Making a survey of the public utility real estate and a 3D visualization of buildings

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Abstract: *The Geographical Information System (GIS) is a computer based instrument and widely used to solve different engineering problems that involve using space data. The GIS technology provides problem solving capabilities that involve data creation and management, information integration, costs visualization and estimation that are not provided by most of the construction management software. Despite the increasing popularity that it enjoys, this technology hasn't managed to reach its fullest potential in the construction industry. In this paper the following will be presented: 3D visualization methodology of buildings using the Allplan software and the changes that occurred in time in a quarter of Constanta city.*

Keywords: *The Geographical Information System (GIS), survey of the public utility real estate, 3D visualization of buildings.*

1. Introduction

According to Law 7/1996 regarding the real estate survey and publicity, the *general survey* is a unitary and compulsory system of technical, economic and juridical record by which we make the identification, registration and representation on maps and cadastral plans of all the plots of land, as well as the other real estate on the whole territory of the country no matter their destination and owner. *The general survey* is organized at the level of each territorial and administrative unit, commune, town, city and county and at the level of the whole country.

The *real estate survey* is a specialized survey (subsystem of systematic record and evaluation of the real estate from a technical and economic point of view, complying with the technical standards issued by the National Office of survey and Map Drawing and the basic data from the general survey regarding the surface, category of use and the owner) that contains the basic elements of the general survey. The Ministry of public works, Transport and Home has the responsibility to organize the real estate that suits its activities.

The basic entities of the general survey are the plot, the building and the owner. By "real estate", in accordance with Law 7/1996 it is meant the plot with or without buildings.

The *real estate survey* provides the gathering of specific information such as the existence of facilities at the level of the plot and building, functional features of the buildings, the position and some features of the public utility network elements, etc.

Actually, the real estate survey includes most of the general survey.

The setting up of a data base for the real estate survey and the record of places is one of the aims of real estate survey papers.

The introduction of the *general survey* and the *specialized surveys* in an administrative territory, in order to accomplish the identification, record, registration and representation on the cadastral plans of the buildings, complying with all the technical standards the regulate this operation, is a complex and long term process that cannot keep up with the requirements that are imposed today by the quick rhythm of the changes brought up by the shift from a socialist society to a market economy society.

This shifting process leads to the appearance of a great number of buildings and owners, as well as the growth in the transactions dynamics on the real estate market. The continuous registration regarding the circulation of these buildings on the cadastral plans and documents, as well as in the Cadastral Register, in order to make the cadastral record and the real estate publicity, and also the quick delivery of cadastral documents that are necessary for making the legal real estate transactions, requires hard work and high expenses, as well as a long time.

Today in the countries where the survey is implemented, these documents may be quickly and completely provided by the basic cadastral plan or by the numerical real estate survey and the final cadastral register, but their accomplishment, in our country, requires great investments and a long time.

2. Drawing up the cadastral digital (numerical) plan :

The cadastral numerical plan is made up of alphanumerical data and information, sorted out according to their type and membership in files, capable of providing immediately and at any moment, the partial or complete graphical expression of the space, at an arbitrary scale.

The *cadastral digital plan* has as its main element, a data base that contains all the information related to the owner and the building.

The manner in which the *cadastral numerical plans* are drawn up is closely related to the way of gathering the data that makes their contents. The cadastral numerical plans may be drawn up in three ways in accordance with the way of gathering data from the plot. Thus, taking into consideration the three ways of gathering the cadastral data, it results three ways of drawing up the numerical plans. The drawing up of the plans when the data is gathered from the plot

- using classic and automatic topographical instruments;
- drawing up the cadastral numerical plans when the data is gathered in a photogrammetric way;
- drawing up the cadastral numerical plans when the data is obtained by digitalizing the existing graphical plans.

