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INSTRUMENTAL METHODS OF LAYOUT GRID RESTORATION ON THE CONSTRUCTION SITE

SVIATASLAU HRAMYKA, EUGENY GRISHCHENKOV
Polotsk State University, Belarus

During the preparatory period of construction a geodetic layout grid is created on a building site in the form of a construction grid, principal and main axes of buildings and constructions.

The main axes of the building are taken out on batter boards, and also are fixed by permanent and temporary signs outside the earthworks. Longitudinal and transverse axes have the design of coordinate that is expressed in a single coordinate system for the project.

Axes are used at all stages of construction and therefore it is important to ensure their safety and stability.

As a result of the work of digging machines and other equipment on a construction site there are cases of loss or displacement of axial signs. In that case there is a need for axe restoration. Thus the problem of axe restoration becomes complicated as axial signs can have only one coordinate of X or Y proceeding from what axis they fix. The problem of axe restoration has not been studied enough therefore a research objective is the development of modern methods of axe restoration.

In this article four instrumental methods of axe restoration are displayed.

Basic data of our research are the axial signs representing axes with the coordinate of X (point A and B) (Fig. 1) and one axial sign of axes with Y coordinate (point C). There is a problem of staking-out of the second axial sign forming an axe with Y coordinate (point D).

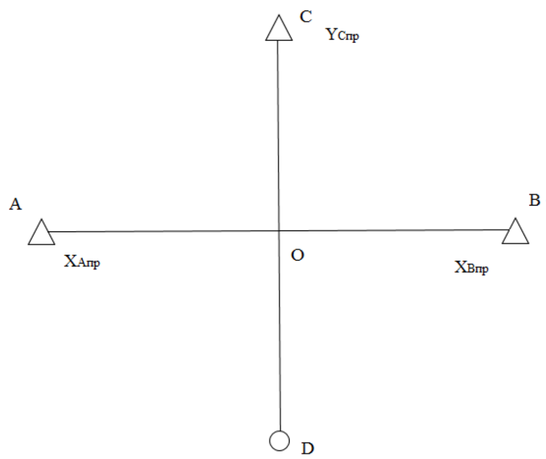

Fig. 1

The first method aims to execute installation of the device at A point, with the direction of a reference point to the other point. As abscissae and ordinates respectively are known in longitudinal and transverse axes, in coordinates of station of the device one parameter will be designed (known), and the other parameter will be conditional. So at station A coordinate is X – designed, and Y coordinate – conditional.

We perform measurements on point C for receiving its coordinates of X and Y. We compare the new coordinate Y with its design value. The value of the received difference of coordinate Y is considered at repeated installation of the device at station A. We repeat the actions described above until the value of coordinate Y of point C coincides with design with the demanded accuracy. Intermediate control will be the equality of values of coordinates X of points A and B with their design value, carrying out measurements on B point in the last approach. Similarly we receive coordinates of point C carrying out installation of the device on B point. Equality of coordinates of point C, received from points A and B will be final control. The device installed in the design system of coordinates of a building site allows staking-out the point D with the design coordinate X forming the lost axis. The solution of the resection at station in point D can be the control of staking-out of point D.

The essence of the second method consists in measurement of corner β_{AC} and the distances of D_{AC}, having installed the device at station A (Fig. 2).

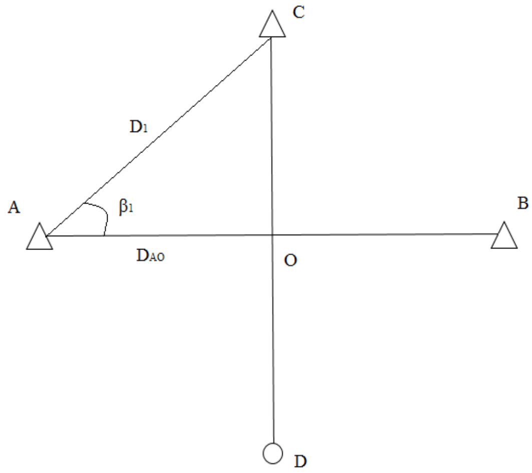

Fig. 2

Using the properties of a rectangular triangle, we find the distance: $D_{AO} = D_{AC} \cdot \cos\beta_{AC}$. Having postponed the given distance from an axial point A, we will receive a point of intersection of axes – point O_1. For a control we carry out similar measurements from point B and we receive point O_2. The points of axe intersection received from two points have to coincide.

