THE APPLICATION OF BUDRYK – KNOTHE THEORY FOR PREDICTING OF POST-MINING DEFORMATIONS IN THE CONDITIONS OF POLISH COPPER ORE MINE

APLIKACE TEORIE BUDRYKA A KNOTHEHO PRO PŘEDPOVĚĎ POSTHORNICKÝCH DEFORMACÍ V PODMÍNKÁCH POLSKÉHO DOLU NA MĚĎ

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Abstract

In the paper has been presented the possibility of using Budryk – Knothe theory for predicting extraction influences of copper ore on ground surface. The example of analyses mining extraction influences on selected building has been presented too. The comparison of the results of calculations and results of measurements suggested that the theory is useful in condition of Polish copper ore mine. The good agreement of calculations results has been achieved in comparison to surveys. However, it is very important to emphasize, that obtained values of parameters differ significantly from those used in Poland for mining – geological conditions of Upper Silesia Basin in hard coal mining. In case of horizontal strain one can notice, that the value of parameter B should be taken for prognoses at the level of B=0.32 r.

Abstrakt

Tato práce prezentuje možnost použití teorie Budryka a Knotheho pro předpověď posthornických vlivů na zemský povrch po skončení dobývky měděné rudy. Příklad analýz těchto vlivů pro vybranou budovu je rovněž ukázán. Srovnání výsledků výpočtů s výsledky měření svědčí o tom, že teorie je použitelná pro podmínky polského měděného dolu. Dobrá shoda výpočtů byla ověřena porovnáním s výsledky měření. Avšak je třeba zdůraznit, že získané hodnoty pro parametry se významně odlišují od těch hodnot, které se vyskytují v Polsku pro hornicko-geologické podmínky Hornoslezské pánve při probíhající těžbě uhlí. Pro horizontální napětí je možné si všimnout, že hodnota parametru B by měla být uvažována pro prognózy s hladinou B = 0,32 r.

Keywords

mining subsidence, extraction of copper ore

Klíčová slova

pokles při dobývání, dobývání měděné rudy

1 Introduction

The Budryk – Knothe theory is the most popular in conditions of Polish coal mine. This theory was carried out in 1953, on the basis of the measurement's results provided on observing lines localized over hard coal's extraction fields. Take a notice that Polish has rich deposit of many minerals, for example copper ore. Extraction of the ore is provided in different geological and mining conditions from extraction of hard coal. Because of this the question: *Is it possible to use Budryk-Knothe theory for predicting extraction of copper ore influences on ground surface?* This is interesting.

The results of determination values of the parameters of the theory were presented in a few papers. For example identification of parameters of Budryk-Knothe theory on the basis of subsidence obtained from geodetic measurements has been already provided (Strzałkowski 2010) – see fig. 1. As we can see, the values of parameters are quiet different from values of parameters characteristic for coal mine. In this case the field of extraction was simple shaped and extracted seam had constant thickness.

