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Application of the GEO-INFO System for Modernization of the Cadastre**

1. Introduction

The land and buildings register (the Polish acronym: EGiB) is subject to constant changes, aiming to improve in the scope of its administration and making data available. A turning point in its management is the computerization of the national cartographic information center. Ultimately, the land and buildings register will be run in the form of a database, which will form the basis not only for surveying, but also for imposing taxes, spatial planning, economic development, or the description of real estate in land registers (KW). Therefore, the modernization of the EGiB is essential, as it aims to adapt the cadastre to the ever-changing legal regulations and factual status of cadastral objects, and to transform it into an eligible real estate cadastre (KN). In accordance with the regulation on the integrated information system for real estate (ZSIN) [7], Cadastral database prepared in such a way will form the basis for the integration of real estate data with the data contained in the land registers (KW).

The aim of this article is to present the possibilities of making use of the GEO-INFO System database [11] for the purpose of modernization of the cadastre. Administrative and technical activities have been discussed on the example of the modernization of the cadastre in terms of it being complemented with a base of building structures carried out in the district of Choszczno [1].

2. Establishing a Register of Building Structures Using the GEO-INFO System

The study, based on which this article was created, was the project called *Capture and distribution of information on building structures in the West Pomerania province*,

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carried out for all the cadastral units of the counties which do not have an established register of buildings [8]. This meant conducting all necessary administrative, organizational and technical measures that are necessary to adapt the current cadastre to the requirements of the regulation of 2001 on EGİB [5]. In this project, a register of buildings for 120 cadastral units was established, which resulted in the preparation of 120 cadastral surveys. The procedure was performed in several stages shown below.

2.1. Capturing Data to Establish a Register of Buildings

The task began with the notification of surveying works to the appropriate local district cartographic documentation centers (PODGİK) in order to obtain all the necessary materials and input files for data exchange.

In response to the notification of the works, the following source materials were obtained which, together with the supporting materials, were used in the course of the presented study:

- the orthophotomap,
- rasters of the base map in the 2000 system,
- *GEO-INFO V Mapa* database [10],
- *GEO-INFO V Integra* database [9],
- topographic database (layer of buildings),
- studies commissioned by the Agency for Restructuring and Modernization of Agriculture, the so-called LPiS database,
- legal and construction documentation being in the possession of the building owners and stored in the departments of architecture and construction of the respective local county authorities and municipal offices,
- documentation of surveys and valuation of dwellings located in the archives of the departments of architecture and construction,
- a list of buildings entered into the register of monuments, deposited with the West Pomeranian Regional Conservator,
- land register numbers,
- data obtained from other public authorities, concerning farmers, streets and ordinal numbering of real estate.

2.2. Analysis of the Materials and Preparation of the Data in the GEO-INFO System for Field Inspection

Analysis of the materials is conducted based on the available maps and databases acquired from the resource of the district cartographic documentation centers (PODGİK). The Center export the database of a given area which is the subject of the study in the so-called *Changes* mode. The *Changes* mode is necessary not to

accidentally modify objects issued to a surveyor, as it will result in errors while importing final database to PODGiK.

The preliminary stage includes the steps to obtain the geometry of building outlines, which in the GEO-INFO System terminology is defined as *the geometry of a building*. Its source are analog maps from which, by vectorization of the base map raster, an outline of a building is obtained and the database is completed with descriptive attributes which are available at this stage: *number in the record book of surveys (KERG)* and *the method of data capture* (in this case, the lexical item: D – *Digitization of the map and vectorization of the base map raster*). Topographic Database (TBD), which was developed in previous years, was also used for the works associated with obtaining a numerical description of the geometry of buildings. For this purpose, a surveyor establishes an empty draft database in the *GEO-INFO Mapa*, to which the data issued by the PODGiK are imported. In this draft database it is possible to enter new data, delete unnecessary information, and carry out all the necessary checks which are available in the system. The checks will be described in section 2.5.

An exemplary process of entering a new building to the database in the GEO-INFO System [10] should have a defined process. Having selected *Enter by code*, the object of interest is pointed on the list by choosing *Select object class* (Fig. 1). In this case, according to the *GEO-INFO Mapa* codes, *GESBZO Buildings* should be selected. It must be noted that the author of the system created their own list of codes for all objects of the base map.

