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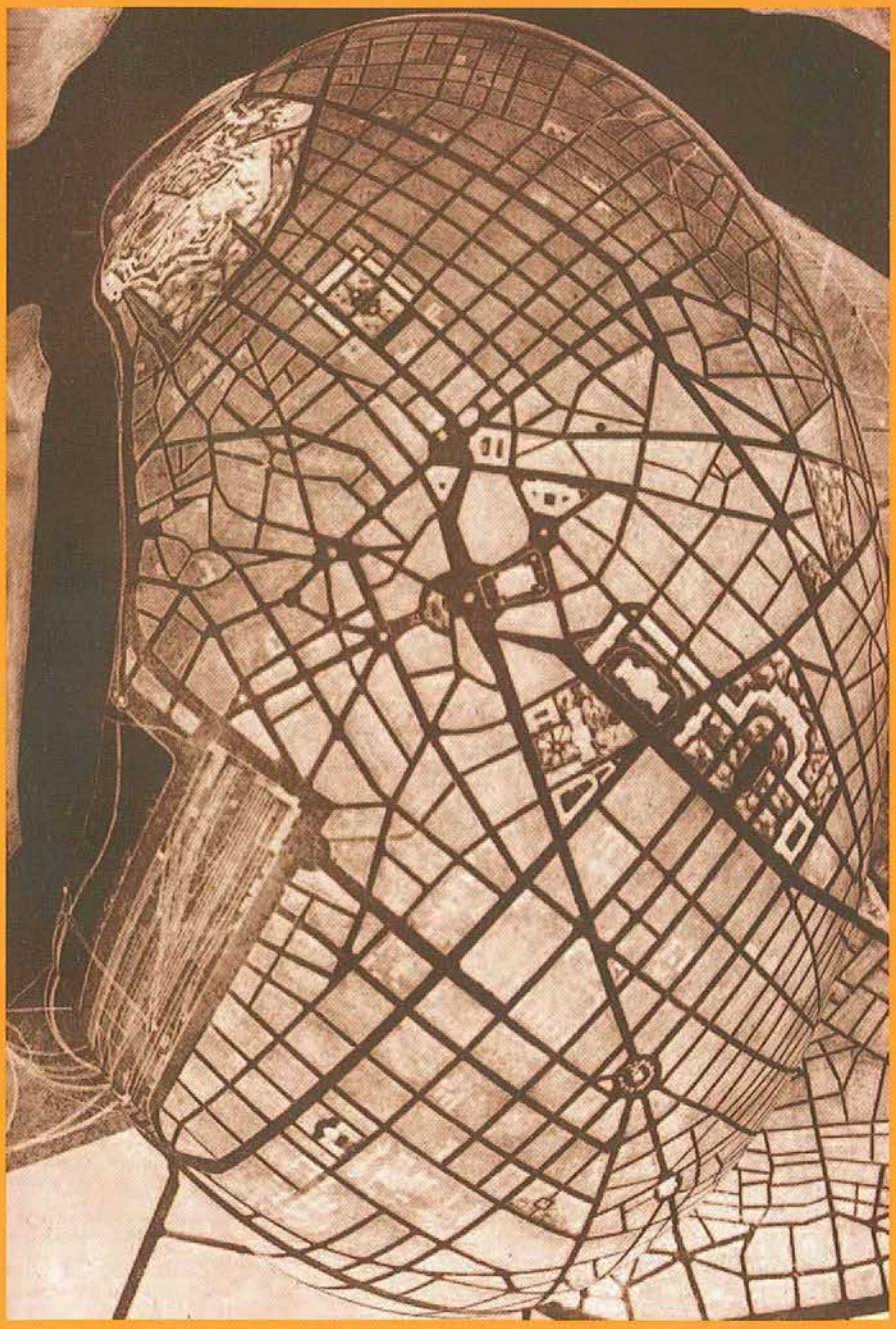

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EDITORIAL

Dear readers,

This issue of journal “SPATIUM” covers a number of papers from the fields of: urban planning and development (viz. urban form, specific urban areas, urban regeneration, and so on); architecture (individual housing, modeling of architectural structures, architectural education, etc.); territorial cooperation in the SEE region; and ecological protection. Also, this issue contains a paper reporting on some of the research results from the FP7 project TURaS. Finally, a Technical Report on some spatial patterns of urban dynamics in India is enclosed.

Editor-in-Chief

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REVISING THE POSITION OF A CITY BLOCK WITHIN THE MORPHOLOGICAL FRAME OF A TRADITIONAL CITY: CONTEMPORARY PERSPECTIVES

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This paper investigates the basic theoretical concepts of urban morphology related to the phenomena of a traditional city and its constitutive elements, including the city block. The traditional city is not considered an absolute model, but a subject of morphological analysis, by which its characteristics are detected, classified and described, becoming a base for new synthetic models in the context of contemporary designing and planning. The paper provides theoretical support to further studies dealing with the practical application of theoretical knowledge and concepts of urban morphology in designing and planning. It points out that the key characteristics of a traditional city identified by morphological analysis are contained within the architectural and urban entity of a city block, which can, therefore, be considered a generative element of its urban structure. Given that the scale of a city block allows for morphological analysis, as well as providing recommendations for future urban development, these research results can be applied to the contemporary context of designing and planning. The paper fits into contemporary studies that link the fields of urban morphology and urban design.

***Key words:** traditional city, morphological frame, city block, urban morphology, urban design.*

INTRODUCTION

Urban morphology is a wide field of study with an international and interdisciplinary framework comprising different theoretical and methodological approaches. Recent studies underline the importance of urban morphological knowledge in the application of theoretical concepts in the practice of architectural and urban designing and urban planning. The physical entity and urban form is a common focus of various urban morphology approaches and studies.

