"Scheme of the planning organization of the land plot" section development based on information modeling

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Abstract. Improving the design efficiency of capital construction projects is one of the promising areas for the science and production development. Today, innovative methods exist and are being developed for rationalization at all stages of construction production. During the design phase, there are certain parts which work needs modernization. Section No. 2 of the project documentation "Scheme of the planning organization of the land plot" was not subjected to automated influence and its design has been carried out in an exclusively conservative way for a long period of time. With the development of design automation tools, including information modeling technologies, new prospects for work and overall rationalization have become opened up for developers. The aim of the work is to analyze the existing methods of computer-aided design for the section "Scheme of the planning organization of the land plot" and their prospects, and the task is to determine the methodology for information modeling, taking into account the existing tools, software systems and the requirements of the legislation in the Russian Federation. This article outlines the features of the automated development in the section, the relationship between the software functionality and the specifics of projects, as well as the prospects for the development and integration of information modeling technologies in the field of land plots organization and planning.

1. Introduction
Planning organization of a land plot (POLP) – is one of the sections of project documentation (PD) for capital construction objects, section No. 2 of project documentation in accordance with the Government Decree of the Russian Federation of February 16, 2008 No. 87 "On the composition of sections of project documentation (GD RF No. 87) and requirements for their content". POLP is required to obtain a positive conclusion of the state PD examination, a permit for the construction of an object, during reconstruction and additional development of a site, during land surveying and other changes in the project.

POLP development is carried out in accordance with the urban planning of the land plot (UPLP), the requirements of BC 42.13330.2016 “Urban planning. Planning and development of urban and rural settlements”, BC 4.13130.2013 "Fire protection systems. Limiting the spread of fire at protected objects", BC 18.13330.2019 "Production facilities. Planning organization of the land plot", BC 59.13330.2016 “Accessibility of buildings and structures for people with limited mobility” and other regulatory documents, taking into account the specifics of the object.
The POLP section includes text and graphics. Each part consists of sections and subsections, the composition of which is determined by the RF Resolution No. 87 and the relevant regulatory documents. Over the past few years, the composition of the POLP section has expanded significantly, and the number of requirements has increased accordingly. This phenomenon is due to the regular amendments to the regulatory legal acts on the land relations regulation and changes in the organization of the Unified State Register of Expertise Conclusions of Design Documentation of Capital Construction Objects (USREC). (Annual report of USREC in Russia for 2019)

Therefore, the number of comments to the POLP section becomes more every year, which generally improves the quality of the section preparation, but at the expense of additional design organization. In most cases, adjustments based on POLP expert comments entail additional changes in other PD sections. As a result, it slows down the passage of the examination and obtaining a positive conclusion, which complicates the obtaining of a building permit and the process of the facility construction itself.

The issue of improving the quality of the POLP section at the design stage is one of the most relevant among designers. In addition to maximum compliance with the current requirements of regulatory documents, it is necessary to use modern computer-aided design tools. These tools can be implemented through information modeling technologies (BIM technologies). The main work of BIM technologies is initially aimed at the tasks of architecture, constructive and engineering support, however, with the right approach and the most effective use of tools, it is possible to develop a POLP section.

2. Methods

2.1 POLP section design according to Autodesk standard

Today, in most cases, specialists in development use the Autodesk AutoCad software package. However, AutoCad is only a tool for 2D drawings of the graphic part, without additional information content and a high level of visualization. If necessary, the specialized graphic editors for 2D and 3D modeling can be used. This conservative design method is the longest, most ineffective and without the possibility of prompt adjustments. The phased implementation of design tasks in this case corresponds to the composition of the POLP project.

The most modern and efficient design method is POLP based on the tools of the 2D and 3D Autodesk programs: AutoCad-Infraworks-ReCap-Civil3D-Navisworks. According to the BIM standard for programmatic interaction, Autodesk forms development POLP tasks with a big difference from the composition of the project, but in the end the result is obtained in full compliance with the RF PD № 87 (Table 1).

| No. | POLP Tasks | Result |
|-----|------------|--------|
| 1   | Creation of space-planning solutions (if necessary, several options) | Space-planning solution |
| 2   | Consideration of options for the placement of sites, taking into account the earthworks volume | Selected site placement option |
| 3   | Development of several options for communication between the sites | Selected communication option between the sites |
| 4   | Uploading data for cost estimation | Assessment of capital costs for planning a land plot (PLP). |
| 5*  | The laser scan results processing: registration and cleaning of point clouds, cutting of point clouds into smaller parts for better control and use | Point clouds ready to use |
| 6   | Get engineering survey data and upload it to InfraWorks | Engineering survey data uploaded to InfraWorks |
As a result of analyzing the Table, it is possible to see that this design method provides much more possibilities for design, in contrast to the standard 2D approach:

1. Ability to develop several design solutions and choose the best;
2. Ability to export and import data, including those from devices and gadgets;
3. The most accurate application of the engineering surveys’ results;
4. Accelerated drafting of a master plan of networks with the ability to search for collisions;
5. Simultaneous development of the basic BIM model and the POLP model.

Along with the advantages of this approach, there are a number of disadvantages that complicate the work: a large amount of software and differences in data exchange formats. The set of software products involved may not always be at the disposal of the design team. Not every project company can purchase several diverse products, train employees or find specialists who own a large number of programs.