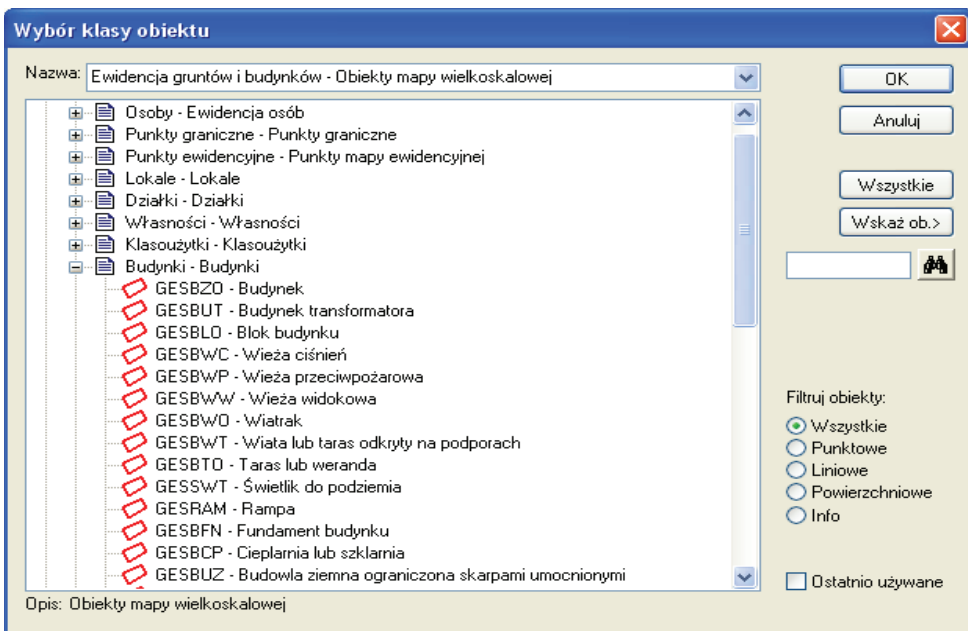


Fig. 1. GEO-INFO Mapa window with the function *Select object class*

An empty window of descriptive and spatial data for a building is displayed (Fig. 2), of which the *Attributes* tab should be clicked on first. The prepared fields must be completed in accordance with the available documentation. One of the attributes of a building is to determine its location, which is defined by the location of a plot and, for example, its number [1].

