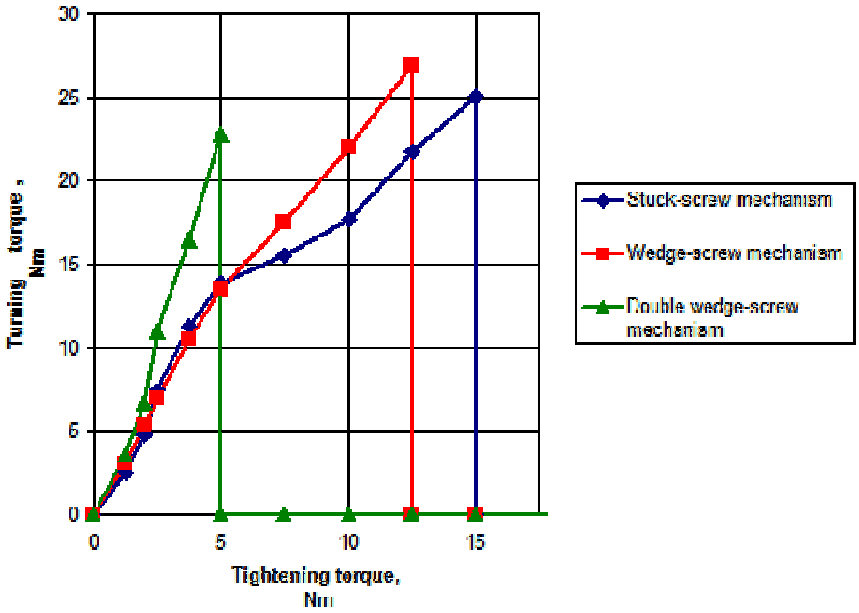

Fig. 5. The dependence of turning torque of the cutting block on tightening torque

REFERENCES

1. Справочник инструментальщика / И.А. Ординарцев [и др.] ; под общ. ред. И.А. Ординарцева. – Л. : Машиностроение. Ленингр. отд-ние, 1987. – 846 с.
2. Сборный твердосплавный инструмент / Г.Л. Хает [и др.] ; под общ. ред. Г.Л. Хаета. – М. : Машиностроение, 1989. – 256 с.
3. Попок, Н.Н. Анализ тенденций проектирования инструментальных систем. Ч. 1. Термины и система обозначения режущих пластин, державок и модулей / Н.Н. Попок // Вестн. Полоц. гос. ун-та. Сер. В. – 2012. – № 3. – С. 71 – 81.
4. Попок, Н.Н. Анализ тенденций проектирования инструментальных систем. Ч. 2. Механизмы крепления модулей / Н.Н. Попок // Вестн. Полоц. гос. ун-та. Сер. В. – 2012. – № 11. – С. 11 – 19.
5. Попок, Н.Н. Анализ тенденций проектирования инструментальных систем. Ч. 3. Инструментальные системы для многоцелевой обработки / Н.Н. Попок // Вестн. Полоц. гос. ун-та. Сер. В. – 2013. – № 13. – С. 19 – 37.

UDC 528.21

EVALUATION OF THE ACCURACY OF THE GLOBAL GRAVITY MODEL EIGEN-6C2 IN COMPARISON WITH THE MODEL EGM2008 IN RELATION TO POLOTSK GEODYNAMIC PROFILE

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Polotsk geodynamic profile was created in 2004 on the basis of geological, geophysical and seismological studies [1, 2, 3], carried out in Polotsk-Kurzeme zone of tectonic faults. This belt isolated relatively recently in the body of the East European Platform group of geologists and geophysicists of the Institute of Geochemistry and Geophysics of Belarus on the basis of gravity, magnetic anomalies and seismological data [1].

Polotsk geodynamic profile includes 12 leveling benchmarks, the centers of which are laid at a depth of 3.0 meters (Fig. 1). Eleven leveling benchmarks were laid in 2004. № 59 leveling benchmark included in the previously established network of state high-precision leveling.

As you know, the height anomaly is one of the characteristics of the anomalous gravity field distribution on the earth surface which can judge the degree of homogeneity or heterogeneity of the local gravitational field of the Earth in the study area. Assuming that the inhomogeneity of the gravitational field in the target geodynamic profile caused by the presence of inhomogeneities in the earth's crust, it is expected that changes in height anomalies in the profile will be observed, first of all, on the faults.

Today thedetermining of the height anomaly is possible in two ways: using gravity data and a combination of satellite and leveling measurements.

