DEPENDENCE OF THE MAXIMUM SURFACE SUBSIDENCE FROM SETUP ENTRY DISTANCE

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ABSTRACT

Based on the subsidence data collected through a comprehensive subsidence monitoring program conducted over longwall in the Western Donbas coal mines, graphical model has been proposed to predict dynamic maximal subsidence in the Western Donbas coal basin.
Key words: coal mines; underground coal extraction; longwall; surface subsidence.

INTRODUCTION

It is known that underground coal extraction is a cause of rocks movement and surface subsidence. Surface subsidence changes in space and time and it's a problem as it caused the constructions and buildings destruction.

As a whole process of surface subsidence can be divided into three stages: subsidence development, full subsidence and subsidence attenuation. These stages concern dynamic surface subsidence. The subsidence trough at the ended surface movement process is distinguished. The subsidence development stage is studied less than others. In general the subsidence development is shown as follows. When the underground working face has moved ahead to a certain distance, surface subsidence begins at this time. With growth continuation of face advancing distance the greatest subsidence and the trough sizes are increase. This increase occurs until dynamic subsidence will reach a maximum. At the further increase of the face advancing, the stationary side and the moving side of the trough are forming.

The subsidence development process laws are studying on the basis of geodetic measurements over the exploitation working.

EXPERIMENTAL DATA

Geological and mining conditions in studied areas

Surface subsidence researches were carried out by mine surveying chair of National mining university (Ukraine) on the basis of surveying measurements at special observation stations. The general geological and mining conditions in studied areas are the following: mining depth changes from 100 to 500 m, thickness of detrital deposits is from 50 to 100 m; slightly inclined stratums. Effective thickness of seams is 0,65-1,10 m; fase advance is 30-100 m/month. Length of longwall is 150-200 m. Roof control is executed by a complete roof falls.

Subsidence monitoring

Regular geodetic measurements in the Western Donbas coal mines have begun in 1960. These measurements are executed on 31 special observation stations, which

are located over 40 coal exploitation workings in 8 mines. Surface subsidence monitoring is carried out on profile lines which lay out along a longwall panel. The profile line represents a system of benchmarks. Distance between benchmarks is 10 m. End benchmarks are located outside of an exploitation working influence zone. Subsidence development takes place on 8 profile lines. Their mining-and-geological parameters are presented in Table 1.

Table 1 Mining-and-geological parameters of observation stations

Station	Mine	Coal seam	Longwall	Mining depth (H) (m)	Alluvion thickness (h) (m)	h/H	Max Subsidence (η_m) (m)	Measur. number
1/2	Anniversary	c_1	2	135	55	0.41	0.60	5
13	Steppe	c_6	604	120	50	0.42	0.88	9
14	Steppe	c_4	415	235	80	0.34	0.85	2
12	Steppe	c_6	606	120	50	0.42	0.90-1.00	20
11	May Day	c_2'	302, 304	140	70	0.50	0.50	5
10	Anniversary	c_6	530	150	60	0.40	0.88	15
9	Anniversary	c_6'	605, 607	250	80	0.32	0.68	15
8	Steppe	c_6'	715, 713	190	70	0.37	0.64	14

On each profile line some series of geodetic measurements (benchmarks leveling, measurement of distances between the next marks) are carried out. The dynamic changes, which occur above ground over the exploitation working, this measurement are displaying. Each single supervision from a series of measurements is corresponds to certain position of the face. It displays a current goaf size influence. Fig. 1 shows the subsidence profiles over longwall 530 (station 10, mine Anniversary).

On date of supervision #3 (the face was 40 m away from the setup entry), surface subsidence was still very small compared with the maximum measured subsidence (η_0) of about 880 mm. With increasing face distance from setup entry (D_t), horizontal moving of a subsidence maximum (distance L_{mt} is increases) and increase of a maximum dynamic subsidence (η_{mt}) are observed.

The dependence of sizes η_{mt} and L_{mt} on distance D_t is studied in this paper.

