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Modernization of the Register of Land and Buildings with Reference to Entering Buildings into the Real Estate Cadastre in Poland

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Abstract. Nowadays, it is frequently the case that the database of the real estate cadastre in Poland is not supplied with the record data on buildings. This study presents the issues related to the comprehensive modernization of the register of land and buildings, especially in the aspect of entering the buildings located in the areas of the modernized cadastral districts, into the database of the real estate cadastre.
The real estate cadastre should provide a reference base for other public records, the data contained in the cadastre should be the basis, for example, for official statistics, real estate management and register of farms, or tax records.
The analysis of this procedure was based on the data derived from the modernization of the register of land and buildings carried out in eleven cadastral units of Gorlice district, province of Malopolska, as part of the national project: Development of an Integrated Real Estate Information System – (ZSIN) – Stage I. In this project, the data for the preparation of the digital description of the contour of a building were captured largely based on high-precision aerial imagery which, having been developed on the stereoscopic model, supplied the digital database of the real estate cadastre.
A serious problem, which hinders the maintenance of the database of the real estate cadastre in Poland updated, are the frequent amendments to the applicable laws. The Regulation on the register of land and buildings, according to which the cadastral database has been built in Poland since 2001, was extensively amended in 2013 and in 2015. This makes it difficult to obtain uniform data of the buildings in Poland.

Keywords: cadastre of buildings, photogrammetry, stereoscopic model, attributes of building structures, record data on buildings.

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Introduction

Real estate cadastre should provide a reference base for other public registers, and the data contained in the cadastre should be the basis, for example, for public statistics, tax records, real estate management, and analysis of the real property market (Jasinska, Preweda 2013). Unfortunately, the cadastre in Poland does not fulfill its role completely (Busko, Meusz 2014; Mika, Salata 2015; Noszczyk, Hernik 2016). Buildings are among the most important objects of the cadastre, unfortunately however, in most parts of the country, they are entered into the database of the register of land and building to a limited extent only. This situation is slowly changing thanks to the construction of the Integrated Real Estate Information System (ZSIN), which in the future should regulate the relationships between the real estate cadastre and the land and mortgage registry system (Przewiezlikowska, Busko 2014). Part of this project includes the modernization of the cadastre in Poland, also of the records of building structures in the database of the real estate cadastre. The object, which formed the basis for this study, is part of the Gorlice district, located in the southern Poland, in the Malopolska province. The numerical data summarized in Tables 1–3 were collected for eleven cadastral districts which, in terms of the state of the real estate cadastre, were typical for the southern Poland.

Table 1. Description of cadastral districts in the cadastral unit of Biecz
(source: own study based on the Terms Of Reference)

Name of the cadastral district	Area of the cadastral district [ha]	Estimated number of boundary points	Number of plots	Number of buildings	
				Entered into the cadastre	To be entered in the cadastre
Libusza	1153	13000	3438	148	2100
Korczyna	426	3800	1297	42	750
Strzeszyn	1387	11700	2221	68	1200
Rożnowice	1160	8500	2040	38	1010
Total	**4126**	**37000**	**8996**	**296**	**5060**

Table 2. Description of cadastral districts in the cadastral unit of Łużna
(source: own study based on the Terms of Reference)

Name of the cadastral district	Area of the cadastral district [ha]	Estimated number of boundary points	Number of plots	Number of buildings	
				Entered into the cadastre	To be entered in the cadastre
Łużna	2038	17000	3796	145	2100
Biesna	572	5000	996	15	394
Wola Łużańska	643	5200	1096	37	632
Total	**3253**	**27200**	**5888**	**197**	**3126**

Table 3. Description of cadastral districts in the cadastral unit of Lipinki
(source: own study based on the Terms of Reference)

Name of the cadastral district	Area of the cadastral district [ha]	Estimated number of boundary points	Number of plots	Number of buildings	
				Entered into the cadastre	To be entered in the cadastre
Wójtowa	966	14000	2535	23	1200
Lipinki	1505	21000	6272	69	1700
Kryg	1064	12300	3305	41	1300
Bednarka	1786	6800	972	6	278
Total	**5321**	**54100**	**13084**	**139**	**4478**

