The role of blue-green infrastructure in redefining the identity of a shrinking city - Hunedoara

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ABSTRACT

Human settlements represent hybrid environments that resulted through complex interaction processes. Components of the natural environment, vegetation, water or fauna have been integrated into urban structures during the history, but accelerated and often chaotic urbanisation has disrupted the connection between man and nature in the past decades, exposing the individual to a predominantly artificial environment, but at the same time affecting the natural resources necessary for life.

This is the case of Hunedoara, a former mono-industrial city, currently in a shrinkage process, but having huge resources for recreating a new identity – the Corvin Castle, one of the most visited monuments in Romania and an interesting blue-green infrastructure, the last one least obvious as a resource, but maybe more important on a long run.

The industrial history of the city has diminished the vitality of the public space and the relationship between man, the urban environment and the natural environment. The major natural components – Cerna River, the Zlasti Stream, the high vegetation - essential for a functional and healthy urban ecosystem, were degraded by human interventions, being excluded from the recreational offer of the city.

The project aimed to develop a strategy for remodelling the post-industrial urban landscape, based on contemporary principles of urban planning, from the ecological sphere. In order to generate a holistic approach to the project, four landscape restructuring methodologies were proposed for analysis. They come from the field of landscape ecology, describing ways to reintegrate natural processes into the human environment, the field of river restoration and the mechanism of image formation of the city.

Following a methodology developed by the authors, based on different maps overlap, working at different scales, from landscapes to sites, the project focused on defining specific issues to be solved in order to transform Hunedoara in a city with a higher quality of life, based mainly on the blue-green infrastructure. The goals can be achieved by correlating the principles of spatial organisation with those specific to ecology and hydrology.

At an urban scale, green spaces become interconnected components of a large network that aims to foster human interactions based on assuming responsibility for environmental integrity, while at a detailed scale, the project aimed to correlate the distribution of mineral surfaces with the water trail accumulated at the limestone level and the impact on the natural sources of ground and underground water in the vicinity.

In conclusion, an interdisciplinary approach based on the theories of ecology and urban design can generate an original solution to a problem faced by many former industrial cities, not only in Romania, but also in Europe.

Keywords: blue-green infrastructure, interdisciplinary, landscape ecology, shrinking city, Hunedoara.

I. INTRODUCTION

Formerly an industrial city, Hunedoara is currently facing serious shrinkage problems, low level of education, poor quality of public spaces - green and mineral - and the functions necessary for a contemporary urban lifestyle. With the cessation of industrial activities began the phenomenon of degradation of urban spaces after 1990. The site proposed for the study is the historic neighbourhood "Old Town" of Hunedoara, Romania. The presence in the neighbourhood of an architectural monument of international importance, Corvin Castle, creates the necessary conditions for the development of a tourist area and the reinvention of the city's identity.

It is the presence of two flowing streams and abandoned green and public spaces that could be the engine of the city's development based on other premises, a sustainable development that has in the foreground the restoration of the connection between the Castle and the city centre, necessary when defining the city as one with highly touristic potential. The paper aims to argue that the blue-green infrastructure can play a major role for redefining a new identity of the city, using an interdisciplinary methodology at the confluence of theories of urbanism, ecology, landscape and architecture. As an example of such an interdisciplinary approach, a project made for public spaces in the central area is presented.

II. HUNEDOARA – A SHRINKING CITY: CHALLENGES AND OPPORTUNITIES

II.1. Shrinking city- the evolution of the concept

Deindustrialisation amplified the effects of urban contraction and contributed to the birth of a phenomenon with significant implications, both quantitatively and qualitatively, in all aspects of society's life and changes in the physical characteristics of cities - shrinking city [1]. Declining birth rates, ageing population, the disappearance of public facilities, social segregation, abandonment of buildings, streets or large areas of land, increased number of demolitions are just a few indicators of the phenomenon [2]. The complexity of the typologies of transformations, contraction and extension, is supported by the social, political, geographical, and physical context in which they occur. Thus, the concept of "shrinking city" includes several typologies of cities whose generated problems are solved in specific approaches based on an experiment with the help of tools from various urban concepts [3].

