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IM. STANISŁAWA STASZICA W KRAKOWIE**

**AGH UNIVERSITY OF SCIENCE
AND TECHNOLOGY**

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Practical verification of Polish 3D cadastral model

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Land registration systems in Poland

- » Information on real estate in Poland is recorded in two independent systems, which are the land and building cadastre and land and mortgage register.
- » The legal basis of the former is the Law on Geodesy and Cartography and the regulation concerning the Land and Building Cadastre.
- » Land and building cadastre objects are land parcels, buildings or separate premises (apartments).
- » The information collected in the land and building cadastre primarily concerns their location in the orthogonal coordinate system, but the database also contains a number of attributes describing the physical and legal status of the cadastral objects.

Land registration systems in Poland

- » The most numerous objects of the land and building cadastre are the cadastral parcels.
- » The only reference to the three-dimensional space in the cadastral system can be considered descriptive information on the number of underground and aboveground floors.
- » The land and mortgage register operates on the basis of the Act on Land Register and Mortgage. Land and mortgage register objects are real estates (properties).
- » Real estate can consist of land parcels, buildings or separate premises (apartments). Buildings and premises may be separate properties or may be part of another object.
- » The building may make the same real estate as land parcel and the premises may be part of a building.

Introduction

- » In the paper "Developing a UML Model for the 3D Cadastre in Poland" written by J.Bydłosz and A.Bieda the existing Polish UML cadastral model is extended, with the outcome of the UML model for 3D cadastre.
- » This model is strictly theoretical, so the authors decided to made a trial of its practical verification.
- » To achieve it the situation diagrams, UML modeling and laser scanning surveys were applied.

Case study – location and map

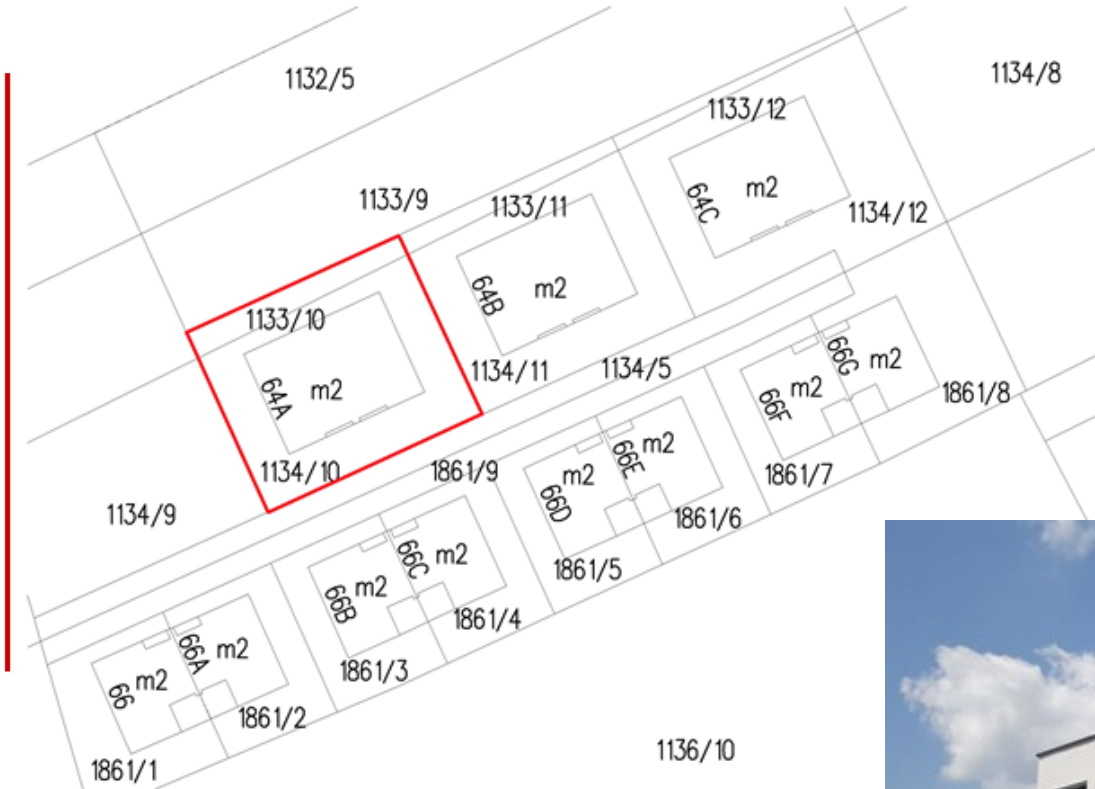


The location of the Krakow County.