The advantages of the cadastral numerical plan:

- The value of the information stored in the cadastral numerical plan is completely guaranteed, its preservation does not depend on a graphical drawing, that almost always is imperfect and generally has an unstable support in time;
- The cadastral numerical plan allows the complete automation of the cadastral works, starting with the gathering of the data from the plot and continuing with their processing, calculating the areas, applying works of plotting/merging, their updating and finishing with obtaining the graphical plan;
- The scale of the cadastral numerical plan is 1:1; so it is independent of the scale of the graphical plan (all the entities of the cadastral numerical plan are recorded through their field coordinates) and refer only to the detailing degree (the density of the represented entities and their calculating precision).
- Obtaining the cadastral graphical plan, on a support, at a certain scale, is made in an easy way, by changing the scale parameter.
- The cadastral numerical plan must have the contents of the basic cadastral plan so that it can be used later also for obtaining smaller scale cadastral plans or thematic cadastral plans and it is necessary that it contains elements that are obtained by field constructions, in order to comply with the requirements from the larger scale, that is the scale 1: 1500 within the built-up area and 1:1000 outside the built-over areas.
- The cadastral numerical plan is very useful in making studies and taking decisions in different fields of activity, because it allows the quick selection, by computer and at the users' choice, of necessary information and then automatically drawing them in the form

of the basic cadastral plan or the thematic cadastral plans (for example, plan for different public utility networks, plan for means of communication, plan for representing the soil units or the fields with eroded areas, plans for real estate survey);

- The cadastral numerical plan allows the quick obtaining and at any scale of the graphic plan, with high precision and speed in performing the drawing, thus compensating for the lack of professional draughtsmen (cartographers).

3. Geographical information system (GIS):

A Geographical Information System (GIS) is an association of people, equipments, programs, methods and standards aiming to gather, validate, store, analyze and visualize geographical data (Fig. 1).

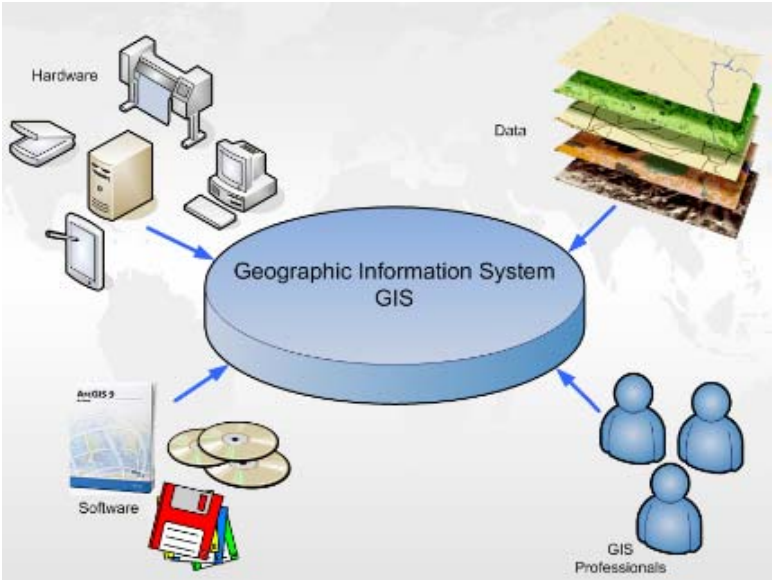


Fig. 1 - **Geographical Information System** (GIS)

GIS (Geographical Information System) is made up of four major components: the software (the system of programs), the hardware (the computers and the input and output peripherical elements), the geographical information – data (geo-referential), the specialized personnel to exploit the above mentioned elements.

GIS cannot function if any of these components is missing.

In order to shape the surrounding world, GIS uses objects and space relationships. The GIS objects may be natural (rivers, vegetation), built (roads, pipes, buildings) or conventional (frontiers, plot limits, administrative units). A GIS object is characterized by a position and a shape in the geographic space and by a series of descriptive features. The space relationships between objects (neighborhood, interconnection, continuity, incidence, etc.) help in understanding the situations and in taking decisions.

The main elements that define the most important processing made on the digital cartographic data (taking into consideration: data acquisition, representing the data in a geographical information system, methods for making the data bases, the insertion of maps and plans and the 5 generic questions that are specific to a GIS) are:

Data acquisition: a GIS allows the insertion of the acquired data at different moments, scales and resolutions, by different methods, the connecting element being provided by the geographic localization in the territory.

Data sources of GIS are: field records and notebooks, map digitalization, scanning and vectorization, CAD data conversion, photogrammetry, teledetection (air or satellite multispectral images), GPS.