II.2. Hunedoara - a short history

Hunedoara is located in the central part of the County with the same name, on the Cerna Valley, 19 km from Deva. Hunedoara first appeared as a townlet near the fortress and then as a city at the confluence of the Zlasti Stream and the Cerna River. The appearance of the city was closely linked to the existence of material resources, which provided people with good living opportunities. There were iron mines in this area since ancient times [4].

Hunedoara was formed by a slow process of urbanisation, most of the inhabitants of this land having agriculture as main occupation. The end of the 19th century is marked by the inauguration of several furnaces in the neighbouring settlements. These were included in the structure of the Iron Factory. In 1919, it became the property of the state, and during the interwar period, the activity in the field of mining and iron extraction was diversified by the appearance of steelworks.

The expansion of the industry began in 1945, shortly after the end of World War II. During its development, the industrial economic unit will be known in the country, but also abroad, under the name of Hunedoara Steel Works. The urban structure of the city is relatively new, the 1950s marking the beginning of its formation as an urban settlement in the full sense of the term [5].

Currently, the city's economy is supported by Corvin Castle, which annually attracts a large number of tourists from all over the world. The functional and symbolic connection of the Castle with the city centre is interrupted by the lack of a coherent network of pedestrian alleys, by the low quality of the urban public space and by the lack of recreational, relaxing or commercial activities and functions.

II.3. Dysfunctions

The dysfunctions can be catalogued according to the field of origin: administrative, social, an-

thropic or natural environment. Since the phenomenon of "shrinking city" is a complex one, the analysis focused mostly on urban aspects – see Fig. 1 (with the presentation of the existing conditions at the administrative and socio-cultural level).

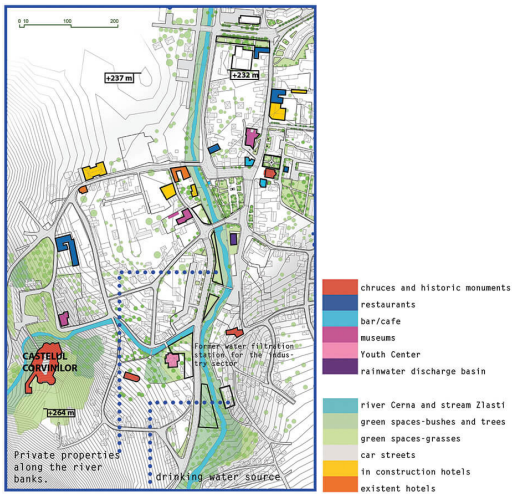

Fig. 1. Dysfunctions

II.4. The objectives of the proposal

The main objective of the project was outlined as the definition of a recreational axis that would function as an attraction for both city's residents and tourists. The importance of creating recreational opportunities within the city is essential in this context, and the social, ecological, cultural and economic benefits will appear as positive consequences of the changes brought by urban design. In this sense, the green-blue infrastructure was the main pillar of the proposal, due to its huge, but most often overlooked potential (site located at the confluence of two watercourses, with semi-wild and abandoned green spaces, with an urban public space generous as surface, but poorly managed).

III. URBAN LANDSCAPE – ANALYSIS AND DESIGN METHODOLOGY

III.1. Theoretical aspects: the landscape - a complex and multifaceted notion

In a broader vision, the landscape must be seen as a complex process of physical and mental evolution. The geographer D. Meining describes the landscape as the union between the physical and the psychological, being composed "not only of what we see with the naked eye but also of what exists in our mind." The city, through its characteristic urban landscape, is the result of the most significant effort to transform the natural landscape. V. Gregotti considers that the formation of cities represented "the most radical transition from the natural state to the cultural one". This introduces a new typology of landscape: the cultural landscape. This type of landscape describes the relationship between man and his living environment from the perspective of temporal evolution [6,7].

From another perspective, in order to be easier to understand, the landscape can be seen as a mosaic consisting of repeatable patterns called patches or corridors arranged in a matrix. Matrix-patches-corridors are 3 flexible tools that are useful in clarifying the organisation of the landscape, delimiting its constituent components and eliminating the ambiguities that could intervene in the interpretation of the natural and anthropic environment [8].

