \; ;$$

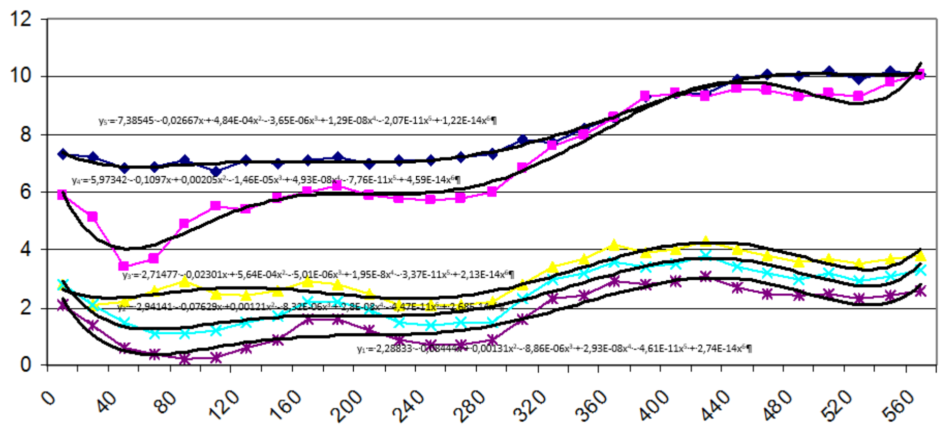
Table 1. Data for digital visualization of lithological difference by 309 conveyor drift

Length of drift, *L, m*																												
0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560
7,3	7,2	6,8	6,9	7,1	6,7	7,1	7,0	7,1	7,2	7,0	7,1	7,1	7,2	7,3	7,8	7,7	8,2	8,6	9,3	9,4	9,4	9,9	10,1	10,0	10,2	9,9	10,2	10,1
5,9	*5,1*	*3,4*	*3,7*	*4,9*	*5,5*	*5,4*	*5,8*	*6,0*	*6,2*	*5,9*	*5,8*	*5,7*	*5,8*	*6,0*	*6,8*	*7,6*	*8,0*	*8,6*	*9,3*	*9,4*	*9,3*	*9,6*	*9,5*	*9,3*	*9,4*	*9,3*	*9,8*	*10,1*
2,8	2,1	2,2	2,6	2,9	2,5	2,4	2,6	2,9	2,8	2,5	2,1	2,1	2,1	2,2	2,8	3,4	3,7	4,2	3,9	4,0	4,3	4,0	3,8	3,6	3,7	3,5	3,7	3,8
2,8	2,1	1,5	1,1	1,1	1,2	1,5	1,7	2,2	2,2	1,9	1,5	1,4	1,5	1,5	2,3	3,0	3,2	3,6	3,4	3,5	3,8	3,4	3,2	3,0	3,2	2,9	3,1	3,3
2,1	1,4	0,6	0,4	0,2	0,3	0,6	0,9	1,6	1,6	1,2	0,9	0,7	0,7	0,9	1,6	2,3	2,4	2,9	2,8	2,9	3,1	2,7	2,5	2,4	2,5	2,3	2,4	2,6

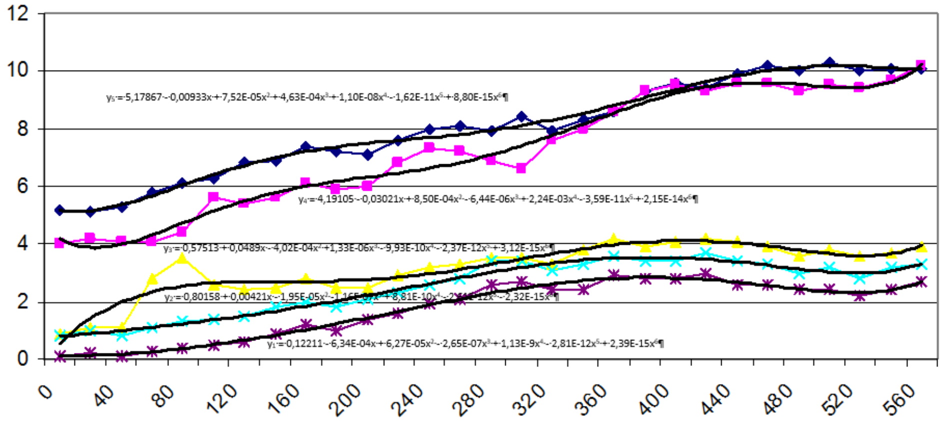
Table 2. Data for digital visualization of lithological difference by 9 board drift