The data representation in a GIS: this handles two types of data: *space data* (represents the position and shape of the terrestrial objects using three graphical entities: point, line and the polygon) and *descriptive data* (represents information about the objects that are placed in a map using features - questions and values of the features - answers)

A GIS data base is actually a digital map that is a collection of geographic data organized in a form that makes them easy to process by the computer.

A GIS must include facilities in order to answer the following 5 generic questions:

1) LOCALIZATION: "What is at…?" – This question aims to identify the objects places at a certain geographic position specified by the denomination, mail address or geographic coordinates.

2) CONDITION: "Where is …?" – This question aims to find the precise position of an object or a multitude of specified requirements.

3) TENDENCIES: "What has changed since…?" – This question aims to underline the changes that occurred in a geographic area in a period of time.

4) SPECIFIC FEATURES: "What specific features are there in the area…?" – This question supposes a complex analysis looking for cause –effect type correlations and abnormalities that occurred at a certain moment in an area having known features.

5) MOULDING: "What would happen if…?" – This question supposes a complex analysis aiming to anticipate the impact of an event (adding/eliminating/transforming an object) on the environment.

A Land Information System (LIS) is an instrument for taking legal decisions both administrative and economic and an aid in planning and developing, that is made of a data base, on the one hand, containing different space data for a certain territory and on the other hand, of procedures and techniques for the acquisition, storing, updating, processing and systematic distribution of data (Fig.2).

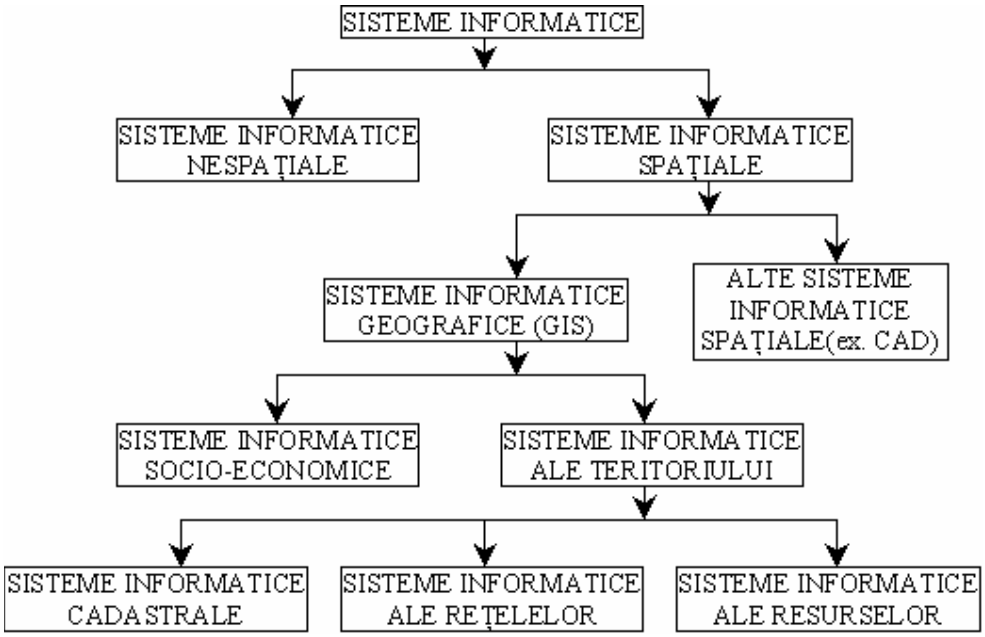


Fig. 2 LIS in the information systems

GIS is focused on the technology of acquisition, storing, retracing, manipulating, analyzing and presenting of data. GIS is oriented to hardware and software and data on a small scale, for example in regional and global studies, starting from the topographic map.

LIS are focused on land problems. It deals not only with the technology side, but also with the institutional relations and the use of data. The LIS definition may be extended to the Land information management (LIM). The processed data of the LIS are at a larger scale and come from the cadastral maps.

The level of abstracting of the GIS is higher than that of the LIS. A LIS is registrative, while a GIS is statistic.