The real estate top view.

Case study – visualisation

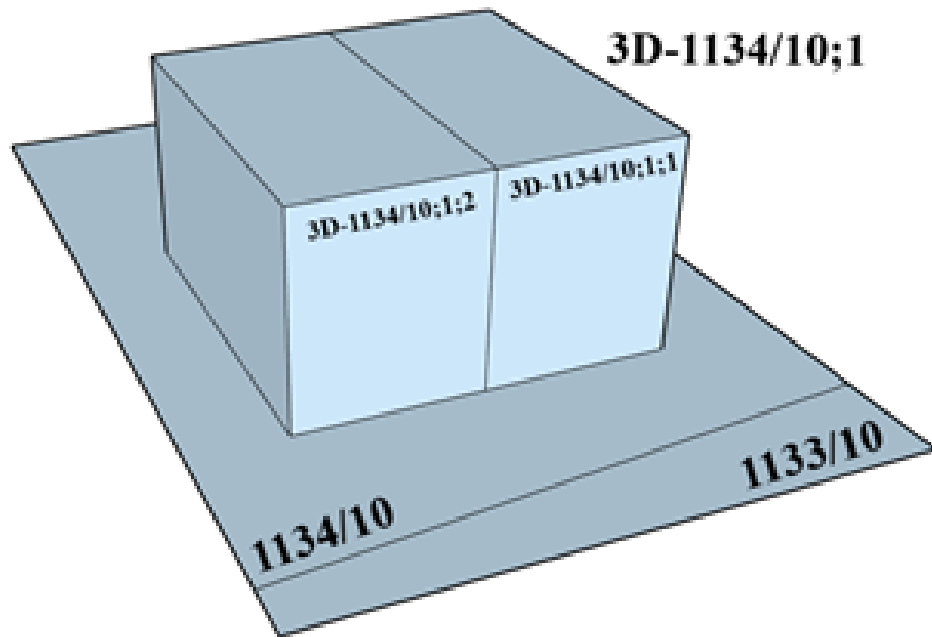


Cadastral map, based on data from the state geodetic and cartographic centre.

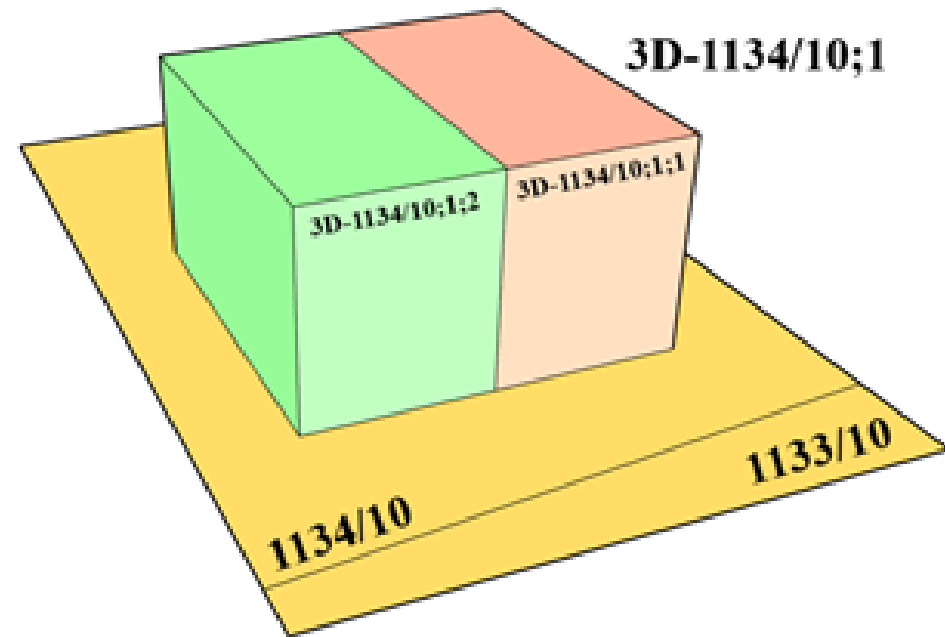
The object's photo.



