Urban water environment intervention: Analyses of the urban-environmental interaction

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ABSTRACT: Water environments are spaces with important physical-environmental characteristics, interacting with several natural processes that occur in our planet. But, with urbanization, its degradation has been quite common, resulting in a physical, social and cultural estrangement of the population in relation to urban watercourses. Architecture and urbanism have developed several theories along time, methodologies and proposals of actions to solve spatial problems due to the process of urbanization, including water environment intervention projects. The objective of this project is to research contemporary experiments in water environment intervention in the area of landscape architecture and urban design, verify the typologies and theoretical trends of these productions and analyze the solutions in relation to environmental, urban and human dimension. The focus of the analyses is to the formal-spatial question, adopting a systemic and dialogic method, developed in a procedural and diagrammatic form in three steps, being: researching urban water environment intervention, selection of paradigmatic experiments and detailed analyses of the selected experiments. 101 projects were researched in water environment intervention which show a dissemination of new paradigms, selecting the projects developed for the cities of Velenje (Slovenia), Denver (USA) and Belo Horizonte (Brazil). These projects show that it is possible to change the reality of degradation and inadequate treatment of water environments, adopting solutions which consider their contexts and the systemic relations between the environmental, urban and human dimension.

Keywords *Landscape Architecture, Urban Design, Urban watershed, River rehabilitation*

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1. INTRODUCTION

Watercourses are elements directly related to the natural cycles. Nonetheless, despite their environmental and landscaping importance, an inadequate treatment in relation to the watercourses is common, adopting the rectification, canalization and road construction along their banks as a solution to the problems of sanitation.

The technical-scientific areas have a vast theoretical and practical production directly or indirectly related to the environmental question of the water environments. The theoretic, methodic and technologic base offer conditions to rethink the technical-scientific model. Even with the difficulty to overcome the dominant culture, there are experiments of water environment intervention projects that establish a more harmonic relation to urban questions as to environmental, respecting the environment dynamics and incorporating the water environment to the morphology and urban landscape.

The objectives of this work are research contemporary experiences of intervention in water environments from the area of urban landscape architecture, urban design and urban planning, check the typologies and theoretic trends of these productions and analyze the solutions in relation to the environmental, urban and human dimensions. There were included in the analysis intervention projects on seafront, giving priority to discussion of interventions in the river system of freshwater.

This research is part of an ongoing doctorate, to be finished by the end of 2016, that has as objective to elaborate guidelines of projects that contribute to improve the urban and environmental quality of urban water environments, taking into consideration the transformations of contemporary cities and tendencies of urbanism with a focus on ecologic-environment.

The main questions related to urban water environments, methodology used to analyze intervention projects in river environments, the results and the conclusions shall be presented next.

2. FLUVIAL ENVIRONMENTS: URBANIZATION AND URBAN INTERVENTIONS

Fluvial environments, due to their ecological-functional interactions, are an important part of the complex natural system of the planet. Nonetheless, there is recurrent degradation of watercourses and their Banks with the process of urbanization.

According to Tucci (2006), the process of urbanization can alter the hydrological conditions and the quality of the water. The waterproofing of the soil and the drainage system increase the superficial flow, and, consequently, maximum outflows and the occurrence of floods. Along with this, the unprotected soil, the disseminated pollution and the precariousness of the sanitation system lead to the pollution of water bodies.

The answer to these problems, in general, present sanitary solutions, focusing water drainage and waterways. Watercourses are rectified, channelized and buffered, receiving motor vehicle roads on their banks.

Binder (1988) highlights that the consequences of this form of action is the impoverishment of the ecosystems and the loss of biodiversity. Mello (2014) complements

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by saying that the introduction of roads and the pollution of the water also leads to the devaluation of the watercourses for leisure and bathing, diminishing its functions.

Kaushal & Belt (2012) point out that there is a critic to this model of sanitarian city, which was dominant before the 21 century, being substituted by a concept that considers the biogeochemical cycles and the peculiarities of the urban ecosystem, producing interventions with multiple functions and an urban design of quality.

The challenge, therefore, is to develop concepts where the city is not only seen as a counterpoint to natural space, by establishing a harmonic relationship with the natural. Odum (2001) claims that a man must comprehend that he does not create new systems, but modifies the natural ecosystems, being impracticable the complete dominion of nature due to the ecological dependence of the human being.

According to Spirn (2001) urban space has its own rationality. Steinberger (2012) stresses that the environment built settles and transforms the natural environment, leaving the urban environment to reflect a specific look that considers the physical dimensions (natural and built), urban life (ambience, living together and conflicts) and the urban quality (life conditions).

