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URBAN PLANNING FRAMEWORK FOR THE EXTENSION AND MODERNIZATION OF ARAD COUNTY HOSPITAL

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Abstract. *The paper presents the elaboration of a Zonal Urban Plan (PUZ) for the extension and modernization of the infrastructure of the Arad County Emergency Clinical Hospital, with the aim of optimizing its functionality and developing the medical services provided at regional level. The study is based on the analysis of the existing situation, the evaluation of the urban and technical conditions of the site, as well as the realization of the topographical surveys necessary to substantiate the urban regulation proposals. The research identified the main dysfunctions of the medical complex, such as inadequate circulation, limited accessibility for special vehicles and deficiencies in the technical and urban infrastructure. The PUZ documentation proposes the reorganization of medical and logistics flows, the development of new buildings, the modernization of the utility networks and the reconfiguration of the functional zoning of the premises. The urban planning proposals aim to increase the functional efficiency of the hospital unit, adapt it to current requirements in the medical field, and ensure its harmonious integration into the urban structure of the municipality of Arad. The documentation constitutes a technical and strategic support for the phased development of the medical infrastructure and for the improvement of the quality of health services at the county level.*

Keywords*: PUZ, Arad County Clinical Hospital, topographical survey, modernization, extension*

INTRODUCTION

Modern urban planning increasingly relies on accurate topographic and geospatial datasets for the representation of existing buildings, cadastral boundaries, circulation networks and technical infrastructure. The integration of surveying measurements with GIS and computer-aided design environments provides a consistent spatial basis for planning and redevelopment projects (GHILANI, 2018; LONGLEY et al., 2015). Recent applications also demonstrate the potential of integrated digital topography and remote sensing for the management and development of complex institutional sites (POPESCU et al., 2025).

The present paper aims to develop a Zonal Urban Plan for the extension and modernization of the Arad County Emergency Clinical Hospital, one of the most important medical units in western Romania. The analyzed site is located in the central area of Arad and includes both historical heritage buildings and medical constructions carried out in different stages of urban development.

The need to develop the PUZ documentation results from the existence of dysfunctions regarding the organization of internal circulations, the insufficiency of medical spaces and the need to modernize the technical-urban infrastructure. Through urban documentation, the aim is to optimize medical and logistical flows, delimit the areas intended for expansion, as well as integrate new interventions into the existing urban and functional context.

In order to substantiate the urban proposals, detailed topographical surveys of the site, analyses of the existing situation and studies on land use and urban indicators were carried out. The research uses methods specific to the field of urban planning, such as documentary analysis, functional evaluation and interpretation of topographic data.

The expected results highlight the potential for efficient reorganization of the hospital premises through the creation of distinct functional sub-areas, the development of medical infrastructure, and improved accessibility. The implementation of the proposals formulated through the PUZ can contribute to the sustainable development of health infrastructure and to increasing the capacity of medical services to respond to the needs of the population.

MATERIALS AND METHODS

Description of the study area

The topographic surveys were carried out using electronic total stations and geodetic GNSS receivers, which allowed the precise determination of the coordinates of characteristic points in the national Stereo 70 coordinate system. Modern GNSS surveying techniques provide an efficient solution for the acquisition of spatial data required in topographic and cadastral applications, particularly when field measurements must subsequently be integrated into digital processing environments (GHILANI, 2018; ȘMULEAC et al., 2017).

The Arad County Emergency Clinical Hospital is located in the central area of the city of Arad, in the western part of Romania (Figure 1). The geographic coordinates of the site are 46.1835° north latitude and 21.3091° east longitude. The city is located at the contact between two major historical provinces, Crișana, north of the Mureș River, and Banat, south of the Mureș River. The analyzed site is identified by cadastral number CF 354486.

The analyzed site houses a built fund with heterogeneous value and different states of conservation:

- Heritage buildings – historical pavilions built in 1836.
- Central building (UPU-SJU) – main building built in 1981.
- Degraded technical annexes – warehouses and the old oxygen station, proposed for reorganization.