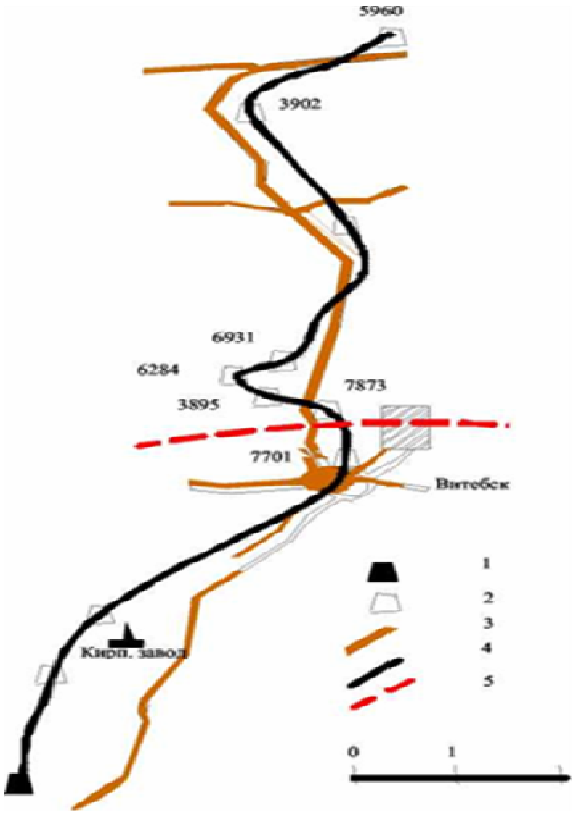

Fig. 1. Scheme of leveling benchmarks on Polotsk geodynamic profile:
1 – leveling frame public network; 2 – over laid leveling frame; 3 – the road;
4 – line leveling; 5 – the expected fault

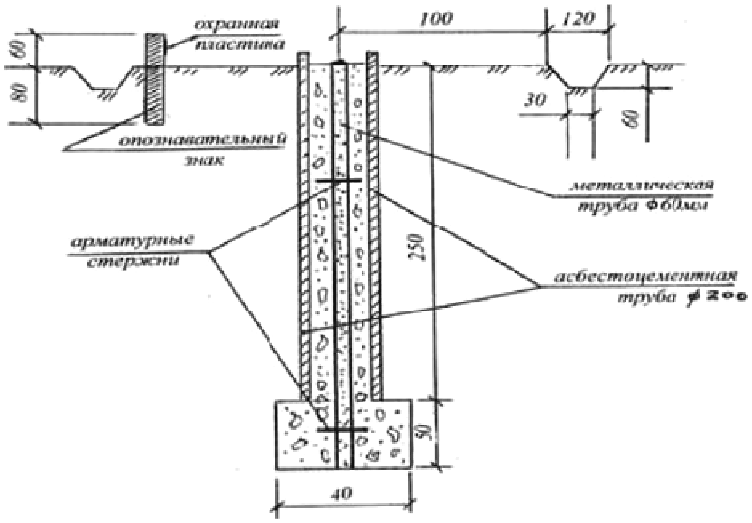

Fig. 2. The design leveling benchmarks on Polotsk geodynamic profile
(basic dimensions are in centimeter)

In accordance with the theory of Molodensky anomaly heights anywhere in the earth's surface is calculated as the difference between geodesic H_M and normal heights H_M^Y [4]:

$$\zeta^M = H_M - H_M^\gamma. \quad (1)$$

The simplest method is based on a combination of satellite and leveling measurements. With the help of satellite measurements obtained geodetic height H_M, and with leveling, reduced to a system of normal heights – normal H_M^Y. In summary:

$$\zeta = H_{SAT} - H_{LEVELING.} \tag{2}$$

To calculate the height anomalies using gravity data there is a strict theory and methods of computation Molodensky [5]:

$$\varsigma = \frac{R}{4\pi\gamma\iint\limits_W (g-\gamma+\delta g)\cdot S(\psi)dw}, \tag{3}$$

where $(g - \gamma)$ – gravity anomaly;

R – radius of the sphere, which is the same surface of the geoid [4];

δg – refines the amendment;

$S(\psi) = \cos\frac{\Psi}{2} - 6\sin\frac{\Psi}{2} + 1 - 5\cos\psi - 3\cos\psi\cdot\ln(\sin\frac{\Psi}{2} + \sin\frac{\Psi}{2})$ – function Stokes;

Ψ – spherical distance from the current point to the point that defines the perturbing potential.

As a result, estimated accuracy of the global gravity model EIGEN-6C2 in comparison with the model EGM2008 for Polotsk profile anomalies by comparing the heights of frames obtained using gravity models EIGEN-6C2, EGM2008 and height anomalies derived as the difference between geodetic and normal heights.