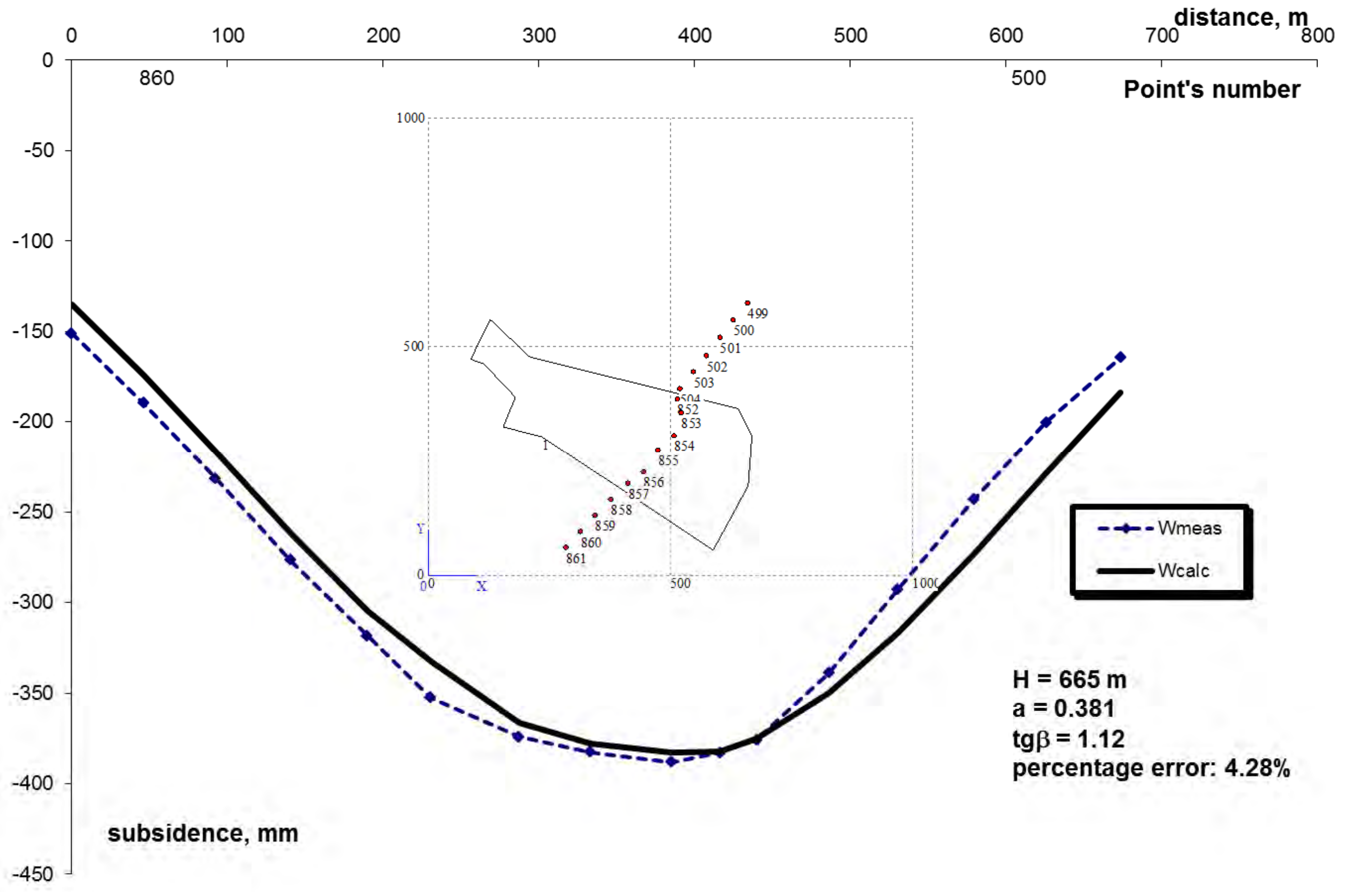

Fig.1. Mining subsidence calculated using Budryk – Knothe theory and obtained from geodetic measurements.

Analysis of mining extraction on influences on selected building, when the extraction fields are of complicated shapes, are more interesting and useful. There is presented the example of analyses mining extraction influence on selected building.

2 The example of analyses mining extraction influences on selected building

The fields of extraction and localization of building have been presented on fig. 2. The extraction has been provided with stowing or caving on the depth from 930 m to 1060 m. Thickness of extraction ranged from 2.5 m to 14 m.

The following values of the parameters of

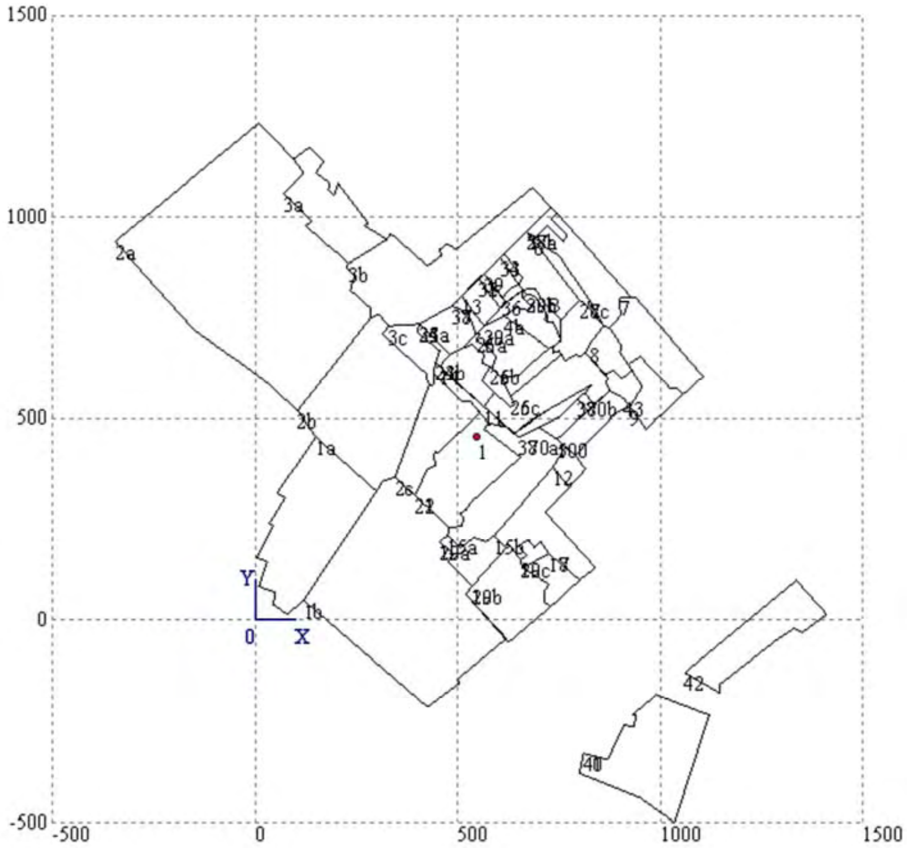

Fig.2 Localization of selected building (point No.1) and mining extraction; drawing obtained from DEFK –Win software (Ścigała 2008)