Mello (2014) points out that rivers are spaces with multiple functions, which can be used to qualify the urban landscape of the cities, taking advantage of degraded areas to value local identity. The change goes through the valorisation of bordering spaces, the promotion of social living, the introduction of sustainable activities, ludic and recreative, which considers the geography, the landscape, the quality of life and the symbolic dimension.

There are experiments of contemporary urbanism with ecological-environmental concerns which seek the rescue of the living life with the clean water, the social living and the dissemination of a new environmental awareness. There are several interventions, with different objectives, scales and forms of actions, such as: Water Sensitive Urban Design, greenways, brownfields, renaturalization, waterfront, daylight, among others.

Spirn (2014) presents a classification of this theoretical and practical production, which even being considered by the author as limited, contributes by demonstrating the trends of contemporary production related to the urban design and urban landscape.

These trends cited by Spirn (2014) were grouped in this study in four great lines of action, established according to their concepts and their production in relation to the interventions in water environments, being: Environmental Art; Landscape Planning, Landscape Ecology e Green infrastructure; Green Architecture, Green Urbanism e Industrial Ecology e finally Ecological Design, Sustainable Design and Planning e Landscape Urbanism

The several lines of action bring important contributions and advances to rethink the interventions in urban rivers and produce actions which qualify the water environment. The ecological Urbanism professionals have an important theoretical and practical production that sets a concern to respect the environmental dynamics and hydric and value the rivers with activities that promote social living and the rapprochement to water.

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3. METHODOLOGY: ANALYZE URBAN INTERVENTION IN FLUVIAL ENVIRONMENT

In the area of architecture and urbanism there are a variety of intervention projects in water environments, applied in the most diverse contexts. This diversity makes it difficult to critically analyse the environmental quality and the urban proposals, specially their comparative assessment.

Architecture is a multi-dimensional knowledge field, relating diverse fields of knowledge, which obliges the comprehension and synthesis of technical questions, related to the functional and constructive aspects, as well as to intangible questions, which impose great subjectivity that makes the process of analyses difficult.

In this sense, which are the concepts and criteria to be established to analyse the theoretical and practical contributions of intervention projects in water environments? The projects incorporate the water environments as elements of the urban morphology in an integrated form with the natural cycles and flows, valorizing the water as imagetic? Which are the elements that bring morphologic and landscape quality to the intervention?

The focus of the analyses will be on the formal-spatial question, approaching its related aspects to the water questions, waterways, aesthetic, ecological and of sanitation. The water will be analysed as element of morphology and of the urban landscape, assessing the formal-spatial of the proposal from the comprehension of the relational dynamics of the water to the city. The commitment of the intervention with the urban and environmental aspects specific to the place and the artistic sense of the work will be evaluated.

The following methods with the objective to verify their application according to the analyses proposed in this work were studied: System Analyses of urban drainage-Multicriteria, Ecologically Sustainable Water Management – MESA; SVAP – Stream Visual Assessment Protocol/RCE-Riparian, Channel, and Environmental Inventory for Streams in the Agricultural Landscape; Transecto urban-rural; Water Sensitive Urban Design –WSUD and Sociological Architecture. These works present important contributions in relation to the parameter of analyses. But, in general, present objectives and applications which do not apply to this research, making the development of a specific methodology necessary.

The answer to the questions described above, goes through the development of a methodology that comprehends the complex relationships that establish themselves among the diverse systems, contemplating multiple scales (regional, urban and local) and dimensions (environmental, urban, human).

According to Lacombe (2007), the thought and the doing of architecture, in an analog way to systemic thought, comes through deductive form, in a complex procedural system that generates innumerable possibilities of structural and functional arrangements. within this reasoning, hypotheses are launched, experimented, back to the results and the process itself, generating discoveries which will be revealed during the reflexive process.

In this sense, the method of analyses should be systemic and dialogical, developed in a procedural way, diagrammatical and open enough to verify the most diverse possibilities and answers, discovering out of the ordinary questions.

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The analyses of the projects were developed in 3 steps, being: a poll of projects of intervention in urban water environment, selection of paradigmatic experiments and detailed analyses of selected experiments.