In many cases a GIS is abstracted from a LIS. An important difference between GIS and LIS is the precision of the space data. This precision is much higher in the case of LIS whose graphic products are at a larger scale (>1:10.000), those of the GIS are at a smaller scale (<1:10.000). Thus, there is such a big difference between their applications that they can coexist without being in competition.

There are four necessary steps in making LIS:

- Acquiring the data and validating and managing the data,
- Manipulating and analyzing the data, generating the final products.

A *urban information system* allows the information processing in different ways: archiving, updating, localizing, editing, typing of reports or generating different types of forms.

The system also offers the possibility of visualizing the associated elements, in an interactive manner, the digital map and the technical data using a software application for the control of the GIS environment.

This way the work with analogical plans is eliminated. The time for using the digital data is much shorter than the time for studying the plans that are not updated, on paper, material that gets easily out of order in time.

A simple and quick solution of looking for information is the space interrogation, that offers a detailed or whole vision, but it is always updated, on the land.

This way, the Public Administration could create its own information system of analysis and town planning that offers advantages such as: monitoring the construction rhythm, the automatic localization of a building or street, the visualization of the digital plan superposed with the latest satellite image, drawing the thematic maps.

This system becomes a working instrument for the Local Administration for starting new activities and projects in the benefit of the town community, such as: the issuing of town planning certificates, issuing the construction permits, as well as supervising them, making a tax control system.

In the construction industry, the necessary information for planning and designing is stored in different ways, such as drawings, rough plans, specifications and diagrams. In the process of planning, the specialist is forced to reorganize in a repeated way and interpret the gathered information from different sources. This process is exhausting and may be subject to errors. Thus, the construction industry needs a system that can integrate different types of data and provide the required and timely information that will finally support different decisions and operations in the construction. Due to the progress in the information technology, the construction industry started to “benefit” from some advantages of this development. GIS is a new instrument in the information technology and can improve the planning of constructions and make the design more efficient by integrating the localization and thematic information in one field. The GIS capabilities of storing large data bases may be used for keeping data in digital form about construction too.

4. Application:

In order to solve a methodology of 3D visualization of a building the Allplan soft is used and the procedure supposes the following steps:

a. The cadastral digital plan (Fig. 3), made up of a complex data base, containing information about the sector limits, streets, houses, buildings, etc. This data base was filled with information that is specific the existing constructions, such as: the mail number, the type of building, appliances, the built-up surface, the unfolded surface, codes for the foundation, for the structure, for walls and others. The integration of these graphic data bases together with the text data bases was made using a specific application that was made precisely for handling information. (Fig. 3).