In this project, special importance was given to the potential of the urban landscape to be understood and traversed in a coherent and intelligible way by observers. Kevin Lynch, architect and urban planner, has identified several characteristics of the built environment through which the individual generates mental (cognitive) maps of the city or parts of it [9].

The fusion between ecology and landscape architecture, by combining spatial planning with understanding ecological processes and natural systems, was initiated, theorised and researched by I. McHarg, who helped shape a discipline that developed strategies for organising the hybridised landscape (anthropic and natural): "landscape ecology" or "urban ecology" [10].

Design principles have not always been correlated with environmental aspects and the effects that characteristic intervention methods have on the environment. Design has become a creative tool for solving environmental problems as the ecological crisis intensifies. Generated on the basis of the idea of "partnership with nature" [11], ecological design is intended to be a model of sustainability and ecological interventions.

Van Der Ryn and Cowan establish a set of rules for an ecological design, formulating in them a

series of essential questions for the elaboration of projects in the urban environment. A first rule states that the solution comes from the site and the right questions refer to what nature allows in that place and how it can help the project. The second rule states that in order to be aware of the importance of nature in maintaining a healthy living environment, man must perceive the nature of being an integral part of one's environment. In order to minimise the negative effects of human interventions on the environment, taking over natural phenomena as solution-generating principles is a desideratum for the third rule, "design with nature" [12].

III.2. Methodology based on maps overlap – at the urban and territorial scale

The methodology developed by the authors is based on different maps overlap, working at different scales, from landscapes to sites, in order to understand and sanalyse complex relationships in the landscape and also to propose a solution that is very well adapted to the context. In order to generate a holistic approach to the project, four landscape restructuring methodologies were proposed for analysis (based on the theoretical aspects presented above). They come from the field of landscape ecology, describing ways to reintegrate natural processes into the human environment, the field of river restoration and the mechanism of image formation of the city.

The project focused on defining specific issues to be solved in order to transform Hunedoara in a city with a higher quality of life, based on the blue-green infrastructure. The goals can be achieved by correlating the principles of spatial organisation with those specific to ecology and hydrology.

The analytical maps used to overlap the information were: hydrographic analysis, circulation analysis, McHarg type analysis and Lynch type analysis:

- the hydrographic analysis reveals important facts about the blue network at territorial scale (Fig. 2);
- the circulation analysis is very important for this particular situation, as there the pedestrian connections are very important and transit traffic between localities could be resolved differently in the area of the historic centre (Fig.3);

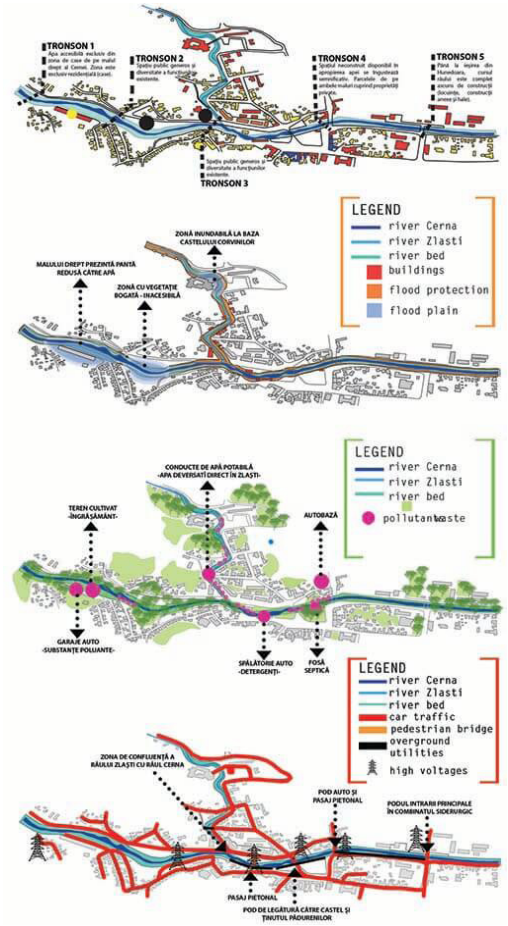

Fig. 2. Hydrographic analysis

-McHarg type analysis - the analysis performed by this method highlighted the way in which the objective of protecting the green-blue corridors can be achieved, through the perspective of the combination of natural components (Fig.4);