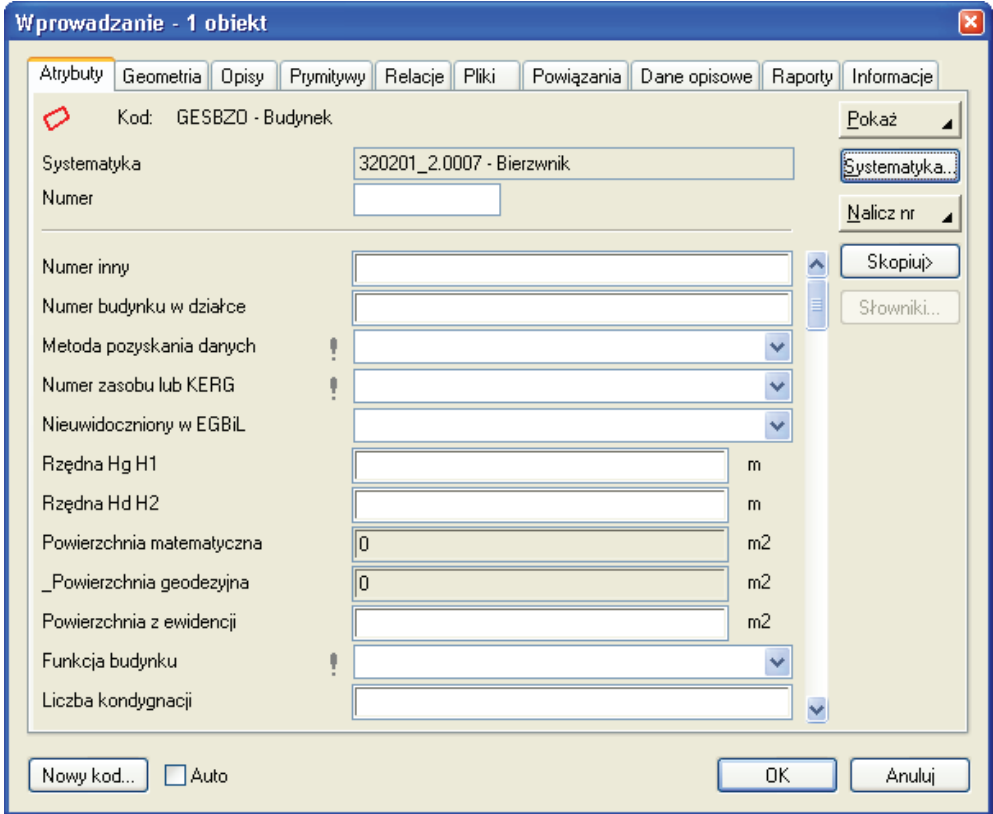


Fig. 2. Attributes window for the Building object

Another tab – *Geometry* (Fig. 3) – contains a numerical description of the outline of a building (a closed line demarcated by a rectangular projection of the intersection line of the outer walls of a building with the surface on the horizontal plane) [4]. The *Geometry* of a building must be constructed on the basis of the so-called *GEPINN*, that is *other geodetic point*. It is equivalent to the topographic point, i.e. the turn point of the object’s outline. *GEPINN* has the appropriate descriptive attributes, such as: *number from a survey, resource number or KERG number, position error, data capture method*. The technology of determining numerical outlines of buildings based on *GEPINN* is very important. A common mistake of some cartographic documentation

centers is entering a building from digitization without defining it by *GEPINN*, just by inserting a fictional graphic point that is not a database item, nor does it have descriptive attributes.

Other more important tabs from the window in Figure 2 include: *Descriptions* – texts displayed on the map for a building, *Relevance* – topological relationships with other objects such as stairs, or the address point of a building, *Files* – the possibility of attaching external files to the object (for example, a scanned measurement sketch), *Descriptive data* – this function allows us to preview the descriptive information of a building contained in the descriptive database – *GEO-INFO Integra* (cadastral subject). *Information* tab – contains information such as: construction date of a building and its modifications, the name of the operator who has entered the data in the current version and the unique database object identifier.

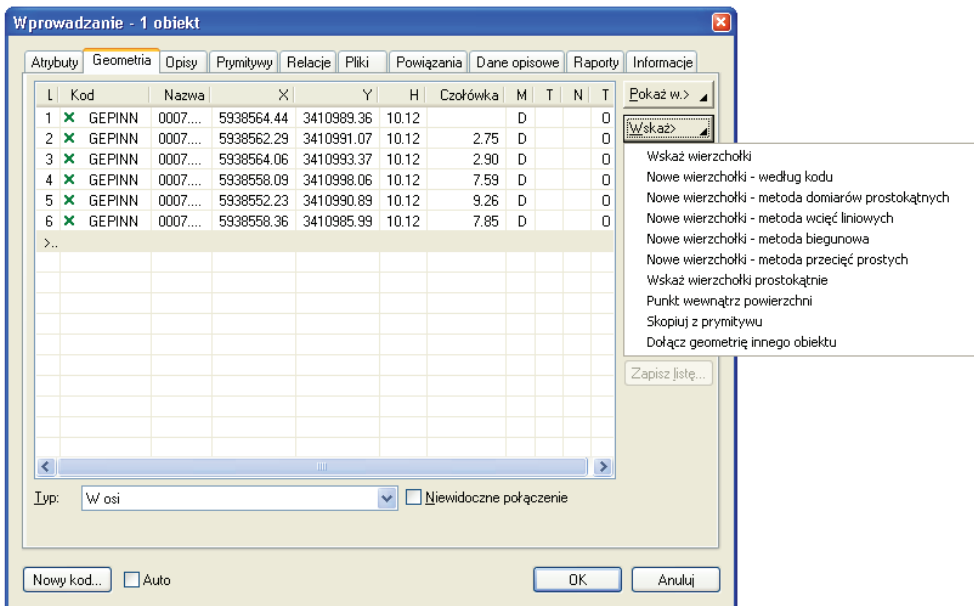


Fig. 3. *Geometry* window of a building

The layer of buildings prepared in such a way, and the map in the 1:1000 scale generated from the database in the 2000 system, together with the raster base in the form of calibrated base maps, must be verified during the field inspection.