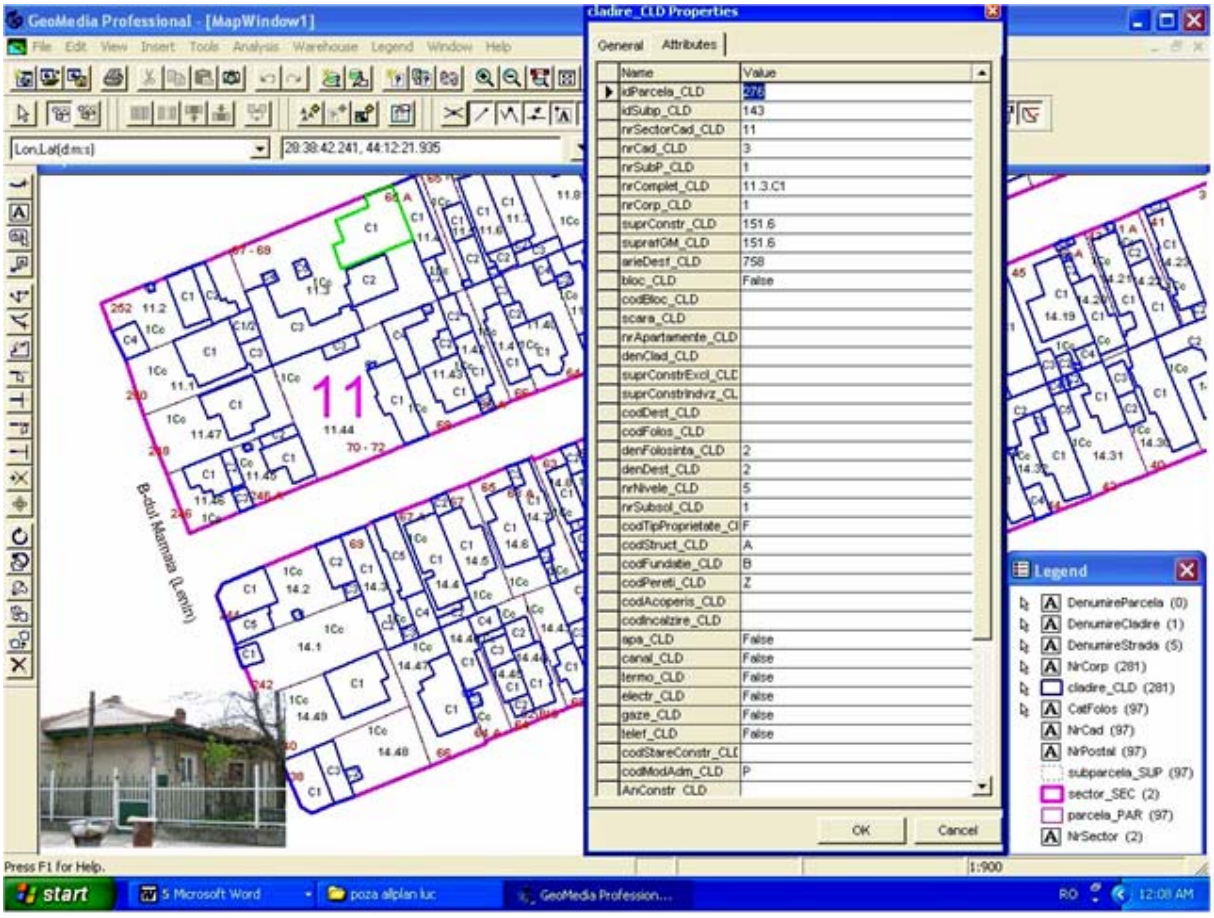


Fig. 3 Digital cadastral plan

Thus, a town information system allows, on the whole, the processing of information in different forms: archiving, updating, localization, editing, typing of reports or issuing different types of forms. The system offers, on the other hand, also the possibility of visualizing certain associated elements.

As a definite example, when choosing a house, simply pressing a button, details such as: ownership titles, topographic plans, construction surveying of the building, even the photo of those constructions will appear.

An interrogation of the feature base has its geographic correspondent, a report being automatically issued.

b. The issuing of the geometric models of buildings and the adding the structures (Fig. 4):

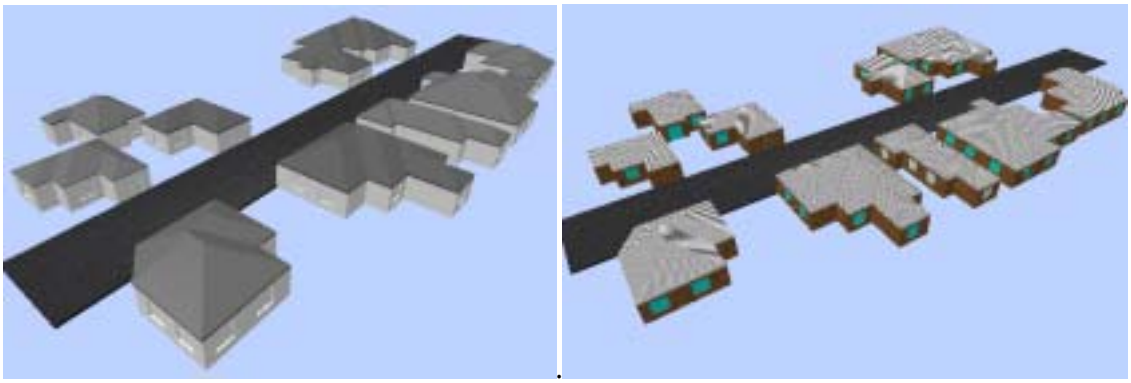


Fig. 4 Geometric model (left) architectural (right)

c. The representation of the architectural drawing of buildings is made on layers in order to perform a 3D view as complete as possible in GIS.

