NORMALIZATION OF ACCURACY OF GEODESIC MEASUREMENTS AND CONSTRUCTION AND INSTALLATION WORKS WHEN ESTABLISHING STEEL RESERVOIRS UNDER OIL PRODUCTS

Roman P. Gorbulin
Omsk State Agrarian University P. A. Stolypin, 4, Sibakovskaya St., Omsk, 644008, Russia, Ph. D. Student, Department of Geodesy and Remote Sensing, phone: (3812)65-37-18, e-mail: rp.gorbulin 06.21.02@omgau.org

Anatoly I. Uvarov
Omsk State Agrarian University P. A. Stolypin, 4, Sibakovskaya St., Omsk, 644008, Russia, Ph. D., Associate Professor, Department of Geodesy and Remote Sensing, phone: (3812) 65-37-18, e-mail: ai.uvarov@omgau.org

It is generally accepted that the accuracy of the geometric characteristics of structural elements is one of the key indicators of construction features. GOST 21778-81 states that the necessary means and principles of technological accuracy are used in the production of the design of structures. The accuracy of building elements according to geometric characteristics depends on inaccuracies in the manufacture of parts, geodetic alignment and construction works. From this it follows that the indicators for the accuracy of geometric characteristics and the reliability of building systems for the purpose are interconnected. The reliability factors of building systems for the intended purpose depend on the level of responsibility of buildings and structures. Therefore, the purpose of our work is to justify the purpose of the accuracy of geodetic works in the construction of steel tanks, taking into account the level of their responsibility. Conducting research by many authors indicate that the distribution of errors in the sizes and positions of the structure of components is subject to the normal distribution law. It is proved that elementary errors in the position of the order of components and nodes are summed up. The value of the reliability factors for the accuracy of the geometric parameters of the building structures of steel tanks is not yet sufficiently substantiated. Tolerances for geometric parameters in the construction of steel tanks are proposed to be assigned taking into account the indicators of their reliability in terms of responsibility. The substantiation of the accuracy standards (mean square deviations) for the geodetic support of the construction of steel tanks was carried out taking into account the class of construction and reliability indicators of their building structures in terms of responsibility.

Keywords: accuracy standards, tanks, reliability factors, geodetic measurements, deformations, indicators of responsibility, geometric parameters, class of construction

REFERENCES

1. GOST 21778-81. (1981). A system for ensuring the accuracy of geometric parameters in construction. Key Points. Moscow: Standartinform Publ., 13 p. [in Russian]

2. Otstavnov, V. A., Smirnov, A. F., Rayzer, V. D., & Sukhov, Yu. D. (1981). Accounting for the responsibility of buildings and structures in the norms of design of building structures. *Stroitel'naya mekhanika i raschet sooruzheniy [Construction Mechanics and Calculation of Structures]*, 1, 1–5 [in Russian].

3. Beshr, A. A. (2004). Accurate surveying measurements for smart Structural members. *M. Sc. Thesis*. Mansoura: Mansoura university Publ., 194 p.

4. Beshr, A. A. (2010). Development and Innovation of Technologies for Deformation Monitoring of Engineering Structures Using Highly Accurate Modern Surveying Techniques and Instruments. *Ph. D. thesis*. Russia, Novosibirsk: Siberian State Geodesy Academy Publ., 205 p.

5. Ehigiator-Irughe, R., Beshr, A. A., Ehiorobo, J. O., & Ehigiator, O. M. (2011). Modification of Geodetic Methods for Determining the Monitoring Station Coordinates on the Surface of Cylindrical Oil Storage Tank. *Research Journal of Engineering and Applied Sciences (RJEAS)*, *1*(1), 58–63 [in Russian].

6. Ashraf, A. B., Ehigiator-Irughe, R. A., & Ehigiator, O. M. (2010). Structural deformation analysis of cylindrical oil storage tank using geodetic observations. In *Sbornik materialov GEO-Sibir'-2010: T. 1 [Proceedings of GEO-Siberia-2010: Vol. 1]* (pp. 38–43). Novosibirsk: SSGA Publ. [in Russian].

7. Seredovich, V. A., Ehigiator-Irughe, R., Ehigiator, M. O., & Oriakhi Henry. (2012). Deformation Prediction Using Exponential Polynomial Functions. In *Sbornik materialov Interekspo GEO-Sibir'-2012: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodeziya, kartografiya, geoinformatika i marksheyderiya*

[Proceedings of Interexpo GEO-Siberia-2012: International Scientific Conference: Vol. 1. Geodesy, Cartography, Geoinformation and Mine Surviving] (pp. 148–154). Novosibirsk: SSGA Publ. [in Russian].

8. Vanatwerp, R. L. (1994). *Engineering and design: deformation monitoring and control surveying: Engineer manual*. USA, Washington DC: US Army Corps of Engineering Publ., 141 p.

9. Rules for accounting for the degree of responsibility of buildings and structures in the design of structures. (1981). *Byulleten' stroitel'noy tekhniki [Bulletin of Construction Equipment]*, 7, 12–15 [in Russian].

10. Stolbov, Yu. V., & Stolbova, S. Yu. (2012). *Geodezicheskoe obespechenie stroitel'stva zdaniy i sooruzheniy [Geodetic support for the construction of buildings and structures]*. Omsk: OmGAU Publ., 119 p. [in Russian].