The buildings are entered into the database of the real estate cadastre subject to the provisions contained in the Regulation on the register of land and building (Regulation of the Minister… 2001). The subsequent amendments to this Regulation were introduced through the amending regulations, in 2013 and 2015, respectively. As far as the definition of the contour of the building is concerned, these regulations introduced very important changes. The definition of the contour of the building was changed each time, which resulted in some buildings, which were entered into the database of the real estate cadastre subject to the previous wording of the Regulation, losing their up-to-dateness in the database of the real estate cadastre.

The data contained in Tables 1–3 were illustrated in Figure 1. The bar chart demonstrates how urgent the modernization of the cadastre in Poland is.

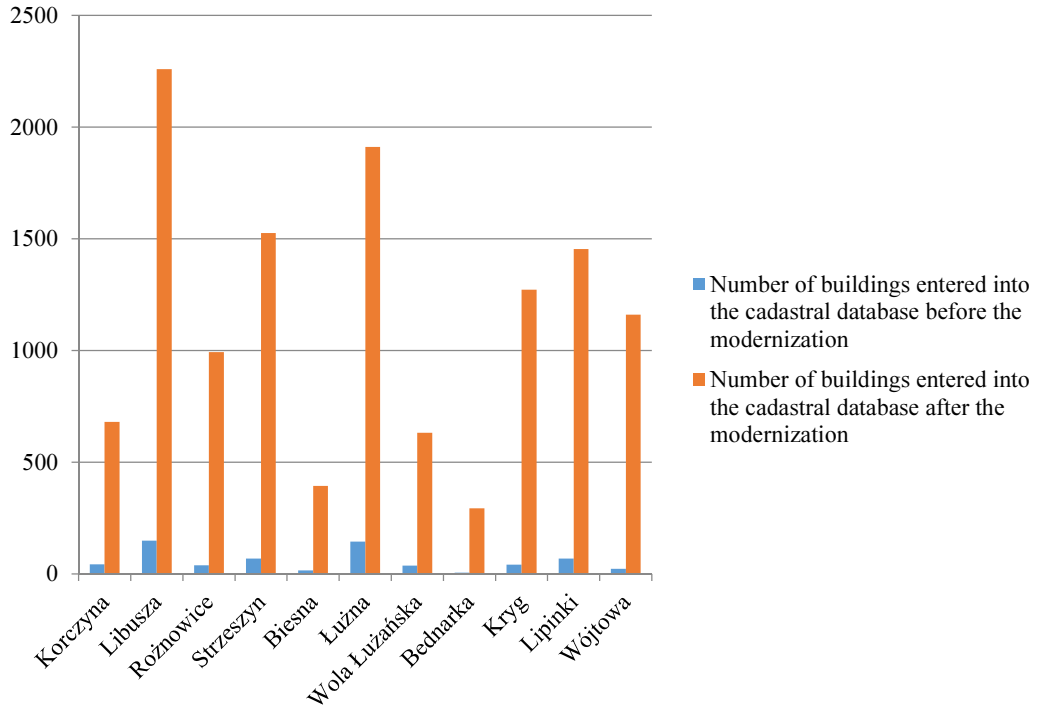

Fig. 1. The buildings entered into the cadastral database before and after the modernization of the cadastre

The construction of the 3D cadastre in Poland is certainly worth considering, which is confirmed by a number of scientific papers (Bydlosz 2015; Jazayeri *et al.* 2014; Paasch *et al.* 2016). However, with such negligence regarding the cadastre of buildings in Poland, the 3D cadastre seems to be a matter of a possible future.

Materials and methods

§63 of the Regulation on the register of land and buildings (Regulation of the Minister… 2001), after its amendment in 2013 and in 2015, specified the cadastral data (attributes), relating to the record building structure. Today, there are 27 attributes, 6 of which are obligatory. Most of them are descriptive attributes, but one of the most important is the contour of the building, which allows for the presentation of the building on the map.

