IMPROVEMENT OF HIGH-PRECISION LEVELLING METHOD BY DIGITAL LEVELS IN THE CONDITION OF NON-SUFFICIENT LIGHT INTENSITY OF LINED ROD

Valerij G. Salnikov
Siberian State University of Geosystems and Technologies, 10, Plakhotnogo St., Novosibirsk, 630108, Russia, Ph. D., Head of Engineering Geodesy and Mining Department, phone: (913)932-62-20, e-mail: salnikov@ssga.ru

The performing of high-precision geometric leveling by short beams with the purpose of control for the process of building and exploitation of engineering structures and industrial equipment is carried out with visual reading levels or digital levels in case there are a lot of disturbance effects, the basic of which are the vibrations of some equipment in operation, rapid temperature changes, and also non-sufficient and irregular light intensity of bar-code or lined rods. The purpose of the article is the improvement of high-precision leveling method performance by digital levels in the condition of insufficient light intensity of bar-code rods. The article considers the influence of insufficient light intensity of bar-code rods on the leveling station work by digital levels. Due to irregular and insufficient light intensity of the rod the receiver of the digital level does not allow to read distinctly the bar-code and to perform its processing and output to the indication unit in metric system. That's why for accurate measurement on the station the light intensity of the rods should be sufficient, nearly similar and regular. The article gives the results of using the rod, equipped with light-emitting diodes to provide its sufficient and regular lighting.

Key words: high-precision geometric leveling, digital level, bar-code rod, light-emitting diodes, light intensity of rod.

REFERENCE

1. Standarts Russian Federation. (2003). GOST 10528-90. Levels. General technical conditions. Moscow: IPK Publ., 29 p. [in Russian].

2. Geodetic, cartographic instructions, norms and regulations. (2004). GKINP (GNTA)–03-010- 03.2004. Leveling guidelines. Classes I, II, III and IV. Moscow: CNIIGAiK Publ., 226 p. [in Russian].

3.Ustavich, G. A., Soboleva, E. L., Rjabova, N. M., & Sal'nikov V. G. (2011). Study of refraction influence on digital leveling results. *Geodezija i kartografija [Geodesy and Cartography]*, 5, 3–9 [in Russian].

4. Ustavich, G. A., Ryabova, N. M., Salnikov, V. G., & Teplykh, A. N. (2010). Study of digital level bar code rods. *Vestnik SGGA [Vestnik SSGA]*, 2(13), 3–8 [in Russian].

5. Ustavich, G. A., Rjabova, N. M., Sal'nikov, V. G., & Rahymberdina, M. E. (2011). Issledovanie cifrovyh nivelirov i reek. *Geodezija i kartografija [Geodesy and Cartography]*, 4, 9–15 [in Russian].

6. Malkov, A. G. (2009). About estimation of elevation measurement accuracy on geodetic leveling station. In *Sbornik materialov GEO-Sibir'-2009. N. 1, ch. 1 [Proceedings of GEO-Siberia-2009: Vol. 1, Part 1]* (pp. 82–84). Novosibirsk: SSGA Publ. [in Russian].

7. Rjabova, N. M. (2013). Study of different light intensity influence on rod reading. In *Sbornik materialov Interekspo GEO-Sibir'-2013: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodezija, geoinformatika, kartografija, markshejderija [Proceedings of Interexpo GEO-Siberia-2013: International Scientific Conference: Vol. 1. Geodesy, Geoinformatics, Cartography, Mine Surveying]* (pp. 42–45). Novosibirsk: SSGA Publ. [in Russian].

8. Golovina, L. A. (2016). Dependance of leveling accuracy on light intensity of object. In *Sbornik nauchnyh trudov po materialam I Vserossijskoj nauchno-prakticheskoj konferencii: Innovacionnoe social'no orientirovannoe razvitie Rossii [Collection of Scientific Papers Based on the Materials of the 1st All-Russian Scientific and Practical Conference Innovative Socially Oriented Development of Russia]* (pp. 374–377). Tomsk: NOO "Professional'naja nauka" [in Russian].

9. Novoselov, D. B., & Novoselov, B. A. (2013). Study of high-precision digital level work in conditions of light deficiency. In *Sbornik materialov Interekspo GEO-Sibir'-2013: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodezija, geoinformatika, kartografija, markshejderija [Proceedings of Interexpo GEO-Siberia-2013: International Scientific Conference: Vol. 1. Geodesy, Geoinformatics, Cartog-*

raphy, Mine Surveying] (pp. 117–121). Novosibirsk: SSGA Publ. [in Russian].