Despite the information exchange formats versatility, data conflicts arise at the time of exporting models. Due to the high level of Autodesk software development, format collisions occur less frequently and with the possibility of correction, however, the time spent on solving the problem may not be replenished in the future. Scheme of software interaction when designing a POLP section according to the design stage is shown in Figure 1.

![Figure 1. Interaction of programs by section POLP](image)

The presented development method POLP the most efficient and commensurate with labor costs for a large-scale project, where the customer is interested in visual presentation and development of options in a short period of time. Taking into account the specifics and dimensions of the object, it is not always necessary and possible to design according to the above-mentioned scenario. In the case of overestimating the goals of the project, the advantages of this method may turn out to be disadvantageous.

### 2.2 POLP section design based on the software package GeoniCS

GeoniCS is one of the developing software systems in the field of horizontal design. GeoniCS is designed to automate the engineering surveys, design topographic plans, general plans, external engineering networks and roads, as well as to create a digital elevation model. GeoniCS is a Russian development, the complex is initially focused on the regulatory requirements of the Russian Federation in the field of POLP and documentation.

GeoniCS works on the AutoCAD platform, was originally developed for the surveyors, but now its functionality is regularly expanded for the work of related specialists in the form of separate modules.
The software complex consists of six modules, each of which gives an opportunity to solve a range of tasks in terms of engineering surveys, POLP section, construction organization project and master plan. In rare cases, the working model in the program can be used for rendering. The functionality of each module is presented in Table 2.

### Table 2. List of basic POLP design works

| №  | Module                  | GeoniCS                                                                 | Function                                                                 | POLP                                                                 |
|----|-------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------|
| 1  | Topoplane and Terplan   | Creation of topographic plans, maps and relief based on archival materials, geodetic marks, data from GIS systems. | The module consists of groups of tools responsible for performing the tasks of designing the master plans: horizontal and vertical planning, landscaping. | In terms of the relief organization diagram and the situation plan |
| 2  | Master plan             | The module consists of groups of tools responsible for performing the tasks of designing the master plans: horizontal and vertical planning, landscaping. | In terms of the area improvement scheme                                |                                                                      |
| 3  | Networks                | Tracing engineering communications, placing and combining networks with the ability to automatically build profiles and monitor compliance according to the standards. Automated documentation. | In the part of the engineering networks’ master plan                   |                                                                      |
| 4  | Circuits                | Design of linear objects using tools for editing geometric elements, plan, horizontal axes. Automated building of profiles and drawings, their editing and export. | In terms of the area improvement scheme                                |                                                                      |
| 5  | Sections                | Automated construction of integrated profiles from the Topoplan and Trails modules, roads and volumes of earth masses movement. | In the part of the earth masses plan                                  |                                                                      |
| 6  | Geomodel                | Preparation of a 3D model complex, automated construction of all types of drawings, adaptation of the model for export, visualization. | In accordance with the reference terms                                |                                                                      |

Along with the specialized functions of the GeoniCS modules, there are fundamental and general tools that help solving the following tasks:

1. Building a 3D model of a full-fledged scenario within the site;
2. Tracing and construction of on-site and access roads in three-dimensional format (3D model of the road);
3. Using and updating the symbol library;
4. Generation of drawings and preparation of documentation in accordance with Russian legislation.
5. Minimal visualization

Based on the maximum adaptation to the design features in our country, there is no need to create and configure templates, create additional libraries and administration. Model Detail Level POLP in each module may be different depending on the purpose and specifics of the object, the requirements of the technical task and the time for the section development. 3D model can be imported from other software systems for correction or revision, and also exported as initial data or assignments for other specialists. (Figure 2)
3. Results
As a result of considering the design automation POLP section, the following general advantages can be highlighted: development time reduction due to the use of software tools, a high level of visualization due to graphic capabilities, processes multitasking and delegation, design solutions’ variability, integration with other software systems, effective use of geodetic and topographic information. Despite the presence of local flaws in development methods, in most cases the advantages of software systems dominate. Depending on the purpose of the project, each tool can be used to varying degrees.

Designing based on the Autodesk standard using a suite of programs is most suitable for the large-scale projects for which visual component, cross-platform and flexibility are important. At the same time, there are all the necessary resources for the highest possible level of implementation: temporary, software and hardware, intellectual and financial.

Working in the GeoniCS software package does not provide a high level of functionality compared to the Autodesk bundle, however, it has a large number of high-quality tools that cover a wide range of works and significantly increase the POLP design efficiency. GeoniCS interface is made on the basis of simple algorithms, which makes learning and mastering the program easier. Working on the Autodesk AutoCAD platform provides fast integration and accelerated work.

4. Summary
Thus, all the design automation tools of the POLP section rationalize development, thereby providing a positive effect not only within the section, but also in the project as a whole. The ability to work out the several options at the same time and promptly make adjustments without routine actions ensure a high level of project development at the initial stages, as well as an accelerated examination of project documentation and obtaining a positive conclusion. Total efficiency from POLP development automation has a positive impact on the entire life cycle of the project. Research in information modeling and land management is shaping new directions for the construction industry.

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