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GEOINFORMATION SUPPORT OF THE WORK OF URBAN CONSTRUCTION AND ARCHITECTURE DEPARTMENT

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Setting a problem

Nowadays, in Ukraine, a significant interest is caused by installing GIS-technologies in the sphere of city building. Such technologies provide operational efficiency, completeness and accuracy of information about the current state of city surrounding within this or that territory of a city, as well about the proposed ways towards its change in a course of exploration and reconstruction. The main aim to apply geoinformational systems is the provision of state bodies and local self-governing authorities with the topical, valid and complex information to conduct a comprehensive operational exploration, evaluation and justification of governing decisions, which are directed at shaping a qualitative surrounding for living and life activities of the population on the city territory, for protecting the environment and its stable development [6].

The main aim of geoinformational provision of municipal services is the consolidation of all municipal informational resources within the single data storage on a single geospatial basis, with using the single coding system and classification of estimation objects. Also, it is sufficient to have a possibility of functioning on a different hardware platform, as there is a discussion about the integration of these various organizations, which conduct the regular executive survey of the territory and use different software means. To execute an effective activity it is important to provide the controlled access to registry-based data with the accurate division of layers being accessible for diverse users for their review or revision [1].

Analysis of the latest investigations and publications, which are related to solving this issue

Geoinformational systems have been for a long time used for solving the tasks related to regulating territories. This problem is being researched abroad by different scholars, such as: Chandio I. Matori A.-N., Lawal D., Sabri S. [8], Manonmani R., Prabaharan S., Vidhya R., Ramalingam M. [9], Tao W. [12] and others.

Among the Ukrainian investigations, the researches of such scholars as Liaschenko A. and Charin A. should be emphasized [3, 11]; they have developed the software called SOFTPRO: City Building Cadastre. The main objective of this complex is shaping and actualizing of informational resources of city building cadastre. The system is service-oriented and based on the standards of ISO 19100 – Geographical Information / Geomatics and ISO/TC 211.

The assignment of SOFTPRO: City Building Cadastre is raising the efficiency of informational support in taking governing decisions by the state bodies and local self-governing authorities concerning the stable city development, as well as satisfying informational demands related to city building activities of organizations, institutions, civil unions and citizens based on shaping, integrating, constant updating and effective use of geoinformational resources on the city territory with using modern geoinformational technologies [3, 11].

As a main problem, a big diversity of software means, which are used by municipal services and organizations making the integration of data complicated, should be noticed.

Unsolved parts of the general problem

Currently, the administration of city building and architecture, specifically in the part of constructing the systems of city building cadastre, is actually an aggregating agent of digital data, which is created by the subjects of topographic-geodesic and cartographic activities by executing pre-project searching tasks or executive surveys. As a rule, the executors of such activities may use different software products and often don't follow the unique coding rules of digital information. It makes the activity more complicated and demands the manual revision of data. Except this, the actual versions of city building cartographic materials, which are available in administration, quite frequently don't provide a multiuser access that causes the mass appearance of old copies.

The absence of multiuser access to the information of all involved parties leads to the fact that a part of activities is executed for the second time, and the search of actual data is a very complicated and absolutely not automated task.

The distributed control of different directions for the vital functions of city building defines the specifics f regulating local territories. The separate services are responsible for land parcels, the other ones – for constructions, engineering communications, etc.; though it is clear that without the information exchange the efficient execution of functions will be impossible. The possibility of entering, revision and exchange of data with the distributed access rights will allow keeping the information in the actual state and provide its use by these local services (including the organizations of heat-, water-, gas-, and energy supply).

That is why it is important to define the software-technical instruments and technological regulations of passing to such multiuser systems with the consideration of specifics of already accumulated data and technologies of tasks, which are used by all participants.

Using the system of regulating the DBMS Postgres/PostGIS will allow raising the efficiency of activity not only for the administration of city building and architecture, but as well other involved organizations and providing the use and exchange of information on the single cartographic basis with the display of changes on the web server.

Setting the task of the problem

The aim of research is to determine the software technical instruments and technological regulations upon converting that are already available within the bodies of city building and the architecture of materials to the system of regulating the database Postgres/PostGIS.