Diagram of ownership situation

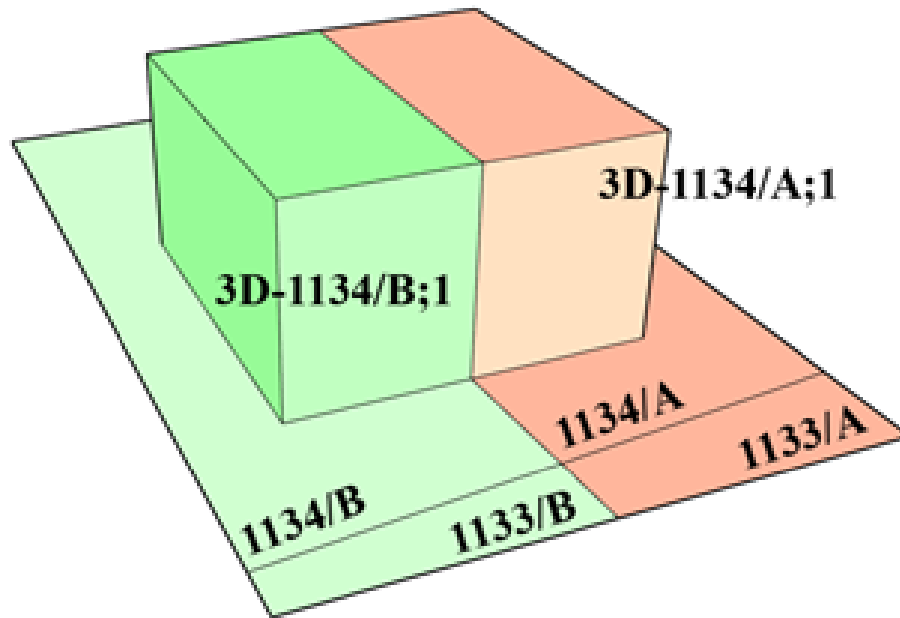


1. Actual (before the sale) – one building with two units and two parcels of land belonging to the developer.

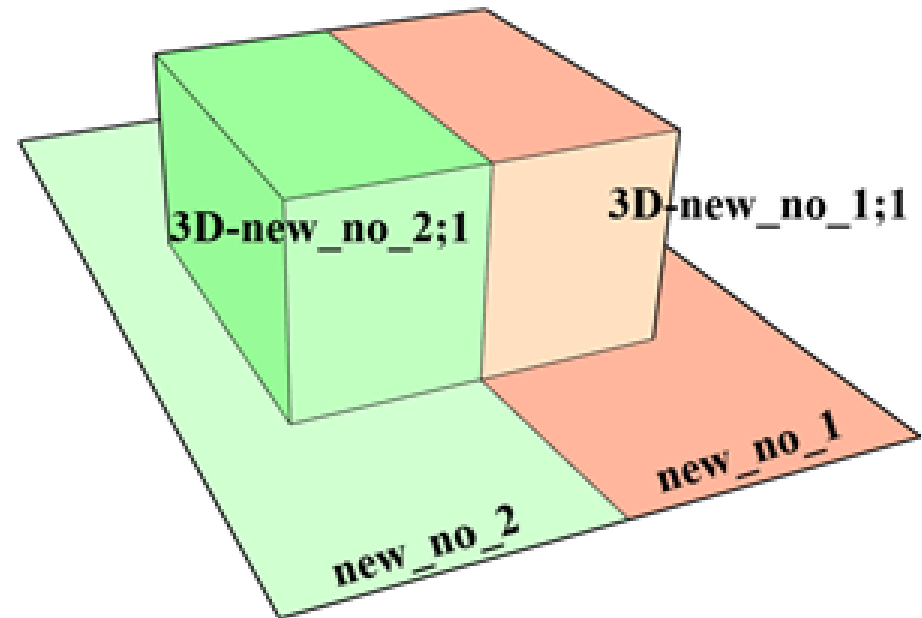


2. Actual (after the sale) – one building with two units belonging to new entities and two parcels of land co-owned by the owners of the units.

Diagram of ownership situation



3. Obtainable through subdivision – two buildings which are components of parcels and the parcels "belonging" to them according to the development plan of the estate



4. Obtainable through merger and subdivision – two buildings which are components of parcels belonging to different entities.

