Conclusions. Having analyzed the structure using the finite element method in the program SolidWorks, we can draw preliminary conclusions on the admissibility of this type of gaps compensation in the threaded connection of micrometer screws in precision cutting tools. However, due to the nature of the calculations in SolidWorks Simulation it is impossible to set the compression of split bushing and then to screw the screw. Thus, further simulation was carried out on real models. It turned out that there are moments when screwing screws into the sleeve propped with insufficient depth of the groove. Suitable torque observed both at the width of grooves and step values in the interval of one to two pitches of the thread. Rigidity of bushings decreases with increasing of depth and width of the grooves in the sleeves.

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THE REFIXATION OF STAKING GRID LINES WITH LEAST SQUARE METHOD

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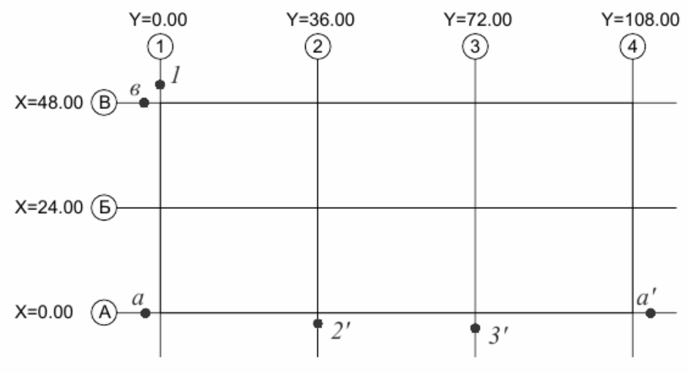
We consider the problem of approximation of the results of linear and angular measurements to refixation of staking grid. Based on the least square method the new coordinates of controls are computed in the coordinate system of building site.

Let staking grid lines of the building are fixed with *n* controls, and line (x) are fixed with *k* controls and the line (y) are fixed with *m* controls. The controls have only one coordinate (x or y) based on what line they fix. For example, for the staked grid depicted in Fig, for controls *a, a', b* the coordinates of *x* are known, and for points *1, 2', 3'* the coordinates of *y* are known.



Model of the staked grid

From the new measurements the coordinates x' and y' of all controls in arbitrary coordinate system are received. It is known that the accuracy of the relative position of controls in the arbitrary system is higher than the coordinates in the system of the staking grid.

That's why the problem of coordinate transformation from the arbitrary system to the coordinate system of the building site with possibility of their refinement with least square method (OLS) is possessed. Thus, the problem can be solved in two stages:

1) coordinate transformation;
2) correction of the coordinates and estimate of accuracy.

Coordinate transformation. Assume that the coordinate transformation is reduced to the conditional rotation of the system on the angle *φ* and to its parallel shift on *ξ* and *η*. The scale of the network will leave unchanged.

This transformation is done using the known formulas of analytic geometry:

$$\begin{cases} x'' = x'\cos\varphi - y'\sin\varphi + \xi \\ y'' = x'\sin\varphi + y'\cos\varphi + \eta \end{cases} \qquad (1)$$

For calculating the transformation parameters a minimum of two tie points with known coordinates in system (*x'*, *y'*) and (*x''*, *y''*) is required. As such points can absent, we should receive the prior values of the coordinates of tie points in the coordinate system of the staking grid, and approximate the transformation parameters with them.

It is obvious that by using various linking points, different transformation parameters *φ*, *ξ* and *η* are obtained, and consequently different coordinates *x'', y''*. To find the single-digit solution to the problem, we will use the least square method [1].

Correction of the coordinates and estimate of accuracy. So, we have the coordinates of the controls in the coordinate system *x*, *y*, and the coordinates of the same controls in the system *x'*, *y'*. As the difference in coordinates is small, we can say that the transformation parameters *φ*, *ξ* and *η* between systems are very small in quantity, and their prior values are equal to $\varphi_0=\xi_0=\eta_0=0$.

Now we need to find the transformation parameters, in which the position misclosures will be minimized. The solution we will find in the form (1). In other words, we need to rotate an additional system to a small angle φ and make its shift at low values of *ξ* and *η* so that the sum of squares of the position misclosures will be minimal.