Displaying the main material of the problem

In the activities of the administration of city building and architecture, particularly, the scanned pads of the size 1:500, where a few main layers in a vector form are created, are applied. (fig. 1). By completing the topographic-geodesic and cartographic activity of geodesic tasks in the vector form, the new cartographic and attributive information is added. However, by this, there appear the technical problems quite frequently that are related to the use of different software products and other naming of data layers by the executors of activities; it makes the activity more complicated and demand the manual revision of data.

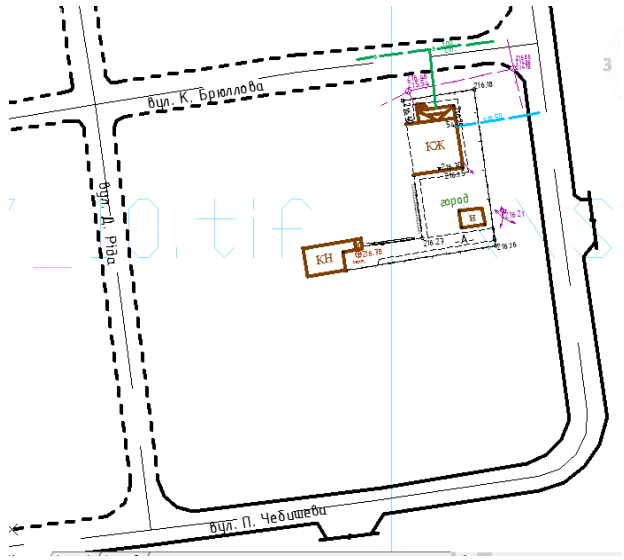

Fig. 1. Fragment of digital map AutoCAD with the vector street network and the added work area by an executor

Basing on the executed analysis concerning the activities of the administration of city building and architecture, as well as available materials, the following main objectives, which have to be solved by the proposed geoinformational system, have been determined:

– creating and updating the single cartographic basis – it means that the system will allow creating the new ones and updating the old digital schemes, while distributing users by some access layer to review and revise, as well as exchange the actual data among them;

– monitoring of the construction processes and other use of the territory – it means an effective consideration of the object of city building activities and city building changes;

– providing the information to users – it means the safe and timely provision of generally accessible information to the maximum amount of users of unprofessional and professional users via web resources;

– informational providing of the processed to give out the permission documentation – it means the realization of creating different documents in the automatic or half automatic modes; as well as issuing construction certificates;

– promoting the development of social, engineering and transport infrastructure – it means a single cartographic basis that will allow the constant update of information and its support in the actual state, thus, the municipal services will be able to revise the exact layers of the system within their responsibility scope;

– providing information for the exploitation of city services' objects (including engineering networks), determination of scopes and terms of their reconstruction – it means the attributive review of data about the material, characteristics, he years of construction and reconstruction of objects, as well as their state for today, etc.

For the data integration from various software resources and provision of multiuser access to them with the segregation of rights, it is appropriate to apply the system of regulating the DBMS Postgres/PostGIS [10], which apart from that is a free software product. For a more detailed analysis of presenting the processes, which are going to be executed in the system, with the help of language syntax of the conceptual IDEF0 modeling, the conceptual model for the activity of the city server of cartographic information has been built (fig. 2).

To describe the algorithms of the system activities and data flows within it, more than dozens of of IDEF0 diagrams, which are presented as a hierarchical tree of nodes, have been developed (fig. 3).

The technological regulations of converting and connecting proposed by us have been checked on the example of one of city buildings' sections in Rivne city. For the system functioning, the enlistment model of geospatial data has been formed – the composition of layers, its attribution and conditional denomination basing on the Single System of Coding and Classification of Cartographic Information has been determined [2, 4, 5].

The available vector cartographic materials of the administration have been developed and are stored in a form of the software product Autocad. To provide the converting from Autocad in the database of attributive data of objects, the intermediate converting in the sdf format has been applied (fig. 4); it may be further placed into Postgres/PostGIS. Particularly, on the figure 5, the view of the campus of the National University of Water Management and Nature Resources Use while connecting to the database of Postgres/PostGIS from AutoCAD is depicted.

As the project organizations may use the software products that are different from AutoCAD, the possibility of connecting to other databases of other software products has been checked: the result of connecting to the database of Postgres/PostGIS from the freely spread software product QGIS has been depicted on the figure 6; from ArcGIS – on the figure 7.