A traditional city has an outstanding place within various urban morphology approaches, primarily as the backbone within the comparative analysis of spontaneous and planned forms of settlements, which was the main theme of the earliest urban morphology studies appearing in the late 19th century and early 20th century. Since the 1960s, in the theory of architecture and urban planning, special interest has arisen in investigating a form of the traditional city in response to problems identified in the built environment that emerged during the Modern movement. An important challenge for urban morphology is to investigate the possibilities of using the current and new theoretical concepts in the context of contemporary planning and design.

However, a well-established attitude among urban designers according to which urban morphology is oriented towards historical analyses and reification of traditional city-building types, as well as that its application in urban design can be seen primarily in the field of urban quality management based on traditional values, and not in a conceptual and experimental design, is one of the important constraints in the application of urban morphology research in the context of contemporary architectural and urban practice (Nasser, 2013). It can be assumed that the existence of the key concept in terms of defining the basic unit of urban growth and transformation which links professional interventions at different scales provides some kind of a central focus contributing to the more purposeful application of urban morphology in practice (Kropf, 2011).

This paper investigates the position of a city block within the morphological frame of a traditional city under the assumption that the city block represents a key morphological concept. The research subject placed in such way further implies that previous urban morphological research and concepts related to the traditional city, out of which the Conzenian concept of the morphological frame stands out as a relevant and comprehensive one with which other relevant concepts can be connected, will be the main theoretical support in the present paper. Primary source material for researchers includes

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texts in the field of urban morphology, particularly the urban morphological discourse within the International Seminar on Urban Form (ISUF), available online as web pages, and in Urban Morphology journal issues published online. In addition, sources include scientific and professional literature in the field of the theory of architecture and urbanism dealing with the introduction of the concept of form in urban planning. The first section of the paper presents the phenomenon of the traditional city from the aspect of urban morphology. The second section describes the position of a city block in the morphological frame of a traditional city. The final section investigates the possibility of using the singled out concepts in designing and planning, namely the possibility of connecting theory and practice.

MORPHOLOGICAL FRAME OF A TRADITIONAL CITY

The term 'traditional city' refers to a form of urban settlement which grew spontaneously in the period before planned forms of settlements emerged. The traditional city is a complex urban form which has affirmed itself as an important topic of research both for urban morphology and for the theory of architecture and urbanism. The urban morphological approach in the study of the form of a traditional city provides results in terms of key characteristics, concepts and terms typical for this morphological entity.

For a long time, urban morphology has been considered a discipline primarily oriented towards the historical analysis of traditional city-building types. In this regard, the research topic of a traditional city has been the backbone of different theories of and approaches to urban morphology, primarily within the comparative analysis of spontaneous and planned forms of settlements, which was a basic theme in the earliest urban morphological studies in early 20th century. It later appeared as a concept which has connected three schools of urban morphology – the British, Italian and French ones (Đokić, 2007, 2009). The traditional city is analyzed and valorized as a paradigmatic model of city-building, whereby these analyses are used for the purpose of describing-explaining why and how cities were built, which is a primary focus of the British school, as prescriptions-recommendations for how cities should be built, which is a focus of the Italian school, or as influences of certain theories on a built environment, which used by the French school of urban morphology (Moudon, 1997).

The contemporary urban morphological discourse developed within the International Seminar on Urban Form (ISUF) is especially concerned with the topic of connecting theoretical research with the practice of planning, designing and building. In this regard, instead of classifying researchers according to which school and tradition they belong, the researchers strive to consolidate knowledge about urban forms and to identify those areas where different morphological concepts, terms and texts overlap, which has resulted in the development of different systems for mapping individual contributions to the study of urban form and synoptic charts of key terms (Gauthier, 2006). The Glossary of International Seminar on Urban Form compiled by Peter Larkham and Andrew Jones is a special contribution to this research aim[2]. It was developed on the basis of Conzen's own glossary and extended with terms found in other publications and theses. For each term, it is indicated to which group of terms it belongs - architectural style, planning, etc. In addition, a group of terms that belongs to the Conzenian terminology particularly stands out. In the context of connecting the theory of urban morphology and the practice of designing and planning, the Conzenian terminology gives a key contribution which stems from his approach whose characteristics include morphogenetic method, cartographic representation and terminological precision (Whitehand, 2007).

Within the urban morphological discourse, the term 'traditional city' is closely related to several terms defined in the Glossary. The first is 'old town'('altstadt') defined as a formed medieval part of a town from which new parts of the settlement develop. It is equivalent to the term 'kernel' as a center of a town, formed from antecedent, most often traditional and medieval units. The other term is 'fortification' ('bastides') defined as fortified smaller towns usually on hilltop sites, most common in France. Similar definition also applies to the Conzenian term 'pre-urban nucleus' or 'urbs' defined as a plan-unit that pre-dates the development of a town. It usually comprises a church and often buildings of an ecclesiastical order or a fortification. All terms are marked as elements of Conzenian terminology stemming from his morphological analyses related to medieval settlements. Studying a medieval town, besides the processes typical for its growth and development, Conzen particularly analyzes the town plan and its complex form. He analyzes the town plan of Alnwick at different urban levels to individual plots and buildings, using maps showing how the town plan developed, how it changed and how the relationship between different components of the plan was established. According to Conzen, the main parts of the plan are: town plan or ground plan (including locations, streets, plots and blocks), the building fabric (its 3D form) and land and building utilization. As main attributes of a complex urban form, Conzen mentions the resistance to change, which can also be called flexibility, adaptability; then, historico-morphological characteristics; and, thirdly, contribution to the hierarchy of units (Whitehand, 2007).