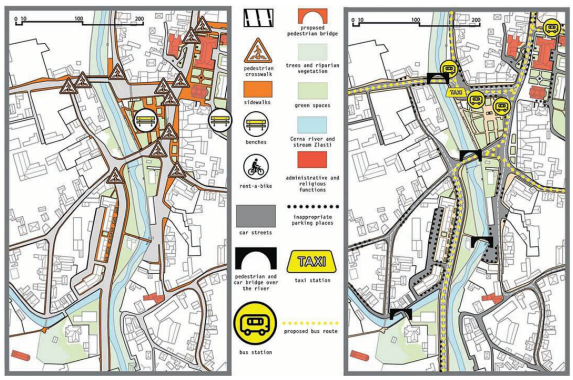

Fig. 3. Circulation analysis

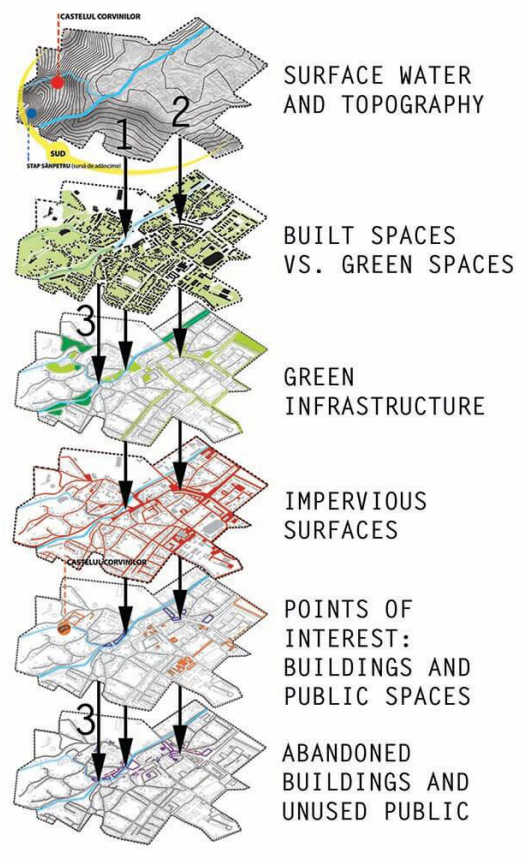

Fig. 4. McHarg type analysis

-Lynch type analysis - this analysis highlights how one can intervene on the spatial organisation so that the newly created links are coherent and adapted to the chosen location (Fig. 5).

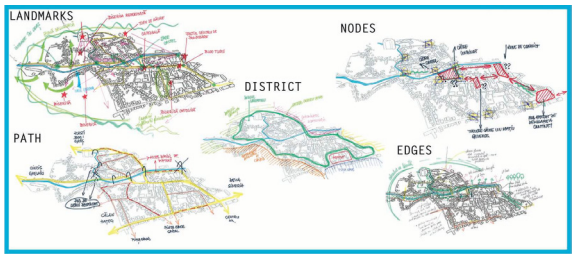

Fig. 5. Lynch type analysis

IV. BLUE-GREEN INFRASTRUCTURE IN THE URBAN LANDSCAPE – DESIGNING WITH NATURE

IV.1. The benefits of creating and managing a blue-green infrastructure in the city

Under the name "Blue-Green Infrastructure" (abbreviated BGI) we find a complex system, consisting of water and vegetation, which integrates hydrological and ecological systems with the design. The result of this interaction is an interactive and functional system that contributes to the generation of natural, socio-economic and socio-ecological benefits in the urban environment [13] – see Fig. 6.

