TOPO-CADASTRAL WORKS FOR THE EXECUTION OF A ZONAL URBAN PLAN

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***Abstract**:The topo-cadastral works conducted for the preparation of a Zonal Urban Plan for the development of a residential area with complementary functions, facilities, and public services were carried out in the village of Urseni, Moşnita Noua Commune, Timiş County. The property is bounded to the north by arable land, to the south by a communal road, to the west by a European road, and again to the east by arable land. The Zonal Urban Plan (PUZ) is the urban planning document that regulates land use and the organization of space for a specific area, serving to complement the General Urban Plan (PUG). For field measurements, Real Time Kinematic (RTK) surveying was employed, using a GPS receiver capable of receiving real-time corrections from the TIM1 station in Timisoara, equipped with a GPRS connection module. The receiver is a dual-frequency Trimble R6 Receiver, model TRM_R6, which is compatible with multiple GNSS networks, including GPS, GLONASS, Galileo, and BeiDou, allowing for extensive coverage and increased precision. The TRM_R6 is an advanced piece of equipment designed for precision measurements in the fields of geodesy, topography, and mapping applications. The coordinates of the boundary points were obtained from the eTerra application database, using the Stereographic 1970 coordinate system, while the leveling reference system is based on the Black Sea 1974. The processing of the measured points was carried out using the Trimble Total Control v.2.73 topographic calculation software.*

***Key words:** eTerra, GNSS, Topography., Mosnita Noua, PUZ, Stereographic 1970 .*

INTRODUCTION

Since the subject of this work is a Zonal Urban Plan (PUZ), I would like to highlight a few characteristics that define it. Specifically, the PUZ sets conditions regarding land use, types of allowed constructions, green spaces or infrastructure, building height limits, the maximum land use coefficient, the land occupancy percentage, and the organization of road and pedestrian traffic.

The purpose of developing a Zonal Urban Plan is to ensure sustainable, balanced urban development that is adapted to the requirements and specifics of the area. It is created by urban planning specialists, following extensive field research, and it must be approved by the local council responsible for the property in question, taking into account, of course, the interests of the local community. If necessary, the PUZ can be modified according to the needs of the community or in line with future development projects. (Tudor, 2016; Bălcescu,2010)

In conclusion, the Zonal Urban Plan represents an essential tool in the planning and management of properties, contributing to the creation of a well-organized, highly productive, attractive, and beneficial environment for people.

GNSS is the abbreviation for Global Navigation Satellite System, which is a global satellite navigation system that provides the general public with highly accurate positioning services, as well as navigation and timing. GNSS includes various satellite constellations such as GPS owned by the United States, GLONASS (owned by Russia, Galileo (owned by the European Union, and BeiDou owned by China. (Smuleac et al.,2020).

MATERIALS AND METHODS

The land discussed in this topographic-cadastral report is private property and is located in the village of Urseni, Moșnița Nouă Commune, in Timiș County. It is situated in the extravilan (outskirts), in the southwestern part of the administrative territory of Moșnița Commune. The plot under study, with the topographic number 408726, borders to the southwest with Hcn 552, to the north and east with Hcn 569, to the west with De 583 - 4m, and to the southeast with plot A584/1/2. Access from Timișoara is via the north-south direction on Calea Urseni, next to the Water Treatment Plant, until the city limits. The route continues along the county road DC 98 Timișoara-Urseni in the east-west direction, and from there, across a small bridge to the parcels within the studied PUZ. The communal road is paved and is in good condition. (mosnita.ro).

Given the quality of the natural environment and the geographic location close to the city of Timișoara, Moșnița Nouă Commune has significant potential for residential development, as well as for complementary activities and services. Morphologically, the area lies within the low plain known as the Banat Plain, which is part of the larger geomorphological unit of the Tisa Plain. This represents the center of a vast alluvial complex, with the Timis and Bega rivers as its longitudinal axis.