Knothe' theory determined as follows:

- Coefficient of roof control for caving and deflection of roof – ***a = 0.50***
- Coefficient of roof control for hydraulic stowage – ***a = 0.2***
- Coefficient of roof control for stone stowage – ***a = 0.4***
- Tangent of main influences angle $tg\beta = 1.33$
- Coefficient ***B = 0.4***

We know these values of parameters from experience of mine. The results of calculations indices of deformation are presented in tab.1.

Tab.1 Values of mainly deformation indices

W [mm]	T_{max} [mm/m]	T_{a1} [mm/m]	T_{a2} [mm/m]	E_{max} [mm/m]	E_{a1} [mm/m]	E_{a2} [mm/m]
-2074.7	0.90	-0.66	-0.61	-3.56	-3.45	-2.41

Where:

W – mining subsidence

T_{max} – maximal value of inclination

T_{a1} – inclination in direct connected with x axis (see fig. 2)

T_{a2} – inclination in direct connected with y axis (see fig. 2)

E_{max} – maximal value of horizontal deformation

E_{a1} – deformation in direct connected with x axis

E_{a2} – deformation in direct connected with y axis

Geodetic measurements have been provided in region of the building. Localization of measurement points and building are presented on fig. 3.The mining subsidence of observing points located next to the building over time are presented on fig. 4 .Mining subsidence of observing points in period 2000 – 2011 were amounted from 2175 mm do 2332 mm. It is compatible with results of calculations.

Horizontal deformation of segment RL 06 1838 – RL 06 1839 and RL 06 1839 – RL 06 1840, obtained from measurements over time, is presented on the fig. 5. Direction of the observing line 6/1 is similar to axis x, because values of horizontal deformation, calculated in direction of the axis x, should be similar to that, which were obtained from measurements. Values of the horizontal deformations in the direction of **a1** are higher than obtained from geodetic measurements. This may be caused by a too high value of parameter ***B=0.4***. If we accept value ***B=0.32*** we will receive the following values of the deformations: E_{max} **= 2.85 mm/m**, E_{a1} **= -2.76 mm/m** and finally E_{a2} **=1.93 mm/m**.

