



ANALYSIS OF THE COMPOSITION OF CARTOGRAMS OF EARTHWORKS.

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ANNOTATION

The article will be of interest to specialists who perform vertical planning and work on calculating the volume of earthworks, for example, general planners or road builders. With the help of the "Cartogram" you can get a graphical representation of earthworks for calculating the volume of these works by the square method.

Key words: *Cartogram, general plan, layout, Civil 3D, cartogram module, excavation volume, embankment volume, cartogram calculation.*

The earth mass cartogram is a graphical representation of earthworks for calculating the volume of these works using the square method. The method of squares became widespread in the era of the absence of programmable computational tools and is a deliberate discretization to enable the calculation to be performed manually. GOST 21.508-93 SPDS <Rules for the implementation of working documentation for master plans of enterprises, structures and housing and civil objects> allows the implementation of the plan of earth masses using other methods. In this case, the content and form of the plan should be determined by the method used and the conditions of the work.

The graphic document for the vertical layout is the earthwork cartogram. The cartogram indicates the actual, design and working marks, the position of the line of zero works (Fig. 1).

When moving from fill to cut and vice versa, a zero work point is found. The position of the zero work points on the sides of the squares in the form of the distance x_i from any vertex is determined analytically by the formula

$$x_i = \frac{r_i}{|r_i| + |r_{i+1}|} \cdot d_i,$$

where d_i – side length of a square; r_i and r_{i+1} – working marks.

Determination of zero work points located on the sides squares, carried out between adjacent working marks that have different signs. By connecting the points of zero works, a line of zero works is obtained.

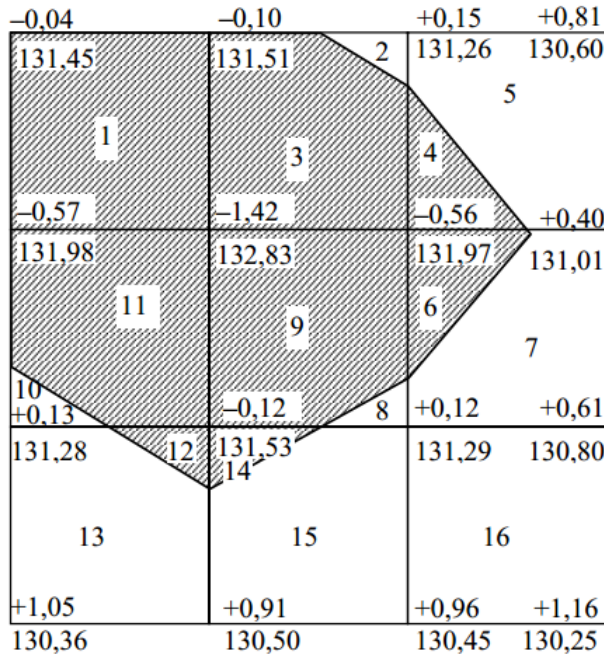


Figure 1. Cartogram of earthworks

Calculation of the volume of earthworks. Excavation volume most often calculated by the method of tetrahedral or triangular prisms. The volume of a tetrahedral prism is determined by the formula

- the height of a homogeneous prism, equal to the arithmetic mean of the working marks located at the vertices of the corresponding positive or negative area.

In today's article, I want to tell you what are the ways to calculate the volume of work in Civil 3D.

All the main tools for calculating volumes are located on the ribbon under the Analysis tab. Volumes can be calculated in the following ways:

- Creation of a surface for calculating volumes;
- Cartogram of earth masses;
- Using volume profiling tools;
- Counting quantities using pay items;
- Calculation of materials and per-picket volumes of earthworks.

Next, I'll tell you in more detail about each of these methods.

Calculation of total volumes. Create a surface for volume. To calculate the total volume of earthworks, it is enough to have 2 surfaces in the drawing: the base surface (usually the surface of the existing earth acts as it) and the comparison surface (usually the design surface).

On their basis, a surface for counting volumes is created. To create such a surface, follow these steps:

Ribbon - Analysis tab - Volume Dashboard - Create a new surface for volume calculation. The Create Surface window appears. Select the reference surface and the comparison surface from the list, give a name and choose style → OK.