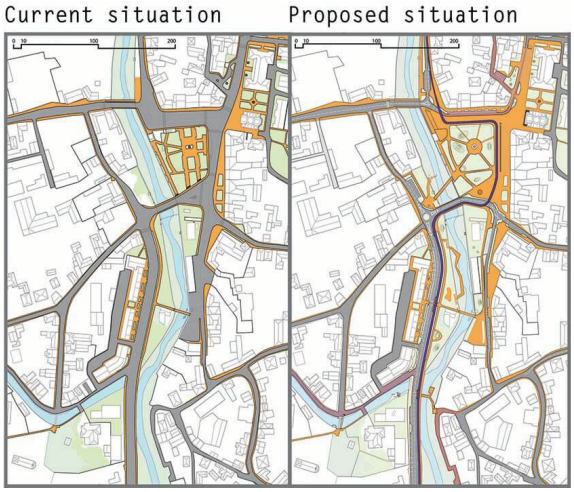

Fig. 6. Current situation vs proposed situation

The importance of green spaces and vegetation was debated and analysed by representatives from various fields: psychology, ecology, landscape design or others. The benefits associated with ecological infrastructure refer to the social environment, climate, ecology or hydrology:

1. Ecological infrastructure shall mitigate the effects of climate change by reducing the heat island effect, limiting day-to-night temperature fluctuations, cooling the air or purifying it.
2. Human exposure to nature has beneficial effects on physical and mental health [14], helping to induce a sense of calm, satisfaction or providing opportunities for sport, recreation, health and social cohesion.
3. From a hydrological point of view, an ecological infrastructure allows the groundwater supply, reduces the accumulation of rainwater on the surface of the land, reduces soil erosion and limits nutrient loss, reduces ecological disturbances in riverine areas and increases rainwater quality through various filtration and natural purification methods.
4. The blue-green infrastructure has economic benefits by lowering the costs for the protection of settlements against floods, provides inexpensive methods of arranging public spaces, reduc-

es costs for water purification and treatment, creates an urban environment that attracts investors, tourists and locals.

IV.2. The project for the blue-green infrastructure - urban scale

Through methods and tools specific to urban design, based on concepts and knowledge from ecology, natural systems can be reintroduced in the city, allowing water quality control. Sustainable methods of rainwater management propose that within the city, there is the possibility of retention, capture, filtration, infiltration of water from rainfall [15]. All this were applied into the project for Hunedoara, from urban scale to smaller scale, even in detail.

The main objective of this work was to restore the connection between the Castle and the old city centre, by creating an ecological infrastructure that has as at its core the natural landscape, the Cerna River and the Zlasti Stream. Although the project was detailed for the central area, the developed ecological infrastructure can be extended to the rest of the city (Fig. 7).

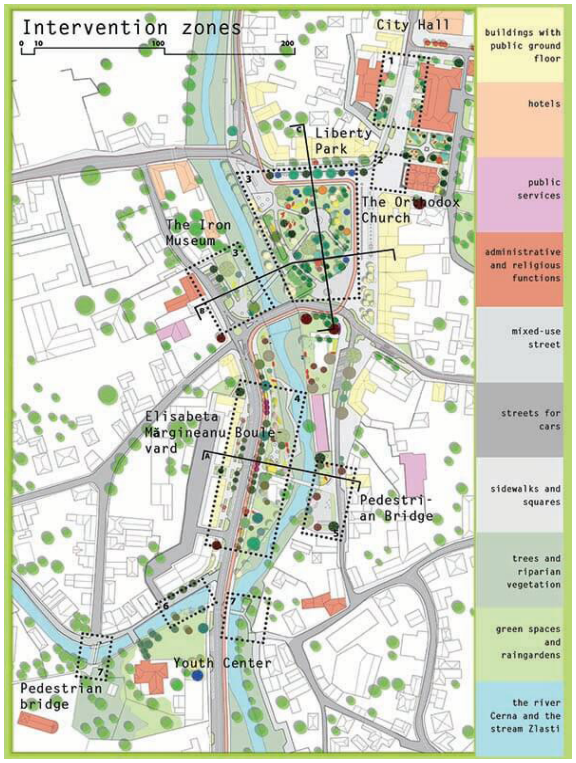

Fig. 7. Intervention zones- redevelopment of existing green spaces and proposing new ones;

The construction of the blue-green infrastructure involves:

-rehabilitation of the banks of the river and the stream according to ecological, natural methods and principles;

- rethinking pedestrian and vehicular traffic and remodeling the urban landscape, adapted to the current needs of the local community (Fig. 8, Fig. 9).