- The plan, front and 3D view of a building (Fig. 5):

Fig. 5 Plan, front, 3D view

- Technical data of the building and information about the materials that are used for its construction (Fig. 6):

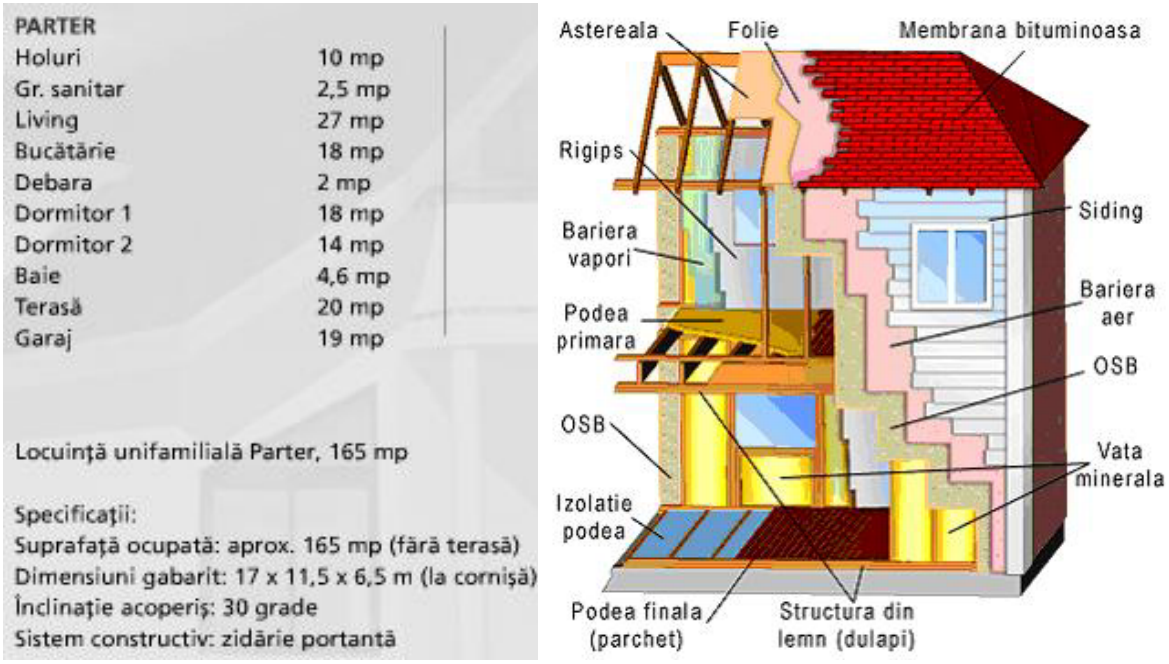


Fig. 6 Technical data, construction data

-Roof detail (Fig. 7):