This way, the connecting to the database of city building cartographic information via other geoinformational software products, which may be available among users, could be provided.

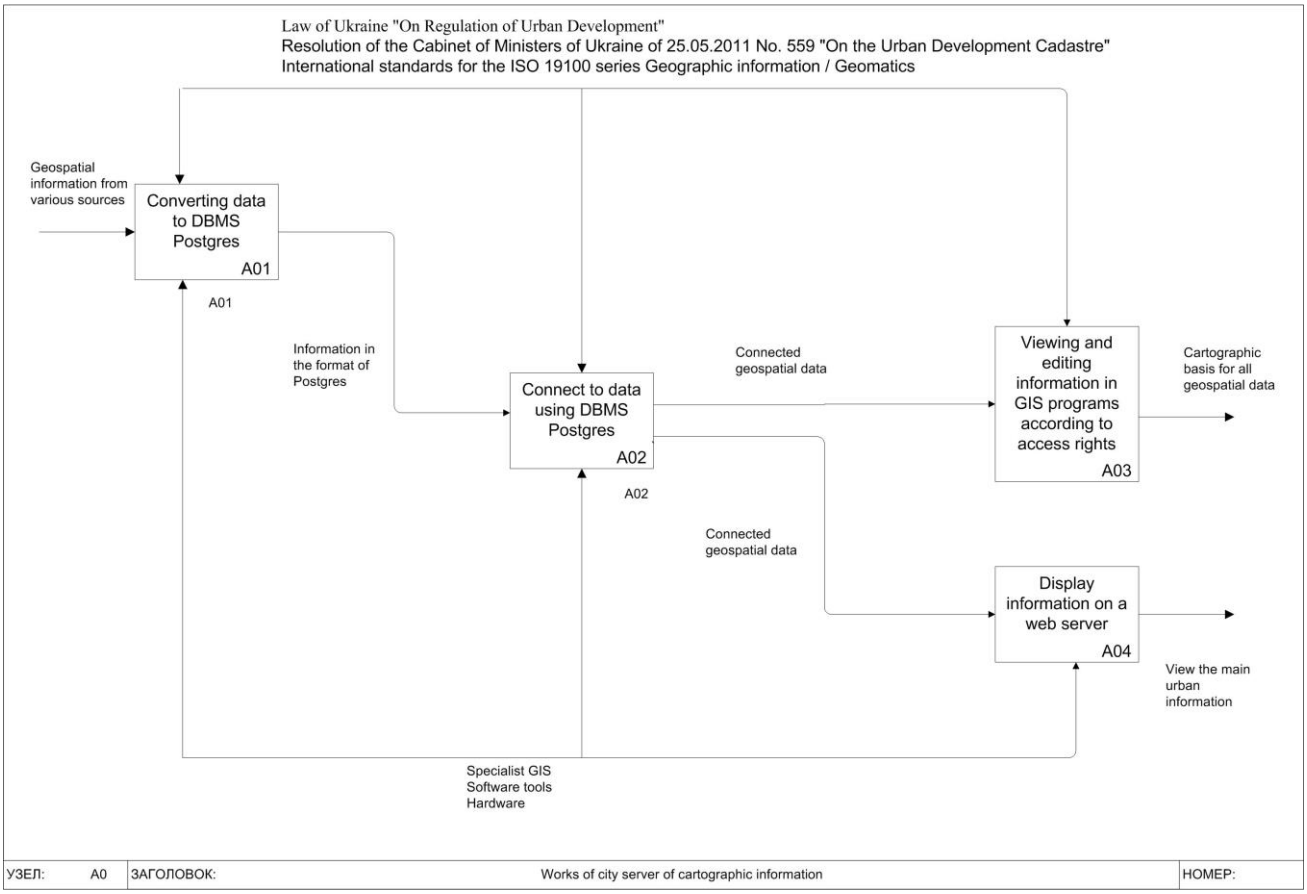