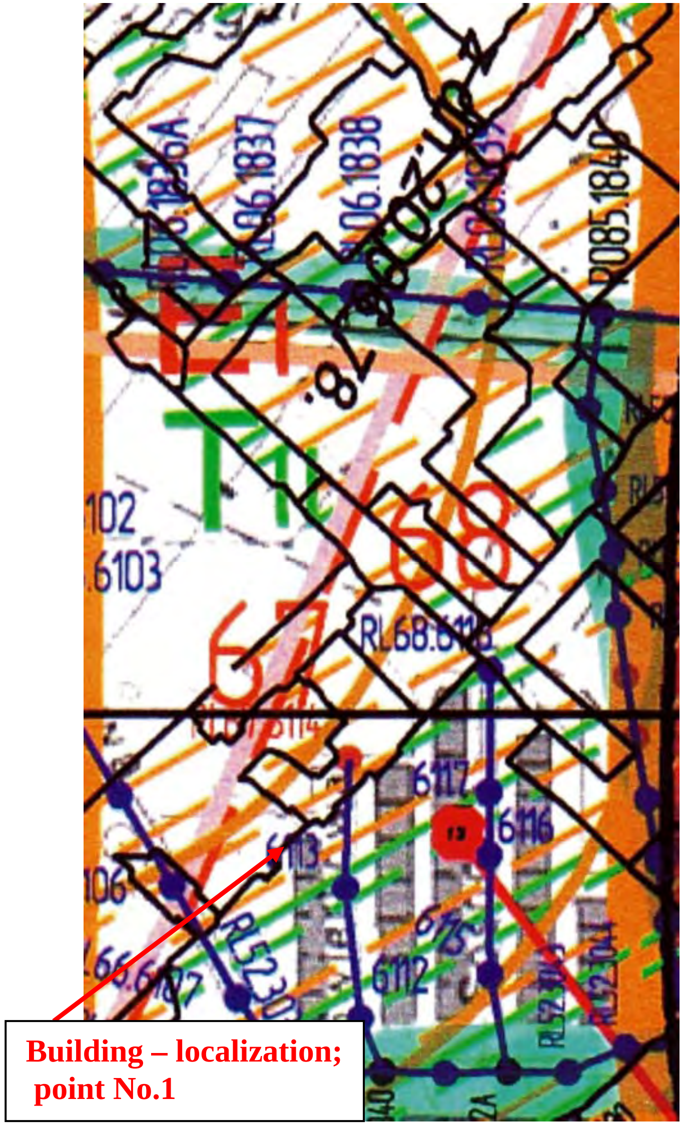

Fig.3 Localization of observing lines and the building

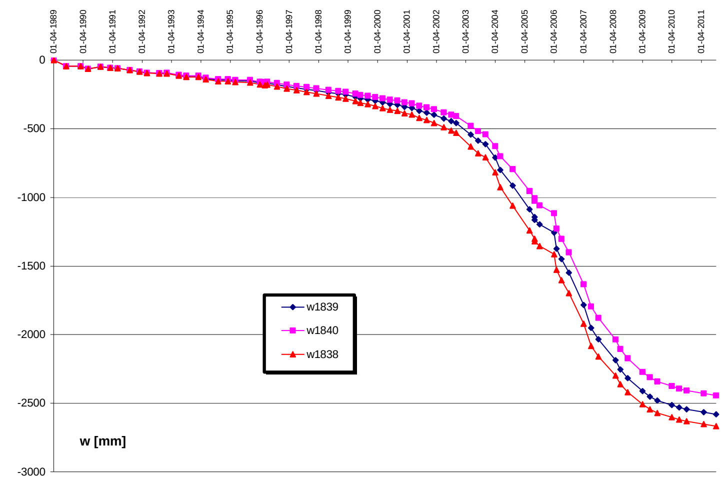

Fig.4 Mining subsidence over time; observing points RL 06 1838 – RL 06 1840

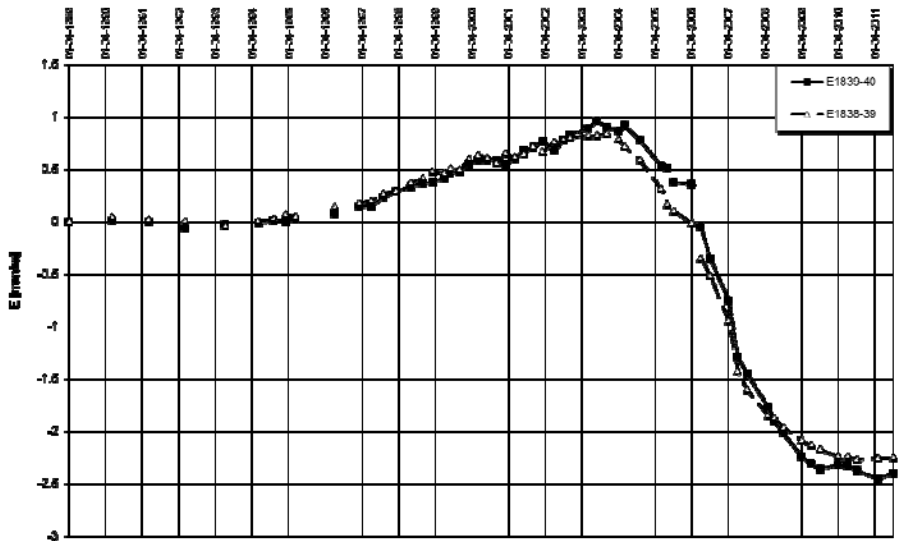

Fig.5 Horizontal deformation over time; segment RL 06 1838 – RL 06 1839 and RL 06 1839 – RL 06 1840

The values obtained from the result of measurements, for period of extraction from 2000 to 2011, for segments: RL 06 1838 – 1839 and 1839 – 1840 are equal: ***-2.85 mm/m*** and ***-2.95 mm/m.*** The value $\boldsymbol{E_{a1}} = \boldsymbol{-2.76}$ ***mm/m*** is similar.

3 Conclusions

The Budryk – Knothe theory has been carried out on the basis of the measurement's results provided on observing lines localized over hard coal's extraction fields. In this paper has been presented the example of analyses of influence of extractions of copper ore on selected building. The results of calculating and comparison with the results of measurements provided on observing points next to building let us consider, that this theory is useful in condition of copper ore mine in Poland.

References

KNOTHE, S. *Prognozowanie wpływów eksploatacji górniczej*. Wydawnictwo "Śląsk". Katowice, 1984.

STRZAŁKOWSKI, P. *Zarys ochrony terenów górniczych.* Wydawnictwo Politechniki Śląskiej, Gliwice, 2010.

ŚCIGAŁA, R. *Komputerowe wspomaganie prognozowania deformacji górotworu i powierzchni wywołanych podziemną eksploatacją górniczą*. Wydawnictwo Politechniki Śląskiej, Gliwice, 2008.

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