Pursuant to the Regulation on the register of land and buildings, the numerical description of the contour of the record building should be specified basing on detailed topographic surveys. Pursuant to the provisions of § 2 of the Regulation on technical standards (Regulation of the Minister… 2011), detailed topographic surveys include: field surveys, photogrammetric surveys and cartometric surveys.

The Regulation on technical standards also defines the building as an unambiguously specified field detail which belongs to the first-order accuracy. Therefore, the measurements of the objects of this type should be carried out in a way, so as to determine their position relative to the nearest points of the geodetic control with the 10 cm accuracy. Control measurements are necessary to be carried out as well. They may involve another, independent, determination of the details of the building, reading the tie distances between the points of the building subject to the measurement, or measuring the distance to another field detail belonging to the first-order accuracy.

During the modernization of the cadastre in the research object, the whole geometric data on the buildings were captured by the photogrammetric method. In order to make a measurement of the ground floor under the eaves possible, a low pass at ca. 1500 m above the ground level was performed and increased the coverage to the values of 80% of the longitudinal coverage and 50% of the transverse coverage. The size of the field pixel of the aerial photographs taken was 7 cm. The measurement results were verified against the data collected during the field inspection. In this way, the requirement set out in § 44 of the Regulation on technical standards was met, which provides for the necessity to verify the contents of aerial photos with the field details, and to complete them with field surveys.

In accordance with the procedure provided for the modernization of the cadastre, the first stage of capturing data on building structures is to enter them into the draft database based on the individual land surveys included in the database of the District Geodetic and Cartographic Documentation Center (PZGiK). Then, these buildings should be checked in terms of their location, basing on the aerial photographs. If the linear deviation exceeds 10 cm, then the contour of the building should be modified. However, if the limit of the linear deviation is not exceeded, the points from the previous field surveys may be used to control the work of the photogrammetric station operator.

The aerial photographs for the discussed modernization of the cadastre were taken in March and April 2014. This time is included into the so-called photoaerial season, which in Poland covers the period between the disappearance of the snow cover (more or less from mid-March) to October, or even November – i.e. before the new snow cover. However, in a wooded area, the period of May–September should be excluded because the leaves on the trees would obscure the image of the surface area. When choosing a date for the performance of the passes, a very important factor to be taken into consideration are the weather conditions, especially the cloudless sky. For the area of the Gorlice district, the likelihood of the cloudless sky in the period of March–November fluctuates at about 39%. The total area subjected to the studies was approximately 127 km².

For all the buildings in the area covered by the modernization procedures, a photogrammetric measurement on the stereoscopic model was carried out, which ensured the accuracy corresponding to the field details of the first-order accuracy – 10 cm. Measurements of buildings on the stereoscopic model involve creating a vector layer corresponding to the buildings on the digital map. Due to the fact that not all the walls are equally visible on the model, it is advisable to create two vector layers, one for the visible walls, the other for the hidden walls.

The buildings are measured along the contour of the outer walls at the point of their best visibility (at any height), divided into two layers, depending on the visibility of the basement walls (visible, hidden walls). The outline of the hidden walls is vectorized according to the most probable course of the basement contour (determined basing on the outline of the roof). The program operator draws contour lines of the building, marking the point where the contour of the building has its turn point. At the same time, the operator runs the line which is appropriate for the object – the building. The measurement involves directing a measurement mark to intersect the ground surface – the point measured in this way receives the coordinates X, Y, Z. The Z coordinate, used in the photogrammetric terminology, should be understood as the H coordinate pursuant to the National Spatial Reference System, in accordance with the model orientation and definition of the coordinate system, which were carried out before the commencement of the survey. The result of the photogrammetric measurement is therefore a vector set of closed structures (buildings) and a set of points with three determined coordinates X, Y, H.