Timișoara is located in the Banato-Crișana Plain, in the subunit of the Timiș-Bega interfluve, which presents itself as a relatively flat and uniform area. The analyzed zone aligns with the general characteristics of the municipality. The land in question is relatively flat, with no risks of flooding or landslides. Moșnița Nouă Commune falls within a moderately continental temperate climate. (primariatm.ro).

Figure 1. Presentation of adjacent areas

The topographic survey of contour points using the "Real Time Kinematic" (RTK) method is an advanced technique used in geodetic measurements that allows for obtaining very precise positioning data in real-time. RTK is based on Global Navigation Satellite Systems such as GPS, GLONASS, Galileo, and BeiDou. These systems provide global coordinates, but the signal can be affected by atmospheric errors, multipath interference, or satellite geometry. This system requires a fixed reference station that knows the exact coordinates and receives signals from the satellites. It then transmits correction data to a mobile receiver, in our case, the dual-frequency Trimble R6 GPS receiver. The rover receives the correction signals from the reference station and applies these corrections in real-time, allowing for an accuracy of under 2 cm under ideal conditions. (Bălan, 2009; Herbei et al.,2018)

This RTK topographic survey method provides much greater accuracy than traditional measurement methods. Measurements can be performed much faster due to real-time processing. The technique can be used in various applications, such as cartography, civil engineering, construction, precision agriculture, and more.

The disadvantages of this measurement method are that it can be affected by buildings, trees, or any objects that can block the GNSS satellite signals. The accuracy may decrease if the distance from the reference station (in our case, TIM1) is very large, and bad weather conditions, such as clouds and rain, can also influence the satellite signal, thus affecting the accuracy of the measurements, potentially causing significant errors. (Smuleac et al.,2017; Casian et al., 2019).

Topographic surveying using RTK is an efficient and precise method for obtaining geodetic data, with diverse applications in engineering, construction, and agriculture. This technology continues to evolve, constantly improving the precision and speed of measurements. (Herbei et al.,2016; Șmuleac et al., 2020)

Figure 2. Trimble R6 GPS receiver

Job name	PUZ Mosnita
Creation date	4 Feb 2024
Version	Trimble General Survey 3.00
Distance Units	Meters
Angle units	Degrees
Pressure Units	mbar
Temperature Units	Celsius

Coordinate system (Job)

System	Romania
Zone	Stero 70 - TDR401
Datum	ETRF89

Projection

Projection	Projection grid
Projection grid file	RO_PGvT4
South azimuth (grid)	No
Grid coords	Increase North-East
Ellipsoid	Semi-major axis: 6378137.000 Flattening: 298.25722154

Datum transformation

Type	Three parameter
Semi-major axis	6378137.000
Flattening	

Projection	298.257223
Projection grid file	Projection
Ellipsoid	Semi-major axis: 6378137.000 Flattening: 298.25722154

Survey event

Survey event	Rover started

Base point

GNSS receiver

Receiver type	R10
Serial number	5312430376
Firmware version	5.2
Antenna type	R10 Internal
Measurement method	Bottom of quick release
Tape adjustment	0.000
Horizontal offset	0.000
Vertical offset	0.199

RESULTS AND DISCUSSIONS

The creation of the topographic support necessary to prepare a Zonal Urban Plan involves several important steps. Here is an overview of these steps:

1. Identification of the land;
2. Analysis of the documents specified in the work start notice issued by OCPI (National Agency for Cadastre and Land Registration);
3. Obtaining the coordinates of the boundary points of the properties in the respective block, which have undergone cadastral works and are registered in the OCPI database;
4. Creation of the land boundary for the area covered by the Detailed Urban Plan (PUD) and its identification on-site;
5. Establishment of a support and topographic survey network required to carry out the topographic measurements;
6. Performing field measurements using GNSS technology to capture the elements that will be included in the subsequent documentation. (Săndulescu, 2017).

