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"СЪВРЕМЕННИТЕ ТЕХНОЛОГИИ, ОБУЧЕНИЕТО И ПРОФЕСИОНАЛНАТА
ПРАКТИКА В ГЕОДЕЗИЯТА И СВЪРЗАНИТЕ С НЕЯ ОБЛАСТИ"
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APPLICATION OF 3D TERRESTRIAL LASER SCANNING FOR CREATION OF PROJECT DOCUMENTATION FOR CADASTRAL OBJECTS

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APPLICATION OF 3D TERRESTRIAL LASER SCANNING FOR CREATION OF PROJECT DOCUMENTATION FOR CADASTRAL OBJECTS

1. INTRODUCTION

3D terrestrial laser scanning

- one excellent possibility for fast and precise way for gathering of spatial information

the application of the technology depends on factors as:

- spatial geometry of the object
- requirements for accuracy and completeness of the information
- outdoor conditions and others

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1. INTRODUCTION

some reasons, which may lead to necessity of usage of **terrestrial laser scanning**

absence of any documentation for the object;

impossible to access parts of the objects;

complexity of the geometry of the buildings, incl. the interior;

the conventional surveying ways could not provide the spatial information in the required completeness with the necessary productivity.

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2. THE TASKS OF THIS PAPER

aims

to study the requirements for the process of scanning complex (with existence of many details) cadastral objects – civil and industrial;

to create from the point cloud the **ready-for-use** data for other professionals;

to propose recommendations, based on the practical activities.

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2. THE TASKS OF THIS PAPER

Key moments

1. to follow the field procedures for capturing of the necessary spatial information;

2. usage of the point cloud to deliver the required digital information for other software products;

3. extraction of the data in appropriate format for the 2D space;

4. application of:
AutoCAD;
Trimble RealWorks;
Trimble RealWorks Viewer;
Internet Explorer

for interpretation of the spatial information.

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3. SOME DETAILS FOR THE REQUIREMENTS AND ADVANTAGES OF 3D TERRESTRIAL LASER SCANNING OF ESSENTIAL IMPORTANCE FOR OUR SPECIFIC CASE

Surveying should not be conducted if the ambient temperature falls below 5 degrees Celsius;

Some requirements

for the application of terrestrial laser scanning **of essence for our case**

Measurements should not be conducted in dust, snow or rain;

Highly reflective or absorbing objects' surfaces will increase the inaccuracy of the measurements.

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Scanning against direct sunlight should be avoided.

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3. SOME DETAILS FOR THE REQUIREMENTS AND ADVANTAGES OF 3D TERRESTRIAL LASER SCANNING OF ESSENTIAL IMPORTANCE FOR OUR SPECIFIC CASE

Some major advantages

of the application of the TLS for this project:

3D terrestrial laser scanning **sealed the object** in time and space;

Possibility to obtain thorough spatial data **in a short time period** at the field.

The usage of **contactless technology** - required for conducting of the geodetic measurements -

as parts of the objects (e.g. **the roof**) - located at practically impossible or dangerous for human access places.

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4. PARTICULARITIES OF THE 3D TERRESTRIAL LASER SCANNING IN THE PROCESS OF CREATION OF DOCUMENTATION FOR CADASTRAL OBJECTS. PROCESSING OF THE RAW DATA. TECHNICAL ISSUES

Particularities in the field work and the data processing

Due to the specifics of the cadastral objects, the scanning was **not always** performed **with the usage** of artificial targets between the scans.

The scanner was positioned on places, which ensured the direct visibility to **each detail** of the building.

In our case, the registration was planned to be done using the cadastral details.

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The processing of the raw data - done, using "**spatial sampling**" instead of sampling by step and adaptive sample.

Homogeneous point cloud was created.

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4. PARTICULARITIES OF THE 3D TERRESTRIAL LASER SCANNING IN THE PROCESS OF CREATION OF DOCUMENTATION FOR CADASTRAL OBJECTS. PROCESSING OF THE RAW DATA. TECHNICAL ISSUES

Particularities in the processing of the 3D data

In the process of creation of the full 3D digital model, some **issues were encountered**.

"Registration using planes" method failed, even though flat walls were existing.

For some of the scans **"Cloud-based registration tool"** was used for the processing of the stations.

1. The method required much more efforts;
2. It was time consuming;

In case there were no artificial targets, the tool could be **useful for creation** of the full 3D digital model.

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5. USAGE OF THE POINT CLOUD FOR CREATION OF 3D AND 2D DIGITAL MODELS FOR PROJECT DOCUMENTATION OF CADASTRAL OBJECTS. SOFTWARE

The created point cloud was used for several purposes,
including and not limited to:
- **full 3D visualization;**
- **creation of vector model of polylines;**
- **extraction of cross-sections, etc.**

example:

extraction of the necessary data for creation of digital models of **plans for each level of a cadastral object,** (Fig. 1)

Fig. 1 The under-roof space
(*.dwg model - point cloud and situation)