2.3. Field Inspection and Follow-up Surveys of Buildings

Due to the fact that, in accordance with the Regulation on EGİB of 2001 [5], a building has both spatial and descriptive attributes, they should be acquired in order for them to be included in the database and in the cadastral data sheets of buildings.

During the field inspection, amendments to the field inspection maps are introduced, and the cadastral data sheets for new buildings are prepared, which are an integral part of the descriptive and cartographic survey [12]. These sheets are prepared during the field inspection, mainly due to a need to obtain the signature of a person providing the information about a building. The inspection maps with the plotted changes are attached to the descriptive and cartographic survey and they are subject to a comparison with the numerical cadastral map.

If during the field inspection, some buildings will be disclosed for which there was no data on the geometry in the material from the topographic database or background maps, then it is necessary to obtain a numerical description of the building geometry from field surveys [6]. The stage of the field works also includes the survey of these buildings whose geometry has changed through extension or partial demolition. These surveys can be carried out using the following technologies: horizontal direct surveys, stereophotogrammetry and surveys using the GPS/GNSS method. The result of field works is also developing a list of changes in records of buildings. They are prepared when a building has already had a cadastral data sheet established earlier.

In the presented modernization, more than 2,000 buildings were eventually eligible for surveys, which accounted for about 50% of their total number.

2.4. Technology for Creating a Database for Records of Buildings in the GEO-INFO System

The next stage of the modernization is entering data on the buildings into the EGIB database in *GEO-INFO Mapa* and preparing the descriptive and cartographic survey. It means verifying and supplementing the existing GEO-INFO System base, based on the materials created during the field works, so that the base was in line with the factual status.

This is done based on:

- field inspection maps,
- supplemented cadastral data sheets of buildings,
- measurement sketches for new or modernized buildings,
- land registers – an electronic form,
- other source documents.

The procedure which was adopted to develop a numerical layer of buildings in the *GEO-INFO Mapa* discussed in this example, had the following course. The basis for the data entry was the field inspection map with cadastral data sheets of buildings, located on a given section of the base map. Based on the field inspection map, the numbering of the buildings was conducted and their number was verified. In the district of Choszczno, The numbering of buildings followed from the plot [1].

The manner of including a building in the *GEO-INFO Mapa* database is dependent upon the results of its identification during the field inspection:

- entering a new building which is not included in the base map raster – it should be entered into the database based on direct measurement;
- entering a change in the shape of a building – new geometry from direct measurement should be entered, while maintaining the existing identifier of the changed structure;
- a building turned out to be dilapidated – there is a need to change into a corresponding code in the *GEO-INFO Mapa*, which is *GESBRO - dilapidated building*;
- lack of a building which was plotted on the field inspection map – in this case, the *GEO-INFO Mapa* uses the *Delete* function, leaving a building in the database history, without its total removal, which would be a consequence of using the *Erase* function;
- division or merging of a building – when the outline on the base map represents one building, and in fact there are the basis for the disclosure of two separate buildings, or vice versa – the information in the database should then be updated;
- a building is situated on more than one plot – in this case, according to the contracting authority's recommendations regarding the project in question, it should be assigned to this plot on which its greater part is located. According to the amendment to the regulation on EGİB, § 26.3 requires the assignment of a building to each of the cadastral units, if it exceeds the real estate boundary with a minimum of 0.60 m [4].

For each entered building, in the descriptive attributes window of *GEO-INFO Mapa* [2] (Fig. 2), the information collected in the field from the property owners, recorded in the cadastral data sheets of the building, should be entered. Then, each building on a given plot should be related to the established database item *GEPADR*, i.e. the address point. Based on the geometry base prepared in the *GEO-INFO Mapa*, Excel files should be generated, which will then be subject to importing into the *GEO-INFO Integra* database. After the preparation of all field inspection maps, cadastral data sheets, documents relating to real estate ordinal numbering by the *GEO-INFO* System operators, the stage of creating a numerical database of the records of buildings is complete.

2.5. Importing Data to the Numerical Map Database of the Cartographic Documentation Centers

The final effect of the work is to provide the contracting authority with a prepared descriptive cartographic survey together with input files, to import it into the EGİB (land and buildings register) database kept by PODGiK (district cartographic documentation centers). The basic form of the transfer of such files is SWDE format, which is a standard for the exchange of cadastral data.