As the first step to begin the work, the land was identified, and its boundaries were determined using the zoning plan and the site plan provided by the Municipality. The data for the property with cadastral number A.584/1/1 was updated in order to register its geometry in the land registry with number 408726 - Moșnița Nouă, covering an area of 10,000 square meters. A reception and registration request was also drafted, aiming to change the property's classification from extravilan (outskirts) to intravilan (urban area). The topographic survey of the contour points was carried out using the "Real Time Kinematic" (RTK) method, and additional measurements were taken with a tape measure to verify the property boundaries and to identify points that could not be measured by GNSS. The data was processed, reports were created, and the coordinates of the boundary points were established in the Stereographic 1970 projection system. (Ghiță, 2014).

As part of the ongoing works, our property was subdivided into 9 different plots, as follows:

- Batch number 1, A.584/1/1/1, area 1092 sqm, intended for collective housing with 9 apartments and commercial/service facilities on the ground floor.
- Batch number 2, A.584/1/1/2, area 1192 sqm, intended for collective housing with 9 apartments and commercial/service facilities on the ground floor.
- Batch number 3, A.584/1/1/3, area 1194 sqm, intended for collective housing with 9 apartments and commercial/service facilities on the ground floor.
- Batch number 4, A.584/1/1/4, area 1310 sqm, intended for collective housing with 6 apartments and commercial/service facilities on the ground floor.
- Batch number 5, A.584/1/1/5, area 1371 sqm, intended for collective housing with 6 apartments and commercial/service facilities on the ground floor.
- Batch number 6, A.584/1/1/6, area 1349 sqm, intended for green space.
- Batch number 7, A.584/1/1/7, area 1588 sqm, intended for streets.
- Batch number 8, A.584/1/1/8, area 398 sqm, intended for streets.
- Batch number 9, A.584/1/1/9, area 506 sqm, intended for streets.