The term 'morphological frame' defined by Conzen in his analysis of medieval settlements represents an 'antecedent plan feature... exerting a morphological influence on subsequent plan development'. The pattern of development forming the kernel of a town is often a constraint to the formation of future development. Constraints can include natural structures – topographic elements, and/or built structures – plot and street patterns. 'Inherited outline' is a term equivalent to morphological frame, thus implying that elements of urban and physical structure are constants in development with high resistance to change. Insisting on constants in development indicates an important feature of the morphological frame as a concept which connects urban forms with processes. Conzen defines the term 'morphological priority' as permanent elements and characteristics of a complex urban form which survive in different 'morphological periods' and act as connecting elements of these periods. According to Conzen, street systems are one of such elements – 'morphological priorities'– with high resistance to change and when once formed, the morphological frame in the historical development of towns have remained unchanged until today, unlike that of land use and the function of architectural structures, which are characterized by high dynamics of change.

The traditional city emerged as a result of complex processes - primarily economic, social and political, while the rules and regularities between these processes and the form of a city can be noted in the development of its physical structure, which is one of the basic starting points of urban morphology. Conzen defines 'morphological period' as any cultural period that exerts a distinctive morphological influence upon the whole or any part of a town. The cumulative effects of different morphological periods on an urban structure make up its 'morphological frame' – which is yet another of the definitions of morphological frame by which

[2] The original explanation of all terms contained in this paper as elements of the Glossary of the Urban Morphology Journal, also including the term „morphological frame", are available on the following website: http://www.urbanform.org/glossary.html

Conzen establishes a relationship between the type of process and the characteristics of an urban form.

Conzen indicates that insufficient awareness of a city as a mosaic of urban forms is a widespread problem, where understanding of how these forms overlap and fit into each other is of crucial importance (Whitehand, 2007). The attitude towards history does not go further than dating and descriptions which, in planning, results in the fact that the administrative boundaries to which the planning guidelines are related too often intersect morphologically homogeneous areas. Thus, Conzen opens the question of defining the boundary of the area for which planning guidelines are given, which is still a topical theme and a problem question in the theory of urban morphology and planning practice. According to the Conzenian terminology, the 'fixation line' is an outer site of a linear feature, which is a line of fortification in a medieval town, while in recent settlements, it can take the form of physical features such as rivers, railways, transportation routes, plot boundaries, etc. He indicates that in the case of the expansion of medieval fortifications outside the town walls, the space within the town walls can be differentiated from the space outside the town walls even after the removal of a fortification. The differences in urban structure manifest themselves through a higher density and compact form within the walls and a lower density and open form outside the walls. Such a structure is a result of typical 'morphological processes' in a compact city, which, by their nature in accordance with Conzenian classification and explanation found in the ISUF Glossary, can be: 'adaptive' processes – they take place through a redevelopment of a plot, or series of plots, within a fixed street system; 'transformative' processes – changes are to a great extent brought about through the adaptation of the existing physical structure to the needs and purposes; or processes of 'repletion' – a gradual intensification of building density. In addition to these three morphogenetic processes typical of a compact city, Conzen also defines a forth type of processes – 'additive' – the creation of new urban forms at the outer edges of an urban area.

The existence of boundaries determines transformations within them taking place under the principle of systemic balance. Thus, the system is an important concept in the analysis of the functioning of an urban form through detecting the elements and relationships between them, namely its structure (Levy, 1999). In the case of a traditional city, one of its characteristics is clarity of structure. In addition to its importance for the functioning of a town, as well as the implications it has for sustainable development, the boundary which defines both the entity of a traditional city and certain entities in its structure provides a special quality to its legibility. Places have their beginning, an end and defined boundary, as well as a center of gathering and trade. Important public and religious buildings are the highest and the most imposing in a town. The parts of a town are clearly separated, not only physically, visually and perceptually, but also administratively, given distinct names (Moughtin *et al.*, 2003). The balanced concentration of the contents within a town boundary is an essential indicator not only of ecological, but also esthetical balance, thus contributing to overcoming the visual disorder. It is analogous to larger scale of urban landscape in which the concentration of a compact urban development is observed.

Within a morphological frame, there are 'morphological regions'– the areas with homogeneous urban form in terms of plan type, building type and land use. The cumulative effects of morphological periods manifest themselves and are read as a quality of urban complexity and multi-layeredness – 'urban sedimentation' (Levy, 1999). The visual effects of unity in diversity are achieved through interweaving different elements and sub-systems within a compact entity defined by city boundaries. Thus, we can speak about the picturesque qualities of a traditional city based on intimacy, urban space diversity, sequential visual contrast and the contrast between open urban green space and the negative volumes of squares (Perović, 2008). For Conzen, this is a 'historical expressiveness' – the term stemming from Conzen's understanding of townscape as a visual experience and, as such, a source of knowledge about social activities and processes (Whitehand, 2007).

POSITION OF A CITY BLOCK IN THE MORPHOLOGICAL FRAME OF A TRADITIONAL CITY

The city block in a traditional city reflects the characteristics of a town on a smaller scale, which is a logical consequence in which its structure has been gradually formed. The principle of connecting different hierarchically positioned elements of urban structure is based upon the same genetic code of all these elements, due to which the growth of traditional cities is also often called organic growth, and cities are identified with living organisms. As a basic generative element and physically static element of a structure, the city block represents a segment of urban tissue and a sample for studying the characteristics of wider urban entities. The generative elements and generic features of cities have a special place in morphological theories dealing with principles of the organic growth of towns, such as the typomorphological investigations of Saverio Muratori and Gianfranco Caniggia[3]. They analyze principles under which traditional Italian towns were built and develop a theory of urban design by looking to historical traditions as the operational techniques for city making. In his work, Muratori starts from two basic hypotheses: that an urban structure can be understood only through historical continuity; and that typology and built urban form is a basis for urban form analysis (Đokić, 2009). The definition of type is in accordance with the principles of consistency, specificity, generality, inclusiveness and coherence in the realm of architecture. Aldo Rossi shares the same perspective as Caniggia (Marzot, 2010), defining the typology as an analytical moment of architecture that can be easily identified at the level of urban artifacts. He cites the concept of the study area, which can be considered an abstraction in relation to urban space corresponding to a certain urban entity. From the standpoint of urban morphology, he defines an urban entity as a typologically homogeneous space determined by similar physical and social characteristics. In reality, he identifies such spaces as city quarters, emphasizing that by introducing the concept of the study area, it has become possible to study the city as a whole, which is construed as a structure of urban entities (Rossi, 2000).