Length of drift, *L, m*																												
0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	560	560	560
5,2	5,1	5,3	5,8	6,1	6,3	6,8	6,9	7,4	7,2	7,1	7,6	8,0	8,1	7,9	8,4	7,9	8,3	8,6	9,3	9,6	9,4	9,9	10,2	10,0	10,3	10	10,1	10,1
4,0	*4,2*	*4,1*	*4,1*	*4,4*	*5,6*	*5,4*	*5,6*	*6,1*	*5,9*	*6,0*	*6,8*	*7,3*	*7,2*	*6,9*	*6,6*	*7,6*	*8,0*	*8,6*	*9,3*	*9,5*	*9,3*	*9,6*	*9,6*	*9,3*	*9,5*	*9,4*	*9,7*	*10,2*
0,9	1,1	1,1	2,8	3,5	2,6	2,4	2,5	2,8	2,5	2,5	2,9	3,2	3,3	3,5	3,5	3,3	3,8	4,2	3,9	4,1	4,2	4,1	3,9	3,6	3,8	3,6	3,7	3,9
0,8	1,0	0,8	1,1	1,3	1,4	1,5	1,8	2,0	1,8	2,1	2,3	2,6	2,8	3,4	3,4	3,1	3,3	3,6	3,4	3,4	3,7	3,4	3,3	3,0	3,2	2,8	3,2	3,3
0,1	0,2	0,1	0,3	0,4	0,5	0,6	0,9	1,2	1,0	1,4	1,6	1,9	2,1	2,6	2,7	2,4	2,4	2,9	2,8	2,8	3,0	2,6	2,6	2,4	2,4	2,2	2,4	2,7

a)



b)



Pic. 2. Visualization of contact lines of lithological difference:
a – by 309 conveyor drift; b – by 9 board drift

To find the square it is necessary to take integral for each expression:

$$P = c_6 \frac{x^7}{7} + c_5 \frac{x^6}{6} + c_4 \frac{x^5}{5} + c_3 \frac{x^4}{4} c_2 \frac{x^3}{3} + c_1 \frac{x^2}{2} + c_0 x,$$

where $c_0 - c_6$ are empirical coefficients of polynomial series. They can be defined by the difference of appropriate coefficients of polynomial series of the top contact line to the bottom contact line.

For spatial display of geometries forms it was set the likelihood ratio of changes of lithological structure by the stope length. Given that in our conditions the length of district drifts is equal, then:

$$\xi = \frac{P_{ki} l_{ri}}{P_{ri} l_{ki}},$$

where P_{ki}, l_{ki}, P_{ri}, l_{ri} – according to the square and the length of outlining district drifts.

This coefficient will be a relationship of lithological structure square to outlining drifts of 309 wallface. Obtained results of the study were filled in the Table 3.

Table 3. Results of variation of the square of rocks of lithological difference by the drifts of 309 wallface

№ п/п	Change of the square of lithological difference by 9 board drift, m^2	Change of the square of lithological difference by 309 conveyor drift, m^2	Coefficient of square variation, ξ
1.	419,0	399,0	1,05
2.	365,0	387,0	0,94
3.	2268,0	2249,0	1,01
4.	456,0	590,0	0,77

Based on the results, it is possible to set a variation of geometrical parameters by the relevant rock layers (Tab. 4) for the formation of spatial reflection systems of surfaces (Grid-systems). Using Surfer 8.0 software, the author obtained surfaces of the contacts of the layers of hardness. For the conditions of 309 wallface the first layer of hardness is the main covering of the seam (Pic. 3).

Using, accordingly, the dependences, shown in the fourth section [4], it is possible to obtain Grid – system of displaying coefficient of lithological structure (Tab. 5) and its spatial reflection (Pic. 4). Displaying of values indicating to the forecast of operation modes of mechanized complexes by length, extraction pillar, the mode of mechanized complex operation by fastening factor (normal, critical and out of limits). When mechanized complex is in “out of limit” zone, the technological process of fastening should be amended its sections should be reinstalled.