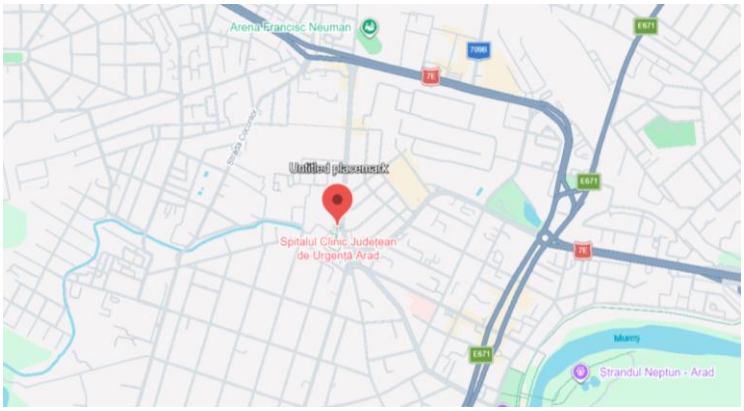


Figure 1. Geographical location

Geomorphologically, the terrain is smooth, with a very gentle west-facing slope and an average altitude of about 100–105 m. The soil stratification is alluvial in nature, consisting of sedimentary deposits of gravel and sand, covered at the surface by dust and clays. The groundwater level is influenced by the rainfall regime in the area and by the hydrological dynamics of the Mureș River (Figure 2).



Figure 2. Arad County Hospital photographed with drone.

The present documentation has as its urban planning objective the extension and modernization of the infrastructure of the Arad County Emergency Clinical Hospital. The study is based on the analysis of the existing urban plans, the national legislation in force and the technical documentation related to medical infrastructure. The research methods used include documentary analysis, urban audit and functional evaluation of the premises.

The topographic surveys were carried out using total electronic stations and geodetic GPS receivers, which allowed the precise determination of the coordinates of characteristic points in the field in the Stereo 70 coordinate system. The data obtained were processed using specialized AutoCAD and GIS software in order to develop the topographic plan and the urban planning documentation related to the PUZ.

The assessment of the existing situation highlighted major constraints regarding traffic flow deficiencies, limited accessibility for emergency vehicles and the need to rehabilitate the technical-urban infrastructure.

Based on the existing situation analysis, the new PUZ proposes:

Complete reorganization of internal circulation, including the separation of medical flows from supply flows.

Establishment of new access points to the major street network.

Delimitation of extension areas for new medical buildings.

Development of utility networks to support the additional demand generated by the proposed development.

The estimated period for the phased implementation of the investments is between 24 and 60 months from the approval of the Zonal Urban Plan, subject to obtaining the Urban Planning Certificates and the related Building Permits (Figure 3).



Figure 3. Processed situation plan

Topographic surveys carried out in the field

In order to develop the urban planning documentation for the extension and modernization of the Arad County Emergency Clinical Hospital, one of the first technical steps carried out was the topographic survey of the site and the adjacent areas included in the urban study. This stage played an essential role in establishing the real situation on the ground and in providing the necessary technical support for the preparation of the PUZ documentation. Accurate topographic surveys represent a fundamental component of urban planning documentation, since the reliability of subsequent spatial analyses depends directly on the positional quality and completeness of the acquired field data (GHILANI, 2018).

During the field works, detailed topographic measurements were carried out using specific high-precision equipment, such as total stations and geodetic GPS equipment. These measurements were used to determine the exact position of all existing elements on the site and to create the digital support necessary for data processing in design software.

Topographic measurements were carried out on an area of 47,781 m² related to the property registered in CF no. 354486, located within the built-up area of Arad.

The table 1 contains the characteristic points of the perimeter, defined by X and Y coordinates in the national Stereo 70 projection system. These data provide the technical basis for the precise delimitation of the area analyzed within the PUZ.

In the first stage, the coordinates were entered in a digital format compatible with computer-aided design and GIS systems. The data were organized in numerical tables and subsequently imported into specialized software such as AutoCAD. The integration of field measurements into CAD and GIS environments enables the creation of consistent digital spatial databases and facilitates the relationship between cadastral information, existing infrastructure and proposed urban interventions (LONGLEy et al., 2015; AGIUS et al., 2018).

Through the measurements carried out, the cadastral boundaries of the properties included in the studied area were identified. The existing medical buildings, technical annexes,

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parking lots and green spaces were measured. For each construction, its position in plan, main dimensions and relationship with the other elements of the premises were determined. This information was necessary for the functional analysis of the medical complex and for establishing the possibilities for its expansion and reorganization.

Table 1.