The French school of urban morphology is characterized by placing a focus on the issue of the relationship between architecture and city, considering a city block as an urban level through which the historical development of physical urban space can be 'read'. Its most important representatives, Castex, J., Depaule, J. and Panerai, P., describe the evolution of a city block through historical periods and geographical expansion (Castex *et al.*, 1980). In their study, the traditional block represents an affirmative paradigmatic model of urban space

[3] The generative elements of a city are the backbone that connect the spontaneous and planned forms of settlements, as a basis of the morphogenetic method typical of any approach to urban morphology. These elements were first defined by Pierre Lavedan in his books Geography of the Cities (Geographie des Villes, 1936) and History of Urbanism (Histoire de l'urbanisme, 1957). He developed the idea about built-up areas and open spaces as constituent elements of an urban space, which later greatly influenced the morpholgical studies of many authors (Đokić, 2007).

which has, ultimately, been negated in modernist conceptions. Considering a city block as the inheritance of a traditional city which develops 'bottom-up', through a gradual growth from original cell-parcel, the 'top-down' approach has resulted in the loss of important morphological characteristics of the city block. In planning models and in relation to a compact traditional block, its front side gradually opens and differences between its front and backside side disappear, thus also 'elements of privatization of place' in the space inside the block. It can be concluded that the morphogenetic processes of a city block, as a concept, reflect the evolution of urban settlements, progressing through a gradual reduction of morphological elements and loss of urban layers. This has resulted in the emergence of the concept of the urban form of a city block in which the relationship between architecture and urbanism has been lost. This is a main impetus to the development of the contemporary discourse in post-modern theory of cities, which has primarily appeared in the form of criticism of modernism concerning the lack of human scale in architecture. The issue of architectural typology and urban morphology has become of decisive importance for the re-establishment of the relationship between architecture and urbanism, not only in theory, but also in the design and planning practice.

According to the Conzenian definition of the term 'morphological priority', street systems are one of the constants in development. The city block as an entity in urban structure bounded by street lines is an implicit unit following from the inherited historical urban matrix or from the urban matrix imposed by plan. Morphological concepts derived from the analyses of a traditional city – boundaries, compactness, systemic organization – are applicable to the city block. As a morphological entity, the city block has a quality of unity in diversity stemming from its complexity, multi-layeredness and the cumulative effects of historical development. Both the concepts of 'traditional city' and 'traditional city block' are related to the medieval period, where the latter is described as: 'a dynamic, with vertical contours, closed solid cubus in which houses bear resemblance to each other by the materials used, façades and way in which roofs were made. Public spaces and semi-public spaces inside blocks were connected through entrance halls of buildings or arched passages. The basic module for a city block is the urban house, the building which essentially differs by its appearance and spatial organization from other structures built on an empty terrain near the city'(Perović, 2008:82).

It can be stated that the city block is the inheritance of the traditional city and the generative element of urban structure – according to the approach of the Italian school of urban morphology. In addition, it is an urban entity whose analysis depicts the evolution of urban settlements, or represents the relationship between physical and social space, according to interpretations of authors belonging to the French school of urban morphology. As an element of the town plan, in accordance with Conzen's approach, a city block is a morphological priority in terms of form and size. The assumption that a city block can be considered as an evolutionary, generic, structural and formal unit within an urban and physical structure is a theoretical base for investigating the possibility of considering the city block as a plan-unit.

THE POSSIBILITY OF INTEGRATING THEORETICAL CONCEPTS INTO CONTEMPORARY PRACTICE OF DESIGN AND PLANNING

The contemporary theory of cities is related to the historical period of post-modernism. It has been developed since the 1960s primarily in the form of a shift away from modernistic theories of urban design and planning, which has resulted in a pluralism of approaches, a set of themes and thought models in other disciplines, for which a search for a new consistent urban paradigm is a common feature.

In the contemporary urban morphological discourse, a question arises as to how urban morphology can provide a repertory of concepts for design and planning in the contemporary context, what types of interventions are appropriate and how an urban design can create a new field of research for urban morphology analysis (Kropf, 2011). Kropf notes that the common conceptual core of various sub-fields and branches of urban morphology focuses on the study of structure, diversity and genesis of urban form, which can further serve as an instrument in other fields and disciplines. In this regard, urban morphology is a service discipline trying to find its application in other academic fields, but also in the professional practice of city building, which emphasizes the need to develop and adjust the language to different applications in design and planning procedures (Kropf, 2009). Nasser speaks about „abstraction", which implies the morphological reduction of the empirical reality of the physical environment using geometric shapes, dimensions, features and types. The abstract language of these elements becomes a common means of expression for urban design and urban morphology (Nasser, 2013). The use of historical predecessor is an important and useful means for linking the urban morphology and urban design that is analyzed. Morphological characteristics, such as the configuration of a series of plots, distances, fronts, parking places and street landscape, are singled out and then varied and combined in a synthesis of new solutions which correspond to the contemporary context. McCormack cites the example of Versailles, which has become a frequent model for morphological research. He advocates the idea that knowledge about urban morphology should be linked to techniques of urban conservation, urban expansion and urban renewal, which is becoming especially important for peripheral zones in which the lack of clarity and coherence of urban form is pronounced. A critical attitude towards history is an important element of designing and city building methodology (McCormack, 2013).