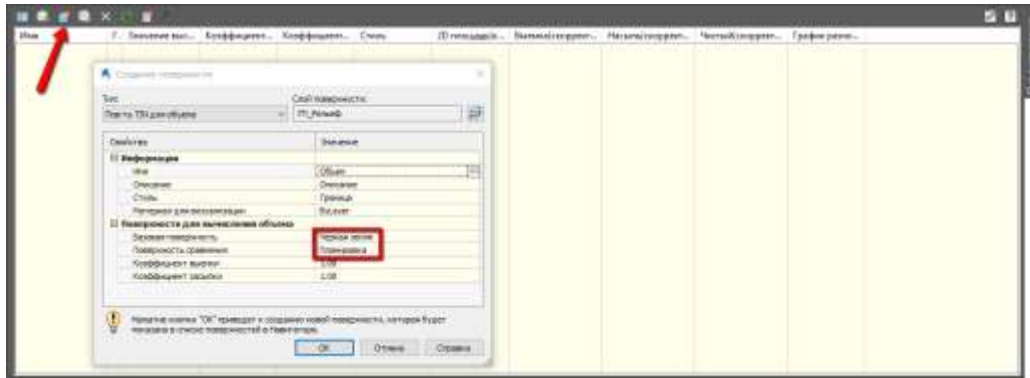


Figure 2. Creating a volume surface

As a result, in the Volume Dashboard, you can always find the results of comparing the two selected surfaces: cut volume, fill volume and net volume. You also have the opportunity to enter additional factors for the volume of cut and fill.

In tabular form, the calculation results can be inserted into the drawing or exported in the form of a report in XML format. The table will appear in the drawing as a block and will be static. Pay attention to this.

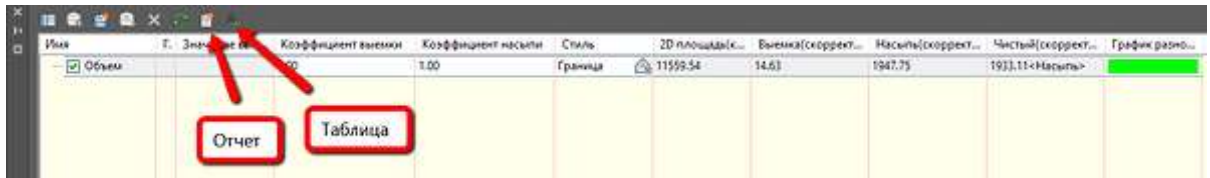


Figure 3. Output of volumes

When making changes to the source surfaces, do not forget to rebuild the surface for calculating volumes, so as not to lose its relevance. For convenience, you can enable automatic rebuilding of such a surface.

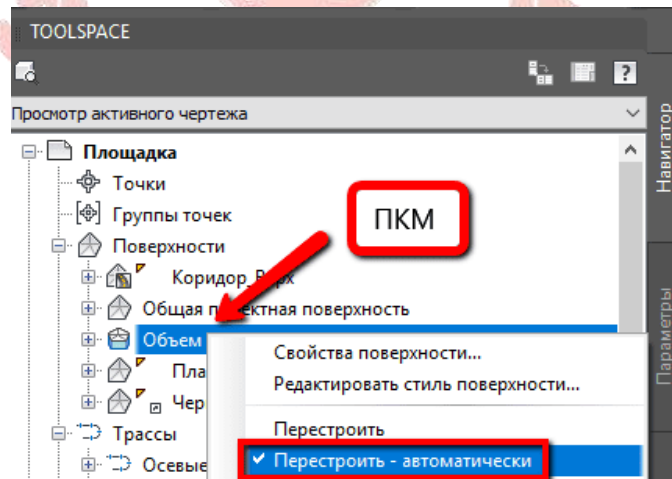


Figure 4. Automatic surface rebuilding

Calculation of the cartogram. To calculate the cartogram, 2 surfaces are also required, which will be compared with each other. It is recommended to calculate the cartogram in a separate drawing. In this new drawing, you can load surfaces using quick links. You also need to draw the outline of the cartogram - it can be an ordinary closed polyline in the drawing.

The module for calculating the cartogram is installed from the additional localization package for Civil 3D - Russian Productivity Tools. Or you can find another suitable app in the vastness of the Autodesk App Store.

After installation, the cartogram from the language pack can be found in the Toolbox on the Toolbox tab under Subscriber Extension Manager.