Table coordinates of the studied area, Stereographic Projection System 1970

Item no.	**X [m]**	**Y [m]**	**Item no.**	**X [m]**	**Y [m]**
1	526997.525	215078.654	14	526908.266	215156.634
2	526990.215	215087.649	15	526902.89	215163.558
3	526975.747	215105.455	...	.....	.....
4	526953.12	215132.402	132	527056.566	215115.723
5	526947.036	215127.091	133	527047.48	215109.947
6	526938.932	215121.501	134	527043.233	215107.247
7	526934.616	215118.743	135	527035.494	215099.472
8	526917.516	215140.89	136	527028.991	215093.42
9	526923.32	215145.322	137	527028.231	215093.022
10	526923.643	215145.572	138	527009.602	215084.305
11	526917.857	215153.035			
12	526914.721	215150.625			
13	526909.437	215157.53			

Another important aspect of the topographic survey was the determination of the land elevations. By measuring the level differences, an altimetric model of the site was obtained, which was necessary for the design of the new constructions and for the organization of internal circulation. The determination of the land elevations allowed the evaluation of the slopes, rainwater runoff and the relationship between the existing terrain and future developments (AGIUS et al., 2018; BILLEN et al., 2014).

The final result of the topographic survey consisted of the realization of the topographic plan of the studied area, which represented the main technical support for the preparation of the drawings related to the PUZ.

The topographic plan includes both the existing natural and built elements, as well as the cadastral boundaries and municipal networks identified in the field. The topographic survey was of particular importance in the process of developing the PUZ because it allowed the correct substantiation of the urban planning proposals and the integration of the new interventions into the existing context of the Arad County Emergency Clinical Hospital.

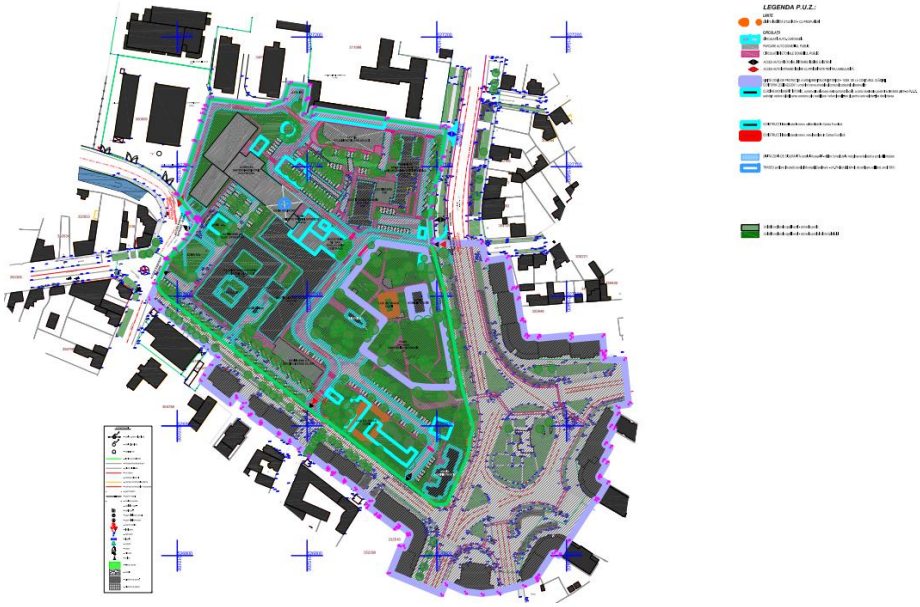


Figure 4. P.U.Z. Representation



Figure 5. Topographic plan scale 1:500/1:2000

RESULTS AND DISCUSSIONS

Proposals for urban regulations

Functional zoning and land use

The Zonal Urban Plan proposes the functional reconfiguration of the 47,781 m² hospital site, identified by cadastral number CF 354486, in Arad, with the aim of optimizing

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medical, administrative and logistical flows. The studied area is divided into the following functional subareas:

- Subarea S_MED (Structural Medical): Intended exclusively for hospitalization units, emergency reception units (UPUs), operating rooms and laboratories.
- Subarea S_TEH (Technical-Urban): Intended for thermal power plants, the new oxygen station, transformer stations and the water household.
- Subarea S_CIRC (Traffic and logistics): Includes the network of roadways sized for special vehicles (ambulances, firefighters), covered parking lots and heliport.
- Subzone S_V (Green spaces and recreation): Green areas with the role of sound protection, squares and interior courtyards arranged for patients.