Morphological analysis in urban design and planning is used for typological classification. The relationship between architectural typology and urban morphology is the most complex form of typological classification (Đokić, 2009). In that, urban morphological researches combine several methods: comparative analysis of examples of theory and practice, and corresponding research methods in urban designing and planning. Through comprehensive studies, elements of urban space are identified and examples with common characteristics are singled out and grouped for the purpose of their classification into the defined type. In addition to the definition of types, the identification of relationships between them through typological classification of open spaces is also important. In this way, by combining methods of architectural typology and urban morphology, the spatial and physical structures are simultaneously considered. A typomorphological approach provides an integrated framework for understanding urban and physical structures and the processes of their formation.

Kropf claims that there is a key concept in urban morphology which is adaptable to illustration, and which can provide a clear focus and linkage between different interest groups, and that is the urban tissue (Kropf, 2011). On the other hand, Tony Hall points to the 'perimeter block structure' as a necessary part of the design of new development. The approximate sizes of street blocks are largely pre-determined by the given context and should be incorporated in planning guidance (Hall, 2008).

Instead of paradigmatic models of urban forms, where the traditional city is considered to be such a model, the opening of a field of research for new synthetic models and free interpretations of formative principles, rules and regularities

obtained through morphological analysis, is emphasized. Thus, certain static definitions of urban morphology discourse become dynamic concepts. The traditional city and traditional city block as its representative segment have become a repertory of concepts which are translated into the contemporary context through analogies in design and planning. This lies at the basis of contemporary concepts of the generic city, the compact eco-city and a city as a project.

The position of a block as an inheritance of a traditional city in the contemporary concept of a city as a project is reflected in the recognition of an urban entity as a relevant entity for which planning guidelines and urban rules based upon the concept of urban form can be defined.

The compactness of a traditional city block is its main physical characteristic on the basis of which it, as a typical organization which can also be recognized in contemporary urban concepts, has been named a 'closed city block'. There is an unambiguous difference between the space inside and the space outside the block, which is physically manifested through contrariness between the front side, street front and backyard side, as well as the spatial difference between the front and backside, which corresponds to the division into the public and private realm. This principle of a clear differentiation between the 'two faces of a block' is also called the 'principle of double coding' (Castex *et al.*, 1980), which is an important instrument in contemporary urban design where the block perimeter and the space inside the block are subject to different codes and which function according different spatial logic.

In the case of Serbia, there is also a problem related to the scant relationship that exists between different levels of design and planning, as well as to the need for new approaches and methodologies. In these investigations, physical structure is defined as a thought-conceptual projection of the built environment, a kind of meta-language that is used in analysis, research, shaping and proposing of urban concepts, and the development models which symmetrically depict the given urban reality (Radović, 1972). Issues of typology, topology and morphology are primarily related to more comprehensive investigation of the current state, according to the assumption that future urban development can be characterized more as a transformation of the existing urban tissue than as further expansion of territory, which corresponds to the tendency towards more compact, sustainable development (Milenković, 1994). For Perović, traditional city elements - urban block, street and square - are major elements both in building new cities and in the reconstruction of the existing ones. They ensure the formation of a 'clear urban form', which is necessary for both technical functioning and visual legibility of urban entities. The city block is a basic element of urban structure which reflects the differences in structure of specific urban entities and represents the backbone of a comparative analysis of historical urban tissues and new, planned settlements. In dealing with the issue of historical urban tissue, Perović is guided by principles of urban reconstruction and an analysis of the current state, while new, planned settlements are considered in terms of identity, character and human scale. Reduced to the level of the block as a representative sample of urban structure, Perović proposes control instruments for growth, development and transformation - horizontal and vertical regulation, inner regulation, the treatment of plots and the way they are utilized, and a general balance of built-up and unbuilt areas of a city (Perović, 2008). In its emergence, formation and contemporary transformations of urban and physical structure, the central zone of Belgrade, its block structure and types of blocks typical for certain parts of urban tissues plays an important role. Contemporary transformations of urban tissue manifest themselves at the level of the city block, leading to deviations from recommended parameters of development, so it is necessary to reconsider the types of city blocks in Belgrade's urban tissue, models to which they should strive, the procedures in the form of interpolations in their reconstruction, and the ways in which guidelines are formulated and incorporated into plans (Marić *et al.*, 2010, Niković, 2013).

CONCLUDING CONSIDERATIONS

A traditional city is a specific urban form which has emerged as a result of complex development processes. One of basic interests of urban morphology is establishing relationships between these processes and the urban form of a traditional city. This stems from an attitude according to which the reconstruction and protection of the existing forms, like the production of new urban forms, should be grounded on the knowledge and understanding of the existing built environment, its specific forms and previous development. The British school of urban morphology developed a glossary of precise terms and definitions which describe and explain the phenomenon of a traditional city. Conzen, the originator of the school, developed one of the key concepts – 'morphological frame ' – describing the cumulative effects of different morphological periods on urban structure, and established a connection between the type of process and characteristics of an urban form.

Concepts defined by Conzen, like that of 'morphological frame', 'morphological period', 'morphological region', 'fixation line', are important because, although derived from the analysis of already established morphological entities of medieval fortifications, they are concepts practically applicable to analysis of contemporary town plans, particularly in terms of the identification of the character of an area and definition of a boundary of the area for which planning guidelines are given. Conzen's approach differs from the approaches of other schools of urban morphology which are focused more on architecture (Italian school) and socio-cultural aspects of city formation (French school). The most important contribution of Conzen's work is the analysis of town plans and complex urban forms aimed at practical application for improving planning, and thus an important basis for a contemporary morphological approach to connect urban morphological research and planning practice.