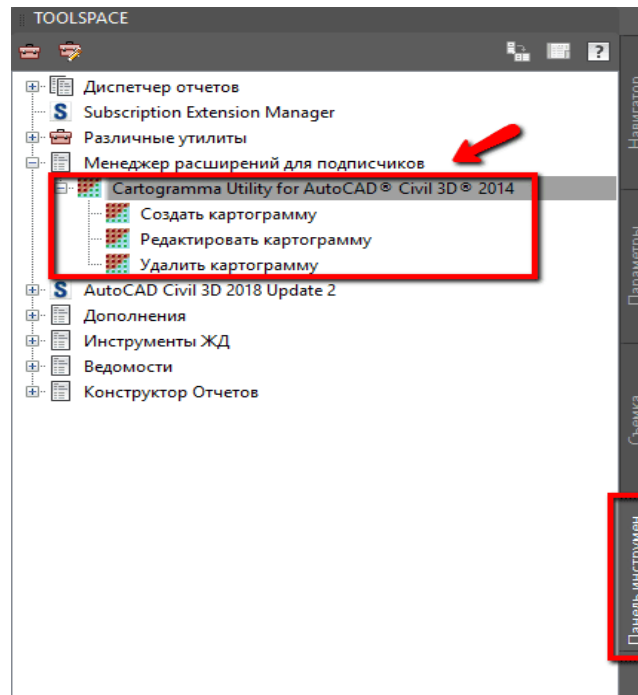


Figure 5. Module Cartogram

Start the process of creating a cartogram, select the required surfaces for comparison, specify the boundary and the starting point for calculating the cartogram. You can also set the rotation angle of the cartogram.

There are 2 methods for calculating cartograms: the triangulation method and the squares method. The triangulation method is more accurate, and the square method allows manual verification of the calculated volumes.

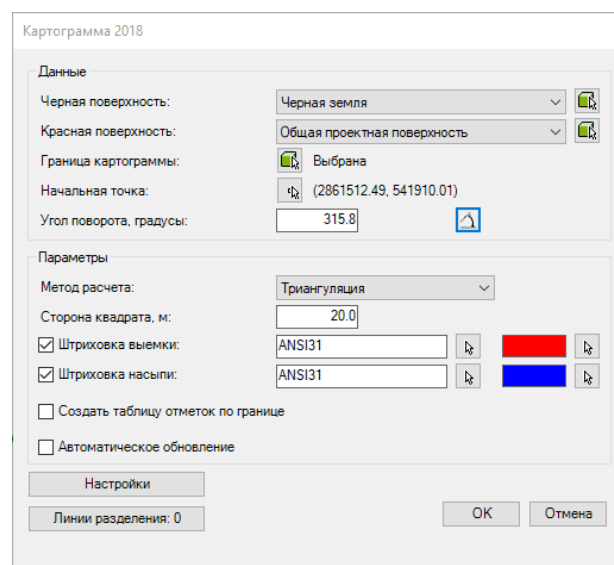


Figure 6. Calculation settings

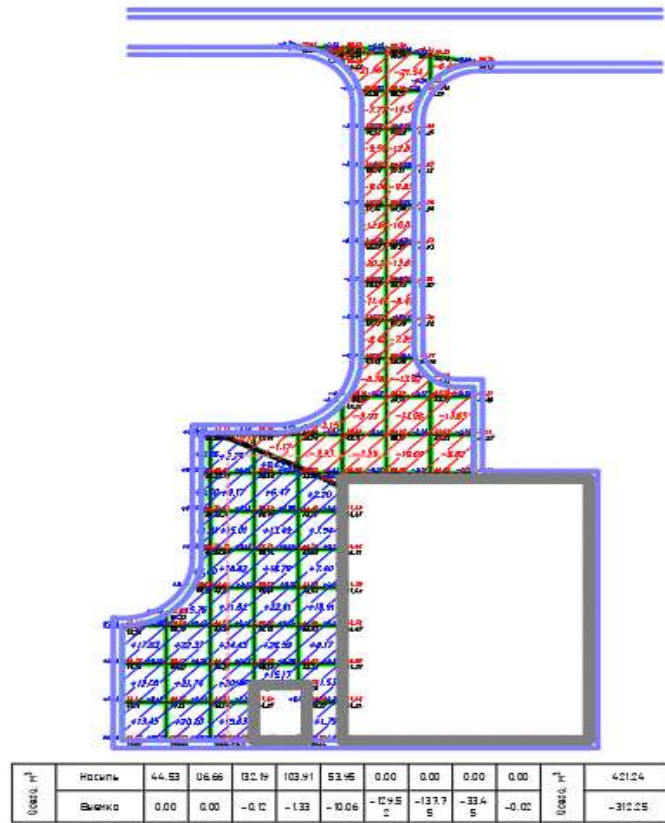


Figure 7. Calculation result

Volume grading tools. You can use the Volume Grading Tools if you have created a grading group, there is a dynamic surface for the grading group, and you have set the base surface for volume calculation in the Grading Group Properties.