Required parameters $T=(\varphi, \xi, \eta)$ and adjusted values of $X(x_1, x_2,... x_k)$, $Y(x_1, x_2,... x_m)$ are connected by the equations

$$\begin{cases} \Phi(T,X) = f(T) - X = 0 \\ \Phi(T,Y) = f(T) - Y = 0 \end{cases}, \qquad (2)$$

where *f(T)* is a function that is described by formula (1).

From equations (2) let's move to parametric equations of the amendments

$$\begin{aligned} v_i &= f_i(\varphi_0,\xi_0,\eta_0) + \left(\frac{\partial f_i}{\partial \varphi}\right)_0 + \left(\frac{\partial f_i}{\partial \xi}\right)_0 + \left(\frac{\partial f_i}{\partial \eta}\right)_0 - x_i \\ v_j &= f_j(\varphi_0,\xi_0,\eta_0) + \left(\frac{\partial f_j}{\partial \varphi}\right)_0 + \left(\frac{\partial f_j}{\partial \xi}\right)_0 + \left(\frac{\partial f_j}{\partial \eta}\right)_0 - y_j \end{aligned} \qquad (3)$$

Calculating partial derivatives to prior values of unknown parameters ($\varphi_0=\xi_0=\eta_0=0$), we obtain parametric equations of the amendments in the form:

$$\begin{aligned} v_i &= -y_i''\delta\varphi + \delta\xi + l_i \\ v_j &= +x_i''\delta\varphi + \delta\eta + l_j \end{aligned}, \qquad (4)$$

where $\begin{aligned} l_i &= x_i'' - x_i \quad & i = 1,2...k \\ l_j &= y_j'' - y_j, \quad & i = 1,2...m \end{aligned}$

In matrix form equation (4) we can write:

$$V = A \cdot T + L \qquad (5)$$

Solving the system by OLS, we find desired parameters by the formulas:

$$Q = \left(A^T \cdot A\right)^{-1}, T = -Q \cdot \left(A^T \cdot L\right) \qquad (6)$$

Using the found parameters $T=(\varphi, \xi, \eta)$, we can calculate the transformed coordinates by the formulas:

$$\begin{cases} x^t = x''\cos\varphi - y''\sin\varphi + \xi \\ y^t = x''\sin\varphi + y''\cos\varphi + \eta \end{cases} \qquad (7)$$

The error of coincidence of the points will be:

$$\mu = \sqrt{\frac{V^T V}{k+m-3}} \qquad (8)$$

We will receive mean-square error of parameters of transformation through matrix elements of the return scales:

$$m_t = \mu\sqrt{Q_{tt}}, (t = 1,2,3), \qquad (9)$$

where Q_{tt} – elements of the main diagonal of the matrix Q.

Here is an example of calculation for a model staked grid depicted in Fig.1. Table 1 shows the coordinates of the controls for staked grid.

Table 1 – The coordinates of the controls of staking grid

Names of the controls	X, m	Y, m	X', m	Y', m
a	0,000		221,246	344,838
a'	0,000		130,925	272,892
в	48,000		191,651	382,582
1		0,000	186,161	383,511
2'		36,000	191,959	318,400
3'		72,000	164,462	295,184

The position angle of the line *A* (*a-a'*) in the coordinate system of the building site will be equal to $\alpha=90°$. From the solution of the inverse geodetic problems we find the position angle $\alpha'=218°32'22''$ and calculate the rotation angle $\varphi= -128°32'22''$.

After the arbitrary coordinate system rotation we will receive the coordinates of the controls, which are shown in table 2.

By calculating the shift parameters by controls *a* and *1*: $\xi=-131,878$; $\eta=384,559$. The transformed coordinates are given in table 2.

Table 2 – The coordinates of the line controls after transformation

Names of the controls	Xr, m	Yr, m	X'', m	Y'', m
a	131,878	-387,906	0,000	-3,347
a'	131,878	-272,433	0,000	112,126
в	179,839	-388,274	47,962	-3,715
1	183,987	-384,559	52,109	0,000
2'	129,446	-348,526	-2,432	36,032
3'	128,419	-312,554	-3,459	72,005

In table 3 the matrix of the coefficients of the parametric equations of the amendments and the vector of free members is shown:

Table 3 – Matrix of parametric equations of the amendments and the vector of free members

φ	ξ	η	l
3,347	1	0	0,000
-112,126	1	0	0,000
3,715	1	0	-0,038
52,109	0	1	0,000
-2,432	0	1	0,032
-3,459	0	1	0,005

By solving the system with OLS, we get the desired parameters $\varphi=0,0002$, $\xi=0,0196$, $\eta=-0,0154$, by which we get adjusted coordinates of the controls in the coordinate system of the building site (Table 4).