'Morphological frame' is an all-embracing term defining a specific empirical reality of a traditional city. It is also a wider referent framework in which other relevant concepts and definitions can be accommodated, thus reflecting the permanent efforts of researchers in the field of urban morphology to consolidate the field of knowledge about urban form, in this case about the form of a traditional city.

Major elements of a morphological frame include boundary and structure, as well as systemic organization. On the basis of studies on the position of a city block in the morphological frame of a traditional city, it can be concluded that the city block is an inheritance of a traditional city which is a paradigmatic city-building model in urban morphology, as well as in the theory of architectural and urban design. The key characteristics of a traditional city, detected by a morphological analysis, are contained in architectural and urban entity of a city block, which can, thus, be considered a generative element of the urban structure. The adjustment of scale in urban planning by reducing it to the scale of a city block is a path leading to the re-establishment of a dialogue between designing and planning.

This research is in accordance with contemporary urban morphology discourse which tries to find free interpretations of city block models which are not determined by binding themselves to the paradigmatic model of a traditional block in which positive values are implied. Nor are they a negation of the open

modernistic block. They are only conditioned by taking into account formative principles, rules and regularities which are obtained through a morphological analysis. The city block occupies a new position within the urban morphological discourse – from the static position of a paradigmatic model in the sense in which it is an inheritance of a traditional city to the key concept which is applicable in terms of the transfer of knowledge between urban morphology and other fields of knowledge and professional activities.

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THE SIGNIFICANCE OF THE TOPOGRAPHIC ELEMENT OF HILL IN THE MODERN URBAN CONTEXT: CRKVINA AND JABLANICA

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The position of the first settlements was determined by geography, which defined their form and set the basis for building the identity of modern urban environments. Although the correlation between the natural and man-made components of towns was changing under the influence of cultural circumstances and the manner of social production of space, primarily in the 20th century, the natural elements still appear as primary urban elements.

The paper analyses the significance of Crkvina hill in the socio-spatial context of the town of Trebinje, as well as the significance of Jablanica hill in the socio-spatial context of the town of Novi Grad. It examines the influence of the topography and hill element on the genesis of urban structures, as well as the ways in which the hill is incorporated into the urban tissues and activities of these towns today. It also analyses the symbolic character of the hill, its role in transmitting socio-cultural processes and in creating collective identity. It further determines the potentials of the element of the hill, which can help increase the quality of urban space and highlight the identity of Trebinje and Novi Grad.

Key words: ***element of hill, identity, urban genesis and space, Crkvina, Jablanica.***

INTRODUCTION

Two factors lay the foundation for forming and developing any town: location, which gives the town its primary shape, and geographic framework, which determines and stimulates the occurrence of roads as essential bearers of urban dynamics (Poëte, 2011). Geographic position is essential to urban genesis and town evolution on one hand, and the creation of specific cultural characteristics of its inhabitants on the other. The relation of the natural environment and community always works both ways: the community influences the environment, and the environment influences the community which inhabits it. Through this mutual interaction, the natural environment becomes part of the urban environment. The apparent conflict of natural and constructed environments, embracing and sometimes redesigning nature, supplies the basic formal characteristics of a town and its identity (Kostof, 1991; Radović, 2009).

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As the most prominent part of the natural framework, the element of hill or mountain had a major role in the historic process of town creation and development. Positioning settlements on a hill or high terrain provided safety and quality of environment. Apart from determining the position, expansion direction and form of the town, the hill element, which is often attributed with symbolic meaning, contributes to the sense of belonging to a place or community, or simply marking the urban space.

Throughout history, topography has always been a tool of expressing spiritual or temporary values and power. In ancient Greece, mountaintops were a place of gods, in the Middle Ages hilltops were the location of feudal castles etc. The tendency of powerful institutions and individuals to occupy the tops of mountains or other higher grounds in the urban landscape has continued to this day. But still, in some cases, high terrain can present obstacles and barriers which marginalize and segregate a certain part of urban space or a social group (Madanipour, 1996).

Along with striking architecture, high terrain or hilltops provide bearings in space and identification with it, which are two basic psychological functions involved in forming a sense of truly belonging to a place (Norberg-Schulz, 1976), with nature playing a vital role in its creation (Lovell, 1998). The hills show the roots of a people, its tradition and mythology –'so significant was the role of mountaintops in the life of people, that the whole history of humanity could be linked to the cult of peaks' (Reclus, 1910: 176).

Bosnia and Herzegovina is made up of two distinct geographical and historical regions, resulting in the appearance of different formal characteristics of the town and cultural patterns reflecting on the character of the urban space. Both regions are predominantly mountainous, which affected the first road routes, and caused the towns to have irregular, but consistent forms. The first towns of the medieval state developed from Old Roman forts that guarded

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Roman road routes. These towns were closely related to the topography of hills and mostly occupied the tops of naturally formed peaks, adapting their form to the 'natural foundations' (Truhelka, 1904).

The elements of natural environment, during periods of further development of the towns, have had different roles in the organization of the urban space or in assigning meaning to it. Their roles were directly linked to the cultural and economic influences of the dominant periods of the urban accumulation process. Since the majority of structure in modern towns originated in the second half of the 20th century – when modernization and urbanization were implemented with regard to industrialization, socialist ideology and the principles of the Athens Charter – the production of urban space was neglecting the natural component. Today, however, the elements of natural environment can be seen as the protagonists of identity, whose role in the urban space of a town is complex and is reflected in various fields of urban and sociological activities.

This makes it necessary to begin carefully analyzing them in order to display and determine: the role of topography in the urban evolution of the town in Bosnia and Herzegovina; the characteristics of the element of hill which defined its form and the identity of the environment; the existing and potential degree of integration – physical, functional and symbolic – in regard to the scale of immediate environment and the scale of the town.