In the third method axial points are coordinated in conditional system of coordinates using a method of free station of the device. The purpose of the method is to find out a point of axe intersection whose arrangement won't depend on the used system of coordinates as all points will be defined in uniform system. The coordinates X_A, Y_A; X_B, Y_B;X_C, Y_C of points A, B, C, are determined respectively (Fig. 3). The coordinates of points O, that forms the lost axis and is the point of axe intersection is determined by the parametric equation of a line on the plane (1).

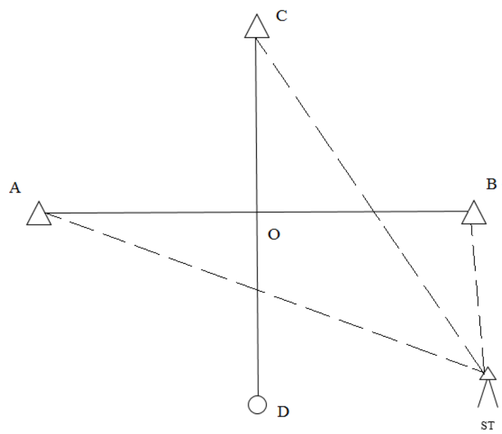

Fig. 3

$$\begin{cases} X_O = X_A + mt \\ Y_O = Y_A + nt \end{cases} \quad (1)$$

where (m, n) – coordinates of vector direction of the line: $m = X_B - X_A$; $n = Y_B - Y_A$;

$$t = \frac{m(X_C - X_A) + n(Y_C - Y_A)}{m^2 + n^2}.$$

The fourth method is realized also in conditional system of coordinates, known values (design) abscissae of axial points A and B ($X_{A_{\text{пр}}}$, $X_{B_{\text{пр}}}$), and value of ordinate of an axial point C$Y_{C_{\text{пр}}}$ are basic data. Installation of the device is carried out by method of free station on condition of visibility of all axial points (Fig. 4).

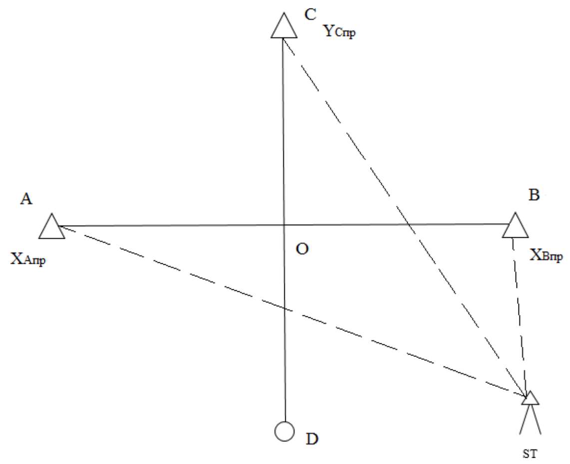

Fig. 4

Using the internal software of the device, we define the distance from point A to point B corresponding to the difference of ordinates of these axial points (ΔY). We appoint coordinates to an axial point A: known design value of an abscissa $X_{A_{\text{пр}}}$ and conditional value of ordinate Y_{A_1}.

Coordinates of an axial point B will be: $X_{B_{\text{пр}}}$, $Y_{B_1} = Y_{A_1} + \Delta Y$. We carry out the installation of the device by method of free station, using the appointed coordinates of points A and B. We perform measurements on point C for receiving its coordinates (X_{C_1}, Y_{C_1}) and compare the received Y_{C_1} coordinate with known from a condition design value $Y_{C_{\text{пр}}}$. The received difference of ordinates $\Delta Y_1 = Y_{C_{\text{ист}}} - Y_{C_1}$ we consider at purpose of new coordinates of an axial point A in the new approach: $X_{A_{\text{пр}}}$, $Y_{A_2} = Y_{A_1} + \Delta Y_1$. We carry out installation of the device and repeatedly we receive coordinates of an axial point C until value of coordinate Y_{C_n} doesn't coincide with reference design value $Y_{C_{\text{пр}}}$ with the demanded accuracy. Thus, the transition from conventional coordinate system to the coordinate system of the construction site is performed by approximations. Without changing stations of the device we take out an axial point D in nature, restoring an axis.

Our research results show that the offered methods allow making external layout grid development and restoration under various conditions on the building site as well as carrying out instrumental check of an external layout grid.

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