As a first step a poll of intervention projects was thoroughly done. The research was done on search sites and electronic reviews, initially looking for projects developed by professionals cited in the study of Spirn (2014) and in sequence extended to collaborators to these professionals and in a search using terms such as: riverfront, daylight, brownfield, greenway river rehabilitation, urban stream and urban watershed. The researched projects were found on Google Earth Pro and exported in files KML to the Quantum program Gis version 2.6.1, where it was possible to make a world map with the distribution of the projects.

From these 3 projects were selected for a more detailed analyses, from the following criteria: implemented project or in implementation, localized in consolidated urban areas, which valorises water as aesthetic element, integrates the water environment to the morphology and urban landscape and presents conditions that favours environmental dynamics and biodiversity.

The third and last step analysed the projects in detail, where first of all the contextualized object was analysed from the research of the conditions of the place. Based on this information a hypothesis was made as to the assumptions and concepts of the idea of the proposal, which offer a strong picture to the elaboration of all the project elements and of the scale relationship and dimensional.

The next step was of the experimentation, adopting the diagrammatical thought to analyze the relations between the water and the urban environment, the watercourses banks and the city, of the stretches along the hydrographic basin, with the water environment with its edified surroundings and the relationship between the project elements in themselves. Diagrams, draft charts, layer separation to identify unique categories and their scale relationships (sectorial, urban, territorial) and dimensional (environmental, urban, human). In this phase there are experiments, re-examinations through new readings, going back to the previous results and re-elaboration of the process itself, this enables finding new discoveries in the assessment, as well as in the methodology.

4. RESULTS

The production of contemporary urbanism with ecologic-environmental concern has different lines of action. Spirn (2014) classifies the main trends, citing their respective professionals, who since the end of the XX century have contributed with its production for the theoretic and practical development for the development of this subject.

The Environmental Art trend is characterized by artistic interventions that makes legible local structures and processes, instigating the perception of reality and behavioral changes. The professionals of Landscape Planning and Landscape Ecology possess a vast production focusing landscape planning in regional scale. The Green Infrastructure trend shares the same theoretical referential, being different because it presents besides the proposal in the macro scale, urban interventions and solutions of sustainable infrastructure. Willian Wenk stands out in this trend, with several projects that take

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advantage of the water aesthetic potential to create vibrant public spaces. The Green Architecture, Green Urbanism and Industrial Ecology act in different scales, nonetheless have in common the use of technology to promote the reconciliation of man with nature. Finally, Ecological Design, Sustainable Design and Planning and Landscape Urbanism are trends which present a relevant production of projects from the areas of Architecture, Urbanism and Landscape Architecture.

Besides the research of production of professionals cited by Spirn (2014), an extensive research on the internet was done, gathering projects that valorize water as an aesthetic element, incorporating the water environment to the morphology and urban landscape. A total of 136 projects of urban water environment intervention were polled (see fig.1). The North American production of 81 projects stands out, having 17 projects in the Denver region. Europe counts with 23 projects, Asia 14, South America 12, Central America 4, Africa and Oceania 1 project. China's case is peculiar, investing in buildings of great size, producing extreme forms of human scale grandiosity.

Figure 1. Intervention Projects in Water Environments. Source: Cardoso, 2016

The typologies of projects with a greater recurrence are greenway, water front, daylight, brownfield, urban park and linear park. In relation to the trends there is a greater number of cases related to Green Infrastructure, Sustainable Design and Planning, Ecological Design, Landscape Urbanism and Green Architecture.

Of the polled projects, the selected ones for detailed analyses, according to the criteria described in the methodology, were the projects developed by Velenje, Denver and Belo Horizonte, evaluating their quality in relation to environmental, urban and human dimension.

4.1 City Center Pedestrian Zone em Velenje, Eslovênia

The city of Velenje received a modern expansion project in the 1950's, to tend to the demand from the growth of the coal extraction. The city is made up of open blocks for the circulation of pedestrians and with a great percentage of permeable areas, possessing a reticular stroke in the central area and organic in the residential sector.

In 2012, Velenje bids a Project to revitalize the central area, with the goal to bring cultural activities and recover its feature of park city. The winning project was from the Slovene office Enota, which proposed a promenade.

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This Project does not have an ecological bias. The dialect between the natural and urban environment comes through an aesthetic conception, where water and the vegetation come as elements which compose the urban scene, valorizing and being valorized by the built elements (ways, bridge, amphitheater, urban furniture and illumination).

The Project establishes a sequence of happenings that develop along the promenade, having as highlight the ensemble bridge and amphitheater at the center (see fig. 2 e 3). The river becomes the main happening, a node of activity and contemplation at the center of the great square (see fig.4). The parking lot without a covering, located at the north limit, was transformed in a volume with commerce on the ground floor and a stage on the superior level, which establish limits and sense of interiority to the space.