Coordinates of the points for which the heightanomalies were determined are presented in Table 1.

Table 1 – Coordinates of the points

pointname	**latitude**	**longitude**	**height (meter)**
2898	N55°32'38,9"	E28°47'12,5"	159,998
3895	N55°32'27,8"	E28°46'45,0"	163,352
3902	N55°34'42,2"	E28°46'47,4"	150,085
59	N55°30'19,6"	E28°44'54,6"	149,273
5960	N55°35'19,6"	E28°47'22,7"	162,723
6931	N55°32'39,9"	E28°46'45,5"	161,913
7100	N55°33'41,2"	E28°47'03,2"	152,858
7130	N55°30'46,4"	E28°45'44,0"	154,649
7701	N55°31'53,9"	E28°47'04,8"	163,448
7873	N55°32'15,5"	E28°47'01,9"	165,143
8372	N55°31'12,7"	E28°45'58,6"	155,879

For height anomalies in designated areas by model EIGEN-6C2 and EGM2008 used data Calculation Service siteInternationalCentreforGlobalEarthModels – ICGEM. Height anomalies models derived from theory Molodensky approximate formula Bruns (4) [6]. The values of height anomalies relative to WGS-84 ellipsoid obtained by the gravity model are presented in Table 2.

$$\zeta \approx \frac{T}{\gamma}. \tag{4}$$

Table 2 – The height anomalies obtained from the gravity model

pointname	ζ EIGEN 6C2	ζ EGM2008
59	20.639	20.613
7130	20.612	20.586
8372	20.595	20.570
7701	20.556	20.532
7873	20.547	20.523
3895	20.546	20.522
6931	20.540	20.516
7100	20.507	20.483
3902	20.483	20.459
5960	20.456	20.432

The anomalies of heights obtained from the gravity model EIGEN-6C2 and EGM2008 regarding point №59, taken as a stable shown in Table 3.

Table 3 – Values of height anomalies regarding point № 59

pointname	59	7130	8372	7701	7873	3895	6931	7100	3902	5960
EIGEN-6C2 Increments, мГл	0	-0,027	-0,044	-0,084	-0,093	-0,093	-0,099	-0,133	-0,156	-0,183
EGM2008 Increments, мГл	0	-0,027	-0,043	-0,081	-0,090	-0,091	-0,096	-0,130	-0,154	-0,181

Comparable with gravimetrical data information about the anomalies of heights was got with the use of results of GPS-measuring and geometrical leveling. Information is got by comparison of differences of geodesic heights between leveling benchmarks of profile and leveling benchmarks № 59, certain from satellite data, with exceeding between these pointfound from the geometrical leveling. Thus, in second case the anomaly of height was determined on a formula (4) [7]:

$$\zeta_I = (H_I^{\circ} - H_{№59}^{\circ}) - \sum_{№59}^{I} h \,, \tag{4}$$

where ζ_I – is an anomaly of height on current репере in relation topoint № 59;

H_i° и H_{59}° – geodesicheights of current point of profile and point № 59, got from satellite data;

Σh – total exceeding on a profile between point № 59 to current point, found from the geometrical leveling.

Values of anomalies of height in relation to a point № 59 (anomalies of heights in relation to the ellipsoid of WGS-84), got on results GPS-measuring and leveling, presented in a table. 4.

Table 4 – Anomalies of height in relation to a point №59, got on results GPS-measuring and leveling [7]

pointname	heightofkvazigeoid, m
59	0
7130	-0,032
8372	-0,052
7701	-0,085
7873	-0,098
3895	-0,104
6931	-0,106
7100	-0,134
3902	-0,151
5960	-0,197

For 10 points statistical treatment is conducted. The differences of values of anomalies of heights, got from the models of EGM2008 and EIGEN6c2 and differences of geodesic and normal heights were processed (geodesic heights in relation to the ellipsoid of WGS-84). The results of treatment are presented in a table 5.

Table 5 – Statistical treatment of differences of values of anomalies of heights

Errors	Model of EIGEN-6C2 by comparison to EGM2008	Model of EGM2008 by comparison to GPS measuring and geometrical leveling	Model of EIGEN-6C2 by comparison to GPS measuring and geometrical leveling
[Δ]/n, см	0,21	0,73	0,52
+Δ, max, см	+0	+0,3	+0,5
-Δ, min, см	-0,3	-1,6	-1,4
СКП, см	**0,23**	**0,90**	**0,75**

It is possible to mark coming from the results of statistical analysis, that the law of distribution of differences of anomalies of heights is near to normal. The difference of surfaces of a geoid (in models) and a quasigeoid (received as a difference of geodetic and normal heights) makes 0,73 sm and 0,52 sm for the EGM2008 and EIGEN-6C2 models causes systematic shift of models concerning results of satellite definitions and geometrical leveling respectively.