The measurement is controlled by the observation of the building performed in the office on the model from different angles, so that, when drawing the contour, a given wall is clearly visible. Because every building must be a closed structure, in the case when one of the walls is not clearly visible, a specific fragment of the contour of the

building is determined basing on the course of the edge of the roof. During the photogrammetric measurement, the location of the building must be verified on all the models, on which it was covered longitudinally and transversely. Depending on which image the building is currently being observed on, its contour – entered previously by the station operator – in relation to the orientation of the building on the current image – gives a false impression of displacement, as seen in the screenshots presented below (Fig. 2 and 3).

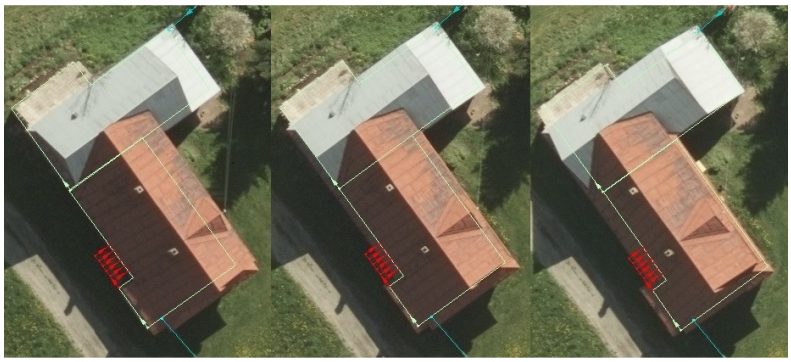

Fig. 2. Apparent displacement of the contour of the building relative to the model – example 1

Fig. 3. Apparent displacement of the contour of the building relative to the model – example 2

In order to ensure the implementation of § 29 and § 44 of the Regulation on standards (Regulation of the Minister… 2011), requiring control measurement of the details of the first-order accuracy, as well as the necessity of the field verification of photogrammetric surveys during the field inspection, it is required to read tie distances between the adjacent turn points of a building, which belong to the contour of the building. These tie distances should be plotted on the map of the field inspection (Fig. 4). It forms the basis for the field verification of a photogrammetric survey.

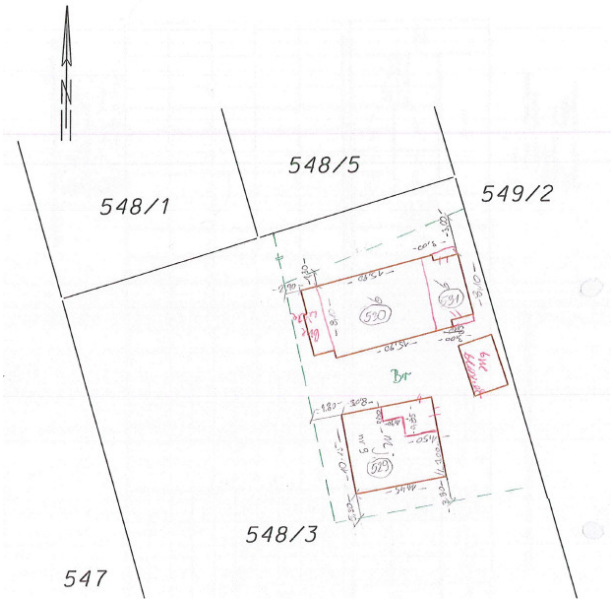

Fig. 4. Field inspection map containing control tie distances of the buildings

The vector database of the outlines of record buildings, created as a result of photogrammetric surveys, is not the final product of this stage of the works (Siejka *et al.* 2014). The documentation will be complete and ready to be attached to the draft record of survey and property description, only after the above-mentioned field verification of the building structures. This procedure involves direct field measurements of tie distances of all the buildings. In addition to the verification of the digital description of the contour of the building, during the field inspection it is also necessary to capture and enter the current descriptive record data of the building into the cadastre, pursuant to §63 of the Regulation on the register of land and buildings (Regulation of the Minister… 2001; Dawidowicz *et al.* 2015).