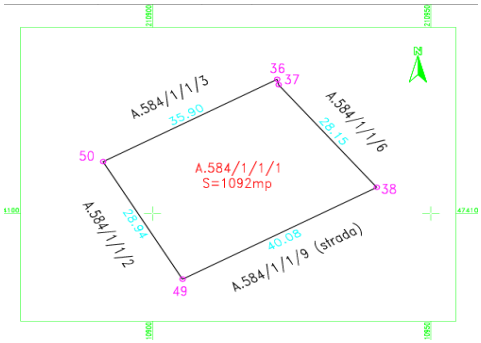

Figure 3. Batch number 1

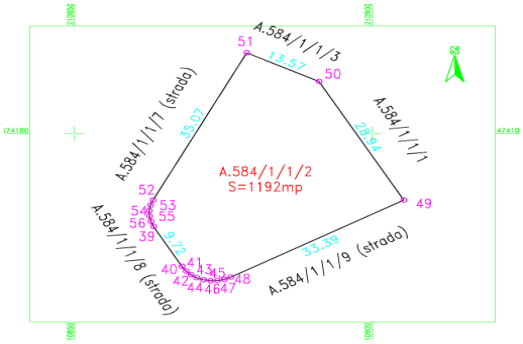

Figure 4. Batch number 2

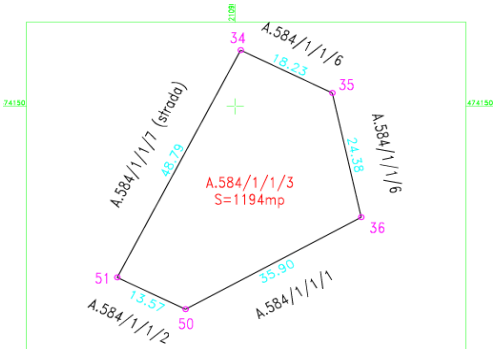

Figure 5. Batch number 3

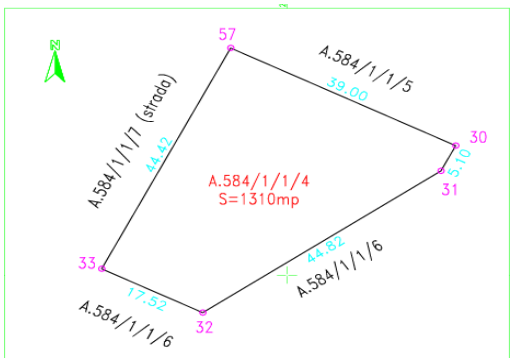

Figure 6. Batch number 4

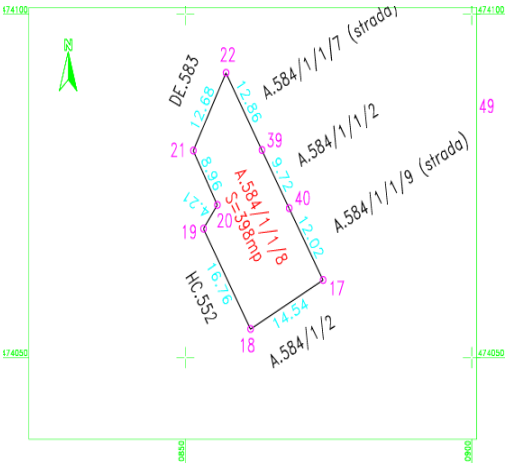

Figure 7. Batch number 5

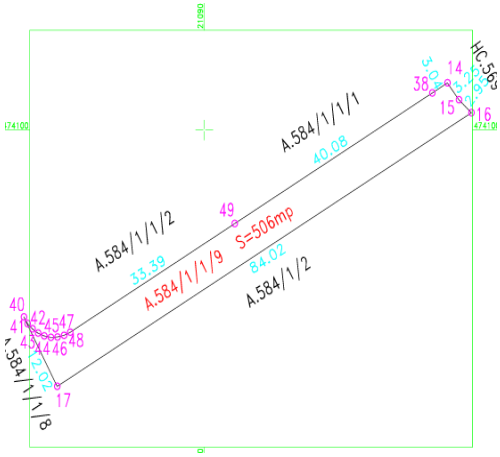

Figure 8. Batch number 6

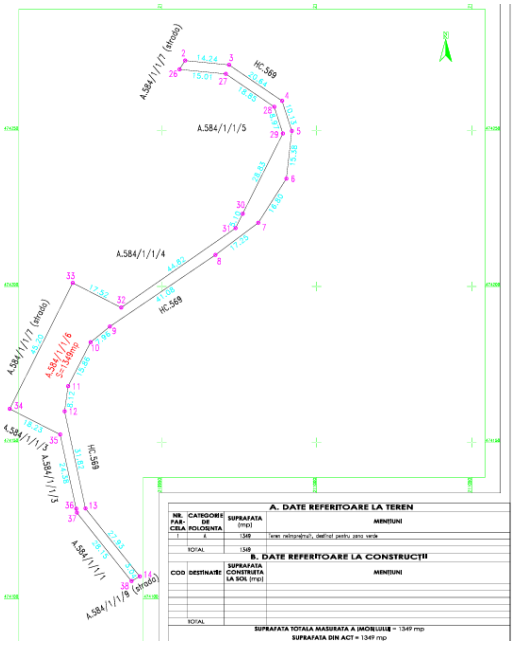

Figure 9. Batch number 7

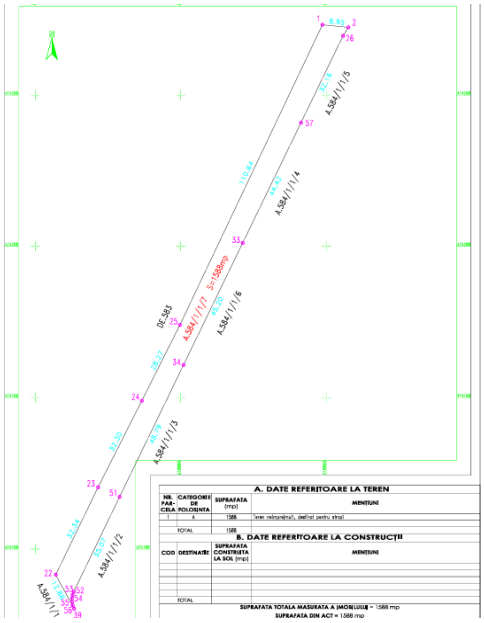

Figure 10. Batch number 8

After completing the previous steps, we move on to the next objective, which is preparing the request to obtain the Urbanism Certificate for the authorization of construction works, as well as requesting the issuance of the Urbanism Certificate for the development of the residential area with public utilities and services.