11. Stolbov, Yu. V., Sinyutina, T. P., Kokulenko, & S. Yu. (1996). Probabilistic-statistical method for calculating the accuracy of construction and alignment works in the construction of multi-storey frame buildings. In *Sbornik materialov mezhdunarodnoy nauchno-prakticheskoy konferentsii: ch. II. Gorod i transport [Proceedings of International Scientific and Practical Conferences: Part II. City and Transport]* (pp. 53–55). Omsk: SibADI Publ. [in Russian].

12. Stolbov, Yu. V., Kokulenko, S. Yu., & Lyashko, S. V. (1999). Justification of the accuracy of a detailed breakdown of axes and installation of structures during the construction of single-story buildings of a yeast plant in the city of Omsk. In *Sbornik nauchnykh trudov: Stroitel'stvo v novykh khozyaystvennykh usloviyakh [Collection of Scientific Papers: Construction in New Economic Conditions]* (pp. 22–31). Omsk: SibADI Publ. [in Russian].

13. GOST 27751–88. (1988). Reliability of building structures and foundations. Key Points. Moscow: Standartinform, 9 p. [in Russian].

14. Garagul, A. S., Uvarov, A. I., & Gorbulin, R. P. (2018). Geodetic monitoring of deformations of structures of the oil and gas condensate complex. *Zemleustroystvo, kadastr i monitoring zemel' [Land Management, Cadastre and Land Monitoring]*, 10(165), 52–59 [in Russian].

15. Gorbulin, R. P., Uvarov, A. I., & Pronina, L. A. (2018). Geodesic methods for monitoring observations of tank deformations. In *Sbornik materialov XXIV nauchno-tekhnicheskoy studencheskoy konferentsii [Proceedings of XXIV Scientific and Technical Student Conferences]* (pp. 41–47). Omsk: Omsk State Agrarian University Publ. [in Russian].

16. GOST 27751–2014. (2015). Reliability of building structures and foundations. Key Points. Moscow: Standartinform Publ., 16 p. [in Russian].

17. GOST 31385–2016. (2016). Vertical cylindrical steel tanks for oil and oil products. Moscow: Standartinform Publ., 5 p. [in Russian].

18. Gulyaev, Yu. P. (2007). Analysis of approaches to substantiating the accuracy of geodetic observations of deformation processes. *Geodeziya i kartografiya [Geodesy and Cartography]*, 8, 11–16 [in Russian].

19. Novoselov, B. A., & Novoselov, D. B. (2012). Geodetic control of the construction and operation of the main building of the Raspadskaya concentrator. In *Sbornik materialov Interekspo GEO-Sibir'-2012: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodeziya, kartografiya, geoinformatika i marksheyderiya [Proceedings of Interexpo GEO-Siberia-2012: International Scientific Conference: Vol. 1. Geodesy, Cartography, Geoinformation and Mine Surviving]* (pp. 66–71). Novosibirsk: SSGA Publ. [in Russian].

20. Kalinchenko, I. S. (2014). Development of technological solutions and research to optimize the method of geodetic monitoring of geotechnical systems of the Arctic. *Extended abstract of candidate's thesis*. Novosibirsk, 24 p. [in Russian].

21. Salnikov, V. G. (2015). Improving the methodology of geodetic measurements to ensure the construction and operation of energy facilities. *Extended abstract of candidate's thesis*. Novosibirsk, 24 p. [in Russian].

22. Gaysin, E. Sh., & Gaysin, M. Sh. (2016). The current state of the problems of ensuring the reliability of reservoirs for oil and oil products. *Transport i khranenie nefteproduktov i uglevodorodnogo syr'ya [Transport and Storage of Oil Products and Hydrocarbons]*, 2, 31–40 [in Russian].

23. Khrisanenkova, T. M. (2015). The study of the deformation of the walls of cylindrical reservoirs. In *Sborni materialov konferentsii: Aktual'nye napravleniya nauchnykh issledovaniy XXI veka: teoriya i praktika. Proceedings of Conferences: Actual Directions of Scientific Research of the XXI Century: Theory and Practice]* (pp. 156–159). Voronezh: VGLTU im. G. F. Morozova Publ. [in Russian].

24. Burkov, P. V., Burkova, S. P., Timofeev, V. Yu., Aleshkina, A. A., & Ascheulova, A. A. (2013). Investigation of the state of the bottom of a vertical steel tank, analysis of the method-diagnostics of diagnosing its condition and identifying the causes of its deformation. *Vestnik KuzGTU [Bulletin of the Kuzbass State Technical University]*, 4, 79–81 [in Russian].

25. Mogilny, S. G., Sholomitsky, A. A., & Frolov, I. S. (2013). Geodetic monitoring and reconciliation of metallurgical equipment. In *Sbornik materialov Interekspo GEO-Sibir'-2012: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodeziya, kartografiya, geoinformatika i marksheyderiya [Proceedings of Interexpo GEO-Siberia-2012: International Scientific Conference: Vol. 1. Geodesy, Cartography, Geoinformation and Mine Surviving]* (pp. 132–143). Novosibirsk: SSGA Publ. [in Russian].

26. Nikonov, A. V. (2013). Features of the use of modern geodetic instruments for monitoring precipitation and deformation of buildings and structures of energy facilities. *Vestnik SGGA [Vestnik SSGA]*, 4(24), 12–19 [in Russian].

27. Gulyaev, Yu. P. (2008). *Prognozirovanie deformatsii sooruzheniy na osnove rezul'tatov geodezicheskikh nablyudeniy [Forecasting the deformation of structures based on the results of geodetic observations]*. Novosibirsk: SSGA Publ., 256 p. [in Russian].

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