Fig. 8. Detail – Cerna riverbank design

Fig. 9. Detail – Main park redesigned

IV.3. The project for the blue-green infrastructure - small scale and details

Over 60% of the urban surfaces are covered with impervious materials that don't allow the stormwater runoff to infiltrate into the soil and recharge the groundwater. Improving the management of stormwater is an imperative condition for creating a healthier urban environment for people, plants and wildlife. Vegetation is the most important element in the process of natural water cycle, as it slows the water movement, reduces the soil erosion and keeps pollutants away from the waterways (Fig. 10, Fig. 11).

Bioretention and bioinfiltration are natural processes that underlie the stormwater facilities like bioretention and bioinfiltration planters, bioretention swale or permeable paving. Permeable materials for paving help reduce stormwater runoff and allow the water infiltrate into the soil. When applied, the context must be considered in order to achieve maximum performance of its capacity.

Bioretention planters are constructed along wide streets, between the road and the sidewalk, and are bounded by vertical concrete walls and a flat bottom area. Before the water is slowly infiltrated into the soil, plantings help treat the stormwater runoff captured from the street.

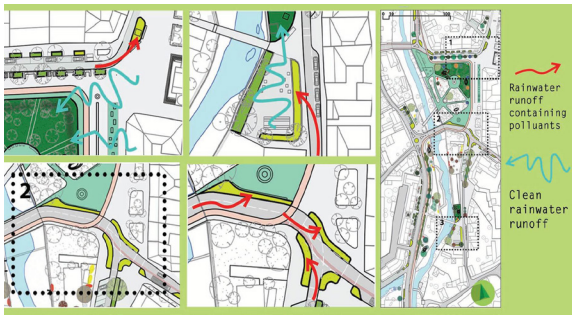

Fig. 10. Plan – stormwater management

Fig. 11. Detail – stormwater management

Biofiltration planters are suitable where infiltration of rainwater is not conducive as it contains a great amount of pollutants. Because the flat bottom area of the cell is made from impervious materials, the stormwater filtrated by plants roots is captures through an underdrain pipe connected to the storm sewer system. This tool helps control the stormwater quality and reduces runoff volumes.

Unlike biofiltration planters, biofiltration swales use more space as they do not need vertical walls to keep the water away from buildings and road infrastructure. They are also less expensive and can be planted with trees and other native species of plants.

Stormwater trees are of great importance for the urban environment's aesthetics but also for the ecological benefits of urbanscapes. When they are well taken care of, trees have a great capacity to collect and treat rainwater, before the transpiration process is initiated. The types of soil and plants used in a bioretention or biofiltration cell are selected according to climate and region-specific condition, the water absorption capacity of the soil.

The project site is crossed by Cerna River and Zlasti Stream. Over time, road rehabilitation processes and lack of green spaces maintenance have degraded the public space and interrupted the natural processes that allowed the stormwater to infiltrate into the soil and recharge the aquifers that feed the rivers. The proposed situation aims to correlate the distribution of mineral surfaces with planted surfaces and the stormwater runoff. Although the mineral surfaces are still predominant, green spaces have been placed between the roads and the riverbanks, in order to stop polluted rainwater runoff flow directly into the rivers. Former unused parking spaces and wide streets were redesigned to provide more space for social interactions but also to define the premises for developing a blue-green infrastructure that would redefine the city's identity.

The stormwater facilities presented above have been applied taking into account the use of public space: areas for pedestrians, mixed-use streets, parking places, parks and roads. Therefore, rainwater coming from different site area

is captured, treated and infiltrated or captured, treated, retained to be reused or directed to the rain sewer system.

Although the ecological aspects are of great importance, social, economic, aesthetic and educational aspects have been considered. The presence of water in public space seeks to show citizens the importance of restoring degraded habitats and protect the most important resource for life, the water.

V. CONCLUSIONS

The creation of a blue-green infrastructure strengthens urban ecosystems, improves the quality of life and promotes sustainable local methods of rainwater management, while contributing to the creation of areas of relaxation and recreation with a high aesthetic value. The proposed project aims to remodel the post-industrial urban landscape using economically and ecologically efficient methods of intervention on public spaces and major natural elements present in the city (water and vegetation), while seeking to integrate user needs. An aspect that should not be neglected is the educational potential of such projects.

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