During the field inspection, it is verified and marked on the printed out raster base map, with the vector cadastral map overlaid, whether the position and the shape of the buildings is up-to-date. For the purpose of the modernization, which is the subject of this study, a special application for mobile devices (tablets) has been developed, where all the attributes regarding building structures are stored. This application is a proprietary software developed by the company MGGP S.A., which is the contractor of the modernization. It allows to collect a great amount of descriptive information about buildings as well as their images, and it significantly simplifies and accelerates the performance of the field work.

The final products of the modernization of the cadastre, in terms of entering buildings into the records, is the database with the attributes of the buildings and the digital cadastral map, complying with the Regulation on the register of land and buildings in terms of its contents, as one of the reports generated from the database.

Discussion

This article presents the issue of the modernization of the register of land and buildings using photogrammetric methods for geometric data acquisition for a digital description of the contour of the building. Currently in Poland, however, there is an enormous problem associated with the lack of stability in the applicable laws. The Regulation on the register of land and buildings, which entered into force in 2001, was subsequently amended twice by the amending regulations, in 2013 and 2015, respectively (Busko, Przewiezlikowska 2016). Each amendment changed the definition of the contour of the building. Table 4 summarizes structural elements of the building, which determine its contour, according to the three versions of the Regulation on the register of land and buildings.

Table 4. Comparison of the elements forming the contour of the building (Busko 2016)

REGULATION ON THE REGISTER OF LAND AND BUILDINGS OF 2001 2001–2013	REGULATION ON THE REGISTER OF LAND AND BUILDINGS OF 2013 2013–2015	REGULATION ON THE REGISTER OF LAND AND BUILDINGS OF 2015 after 2015
external planes of *the outer walls of the ground storey*	*the exterior walls of the building*	*the exterior walls of the building*
	if the foundation wall intersects the surface – *the outer edges of the foundation*	if the foundation wall intersects the surface – *the outer edges of the walls of the storeys* which are supported on these foundation walls
if the storey is on pillars – *the exterior walls of the storey* supported on these pillars	if the storey is on pillars – *the outer edges of the pillars*	if the storey is on pillars – *the outer edges of the walls of the storeys* which are supported on the pillars
		if the roof is on pillars – *the outer edges of the roof*

When analyzing the data contained in Table 4, the discrepancies occurring in the definition of the contour of the building and the development area, the value of which results from the defined contour, should be emphasized. These changing regulations make it impossible to keep the real estate cadastre updated, which results from the instability of the legislation pertaining to the register of land and buildings. Moreover, the discrepancies between the laws related to surveying, and the legal regulations on construction, should be highlighted as well. The situation, where there are two different definitions of the building and two different development areas for the same object existing in one body, such as the district governor, should not be tolerated any longer. A good opportunity to improve and standardize the definitions is associated with the Code of Urban Planning – Building Regulations, which is currently being prepared in Poland. It is also necessary to correct the content of the Regulation on the register of land and buildings, at least as to the exclusion of the roof from the contour of the building, if this roof is based on pillars (Busko 2016). It is absolutely essential to bring into compliance the Regulation on the register of land and buildings with the building regulations.

Conclusions

To sum it up, some recommendations for the use of photogrammetric methods for the modernization of the cadastre, which are related to entering buildings into the database, can be formulated:

- in the case of inexperienced operators of the photogrammetry workstations, the measurements can be carried out on hidden corners; therefore, it is necessary to control the length of the walls of the building, implemented as a measurement of tie distances of the building in the field;
- when measuring the building on the stereoscopic model, some difficulties may arise in the interpretation of certain elements of the building, and thus the measurements of the buildings on the model should be carried out before the collection of the descriptive data in the field, in order to point out the elements necessary to be explained to the field teams;
- adequate time and parameters of the pass should be planned, so that the buildings were depicted in the pictures in the optimal way;
- photogrammetric technique is optimal for larger surface area covered by the modernization of the cadastre, with not very dense development, in the areas with poor tall vegetation which might obscure the buildings subjected to the measurement. The choice of the measurement method and the instruments used should always be appropriate for local conditions and requirements of the accuracy (Busko *et al.* 2014).

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