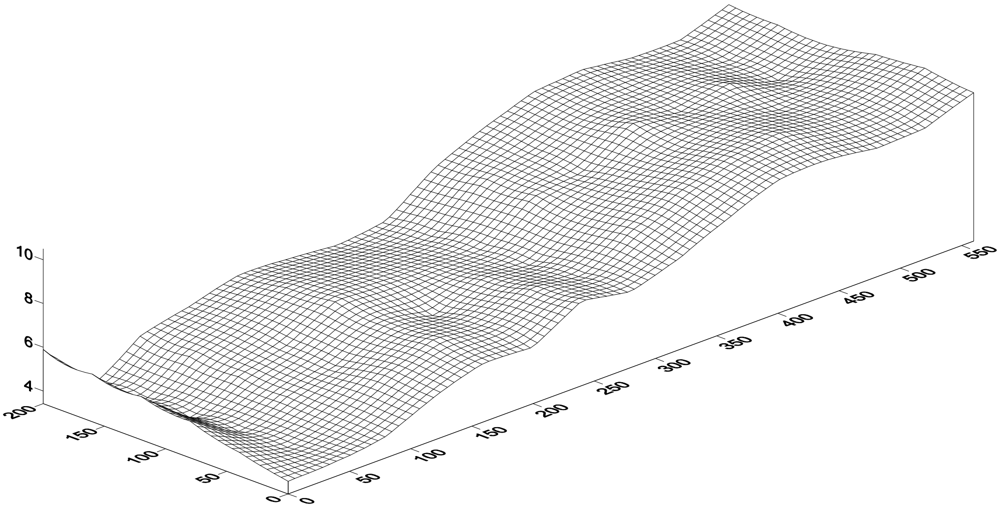
Table 4. Coordinates of the points of forming the square
of the main covering rock with top rocks

Coordinates of points																			
Displaying of lithological structure by 9 board drift	length of wallface																		Displaying of lithological structure by 309 conveyor drift
	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	
	0	0	4,0	0	40	4,5	0	80	5,1	0	120	5,4	0	160	5,6	0	200	5,9	
	40	0	4,1	40	40	3,9	40	80	3,8	40	120	3,6	40	160	3,5	40	200	3,4	
	80	0	4,4	80	40	4,5	80	80	4,6	80	120	4,7	80	160	4,8	80	200	4,9	
	120	0	5,4	120	40	5,6	120	80	5,2	120	120	5,3	120	160	5,5	120	200	5,4	
	160	0	6,1	160	40	6,4	160	80	6,2	160	120	6,5	160	160	6,3	160	200	6,0	
	200	0	6,0	200	40	6,2	200	80	5,8	200	120	6,4	200	160	6,2	200	200	5,9	
	240	0	7,3	240	40	7,1	240	80	6,7	240	120	6,4	240	160	6,1	240	200	5,7	
	280	0	6,9	280	40	6,8	280	80	6,5	280	120	6,4	280	160	6,2	280	200	6,0	
	320	0	7,6	320	40	8,0	320	80	7,7	320	120	7,9	320	160	7,8	320	200	7,6	
	360	0	8,6	360	40	9,0	360	80	8,6	360	120	8,2	360	160	8,4	360	200	8,6	
	400	0	9,5	400	40	9,7	400	80	9,3	400	120	9,6	400	160	9,2	400	200	9,4	
	440	0	9,6	440	40	10,0	440	80	9,7	440	120	9,3	440	160	9,4	440	200	9,6	
	480	0	9,3	480	40	9,6	480	80	9,4	480	120	9,8	480	160	9,5	480	200	9,3	
	520	0	9,4	520	40	9,7	520	80	9,6	520	120	9,1	520	160	9,2	520	200	9,3	
	560	0	10,2	560	40	10,5	560	80	10,3	560	120	9,9	560	160	10,0	560	200	10,1	