Laser scanning and 3D BIM model

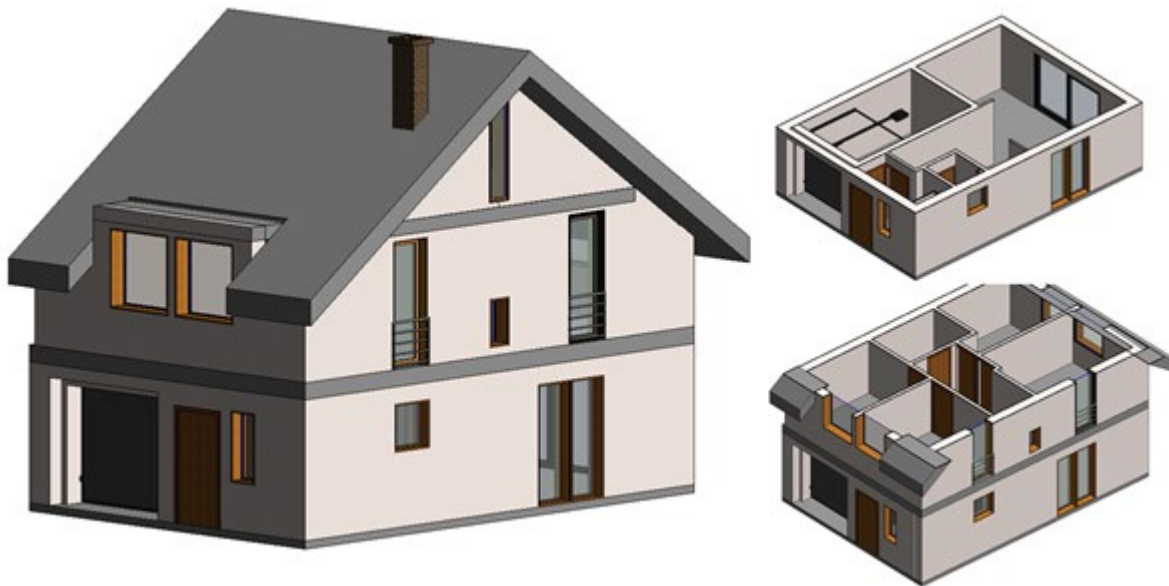
- » The point clouds were acquired with the Faro Focus 3D X130 terrestrial laser scanner. The entire project consisted of 26 scanner positions, of which scans 1st to 8th covered the facades of two buildings (64A/1 and 64A/2), while scans 9th to 26th covered the interior of one of the twins (64A/2). All point clouds were acquired together with RGB photos. Nominal point cloud densities were set to correspond to 10m distance from the scanned object. They were 6.1mm at the facade and 7.6mm for the interior of the building.
- » The individual scans were registered into one coherent project in Trimble Real Works 11.3 using the c2c method with an overall Cloud-to-Cloud Error at 1.69 mm. The entirety of the acquired data is almost 680 million points in 26 files with a total volume of 16.3 GB in LAS 1.2 file format.



Point cloud of the research object coloured by RGB values.