In the case of a large number of cadastral units, the import of files to each of them must be conducted individually. Work in the *GEO-INFO Mapa* should be carried out appropriately in the so-called *Changes* mode. Working in the *Changes* mode is important due to the fact that only after the actual completion of a given *Change*, the objects become the current elements of the database, and until that happens, it is always possible to withdraw them completely. Furthermore, opening the *Changes* mode results in the locking of modifications to the objects issued to a surveyor for other operators, which allows for avoiding import errors.

The import procedure in the *GEO-INFO Mapa* system, starts with *Changes*, through the function *Current database and change*. Figure 4 depicts a list of the assumed *Changes* in accordance with the recommendations of the contracting authority to make individual imports in separate *Changes* for each cadastral unit.

Having started an appropriate *Change*, it should be activated and then one should go to the right import process. To do this, the option *Entry* and *Data Import* should be run.

Figure 5 presents a window which requires a specification of basic parameters:

- *Taxonomy* – the cadastral unit which is currently being imported should be selected from the list,
- *File format* – depending on the application which the surveyor has at disposal,
- *Data file* and *report file* – appropriate target path must be specified,
- *Options* – selecting detailed import parameters,
- *Checks of objects* – the operator has access to the object-controlling mechanisms.

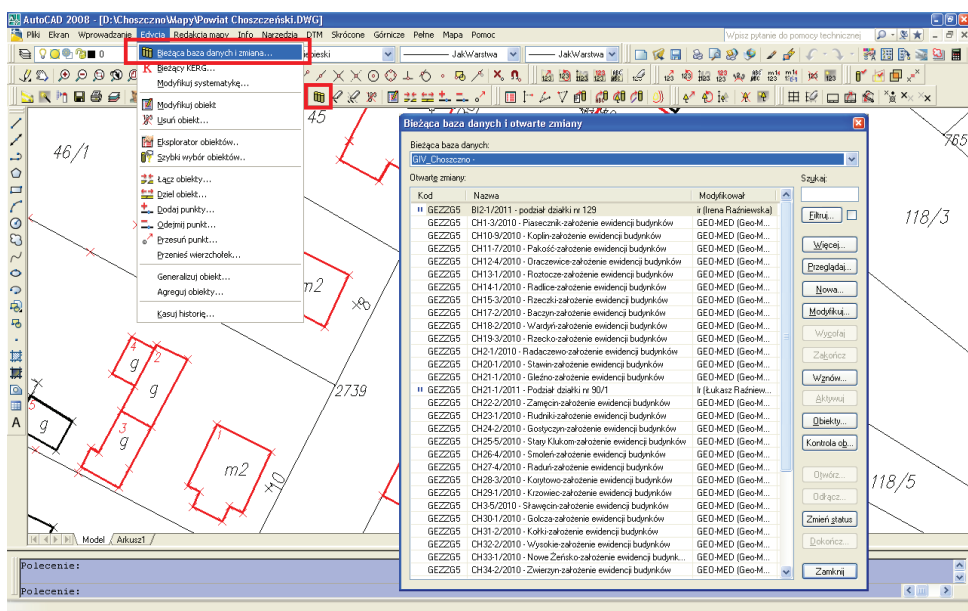


Fig. 4. The window of opened *Changes* in the *GEO-INFO V Mapa*

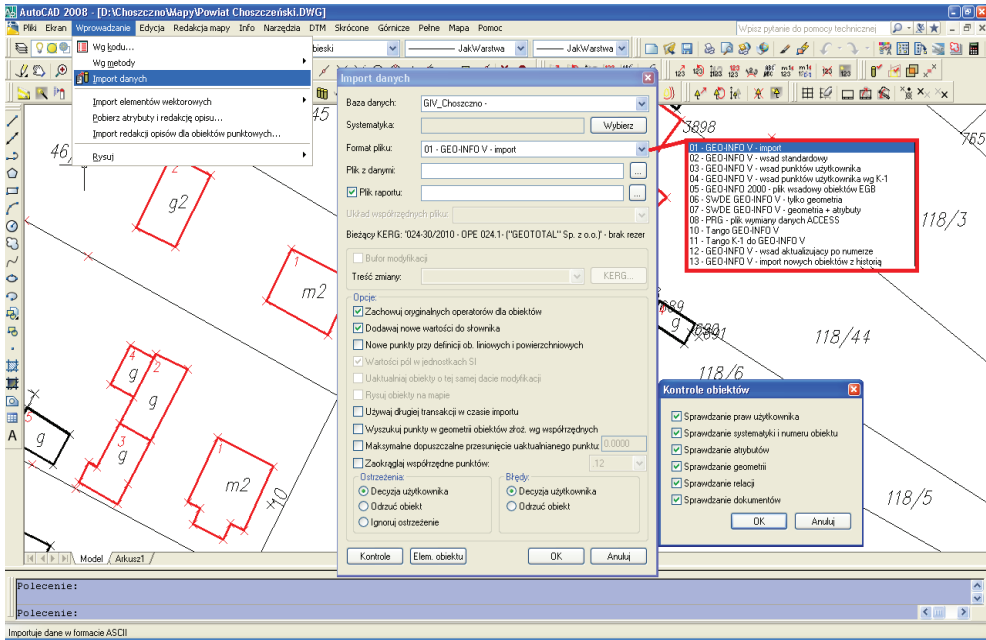


Fig. 5. The window *Data import* in the *GEO-INFO Mapa*

When dealing with establishing or modernization of the register of buildings, it is necessary to carry out a complete inspection, with the *Surface deviation* option. Additionally, inactive options can be activated: *Control addresses*, *Ignore case* when comparing addresses, *Control plots* and *Include projection correction*. The checking result is displayed in a separate file, from which a report can be prepared, necessary to remove the errors. The operator has a possibility for self-filtering various types of errors.