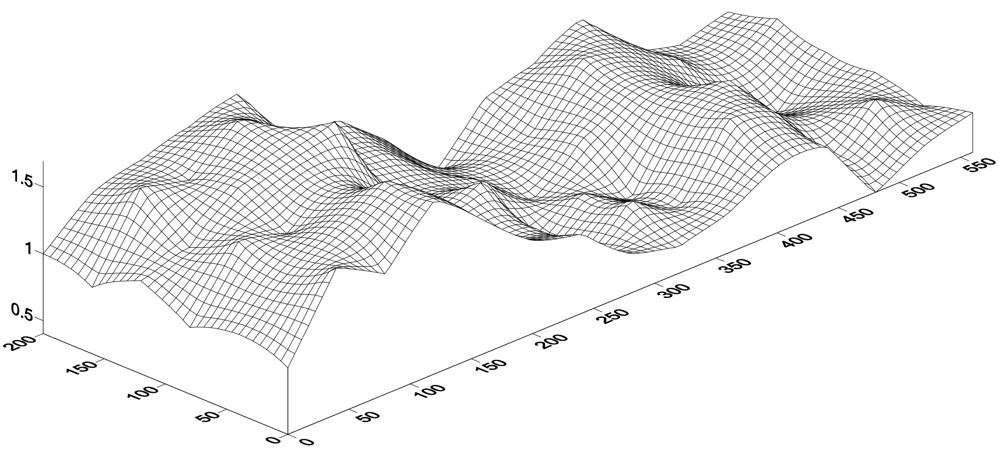
Table 5. Grid – system of displaying coefficient of lithological structure
by the square of 309 wallface

Displaying of lithological structure by 9 board drift	Coordinates of points																		Displaying of lithological structure by 309 conveyor drift
	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	
	0	0	0,9	0	40	1,0	0	80	0,9	0	120	1,1	0	160	0,9	0	200	1,0	
	40	0	1,5	40	40	1,3	40	80	1,4	40	120	1,2	40	160	1,5	40	200	1,3	
	80	0	1,3	80	40	1,5	80	80	1,3	80	120	1,5	80	160	1,4	80	200	1,4	
	120	0	1,7	120	40	1,7	120	80	1,5	120	120	1,6	120	160	1,7	120	200	1,5	
	160	0	1,4	160	40	1,4	160	80	1,2	160	120	1,7	160	160	1,4	160	200	1,6	
	200	0	1,1	200	40	0,9	200	80	1,0	200	120	0,9	200	160	1,1	200	200	1,0	
	240	0	1,0	240	40	0,9	240	80	1,1	240	120	0,9	240	160	1,0	240	200	1,1	
	280	0	0,7	280	40	0,5	280	80	0,4	280	120	0,8	280	160	0,7	280	200	0,8	
	320	0	0,6	320	40	0,8	320	80	0,7	320	120	0,5	320	160	0,6	320	200	0,4	
	360	0	0,7	360	40	0,6	360	80	0,5	360	120	0,8	360	160	0,7	360	200	0,8	
	400	0	0,9	400	40	1,1	400	80	1,0	400	120	1,0	400	160	1,1	400	200	0,9	
	440	0	0,9	440	40	1,0	440	80	1,1	440	120	0,9	440	160	1,0	440	200	1,1	
	480	0	0,4	480	40	0,5	480	80	0,7	480	120	0,5	480	160	0,8	480	200	0,7	
	520	0	0,6	520	40	0,8	520	80	0,6	520	120	0,4	520	160	0,6	520	200	0,6	
	560	0	0,7	560	40	0,6	560	80	0,7	560	120	0,7	560	160	0,8	560	200	0,7	

Determining the average values of strength characteristics of covering rocks, power parameters of sections mechanized fastening and lithological structure factor by the length of extraction pillar are given in the Table 6 and Pic. 5 - 7.