The preparation of the necessary documentation for authorizing construction works will be carried out in accordance with the provisions of Article 3, paragraph (1) of the law. This includes works for construction, reconstruction, repair, extension, protection, consolidation, restoration, and conservation, as well as other activities related to buildings that are historical monuments, in accordance with the applicable legislation.

Additionally, consideration will be given to works involving the construction, modification, extension, and modernization of communication routes, forest roads, civil engineering works, networks, and technical public utilities, as well as hydrotechnical works, riverbed arrangements, land improvements, infrastructure installations, the creation of new capacities for the production, transportation, and distribution of electricity and thermal energy, and the rehabilitation and modernization of existing facilities. Other works include fencing, urban furniture, the development of green spaces, parks, squares, and other interventions in public spaces. (Lăzăescu, 2019; Smuleac et al., 2018).

The next phase aims to develop the topographical and cadastral support required for the development of the Zonal Urban Planning document. To achieve this, the following activities are necessary: land analysis, reviewing the documents mentioned in the work commencement notice issued by OCPI, obtaining the coordinates of the boundary points of the properties in the respective block that have been subject to cadastral work and are registered in

the OCPI database, outlining the land that is the subject of the Detailed Urban Planning (PUD) and identifying it on the ground, establishing the support network and the measurement network necessary for carrying out the topographical surveys, and performing field measurements using GNSS technology to collect the data required for further documentation preparation. The measurement processing will be done using the topographical calculation software "Trimble Total Control." (Roxana et al., 2020; Paunescu et al., 2020; Pascalau, 2021).

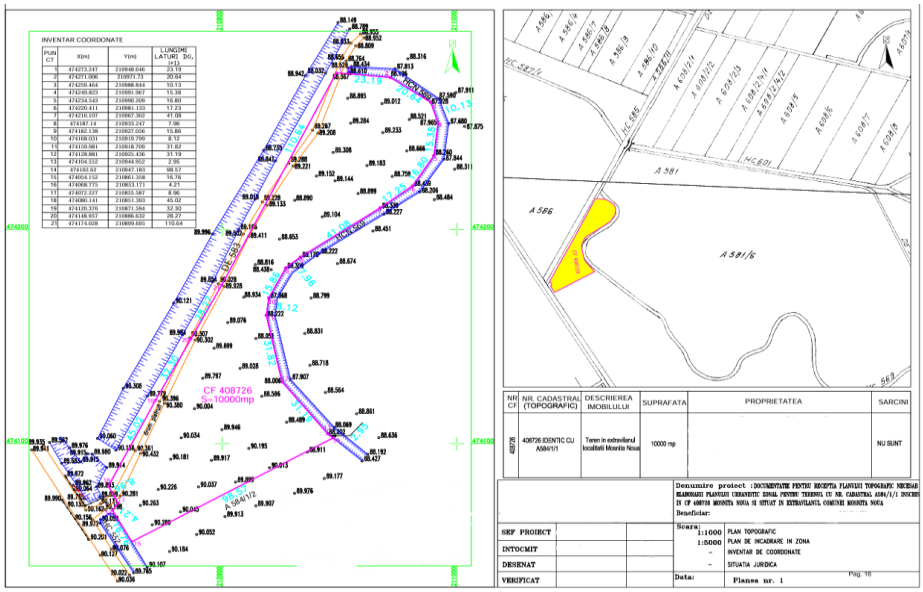

Figure 11. Zoning Location Plan

The results obtained from the measurement processing, both in digital and analog formats, will be included in the documentation necessary for obtaining the specialist approval from OCPI for the Zonal Urban Plan. This will be done in accordance with Article 264 of the Regulation on the approval, acceptance, and registration in the cadastral and land registry records, approved by the Order of the General Director of ANCPI no. 700/09.07.2014, with all subsequent amendments and additions. The precision requirements for calculating the coordinates of detail points corresponding to the extravilan will be respected. (Ghiță, 2014).