Fig. 2. Activity of the city server of cartographic information

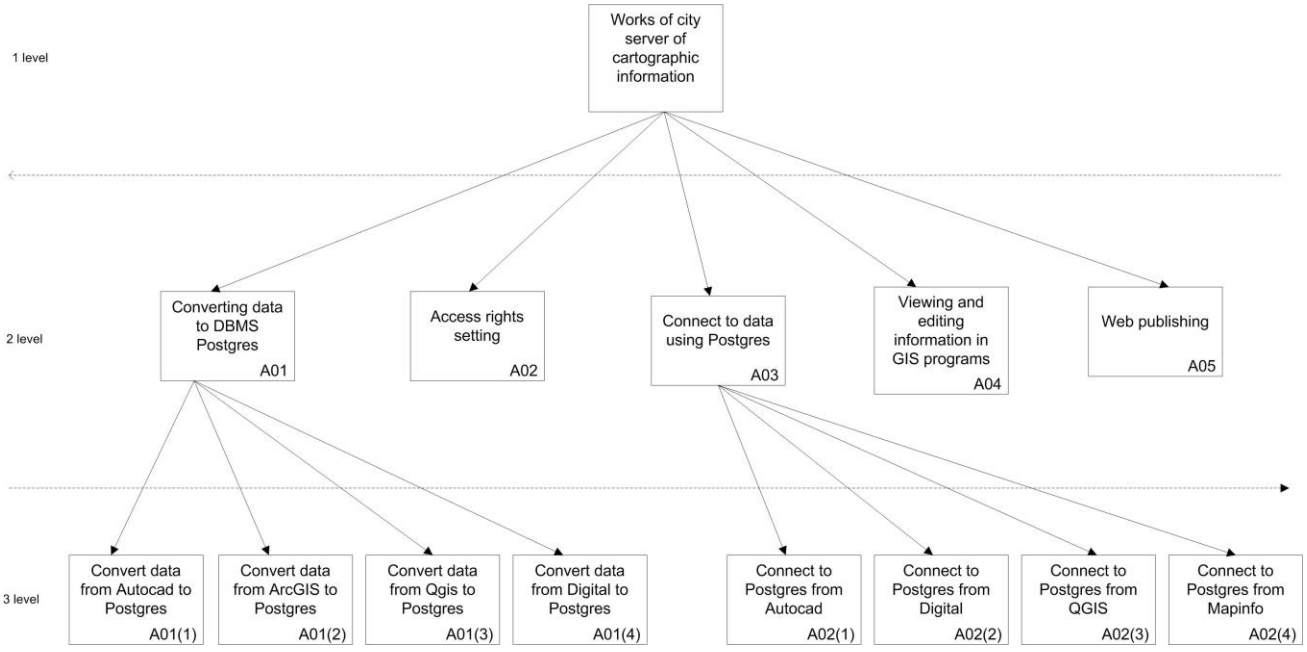

Fig. 3. Tree of nodes of the functional model of city server of cartographic information