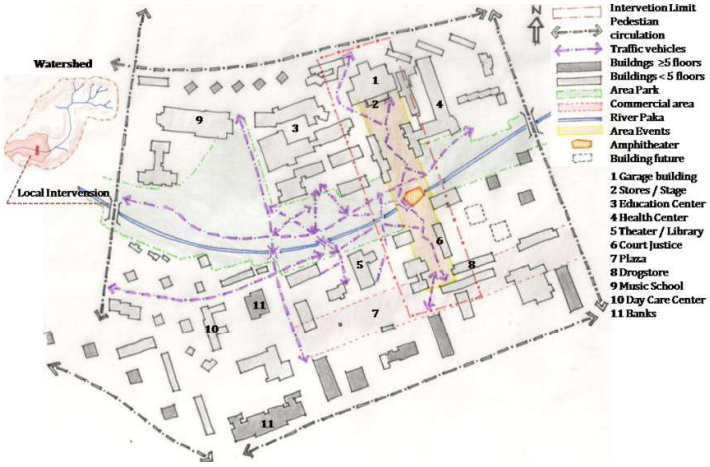

Figure 2 and 3. (Left) Amphitheater and promenade. Source: Landezine, 2016
Figure 4. (Right) Diagram with main axis and functional sectors. Source: Cardoso, 2016

The conceptual image is strong, having as a conducting line the sinuosity and the complexity, which can be verified on the way, on the amphitheater and on the benches along the square of events. The design promotes the integration of the river with the Center of Velenje, instigating the flow of the senses and the fascination for the space.

4.2 DowntownCreekfront in Denver, Colorado, United States

Denver is a metropolis with a sub-urban standard of growth that privileges the means of individual transportation. In the 1980's a General Plan triggers a series of investments for the improvement of urban quality and the environment, including actions on the Platte River basin and later on the Cherry Creek.

Downtown Creekfront was projected by Wenk Associates, as part of a series of actions that seek to promote the biodiversity of the hydrographic basins. The intervention area is located at the mouth of Cherry Creek, which was altered through time to tend to human needs, be it due to mining activity in the origins of the city or by the rectification, canalization and road construction along its banks, which resulted in a stream at a level lower than then the city, confined between the road system.

At the main point of intervention, a belvedere is created which gives view to Cherry Creek and at the same time generates a feature that invites the passer-by to approach the river and access the greenway implemented along its banks (see fig.5). This way connects

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several public spaces, stretching out over 45 km in direction to its headwater, where there are actions of preservation, conservation and environmental recovery. (see fig.7)

The project presents a simple solution, having as identity the linearity of the way and its landscape composition. The sinuosity of the river, its ascents and slopes, small rapids with stones, bridges for pedestrians and cyclists offer different scenery which contribute to sharpen visual perception of the environmental dynamics (see fig.6).

Figure 5 and 6. (Left) Greenway access point with belvedere and the rapids. Source Wenk, 2016
Figure 7. (Right) Downtwon Creekfront. Source: Cardoso, 2016

The dislocation of the watercourse with the surrounding urban space, imposed by the conception that privileges the urban drainage and road systems, it is a recurring condition in several cities. The project takes advantage of this limitation, conforming a protected way from the movement of the surrounding streets, in a cozy ambience that provides the possibility of visual and physical contact with the water.

4.3 Nossa Senhora da Piedade Park in Belo Horizonte, Minas Gerais, Brazil

Belo Horizonte is a city which was projected in the end of the XIX century to be the capital of the state of Minas Gerais. Its conception presents a geometrical rigor that did not take into account the natural drainage lines and the watercourses, being later channeled and closed to solve the problems of sanitation and drainage.

The north region, where the Nossa Senhora da Piedade Park is found, is an occupation out of the limits of the projected city, growing in a spontaneous and disorganized way. Nonetheless, it follows the logic of inadequate treatment of water environments, which is made worse by irregular occupations and by the lack of equipments and urban infrastructure.

As a solution to the drainage problems, the Program of Environmental Recuperation of Valley Ends and Streams in Natural waterbeds of Belo Horizonte was created. DRENURBS, foresees among its objective the revalorization and landscape incorporation of the watercourses, as an element of urban mesh.

The Nossa Senhora da Piedade stream was one of the selected areas, receiving where there were irregular occupations before an urban park designed by the office B&L Architecture. At the headspring a detention pond was built to diminish the flood peak, having a spillway made of water mirrors that can be gazed at from within and from outside the park (see fig.09 and 10).