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extraction and creation **of cross-sections** (Fig. 2)

creation of digital models of **plans for each level of cadastral objects** (Fig. 3)

examples

extraction of information for creation of the relevant digital models

Fig. 2 Industrial object with "raw" cross-section

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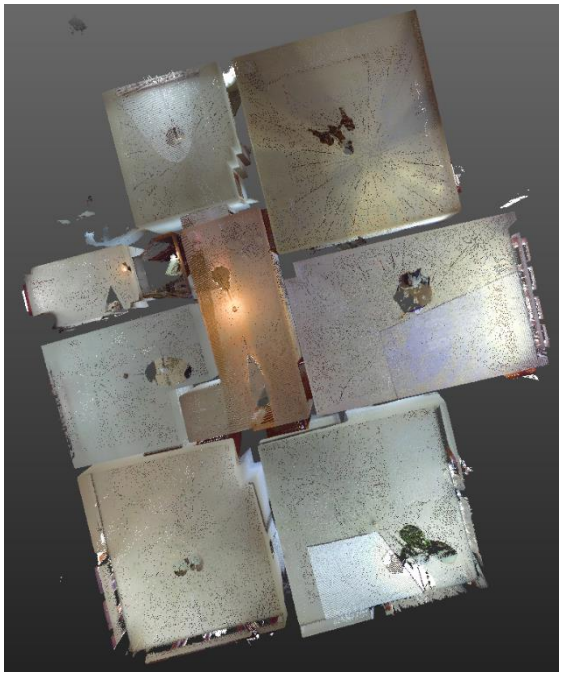

Fig. 3 Rooms in a house /view from above/

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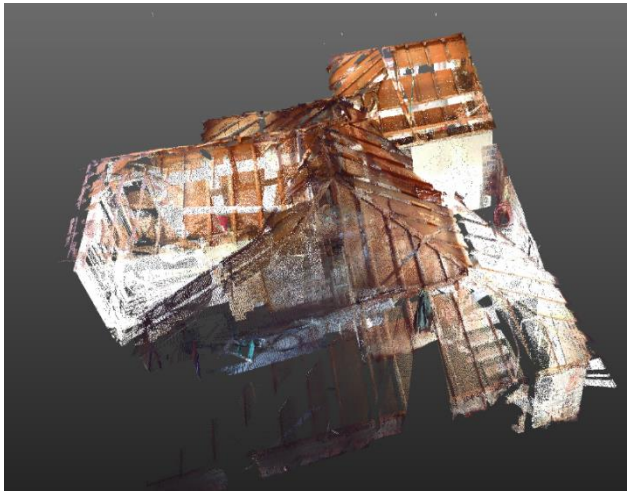
creation of digital model of a roof
extraction of the necessary data
from the point cloud (Fig. 4)

In this specific case, the scan of the roof was done from the last floor.



The **visual information,** available in Trimble Realworks, also the **cross-sections** - useful for creation of the digital documentation.

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Fig. 4 Roof, viewed from aside in the virtual environment of Trimble RealWorks.

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5. USAGE OF THE POINT CLOUD FOR CREATION OF 3D AND 2D DIGITAL MODELS FOR PROJECT DOCUMENTATION OF CADASTRAL OBJECTS. SOFTWARE

Software aspects

Several software products exists,
which could handle the information from
the 3D terrestrial scanning in this specific case:
Trimble RealWorks;
Trimble RealWorks Viewer;
AutoCad;
Internet Explorer, etc.

The final products for this project **could be** and **not limited to**:
- *.dwg files containing plans for the respective level of the object;
- *.dwg models of a vertical cross section of the facades;
- Vector models containing the schemes of the separated objects for each floor of the building;
- Created dimensions in the 3D space, etc.

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6. RESULTS AND ANALYSIS

The work load in the project could be separated into:
a) **Creation of a complete digital model of the point cloud for the object**;
b) **Extraction, processing and preparation in the appropriate format the required information in 3D and 2D spaces**.

a) Generally, creation of a **complete model** might require **specialised human intervention** for the process "cloud-based registration tool".

The overall error here was about several centimetres, depending on the fitting between the reference and moving clouds. The procedure **might require time**, based on the used **hardware** and **amount of processed data**.

6. RESULTS AND ANALYSIS

If artificial targets were used, the achieved accuracy of the point cloud varied from **2 mm. up to 5 mm.**

b) In this case, human intervention was required for **extraction and processing of the data** in the relevant space, incl. creation of the vector model.

Depending on the existing obstructions in the vicinity of the object, it was necessary to be paid more attention, also **virtual walks** to be performed in the environment of Trimble RealWorks or Trimble RealWorks Viewer.

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7. CONCLUSION. RECOMMENDATIONS

This paper studied the procedures, which should be followed in the process of creation of a project documentation for objects of cadastre /**civil and industrial buildings**/ with information derived from already created point cloud by 3D terrestrial laser scanning.

Issues, which might appear during the processing of the data were also noted.

The final results from the measurements – both 3D and 2D digital models in the relevant format were used for creation of **plans of the respective floors** and various **cross-sections** of the cadastral objects.

Based on the data from the created digital models in *.dwg format it could be summarised, that for the needs of creation of documentation for cadastral objects **for our specific case**, 3D terrestrial laser scanning **could be successfully applied as fast, reliable and contemporary technology** in the surveying practice.

Current survey methods **may be outdated** for this specific case, if completeness of the data and productivity of the process are of essence.

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7. CONCLUSION. RECOMMENDATIONS

Taking in mind the structure and the size of each object, it could be noted that the used technology successfully fulfilled the requirements for: data delivery in the relevant **digital format** and the overall quality.

Based on the described technical details in the paper, it could be **recommended the usage of 3D terrestrial laser scanning and its results** for specific tasks in geodesy and connected professional areas for creation of project documentation.

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10. http://tinyurl.com/o7gm5vw

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USED SOFTWARE

1. Trimble RealWorks (http://tinyurl.com/pdckrlr);
2. Trimble RealWorks Viewer (http://tinyurl.com/qhwj92w);
3. Autodesk Autocad (http://tinyurl.com/nma4923);
4. Microsoft Internet Explorer (http://tinyurl.com/ocxn2by).

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Thank you for your attention!

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