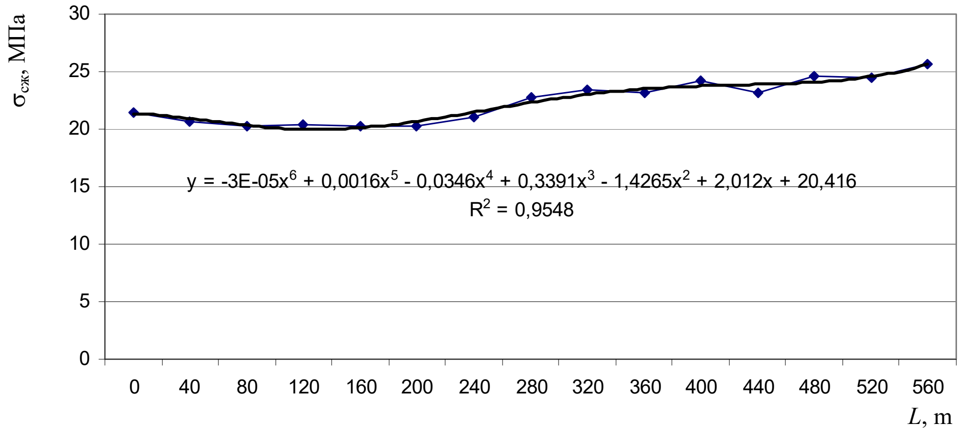
Pic. 3. Spatial displaying of the square of contact of the main covering rock
with top rocks for 309 wallface conditions



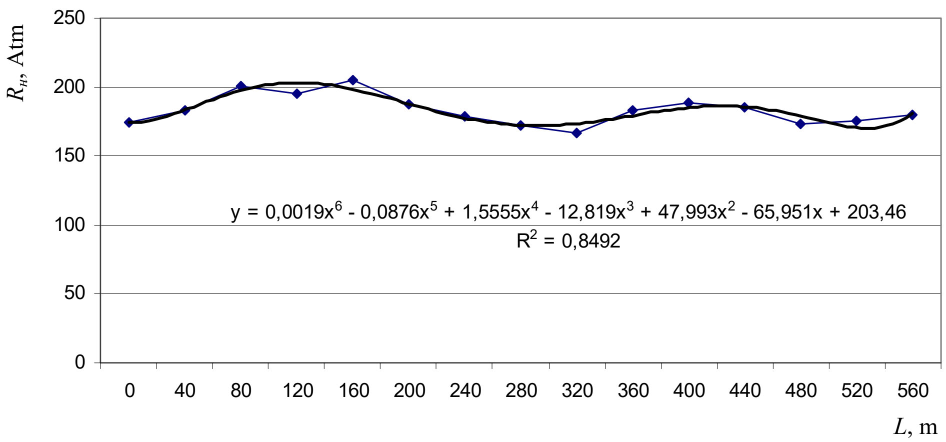
Pic. 4. Spatial displaying of changing of the coefficient of lithological structure
for conditions of 309 wallface of the mine "Zarichna" of the SC "L'vivvugillya"

Table 6. Values of strength characteristics of the rock array

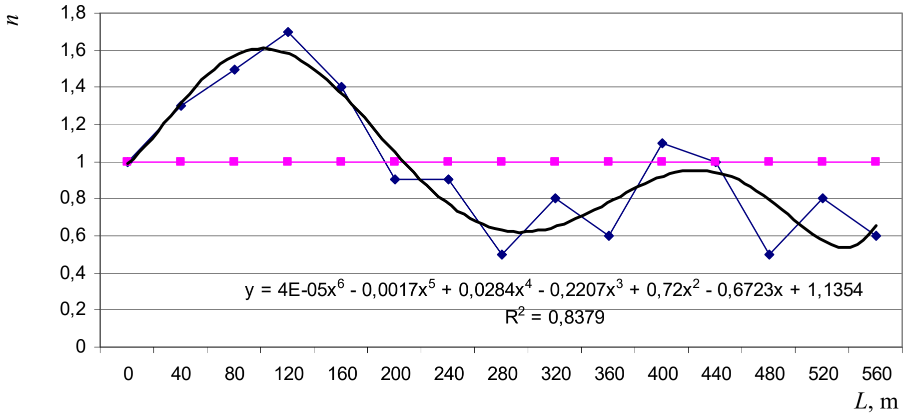
Parameter	Values														
Length of extraction pillar, m	0	40	80	120	160	200	240	280	320	360	400	440	480	520	560
Limit of strength on the uniaxial compression, MPa	21,4	20,7	20,3	20,4	20,3	20,2	21,1	22,7	23,4	23,1	24,2	23,1	24,6	24,5	25,6
Pressure in stilts (loadings) of the sections MK, Atm.	174	183	201	195	205	187	179	172	167	183	189	185	173	175	180
Coefficient of lithological structure	1,0	1,3	1,5	1,7	1,4	0,9	0,9	0,5	0,8	0,6	1,1	1,0	0,5	0,8	0,6