The final stage of this project involves developing the Zonal Urban Plan for the development of the Residential Area, including complementary functions, facilities, and public spaces (Mita et al., 2020).

Regarding the methods used, considering that the area targeted by the PUZ is 10,000 sqm, two reference points were established using a GPS receiver with the static method. The cadastral field measurements were performed using kinematic determinations with the Real-Time Kinematic (RTK) technique, using a Trimble R6 dual-frequency GPS receiver that receives real-time differential corrections from the permanent station TIM1 with coordinates x=482495.124, Y=207132.251, H=111.636, via the General Packet Radio Service (GPRS) connection.

The coordinates of the boundary points were extracted from the eTerra application database. The measurement processing was performed using the Trimble Total Control v.2.73 topographical calculation software, and the coordinates were established in the

STEREOGRAFIC 1970 projection and the Black Sea 1970 leveling reference system. The data extracted from the device were saved on digital media and organized into files named: "14.06.2023.dc," "14.06.2023.htm," "14.06.2023.job," and "14.06.2023.jxl," which were attached. The representation of these data in the documentation was done according to the standards in the Atlas of Conventional Symbols for topographic maps at scales 1:5000, 1:2000, 1:1000, and 1:50. (Bălcescu.2010; Simon et al., 2017)

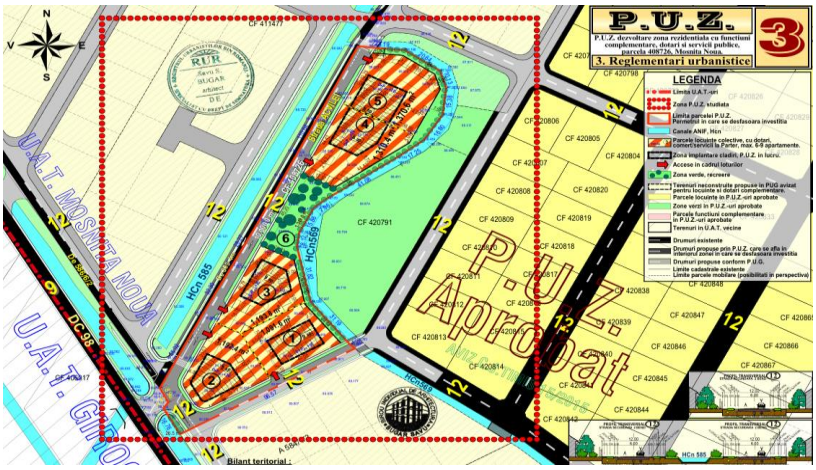

Figure 12. PUZ Regulatory Plan

CONCLUSIONS

This work aims to carry out topographical surveys for the development of the residential area, which will include complementary functions, facilities, and public services, in order to create a site plan based on the actual conditions of the land, necessary for the development of the Zonal Urban Plan. The measurements were taken using GNSS equipment, adhering to the precision requirements for calculating the coordinates of detail points: Hz = 0.009 – 0.037, Vt = 0.011 – 0.053.

The development of the Zonal Urban Plan was carried out in accordance with the Guide regarding the methods for implementation and the content of the PUZ, approved by the Ministry of Public Works and Territorial Development through Order no. 176/N/2000, while respecting the applicable legislation.

In conclusion, the purpose of a Zonal Urban Plan is to regulate land use and organize urban development in a coherent and sustainable manner. The PUZ facilitates the integration of residential, commercial, and service functions, while ensuring environmental protection and compliance with legal standards. By establishing a clear framework for urban planning, the PUZ contributes to the creation of well-structured communities that meet the needs of citizens and promote harmonious urban space development.

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