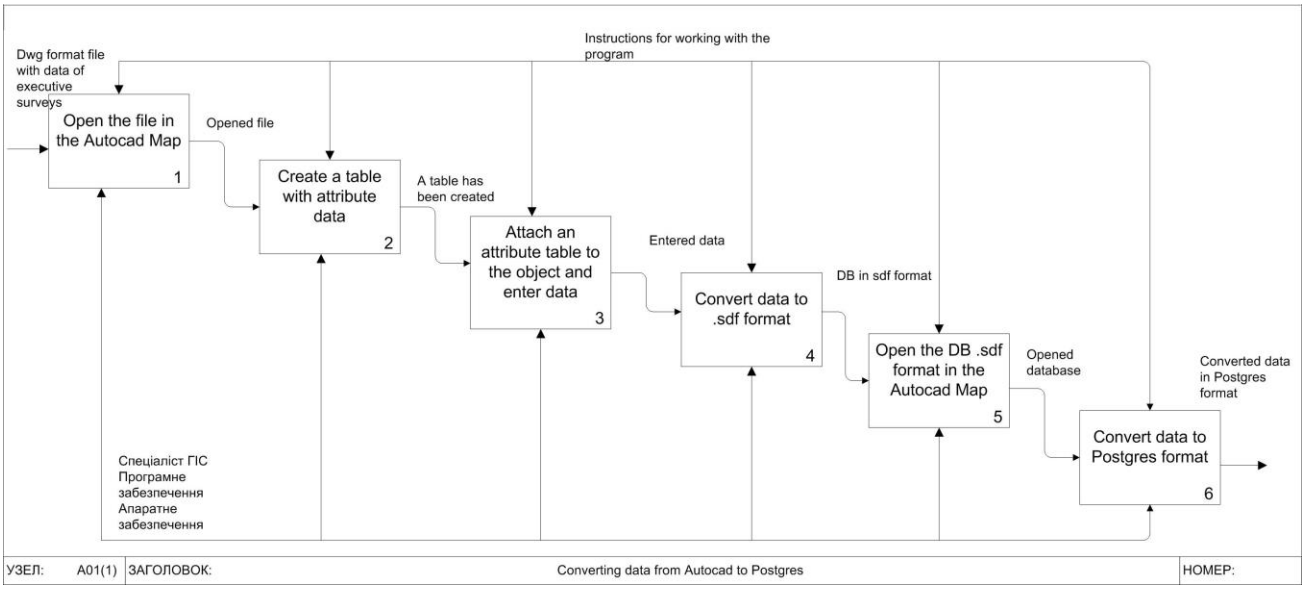

Fig. 4. Algorithm of converting data from Autocad into Postgres/PostGIS

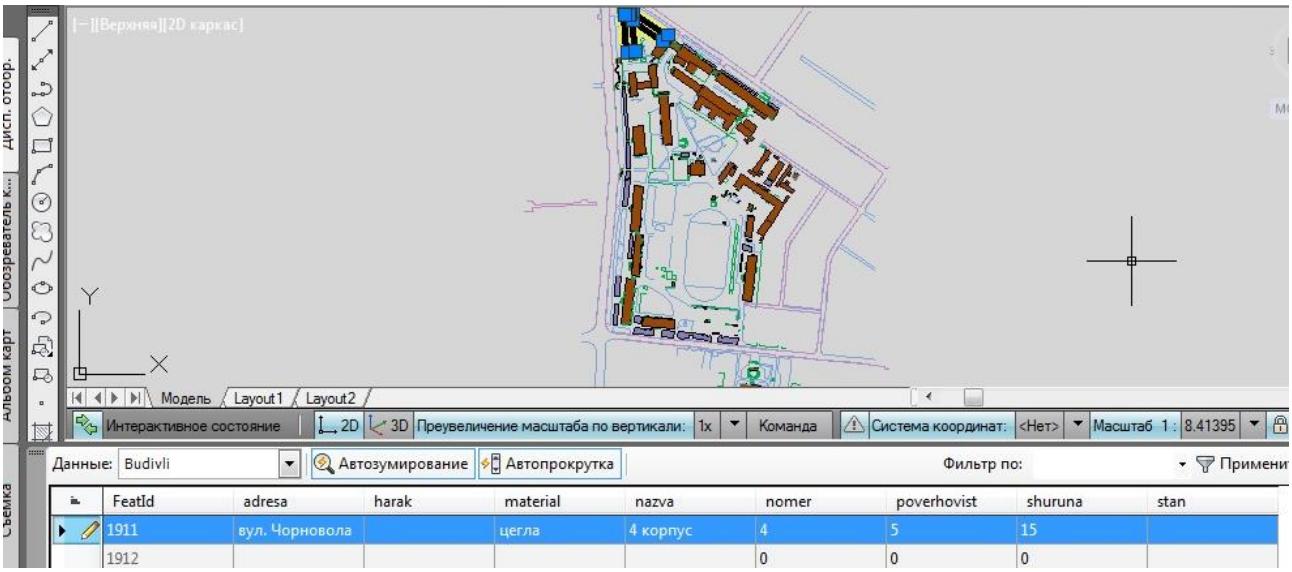

Fig.5. Result of connecting to the DB of Postgres/PostGIS from AutoCAD

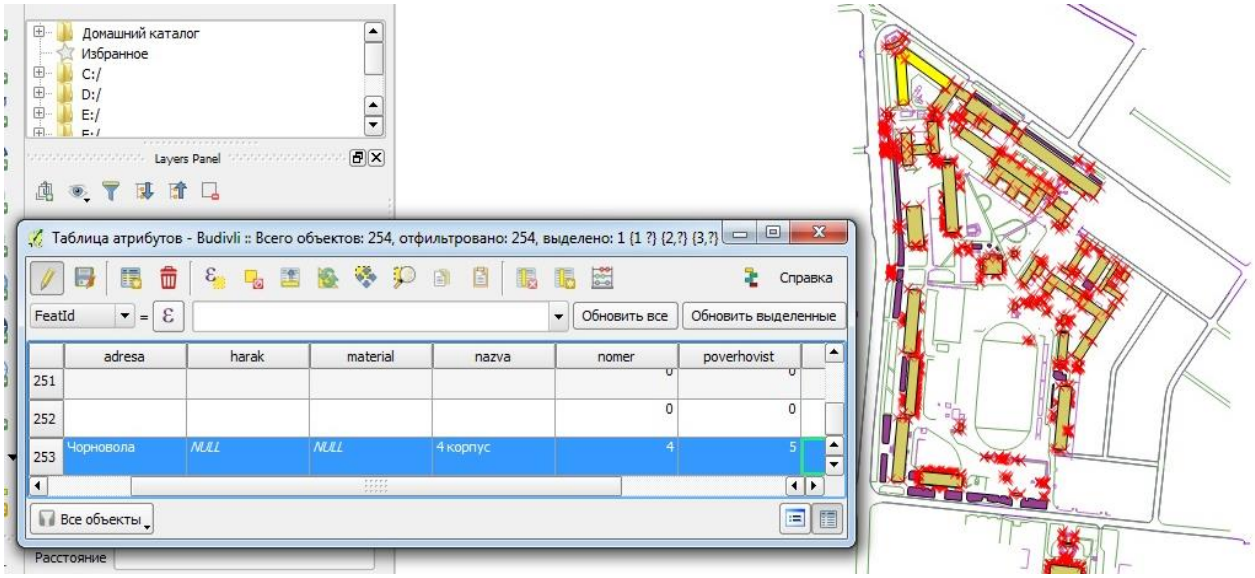

Fig.6. Connecting to the DB of Postgres/PostGIS from QGIS

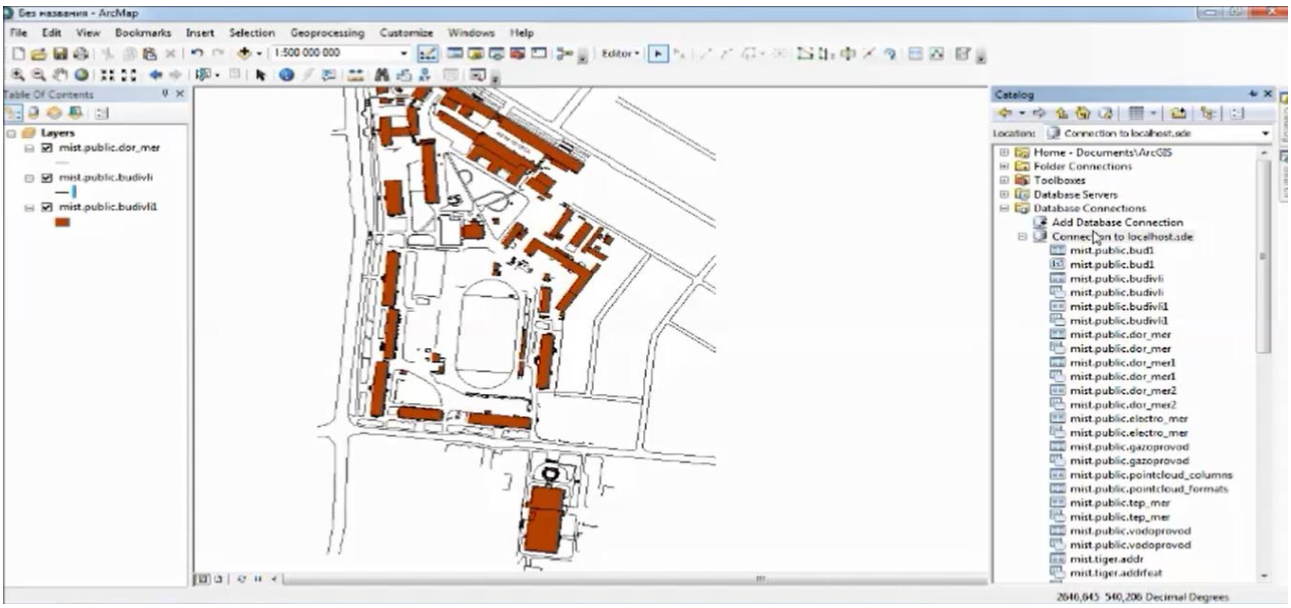

Fig.7. Result of connecting to the DB of Postgres/PostGIS from ArcGIS

For the efficient work, the controlled access to cartographic data with the exact distribution of layers, which are available to different users for their review or revision, should be provided. Depending on the necessity the access rights level for the newly created users may change either from just a review to entering the changes, as well as creating and deleting the existing objects. It should be noted that in Postgres/PostGIS there is a possibility to authorize these rights not only for the whole database but also for separate tables of data.