METHODOLOGY

The article incorporates elements of basic and applied research, implying complex methodology which is aimed at understanding and explaining the complex roles of the hill element in urban space and life within that space. Because of the two distinct historical and geographical entities of Bosnia and Herzegovina, comparative research design was used, unifying various spatial and pivotal levels of analysis and reducing them to exploring the significance of Crkvina hill in the socio-spatial context of Trebinje, and the same for Jablanica hill in Novi Grad. The applied comparative research design implies not only results reached through exclusive comparison of two case studies, but each case study can be considered a result in their own right (Flyvbjerg, 2001). The two towns were selected based upon a group of parameters, which apart from the primary parameter of belonging to different geographical regions include approximate extent of urban space and number of residents, which places them in medium-sized municipalities, which are dominant in Bosnia and Herzegovina, and various cultural influences.

The focus of research was placed on the spatial level of the hill, its immediate surroundings, including the town central zone, and on the current time period, observed through the composite of previous periods and their corresponding cycles of urban evolution. The research was done in regard to three aspects of approaching the issue coming from the theoretical framework laid out in the introduction and from the spatial level of research:

- The influence of the hill on the genesis, structure and characteristics of the urban space, and vice versa;
- The symbolic meaning of the element of hill in creating urban and collective identity;
- The integration of the element of hill in relation to various scales of the environment: form, connection, activity and flow.

Throughout the research three important approaches to urban research were used to a lesser or greater extent: the time-space system, comparative analysis, and the relation between process and consequence.

CRKVINA HILL IN TREBINJE

Trebinje belongs to the region of Herzegovina, which determined the basic morphological characteristics of the town, whose form was defined by karst landform mountain ranges with slopes of over 30º. To the west, the ranges end in the form of Crkvina hill (406 m.a.s.l.; surface area cca 34 ha), which is adjoined by the Trebišnjica river on the north side. Crkvina protrudes from a compact massif of the mountain range into the flatlands (275 m.a.s.l.) where the current town is located (Figure 1).

The specific relation of the river, the hill and the flatlands was most probably the main reason why the first settlement in the modern-day urban space of Trebinje, according to most authors who have studied the region (Figurić, 1930; Korać, 1966), developed at the Crkvina hillside. The terrain, cover from wind and access to water made this a unique place, necessary for further development of the settlement. It is believed that the first settlement on Crkvina appeared in the time of the Illyrians (Korać, 1966), and the recovered relics are estimated to date from before the 7th century. An archeologist named Janković (2009), member of the archeological team at the Crkvina site in 1996, put together the following reconstruction of the formation and transformation of the settlement on Crkvina: it is assumed that originally there was a Roman camp located on the hill, from which a town was formed in Late Antiquity. With the arrival of the Ottomans (1466), Crkvina loses the role of the urban center and becomes a strategic point of a new, Ottoman town developing on the other side of the Trebišnjica river.

Along with the Trebišnjica river, Crkvina defined the position of the original settlement and

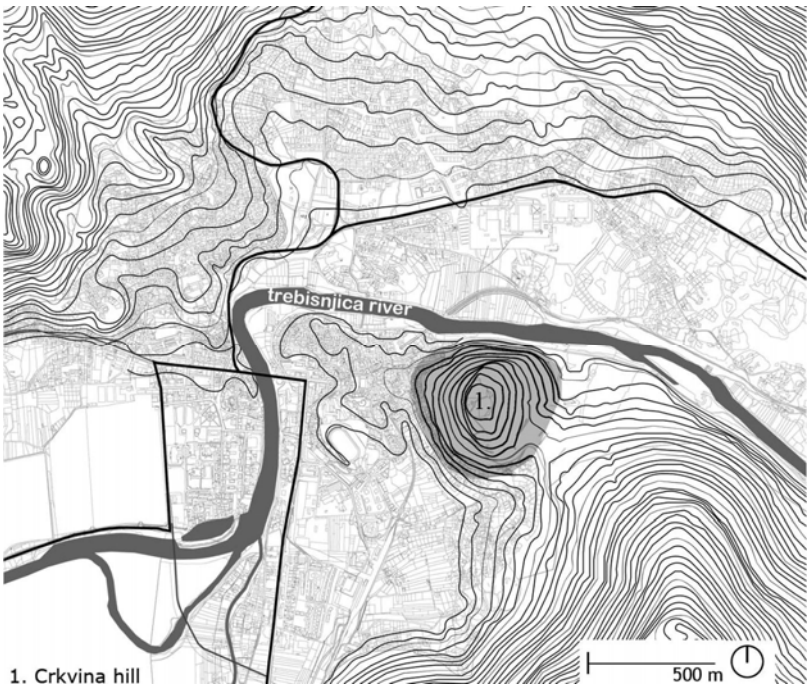

Figure 1. Form of the town in relation to topography, position of Crkvina hill.
Source: Isidora Karan

influenced its further expansion. Although at a certain historical moment Crkvina was a nucleus from which the current town developed, today it is perceived as part of its natural borderline; there are, however, plans to build structures on the east side of the hill (Urbanistički zavod RS, 2002). Since the appearance of the first settlement, Crkvina has had the role of an urban impeller, influencing the development of the urban space, albeit with reduced intensity since the arrival of the Ottomans.

In the context of the current town, Crkvina's primary role is that of the urban identifier, in terms of creating a clear image of the town and in terms of forming its identity. Crkvina represents the fundamental element of 'urban horizon and portrait' of Trebinje. (Kostof, 1991) In forming the town, it operates in both the outside-inwards perspective, from the mountain ranges towards the urban space, and the inside-outwards perspective, from the urban space towards Crkvina. As a landmark in the open urban space of Trebinje, providing for the opportunity to encapsulate the entire structure of the town into one image, it enhances our impression, primarily the visual one, of the town, and it also provides bearings in the town (Figure 2).