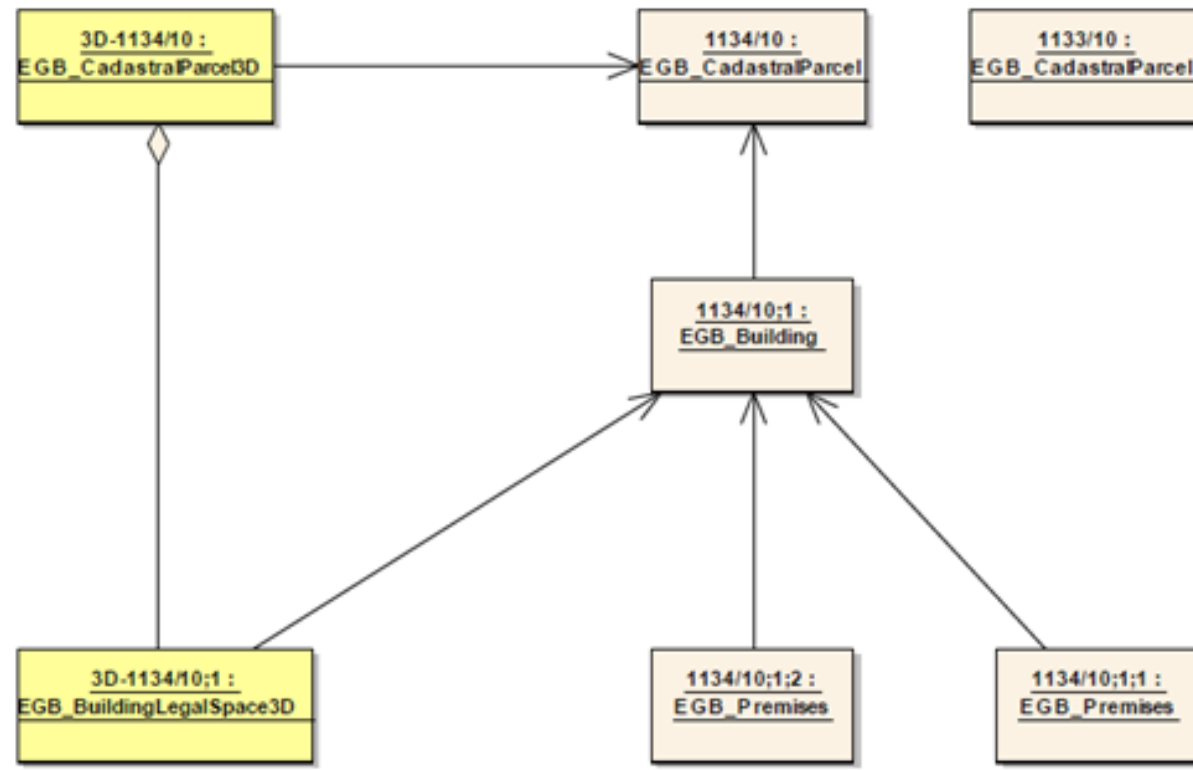
Laser scanning and 3D BIM model

- » The design documentation and the actual state of the building differ after the building is constructed.
- » Therefore, in order for the developed model to reflect the actual state of affairs as much as possible, it was decided to perform a laser scanning which will be the basis of 3D model.
- » LOD was setting up at level 100. The main structural and architectural elements were modelled – walls, ceilings, beams, roof, doors and windows. However, the inventory did not cover any elements of technical equipment – pipes, conduits nor ducts etc.



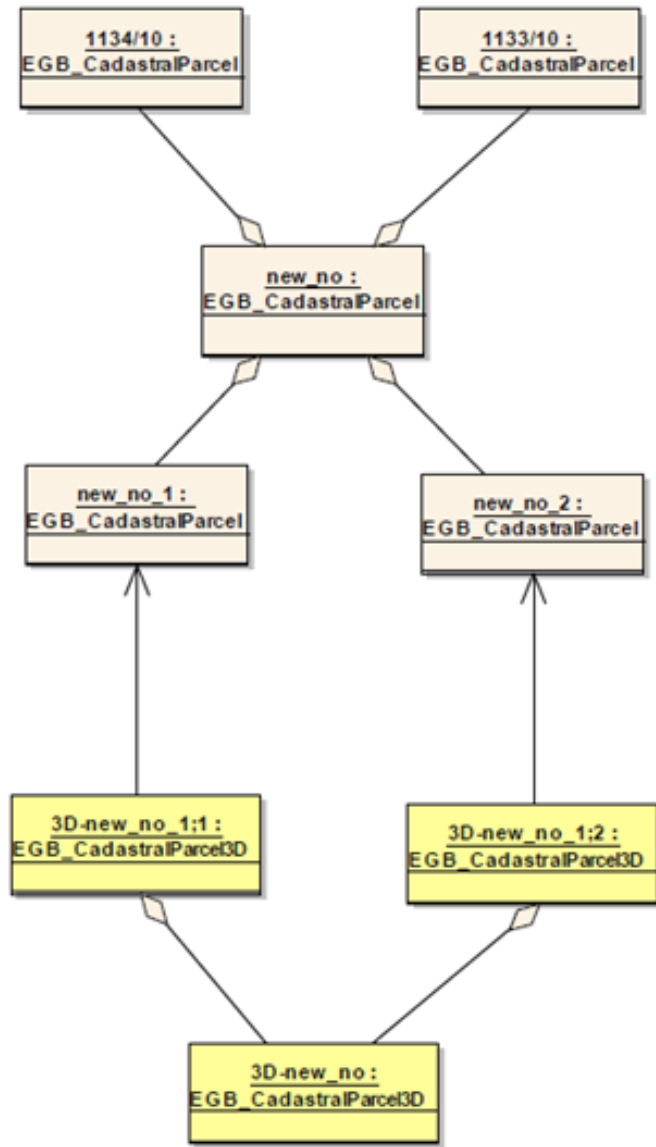
3D BIM model of the research object (whole on the left) and parts of model divided by levels (right)