For example, the *energo* user has been created, which was authorized with a possibility to review all main layers and revise the data related to the power transmission lines (fig. 8).

While entering the information by the user to the map, the update of the information in the database is happening in the online mode, within the execution. To display the changes on the screens of other users it is sufficient only to update the connection with the database, without any necessity to reload the software.

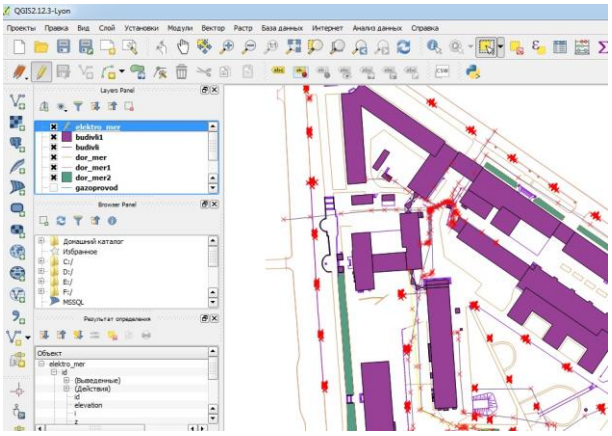

Fig. 8. Possibility to revise the data about the Power Transmission Lines by the energo user

For the involved parties to get acquainted with the actual city building information there is a possibility to customize the web publication from the database Postgres/PostGIS. In this example, the software Geoserver for the publication has been applied; it allows displaying all entered changes in the current mode and review the attributive information by objects (fig. 9).