Proceeding from the done work it is possible to draw the following preliminary conclusions:

Data of anomalies of heights are obtained by means of the gravitational EIGEN-6C2 and EGM2008 models, and by means of a combination of GPS and geometrical leveling. According to these data it is possible to claim that the correct use of these gravitational models yields quite decent results which can be used and without attraction of other data.

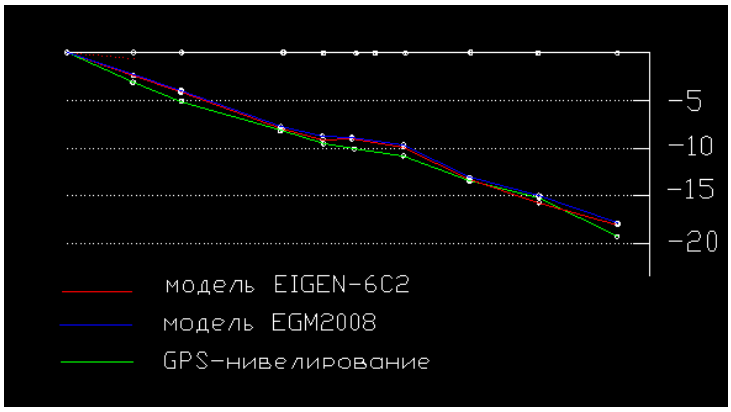

Fig. 3. The schedule of anomalies of heights concerning point 59

The proved EGM2008 model doesn't concede on the accuracy of the latest gravitational EIGEN-6C2 model. These models have very similar characteristics and yield almost identical results. Because the EGM2008 model is long enough used and showed good convergence with results of satellite and leveling measurements in the territory of Belarus, we can't unambiguously recommend the new EIGEN-6C2 model for replacement of the EGM2008 model yet in those works in which the EGM2008 model was used.

The made analysis shows the need of far deeper study of the new EIGEN-6C2 model with attraction of the additional information of bigger volume covering all territory of the republic, and bigger density of data: satellite measurements, high-rise component of the republic, data of gravitation measurementsThe regional model of a geoid of Republic of Belarus of the accuracy of 2 – 3 cm has to be an ultimate goal of such research. As a basis perhaps the EIGEN-6C2 model can also serve.

REFERENCES

1. Garetsky, R.G. Polotsk-Kurzeme belt of breaks / R.G. Garetsky, G.I. Karatayev, V. Astapenko // Reports of NAN of Belarus. – 2002. – T. 46, № 6. – P. 85 – 89.
2. Karatayev, G.I. Monitoring of a gravitational field of the territory of Belarus: results of supervision and interpretation / G.I. Karatayev, Yu.V. Belov // Reports of NAN of Belarus. – 2004. – T. 48, № 4. – P. 83 – 86.
3. Mastyulin, L.A. Not tidal variations of acceleration of gravity on the Belarusian-Baltic geophysical ground / L.A. Mastyulin, V.N. Astapenko, Yu.N. Kuznetsov // Reports of NAN of Belarus. – 1993. – T. 37, № 3. – P. 98 – 100.
4. Sharoglazova, G.A. Gravitation measurements : UMK / G.A. Sharoglazova. – Novopolotsk, 2006. – 195 p.
5. Ogorodova, L.V. Gravimetriya / L.V. Ogorodova, B.P. Shimbarev, A.P. Yuzefovich. – M. : Subsoil, 1978. – 321 p.
6. http://icgem.gfz-potsdam.de/ICGEM/International Centre for Global Earth Models (ICGEM).
7. The report on research work of GPOFI "The Subsoil of Belarus 13" for 2006 – 2010 years "Diagnostics of modern earth movements of Belarus by results of geodetic and geologic-geophysical researches" GB-4026 / G. A. Sharoglazova [et al.].

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PNEUMATIC TRANSPORT OF CRUSHED PEAT

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Traditional area of peat use as a fuel, which was important in recent years, especially in the post-war period, remains in demand and now. Peat is also unique and often indispensable raw material for the production of a number of high-tech and high import-substituting products (bio-stimulants, growth substances and feed additives, sorption materials for absorption of harmful and toxic hazardous substances, including heavy metals and radio nuclides from water and gases, natural dyes, rust converter, complex biologically active granular and