RESULTS AND ANALYSIS

The subsidence profiles different supervision at observation stations differ not only by sizes, but also conditions in which they are measured. To compare these profiles is impossible. Therefore all linear sizes of profiles are related to a mining depth magnitude (H). Maximum dynamic subsidence (η_{mt}) are divided into final subsidence (η_m) to smoothing of a coal seam thickness influence and influence of a longwall cross dimensions. Thus, 85 couples of (L_{mt}/H; D_t/H) ratio, and 85 couples of (η_{mt}/η_m; D_t/H) ratio for analyzed profile lines (see Table 1) are received. The distribution diagrams of these parameters are shown in Fig. 2 and 3.

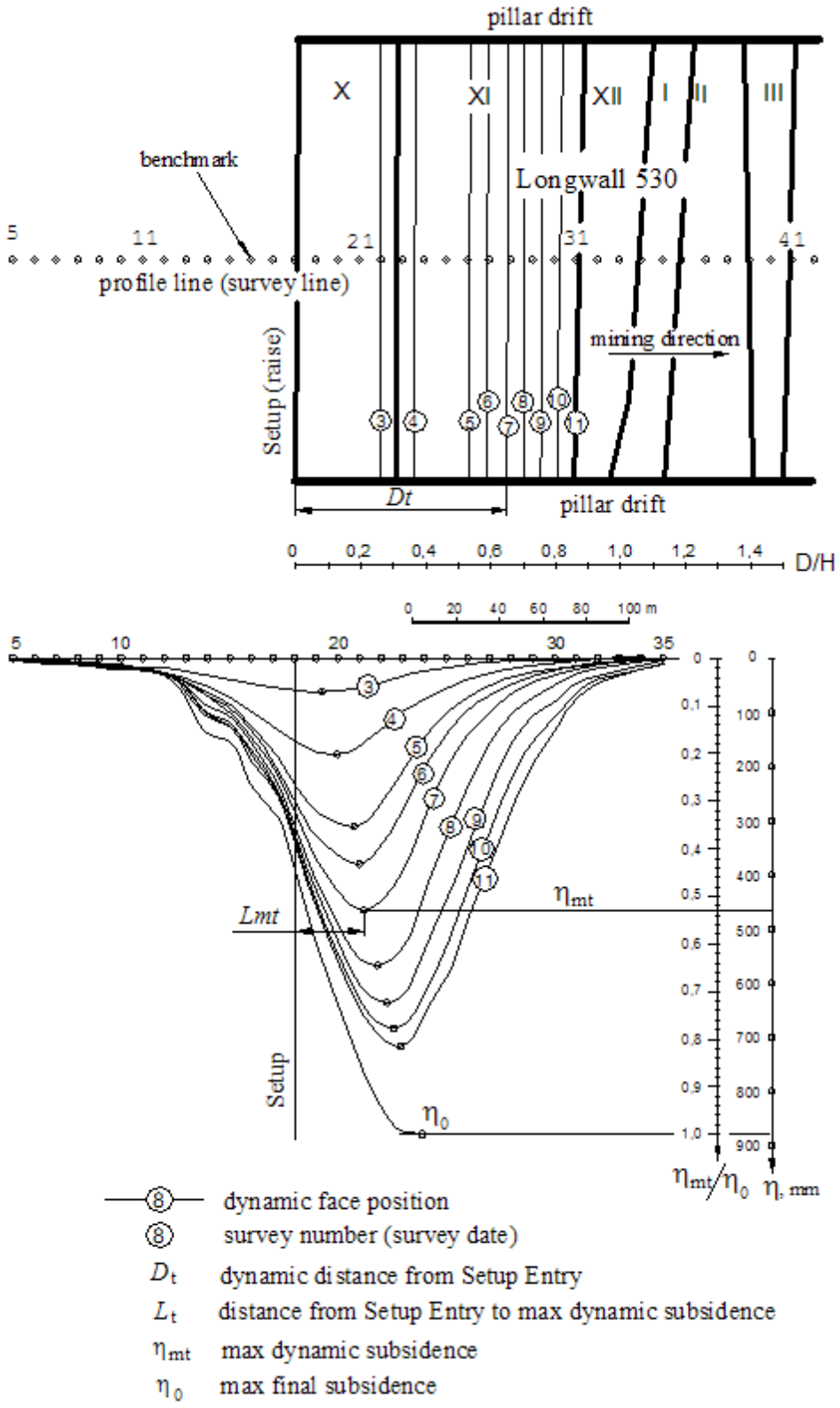

Fig. 1 Longwall 530 layout and location of profile line at observation stations 10

On the basis of relations shown in fig. 2 and 3 is constructed a resulting diagram. It characterizes location and value of the maximum dynamic surface subsidence over moving at subsidence development stage. This diagram is shown in fig. 4.