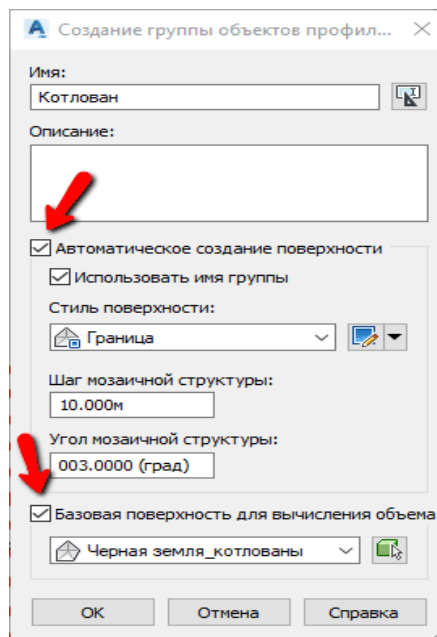


Figure 8. A group of grading objects

In the volume grading tools, you can compare two surfaces - fill volume and cut volume. If you are not satisfied with the resulting volume, you have the option to raise or lower the base feature line against which the grading is supported. Thus, the volume will change.

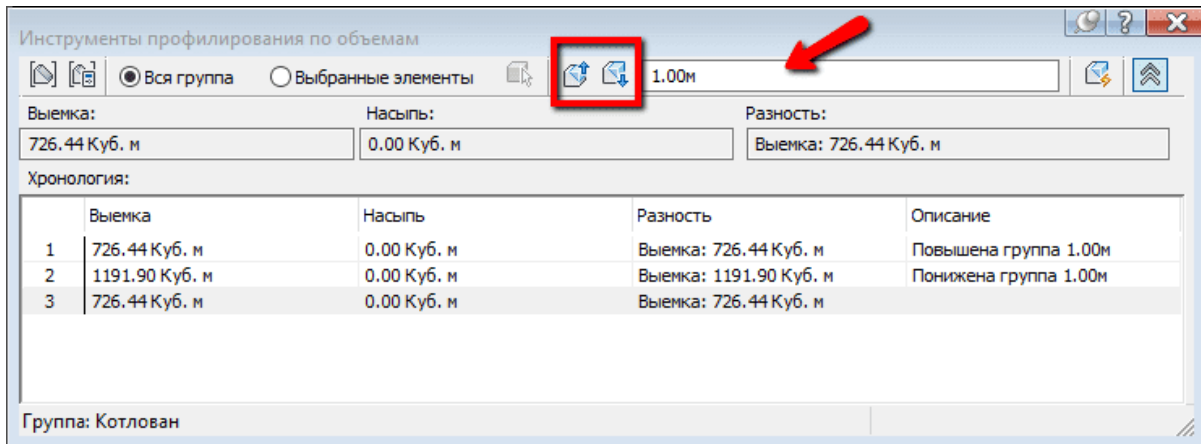


Figure 9. Grading volume tools

In addition, you can bring the amount of work to a certain value. For example, to get the value of the difference between cut and fill volumes close to zero, you need to enter 0 in the automatic volume leveling window.

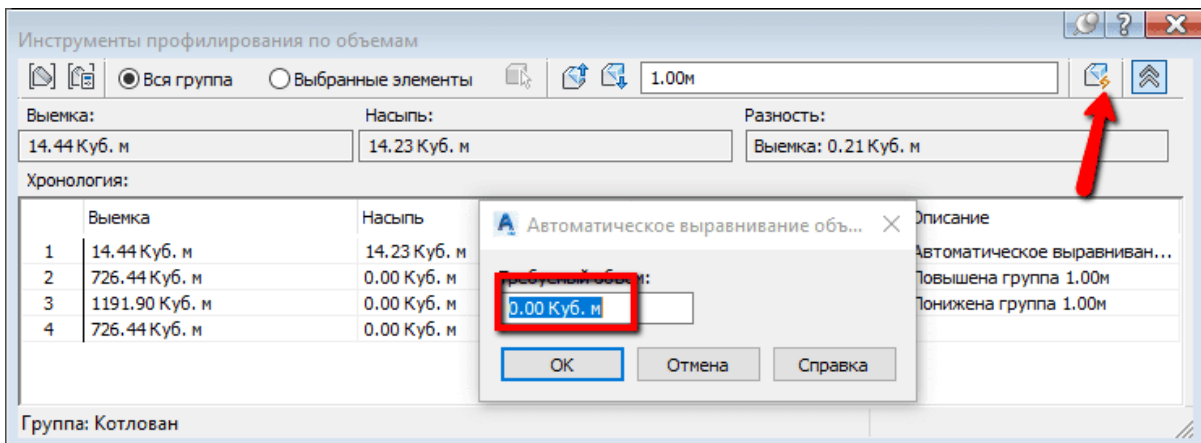


Figure 10. Automatic leveling of volumes

CONCLUSION

The ability to automatically calculate volumes and create initial data for their calculation is a useful skill for any designer of our time Civil 3D has a convenient set of tools for calculating volumes.

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