Table 2

Territorial balance sheet

Land Destination / Indicators	Existing situation	Situation Proposed by PUZ
Medical & Administrative Construction	14,334 sqm (30%)	21,501 sqm (45%)
Circulations, platforms, parking lots	19,112 sqm (40%)	16,723 sqm (35%)
Landscaped green spaces	14,335 sqm (30%)	9,557 sqm (20%)
Total land area	47,781 sqm (100%)	47,781 sqm (100%)
Percentage of Land Occupation (POT)	max. 30%	max. 45%
Land Use Coefficient (CUT)	max. 1.2	max. 2.5



Figure 6. Urban regulations plan

Proposed urban indicators

In order to allow the expansion of the hospital infrastructure, the urban indicators previously approved by the General Urban Plan (PUG) Arad are modified, according to the table 2:

The proposed urban regulations allow for a significant increase in the development capacity of the hospital site while maintaining the overall land area of 47,781 m². The area allocated to medical and administrative buildings increases from 14,334 m² to 21,501 m², representing an additional 7,167 m² available for the development of hospital-related functions. This increase is supported by the proposed modification of the Percentage of Land Occupation (POT), from a maximum of 30% to 45%, and of the Land Use Coefficient (CUT), from 1.2 to 2.5.

The proposed functional organization is intended to improve the separation and management of the main activities within the hospital premises. The S_MED area concentrates the main medical functions, while the S_TEH area provides dedicated space for technical and utility infrastructure. The S_CIRC area is designed to facilitate internal circulation and logistical operations, with particular attention to the requirements of emergency vehicles and fire-fighting access. The S_V areas provide landscaped spaces that contribute to the environmental quality of the hospital premises and offer recreational areas for patients and staff.

The reorganization of the circulation system represents an important component of the proposed urban solution. The separation of medical and logistical flows is intended to reduce potential conflicts between emergency access, patient circulation, staff movement and supply activities. The proposed circulation structure also provides dedicated routes for ambulances and other emergency vehicles, improving accessibility to the medical buildings and supporting the operational requirements of the hospital.

The proposed increase in the built area is accompanied by a reduction in the proportion of land allocated to circulation, platforms and parking areas, from 40% to 35%, and to landscaped green spaces, from 30% to 20%. This change reflects the need to accommodate additional medical functions within the existing hospital site. However, the remaining green areas should be organized as coherent landscaped spaces, with an emphasis on accessibility, patient comfort, staff recreation and environmental quality.

From an urban planning perspective, the proposed PUZ provides a framework for the phased development of the hospital infrastructure while maintaining the functional relationship between existing and proposed buildings. The proposed configuration allows the medical complex to be progressively modernized and extended according to future investment priorities and technical requirements (LONGLEY et al., 2015; RANZINGER and GLEIXNER, 1997).

The integration of new medical, technical and circulation functions within the existing urban structure of Arad represent an important condition for the long-term development of the hospital site. The comparison between the existing situation and the proposed PUZ configuration indicates a clear shift in the functional structure of the hospital site towards medical and administrative development. The increase in the built area and in the allowable urban indicators creates the possibility of accommodating additional hospital functions within the existing property, while the reorganization of circulation and technical areas supports the operational requirements of the medical complex. These changes indicate that the proposed urban planning framework is primarily oriented towards improving the functional efficiency and development capacity of the hospital premises rather than expanding the site beyond its existing cadastral boundaries (POPESCU et al., 2025).

CONCLUSIONS

The elaboration of the Zonal Urban Plan for the extension and modernization of the Arad County Emergency Clinical Hospital demonstrates the importance of integrating urban planning with the functional requirements of modern medical infrastructure. The analysis of the existing situation, supported by detailed topographic surveys, allowed the identification of the main functional, circulation and technical infrastructure deficiencies, as well as the development potential of the hospital site.

The proposed PUZ provides solutions for the functional reorganization and extension of the medical complex, including the improvement of medical and logistical flows, the development of new medical and technical facilities, and the modernization of the technical-urban infrastructure. The proposed functional zoning and urban indicators provide the necessary framework for increasing the development capacity of the site while maintaining the operational requirements of the hospital.

The proposed interventions contribute to improving accessibility, optimizing the organization of the hospital premises and adapting the existing infrastructure to current functional and technical requirements. The reconfiguration of the site also allows the existing and proposed buildings to be integrated into a coherent functional structure, supporting the long-term modernization of the medical complex.

Overall, the developed urban planning documentation represents a technical and strategic framework for the phased implementation of future investments and for the long-term development of medical infrastructure and healthcare services at county and regional levels. The proposed planning framework provides a basis for the future modernization of the hospital site while ensuring its functional integration into the urban structure of Arad.

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