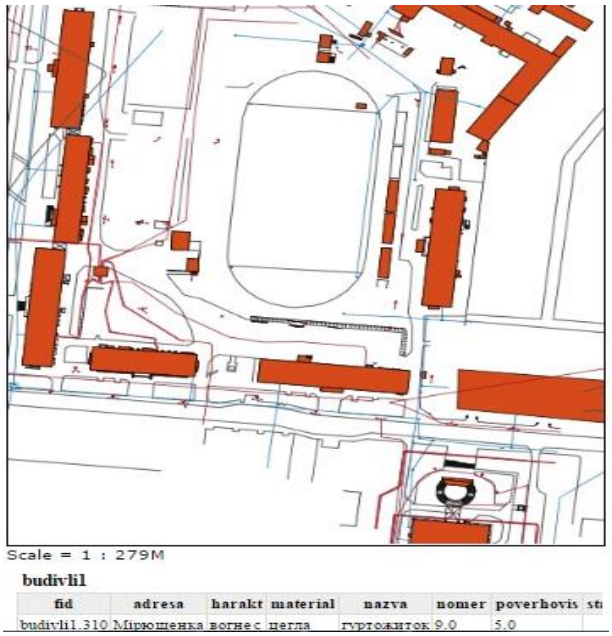

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Fig. 9. Fragment of information on the web server

Conclusion

The technological regulations of using the system of regulating the DBMS Postgres/PostGIS have been applied in order to increase the efficiency of activities of organizations and companies, which provide the control over the city infrastructure. The main objectives have been determined; they have to be solved by the geoinformational system. With the help of the language syntax IDEF0, the algorithm of activities from converting data from the popular cartographic software means in the system of regulating the DBMS Postgres/PostGIS, as well as connecting to the data of the system of regulating the

DBMS Postgres/PostGIS via different software means has been displayed.