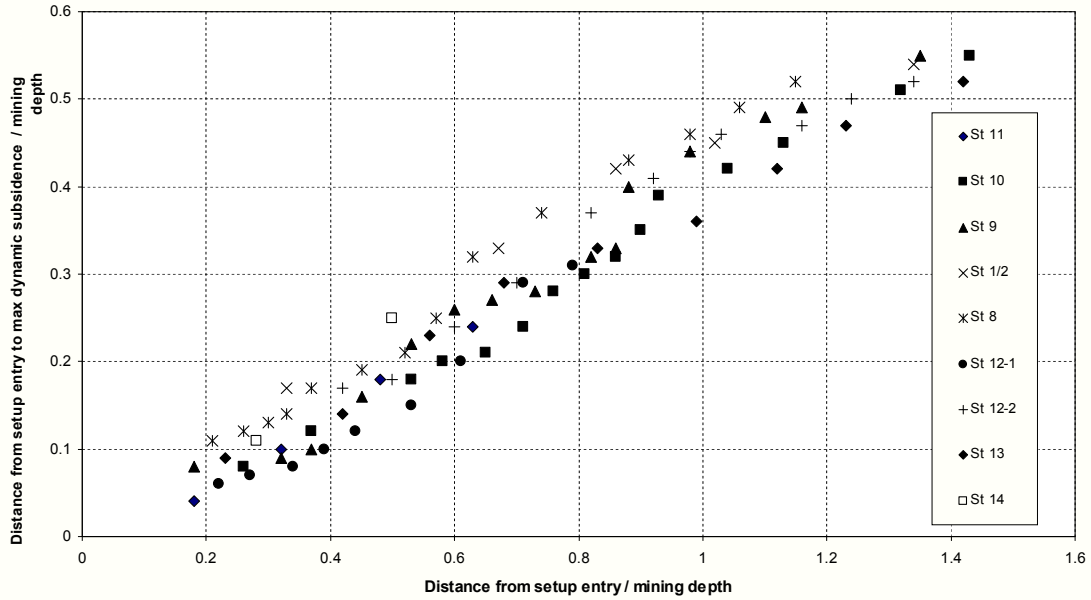

Fig.2 Relation of a maximal subsidence location from a working face location

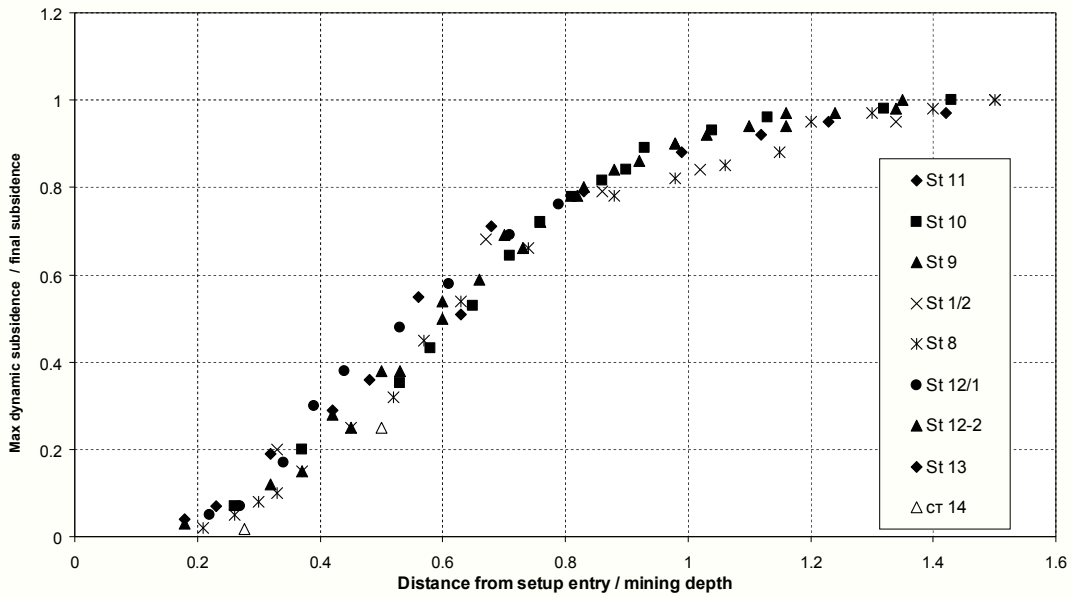

Fig. 3 Relation of a maximal subsidence value from a working face location

Fig. 4 shows the subsidence process beginning when the working face will depart from the setup entry on distance $0.1H$. To distance $0.8H$ the maximum subsidence increase and its moving occurs by linear law. On the interval D_t/H from 0.8 to 1.6 the maximum subsidence asymptotically increases to value 1.

The law established by us, can be used for the maximum subsidence forecast in the conditions of the Western Donbas coal mines and other coal fields, which have similar geologic parameters.

Case demonstration

Let's assume, that the coal seam is working by longwall on depth 200 m. To define a maximum subsidence value, when distance from face to setup entry is 120 m, will be necessary.

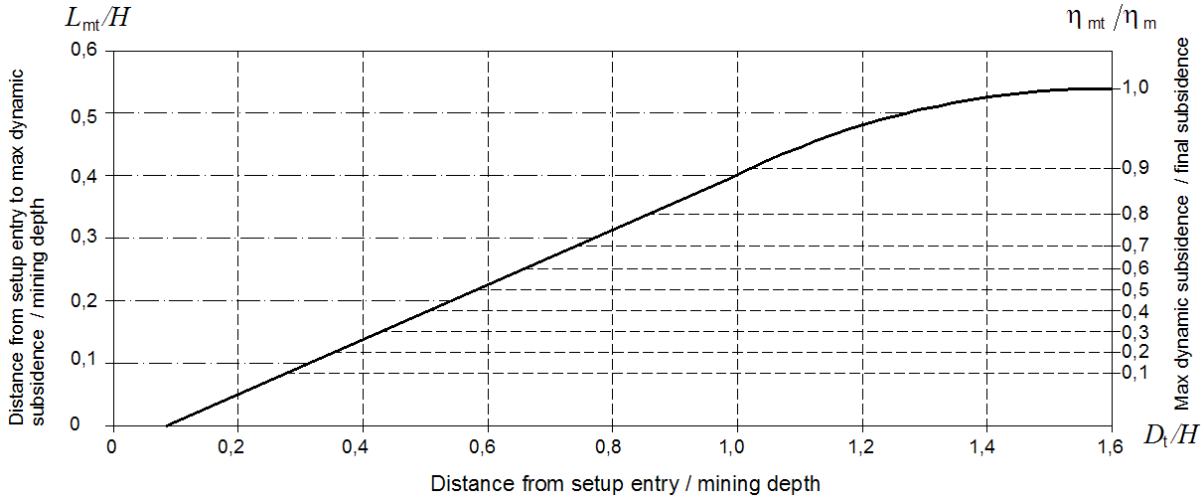

Fig. 4 Variation of max dynamic surface subsidence with distance from setup entry

In these conditions the ratio D_t/H is equaled 0.6. On a curve (Fig. 4) we find a point, which has such ordinates: $L_{mt}/H = 0.22$; $\eta_{mt} / \eta_m = 0.5$. Hence, at the required moment of time the maximum subsidence will be on distance 44 m from the setup entry. The maximum subsidence will be $0.5\eta_m$ (the value η_m is find by known formulas).

CONCLUSION

A large amount of quality subsidence data collected over longwall panels in the Western Donbas coal mines has provided us an excellent opportunity to acquire a better understanding of the nature of surface subsidence process in the Western Donbas coal basin. Based on the collected data in these mines, graphical-empirical model has been developed for predicting dynamic subsidence for the Western Donbas coal basin. The model has demonstrated promising prediction accuracy.

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