2.6. Importing Data to the Descriptive Part of the Cartographic Documentation Center Base

The procedure for importing data to the descriptive part of the resource kept in the *GEO-INFO Integra* involves the use of the Excel files generated from the *GEO-INFO Mapa* database. The first step is to open *Changes*, as in the *GEO-INFO Mapa*, separately for each cadastral unit. After opening and selecting a specific *Change*, a window with tabs appears, which are used to enter changes to the descriptive part of EGİB for different types of studies. For modernization purposes, *Input operations* function is used (Fig. 6).

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PRZENIESIENIE PODZIAŁ SŁOWNIKOWE ZAMROŻENIE PORZUCZENIE EDYCJA OPISU ZMIANY OPERACJE WSADOWE RAPORT ZMIAN DZIAŁKI KONIEC

LOKALE
BUDYNKI
ZAKŁADANIE JRB DLA WU

Wsadowe zakładanie kartotek budynków

Budynki Parametry

KOMÓRKI

JEDNOSTKA EWIDENCYJNA:	RZĄD:	KOLUMNNA:
	3	3
OBRĘB:	4	3
MIEJSCOWOŚĆ:	2	3

KOLUMNY

ID BUDYNKU:	KOD SWDE F.UŻYTKOWEJ:	MATERIAŁ:
2	8	13
ULICA:	ROK:	REJESTR ZABYTKÓW:
4	9	22
NUMER DOMU:	POW.ZABUDOWY:	UWAGI:
5	10	0
ARKUSZ MAPY:	KOND.NADZIEM.:	USUNĄĆ:
0	11	0
OBRĘB:	KOND.PODZIEM.:	NOWY BUD.DLA LOKALI:
6	12	0
DZIAŁKA:	MUR:	LICZBA LOKALI W BUD.:
7	0	20
	DREWNO:	POW UŻYTKOWA:
	0	0
	INNY MAT.:	NUMER ARKUSZA EXCEL:
	0	1

RZĄD POCZĄTKOWY: 13

Wczytanie danych do bufora Usunięcie danych z bufora zapisz parametry do pliku odczytaj parametry z pliku

Liczba budynków:0

Fig. 6. The *Parameters* tab of the window *Enter changes* in the *GEO-INFO Integra* program

The excel input file must be properly formatted, subject to the reservations contained in the relevant instruction [2]. Importing numerous cadastral units, one by one, it is advisable to adopt one model for all of them, because once established values can be saved using the option *Save parameters to a file* and loaded each time. After loading, data are imported, which become visible in the *Buildings* tab (Fig. 7).