The proposed approach has been tested on the example of the campus of the National University of Water Management and Nature Resources Use. The work possibility via different software means (i.e. AutoCAD, QGIS, ArcGIS) and in the multiuser access with the rights segregation has been checked. The publication of data on the web server (with the help of Geoserver) has been implemented.

Implementing the proposed decisions will allow increasing the efficiency of activities of the administration of city building and architecture on the single cartographic basis, decreasing the time spent for their interaction, and providing the possibility to review the main city building information on the web server.

For further, this system may be widespread by other data: ecological, geological, economic-static ones, etc., which may be useful for the activities of municipal services while administering the city territory.

References

1. Біленков В. Застосування геоінформаційних технологій "Панорама" та даних ДЗЗ при веденні інформаційних систем забезпечення / В. Біленков, 2012. [Електронний ресурс]. – Режим доступу: http://msdp.undp.org.ua/data/publications/Біленков.pdf
2. Класифікатор інформації, яка відображається на топографічних картах масштабів 1:5000, 1:2000, 1:1000, 1:500. Укргеодезкартографія, К.: 1998. – 36с.
3. Лященко А. Досвід використання відкритих геоінформаційних програмних продуктів в системах містобудівного кадастру / А. Лященко, А. Черін, 2016 [Електронний ресурс]. – Режим доступу: http://zgt.com.ua/wp-content/uploads/2014/09/ДОСВІД-ВИКОРИСТАННЯ-ВІДКРИТИХ-ГЕОІНФОРМАЦІЙНИХ-ПРОГРАМНИХ-ПРОДУКТІВ-В-СИСТЕМАХ-МІСОБУДІВНОГО-КАДАСТРУ-Лященко-А.-Черін-А..pdf
4. Постанова КМУ «Про містобудівний кадастр», 2011 [Електронний ресурс]. – Режим доступу: http://zakon0.rada.gov.ua/laws/show/559-2011-%D0%BF
5. Проект Закону України “Про Національну інфраструктуру геопросторових даних”, 2016 [Електронний ресурс]. – Режим доступу: http://land.gov.ua/info/proekt-zakonu-ukrainy-pro-natsionalnu-infrastrukturu-heoprostorovykh-danykh/
6. Сухоставець О.П. Застосування геоінформаційних систем у містобудуванні / О.П Сухоставець // Матеріали НТК викладачів, аспірантів та студ. юридичного факультетуту. – Суми: СумДУ, 2013. – С. 112.
7. Черемных С. В. Моделирование и анализ систем. IDEF-технологии: практикум / С. В. Черемных, И. О. Семенов, В. С. Ручкин. – М.: Финансы и статистика, 2006. – 192 с.
8. Chandio I. A. Integrating Geographic Information System (GIS) and Analytic Hierarchy Process (AHP) in public parks planning in Larkana city / I. A. Chandio, A.-N. Matori, D. U. Lawal, S. Sabri // Modern Applied Science, Vol. 5, No. 4, 2011 .P.p.177-189.
9. Manonmani R. Application of GIS in urban utility mapping using image processing techniques /R. Manonmani, S. Prabaharan, R. Vidhya, M. Ramalingam // Geo-spatial Information Science Vol. 15 , Iss. 4, 2012. P.p.271-275.
10. Postgis Spatial and Geographic objects for PostgreSQL. Documentation [Електронний ресурс].– Режим доступу: http://postgis.net/documentation/
11. SOFTPRO: Містобудівний кадастр [Електронний ресурс]. – Режим доступу: http://cadastre.com.ua/
12. Tao W. Interdisciplinary urban GIS for smart cities: advancements and opportunities / W. Tao // Geo-spatial Information Science Vol. 16 , Iss. 1, 2013 P.p. 25-34

Geoinformation support of the work of urban construction and architecture department

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The use of available cartographic materials of urban construction and architecture department is analyzed. The model of the city server with cartographic information is presented. To describe the algorithms of the system's operation and data flows in it by IDEF0 diagrams, describing the processes of data conversion, connecting to the Postgres/PostGIS database from AutoCAD, QGIS, ArcGis, multi-user access settings. The offered algorithms are tested on an example of one city-planning quarters in the city of Rivne.