Table 4 – Adjusted coordinates in the coordinate system of the building site

Names of the controls	X^t, m	Y^t, m
a	0,020	-3,363
a'	-0,002	112,110
в	47,982	-3,721
1	52,129	-0,005
2'	-2,419	36,017
3'	-3,454	71,989

In conclusion we note that this task of adjustment and estimate of accuracy of transformation parameters of coordinate systems, can occur in the following cases [2]:

- instrumental testing of the existing staking grid;
- the refixation of controls of staking grid;
- adjustment staking grid at the mounting level.

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PROTECTION OF FACTORY WORKERS AGAINST THE HARMFUL INFLUENCES OF THE USED LUBRICANTS

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The analysis of the impact of used lubricants on a person is carried out. The possibility of using the emulsion, based on used oil products, made by means of shock waves, generated during the operation of the pneumatic radiator as an antiadhesive coating of the moulds in the manufacturing of concrete reinforced products instead of commodity emulsols and emulsions is proved.

The global annual demand for lubricants exceeds 40 million t. and is growing by about 2% per year. [1]. Nowadays the bulk of these materials is produced on the base of petroleum oil. However, since the early 90s of the last century (mainly in Europe), there is a tendency to use a vegetable oil or its mixture with petroleum or synthetic oils acting as the dispersion medium in the production of lubricants. Key environmental advantage of the lubricants is their biodegradability. This trend should be developed in connection with the widespread tightening of legislation in the field of ecology.

In the global production and use of lubricants there have been two major lines of the solution of environmental problems. The first - the creation of environment-friendly lubricants - non-toxic, non-polluting, with high biodegradability and ease of disposal after the end of their life durability. The second trend - the improvement of the recovery means of used lubricants (UL) by eliminating their harmful impact on the environment [2-4].

The challenge in the direction of rational use of UL is to organize the collection and formulation of quality requirements for subsequent processing and use. Data collection is conducted sporadically and in most cases is associated with the environment protection. This is due to organizational data collection difficulties from small consumers, little quantities of these materials at small enterprises. In the case of large consumers of lubricants (railways, centralized lubrication systems of steel production) UL collecting can be up to 80% of the consumption of the fresh ones. Collection and disposal of UL on a wide industrial scale will give the possibility to solve the problem of environmental protection, as well as significantly expand the resources of raw materials for the production of petroleum products for various purposes.

The goal of research is to eliminate the influence of the exhaust oil products upon the health of factory workers at the expense of their conversion into emulsion, followed by their usage as antiadhesive material for the moulds in the production of concrete products.

Influence of oil exhaust products on the health of a person. Used lubricants are complex multicomponent systems formed in the operation process. UL contain a lubricant base and additives, decomposition products of the base components and those of additives wearability and impurities. UL composition determines, firstly, the degree of exposure to the environment and human, and, secondly, the methods for their recovery. The vast majority of changes in the chemical composition of the used lubricants taking place under the influence of temperature, pressure, oxygen, air, water, the catalytic action of the metals, solar and artificial light, impurities, microorganisms, lead to increased environmental hazards, so that at the end of the life durability of environment-oriented aspect prevails over the economic, taking into account the profitability and technical feasibility only of the re-use of valuable chemical raw materials.

While evaluating the environmental properties of UL it is extremely important to know the precise definition, closely related to the concept of "life durability". Both in Belarus and all over the world, this problem is far from being solved. Extended life durability, profitable from the economic (technospheric) point of view, in most cases leads to the accumulation of ecologically dangerous products in the UL, complicating the processes of utilization themselves. There are no objective and unambiguous criteria of the lubricants wearability. These problems cause considerable difficulties in determining the life of oils, lubricants and coolants, in the assessment of their environmental risks and the choice of methods of rational utilization of the UL.