Pic. 5. Average values of the strength limits of the main covering rocks on the uniaxial compression by the length of extraction pillar



Pic. 6. Average values of the pressure in stilts of sections of mechanized fastening



Pic. 7. Average values of the coefficient of lithological structure by the length of extraction pillar

Results of the study of manifestation of the rock pressure in working area of the wallface

These studies aimed at establishing dependency of rock pressure when moving of the stope in highly productive extraction pillar. This is done by determining stress by experimental-analytical methods. Manifestation of stress over time is a mounting on the fastening of the stope corresponding to the pressure of the working fluid in the power supply system of sections. At the first phase it is established the areas of mine field with gradient stresses. They correspond to the mining areas, where the stable movements of the lateral rocks took place and they are beyond the high or the low pressure zone. Change of displacements leads to an adequate change of stresses. And the numerical ratio of these parameters is equal to each other. The ratio of the obtained values to the gradient values shows the increase of stresses at the studied area of extraction pillar.

Moving of rocks in the workspace of wallface was defined by measuring stilts SUI - 2 with nozzles and surveying tape. Analysis of the values of the load of lateral rocks was performed using mine manometers and setting pressure in stilts of mechanized fastenings.

The changes in geological conditions of the seam laying were studied in details: variations of thickness and inclination angle of seam, physical and mechanical properties of the coal and lateral rock. Basing on them, it was developed recommendations on the features of performing technology processes in wallface and recommendations on the control over the mine pressure [4]. The obtained dependences confirm, that the distance of the primary position of the covering rock (*d1*) under the highly-mechanized extraction of thin and very thin coal seams in weakly metamorphosed covering rocks (cover B2, B3, A1, A2) are determined by dependence, closed to linear from the coefficient of lithological structure (n), that is expressed in general by the following dependence:

$$dl = kn + c,$$

where:

k, c – empirical coefficients that characterize the geological structure of the array,

k – tangent of the angle of deviation of rocks (determined on the basis of Coulomb-Mohr’s principle),

c – coefficient, characterizing the strength and power of the layer of hardness (in this case the main covering rocks).

CONCLUSIONS

The formation of appropriate geometric dimensions of extraction area is based on the all-round study of the mechanism of formation the field of mechanical strength of the coal containing rocks and its relaxation as the movement of stopes along the extraction pillars. Unloading of the rock array is made by the mode of compulsory stoppage of the stopes or reducing the speed of wallface moving to the limits of the primary position of the main covering rock at the level of 2 - 3 thicknesses of the coal seam that is extracted. The current correction of the power parameters of mechanized fastening is performed by changing the pressure of the working fluid in the stilts and the introduction of additional elastic elements to the intersectional space of the wallface.

Lithological structure coefficient (n) is one of the key when setting geometric parameters of the stope area and serves as an indicator to determine effective ways to control mining pressure during the high mechanized extraction of thin and very thin coal seams. It also provides the ability to set geometric parameters of the stope to economically viable sizes by reducing costs of preparing extraction pillars, to make improvements to the technology of control over the rock pressure by criteria for geological structure of weakly metamorphosed rocks and so on.

REFERENCES

[1] Innovation in coal industry // Expert. – 2011. − No 5. – 104 p.
[2] Pivnyak, G.G. The role of coal in stable development of energy sector / G.G. Pivnyak // Naukovyi visnyk NGA Ukrajiny. – 2001. – No 1. – С. 81 − 84.
[3] Tulub, S.B. Ecology problems of development coal deposits / S.B. Tulub // Naukovyi visnyk NGA Ukrajiny. – 1999. – No 1. – С. 23 − 26.
[4] Dychkovs'kyi R.O. Scientific bases of the synthesis of the coal mining technologies in weakly metamorphosed rocks / R.O. Dychkovs'kyi. – D.: Natsionalnyi hirnychyi universytet, 2013. – 262 p.