UML models



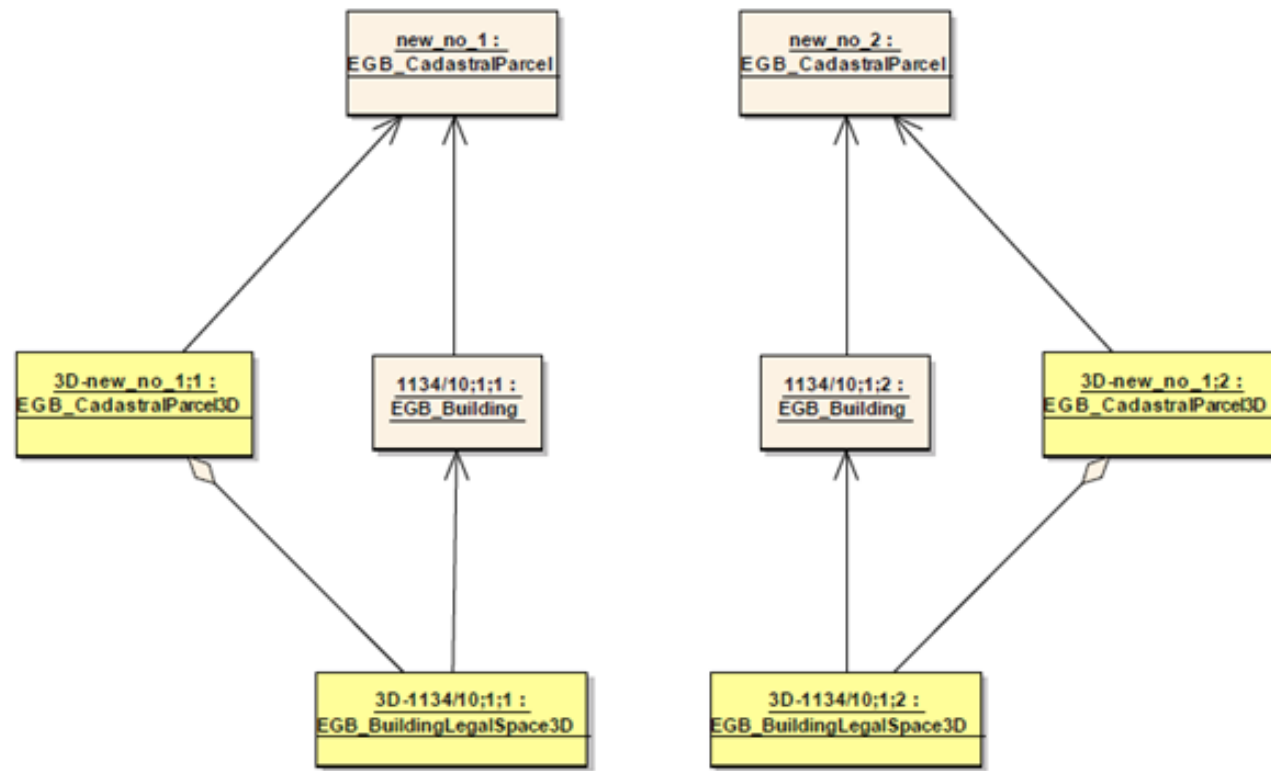
UML Diagram defining the relationships between 2D and 3D cadastral parcels, buildings and its legal spaces for parcels 1134/10, 1133/10 and buildings – corresponds to situation no. 1

UML models



Schema of subdivision and merging of 2D parcels 1134/10, 1133/10 and new 3D cadastral parcels.

UML models



The situation after subdivisions and creating new parcels
– corresponds to situation no. 4.

Discussion and conclusions

- » Some problems independent from applied surveying method but resulting from the analysed case appeared.
- » The proposed solution is the division of parcel to create two independent real estates and correspondingly all 2D and 3D cadastral objects.
- » Preparing a 3D BIM model of an object based on a point cloud from terrestrial laser scanning is more expensive and requires more time than preparing a model based on the design documentation.
- » The application of laser scanning in of 3D cadastral model verification requires further research.



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Thank you.

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