

The usage of telemetry measurements methods to determine shaft tube deformations caused by natural and anthropogenic rock mass movements

Mateusz Jabłoński, Wojciech Jaśkowski

AGH University of Science and Technology, Faculty of Mining Surveying and Environmental Engineering, al. A. Mickiewicza 30, 30-059 Krakow, Poland; e-mail: jablon@agh.edu.pl, jaskow@agh.edu.pl

© 2016 Authors. This is an open access publication, which can be used, distributed and reproduced in any medium according to the Creative Commons CC-BY 4.0 License requiring that the original work has been properly cited.

Mining shaft is the most important element of the underground mine. It determines the mine's ability to work efficiently. Mining shaft is used for transporting employees, equipment and dirt or output. It also allows to perform fast rescue operation and ensures that employees in danger can be quickly evacuated. Last but not least, it allows ventilation and functioning underground. Mining shaft and especially the shaft tube are subject to influences, both geological and anthropogenic. In details: local geological structure (deposit tectonic structure), mass rock movements due to exploitation inside and outside of safety shaft pillar, underground watercourses and leakages of shaft or voids around the shaft (especially dangerous in case of salt exploitation).

Ensuring shaft's safe operation is the primary aim of measurements and observations performed in mining shafts. This involves not only determining the current technical condition of the mining shaft, but also determining causes of observed changes (Szczerbowski & Jóźwik 2002). In order to preserve the efficiency of every shafts several inventory works have been performed, described in details in Ordinance (Regulation of the Minister of Economy from 28th of June 2002) and its appendix (Appendix nr 4 to Regulation of the Minister of Economy from 28th of June 2002, Jaśkowski 2013).

This paper presents an overview of measurement techniques which are in use in order to

perform shaft tube's inventory, with particular emphasis on telemetric measurement methods. The author compares classical measurement methods with possibilities of telemetry in few cases: financial, time-consuming and measurable. As an example monitoring system designed for the "Wieliczka" Salt Mine has been described in details. The system based on extensometers (vertical and horizontal strain gauges) and inclinometers, joined on each level and sent to the data centre was used in 2014 and 2015 to monitor deformations on and between five levels (from 0 m to –36 m) during sealing and stiffening the shaft housing. Material, injected under considerable pressure (up to 30 MPa) to 92 boreholes located few meters from the shaft, could damage the reinforcement and cause critical failures of the shaft. In order to prevent such situations, mobile system for monitoring the condition of the structure of the shaft was mounted. Its indications allowed to define in the current time the value of deformation occurring in the shaft and, if necessary, to immediately modify the schedule and course of injection works. Analysis of the results shows a slight deformation of the shaft housing during the injection and demonstrates the advantages of the monitoring system as well as a novel method of high-pressure injections (Jaśkowski et al. 2016).

The system and the implemented software were created within the project "Developing technologies

of sealing mine shafts by Salt Mine «Wieliczka», co-financed by the European Regional Development Fund. 11.11.150.195.

REFERENCES

- Jaśkowski W., 2010. Modular Measurement system for mine shaft inventory. *Archives of Mining Sciences*, 55, 81–90.
- Jaśkowski W., 2013. *Kompleksowe wyznaczanie geometrii szybów górniczych za pomocą Modularnego Systemu Pomiarowego*. Wydawnictwa AGH, Kraków.
- Jaśkowski W., Lipecki T. & Jabłoński M., 2016. Deformacje szybu „Kościuszk” KS Wieliczka wywołane pracami uszczelniającymi obudowę szybu. *Przegląd Górniczy*, 72, 1, 4–10.
- Rozporządzenie Ministra Gospodarki z dnia 28 czerwca 2002 r. w sprawie bezpieczeństwa i higieny pracy, prowadzenia ruchu oraz specjalistycznego zabezpieczenia przeciwpożarowego w podziemnych zakładach górniczych. Dz.U. 2002, nr 139, poz. 1169.
- Szczerbowski Z. & Jóźwik M., 2002. Przykłady naturalnych i górniczych uwarunkowań deformacji szybów górniczych. [in:] *Geotechnika i budownictwo specjalne 2002: ze szczególnym uwzględnieniem problematyki towarzyszącej eksploatacji rud miedzi: XXV Zimowa Szkoła Mechaniki Górotworu: Zakopane, 18–22 marca 2002*, Wydawnictwo KGBiG AGH, Kraków, 671–680.
- Załącznik nr 4 Szczegółowe zasady prowadzenia ruchu w wyrobiskach [appendix to Rozporządzenie Ministra Gospodarki z dnia 28 czerwca 2002 r. w sprawie bezpieczeństwa i higieny pracy, prowadzenia ruchu oraz specjalistycznego zabezpieczenia przeciwpożarowego w podziemnych zakładach górniczych. Dz.U. 2002, nr 139, poz. 1169].