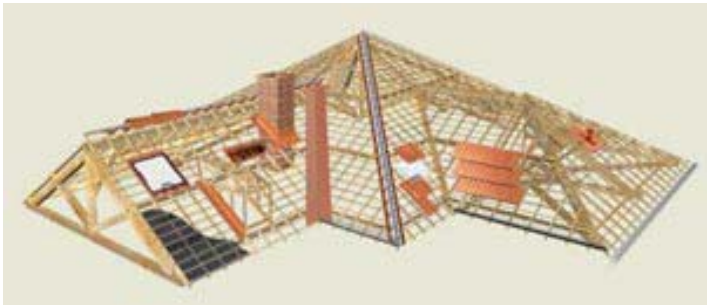
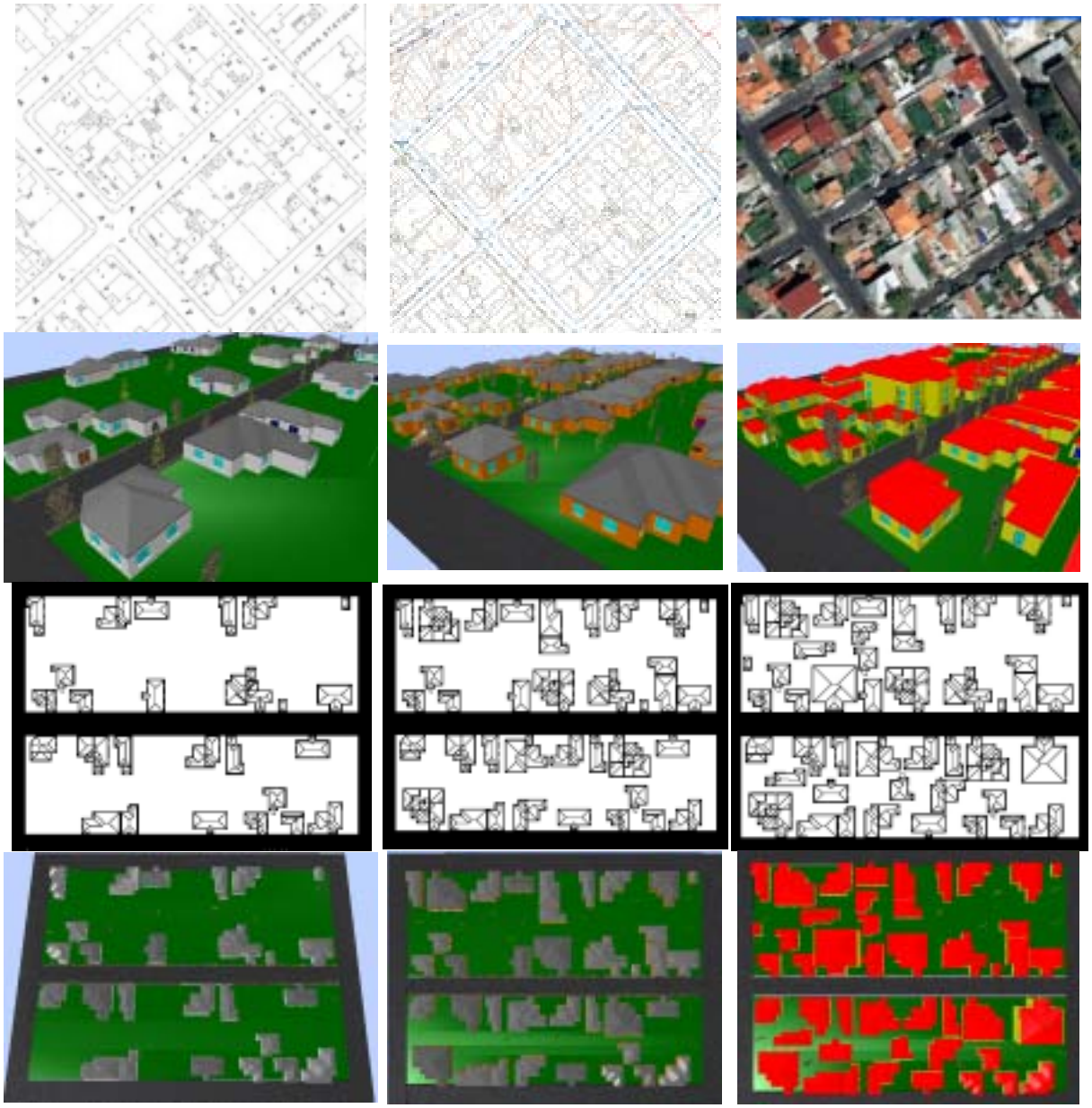


Fig. 7 Roof

-Information about the foundation, roof, structure and interior (Fig. 8):

Fig. 8 Foundation, roof, structure and interior

5. Changes that occurred in a quarter of Constantza City in time:



1936 1997 2008

6. Conclusions:

The aim of the information system specific to the real estate-public utility domain, by the data and information that it provides to the local public administration, assures not only the record of the real estate and public utility facilities and the registration of the house, but also have a special role in determining a fair system of taxes and charges, in the developing of the real estate market, the environmental protection, the town planning, etc., also having the possibility of accessing them by the citizens, using the internet, having an important role in the process of informing, transparency and debureaucratization.

The time for using the digital data is much shorter than the time for studying the plans that are not updated, on paper, material that gets easily out of order in time.

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