10. Malkov, A.G., & Bryskin, R. M. (2019). Modern methods of high-precision geometric leveling. In *Sbornik materialov Interekspo GEO-Sibir'-2019: Mezhdunarodnoy nauchnoy konferentsii: T. 1, No. 2. Geodezija, geoinformatika, kartografija, markshejderija [Proceedings of Interexpo GEO-Siberia-2019: International Scientific Conference: Vol. 1, No. 2. Geodesy, Geoinformatics, Cartography, Mine Surveying]* (pp. 32–38). Novosibirsk: SSUGT Publ. [in Russian].

11. Nikonov, A. V., Chesheva, I. N., & Lifashina, G. V. (2016). Influence of environmental temperature changes on the main condition of digital level when surveying foundation settlement of building and structures. *Vestnik SGUGiT [Vestnik SSUGT]*, 2(34), 24–33 [in Russian].

12. Novikov, Ju. A., & Kraev, A. N. (2019). Geodetic survey of building settlement in geotechnical monitoring provision. *Vestnik SGUGiT [Vestnik SSUGT]*, *24*(1), 28–41 [in Russian].

13. Ustavich, G. A., Shaul'skij, V. F., & Vinokurova O. I. (2003). Design and development of state leveling technology, I, II, III and IV class. *Geodezija i kartografija [Geodesy and Cartography]*, 8, 5–11 [in Russian].

14. Sholomickij, A. A., Lagutina, E. K., & Soboleva, E. L. (2017). High-precision geodetic measurements in Aquapark deformation monitoring. *Vestnik SGUGiT [Vestnik SSUGT]*, *22*(3), 45–59 [in Russian].

15. Nikonov, A. V., Soboleva, E. L., Rjabova, N. M., & Medvedskaja, T. M. (2015). Determination of mean square error of elevation measurement on the station by digital level. In *Sbornik materialov Interekspo GEO-Sibir'-2015: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodezija, geoinformatika, kartografija, markshejderija [Proceedings of Interexpo GEO-Siberia-2015: International Scientific Conference: Vol. 1. Geodesy, Geoinformatics, Cartography, Mine Surveying]* (pp. 77–84). Novosibirsk: SSUGT Publ. [in Russian].

16. Rahymberdina, M. E. (2013). Research for improvement of high-precision engineering-geodetic leveling by digital levels and total stations. *Extended abstract of candidate's thesis*. Novosibirsk, 24 p. [in Russian].

17. Popov, B. A., & Redzhepov, M. B. (2019). Influence of territory light intensity on leveling accuracy. In *Sbornik materialov I mezhdunarodnoj nauchno-prakticheskoj konferencii fakul'teta zemleustrojstva i kadastrov VGAU: Aktual'nye problemy zemleustrojstva, kadastra i prirodoobustrojstva [Proccedings of the 1st International Scientific and Practical Conference of the Faculty of Land Management and Cadastres of the VSAU: Actual Problems of Land Management, Cadastre and Environmental Management]* (pp. 257–261). Voronez: VGAU Publ. [in Russian].

18. Nefedova, G. A., & Ashheulov V. A. (2009). *Teorija matematicheskoj obrabotki geodezicheskih izmerenij v konspektivnom izlozhenii [Theory of mathematical processing of geodetic measurements in summary]*. Novosibirsk: SSGA Publ., 140 p. [in Russian].

19. Shal'neva, V. D. (2019). Use of MS Excel for level notes. In *Sbornik statej VI Mezhdunarodnoj nauchno-prakticheskoj konferencii: Innovacionnoe razvitie nauki i obrazovanija [Proceedings of the VI International Scientific and Practical Conference Innovative Development of Science and Education]* (pp. 66–70). Penza: MCNS Publ. [in Russian].

20. Ustavich, G. A., Sal'nikov, V. G., & Rjabova, N. M. (2014). Scheme of field tall testing stand for verification of system "digital level – bar code rods". *Izvestiya vuzov. Geodeziya i aerofotos"emka [Izvestiya Vuzov. Geodesy and Aerophotography]*, S/4, 51–55 [in Russian].

Received 13.05.2020

© V. G. Salnikov, 2020