Figure 7 presents the data loaded by the software into the buffer, including the control procedure. If, having used the *Only incorrect* function, the list of buildings will be empty, then we can select the option *Transfer correct to the database*. However, if the list contains any values, it is necessary to correct the errors. The type of error will be signaled automatically by checking the type of error for a given building in the appropriate column. The errors need to be corrected in the original Excel file, which is created by the *Save to excel* function. After the correction, the file is loaded again, until the empty list of errors is obtained.

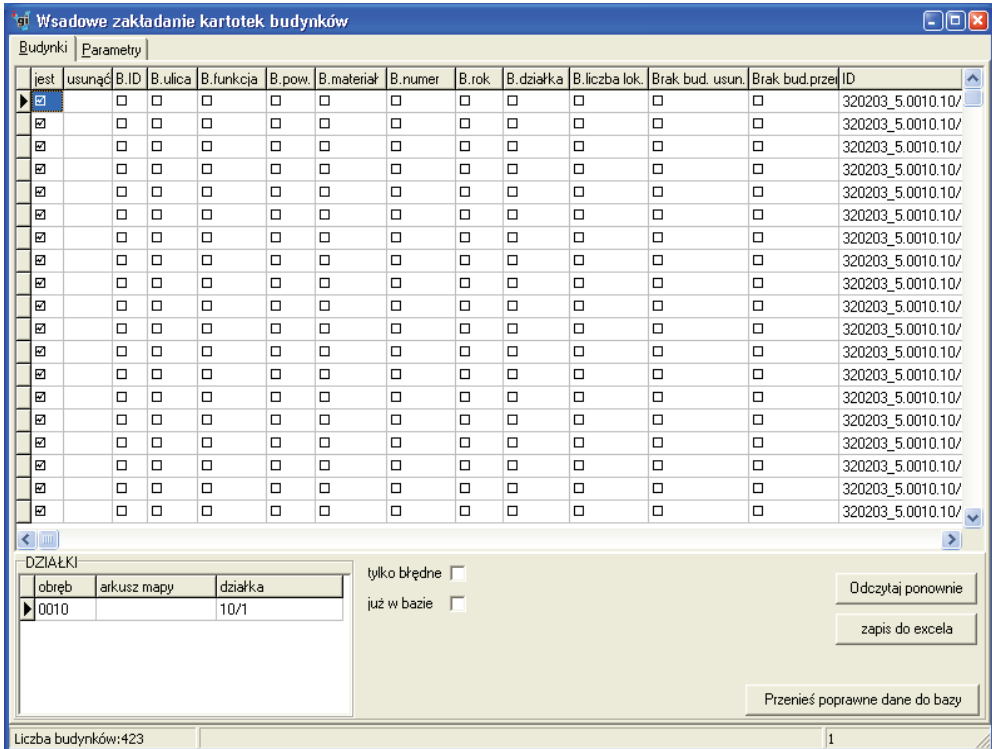


Fig. 7. Buildings tab to import data in the GEO-INFO Integra

Assuming that the data is correct and have been transferred to the base, the procedure shown in Figure 6 follows. In the *Input operations* tab, having selected *Setting Building Cadastral Unit for Perpetual Usufruct* option, a window appears: *Input setting of records for buildings*, so that the building cadastral unit is established automatically.

Having conducted the appropriate control procedures and possible error correction, one can be assured of the integrity of the descriptive and geometric data.

3. Summary

Replacing traditional records and analog maps with computer databases has a positive effect on the update of the national cartographic resource. Summarizing the description of the works associated with the modernization of the cadastre in terms of creating the database of buildings, it can be concluded that, thanks the control procedures proposed by the software, the computerization of the geodetic and cartographic resource improves considerably record keeping and upgrades the quality of the record data.

GEO-INFO System provides an opportunity to quickly update the resource and offers effective possibilities to control the quality and consistency of the descriptive and geometric data.

Legal regulations in the field of geodesy and cartography require fundamental amendments due to deficiencies in the legislation relating to the cadastre. This is the reason for numerous ambiguities and technical problems. It is evidenced by the fact that the cartographic information centers still refer to the provisions contained in the technical manual G-5 [1], which is not an applicable technical standard.

Another national problem is the lack of consistency in the legislation concerning the areas of: taxation, surveying and architectural construction. This results in the inability to effectively enforce investors' obligation to timely conduct an inventory of an as-built building, in order to report the completion of a construction. Such conduct is often due to the intention to delay calculating tax on the usable area of an accepted building.

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