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The park is fenced for security reasons, having the crossing of the watercourse by earth substituted by a bridge that separates the internal from the external circulation, keeping the flow and the continuity at the park level and the visual contact at city level. (see fig.8)

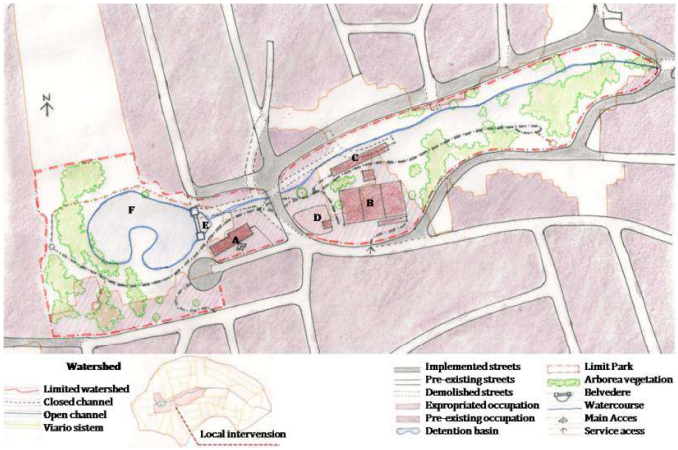

Figure 8 and 9. (Left) Spillway, detention basin and way within the park. Source: Bueno, 2016
Figure 10. (Right) Diagram with main axis and functional sectors. Source: Cardoso, 2016

The intervention has a transforming effect from a dense urban context and without arquitectural reference. With a relatively low cost, the project reconciles solutions that value the landscape, offers amenities to the population and contribute to the urban drainage problem.

5. CONCLUSION

Contemporary urbanism has several trends that seek to establish a new technical-scientific model based on ecological-environmental questions. The research on urban water environment intervention projects show a dissemination of new paradigms. There is a diversity of examples of projects which take in to consideration the relationship between environmental and urban dynamics, integrating water into the morphology and in the urban landscape.

The analyses of the projects should consider the context and the systemic relations between the environmental, urban and human dimension. It is necessary to comprehend the limitations imposed by the physical-environmental and socio-economic conditions and how the project relates the built environment to flow and natural cycles.

The analysed projects presented different answers to this question. Velenje is a local intervention, with a sinuous design that leads attention to the ensemble of the bridge/amphitheater and instigates the perception of the river. Denver implements a greenway at a lower level of the city, separated from the hectic city life which offers the cyclists and pedestrians a contact with the water and the vegetation. In Belo Horizonte the degraded spring is revitalized, receiving a retention pond and landscape elements which lead to the qualification of the landscape of a neighborhood needy of architectonic and urbanistic references. (see table 1)

The experiences show that the difficulties and the inherited problems can be overcome, even in Brazil, where the conditions are worsened by social inequality, the precariousness

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of the sewer and drainage systems, the lack of equipment of the state and of economic resources. The Belo Horizonte experience shows that it is possible to change the reality of degradation and of inadequate treatment of water environments in Brazil, which in this case was the outcome of a long process initiated in the 1990's with the creation of the Manuelzão Project. This Project was created by the UFMG Medical School with the objective to improve the environmental conditions and the lives of the inhabitants of Rio das Velhas, becoming nowadays a structuring project of the State of Minas Gerais.

Table 1. Analyzed projects, in relation to environmental, urban and human dimensions.

Project (date of Project)	**Dimension**		
	Environmental	**Urban**	**Human**
Velenje (2012)	Ponctual intervention with aesthetic, urbanistic concept, without ecological focus.	Multiple uses, integrating the river into the morphology and urban landscape	Strong image that instigates the perception of the river and social living
Denver (not informed)	Landscape recomposition and bed of headspring of Cherry Creek respecting natural dynamics	Formation of a Greenway along the river, separated by different levels of its surroundings	Sense of protection sharpening the contact with the dynamics of the water
Belo Horizonte (2001)	Environmental recovery and the introduction of a retention basin	Urban park with Access control, offering leisure and recreation	Landscape solution that qualifies and valorizes urban landscape

The technical and aesthetic solutions may be of the most varied forms, avoiding pre-conceived models. The elaboration of the projects should come from the comprehension of the environmental and urban dynamics, establishing principles and coherent criteria with this reality and present multiple objectives, which take into consideration the multiple scales.

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