The presence of the Crkvina directly identifies the location as Trebinje, and not some other town of similar topography and form. Without Crkvina Trebinje would not be the same town. Its significance lies in the satisfaction it induces within a person, from being in this particular town (Lynch, 1974). Apart from bearings, Crkvina provides association with the urban space of Trebinje.

The specific position and form of the hill in regard to the natural surroundings are what gives it symbolic meaning, which has been expressed through architecture. Before the Ottomans came, there had been a church on Crkvina hill. The Ottomans built a tower in place of the church, which was removed by the Austro-Hungarians when they established their authority in Trebinje (1878), building a fort like on many other mountaintops towards the border with Montenegro (Korać, 1966). At the beginning of this century, an orthodox church named Hercegovačka Gračanica (Gracanica of Herzegovina) was built on top of Crkvina, where it remains today. The alternation between sacral and military structures corresponds to periods of different dominions. Crkvina served as a crossroads of different periods of urban evolution of Trebinje, which did not result in superposed physical form, but in forming awareness of Crkvina as a primary element. The process of changing structures was accompanied by changing the name of the hill, where toponyms had always originated from names of man-made structures (Pujić, 2003), which indicates the significance of Crkvina in the urban space and processes.

Hercegovačka Gračanica was built as part of the testament of poet and diplomat Jovan Dučić (1871-1943), who left an impression on Trebinje of the 20th century. The church is a replica of the monastery church Gračanica near Priština, Kosovo. The Kosovo Gračanica was built in the beginning of the 14th century and is one of the most influential monuments of Serb culture built in the Serbo-Byzantine style. It has been on UNESCO's list of World Heritage Sites since 2006.

The construction of the Hercegovačka Gračanica just several years after the civil war in Bosnia and Herzegovina (1992-1995) was seen as an attempt to associate the territory to an ethnicity, in this case Serbian. On the other hand, its design mimicking the Gračanica in Kosovo amplifies the Hercegovačka Gračanica as an ethnic symbol. The quest for the past, a global phenomenon arising from anti-globalist tendencies, mostly expressed through religious structures (Rykwert, 2004), affected the urban identity of the town, and the Hercegovačka Gračanica became a landmark in Trebinje. Alexander (1977: 66) describes religious objects as 'doorways', through which the individual 'enters the world and leaves it', and in a way the Hercegovačka Gračanica is the 'doorway' into the period of religious renaissance, which came about after the fall of the socialist regime, and an element where the collective and personal identities of the residents of Trebinje can be formed.

In the urban tissue of Trebinje, Crkvina stands out as a specific entity which loses definition as one gets closer to it. From the urban space, it is difficult to determine its edges and borders, either natural or urbanized. Lacking clearly defined borders can have the positive effect of gradual progress through space, but the difficulty of identification and lack of roads leading to the top have the negative effect of spatial confusion. Visually and spatially Crkvina can be clearly identified, unlike the roads leading to the top. Mostly because of distinctly steep terrain, variations of possible two-rut roads have been reduced to one road, coincidently the main pedestrian access road. The connection routes, mainly pedestrian ones, which are more adaptable to sloping terrain, are inadequate, especially when coming from the south part of the town (Figure 3).

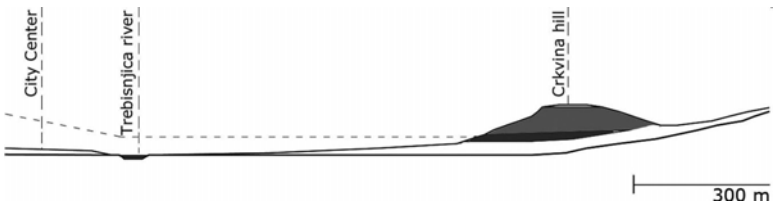

Figure 2. Crkvina hill as a dominant visual marker (section).
Source: Isidora Karan

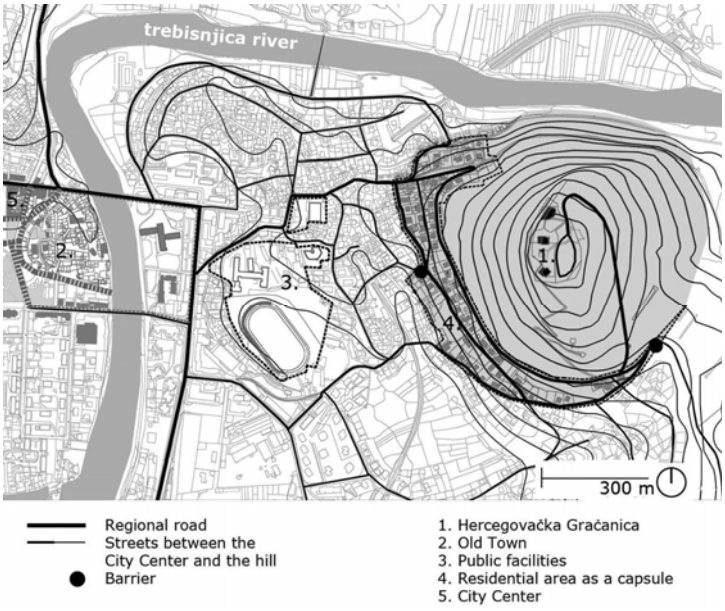

Figure 3. The correlation of Crkvina, its immediate surroundings and the city center.
Source: Isidora Karan

One way of dividing the area referred to as Crkvina in this paper, in regard to its typology, texture and content, is into three zones, or horizontal rings: the residential zone, the green zone and the zone of Hercegovačka Gračanica.

The residential zone develops in the form of a horizontal strip on the western slope, adapting to its configuration. It is defined by concentric streets which encompass a distinctly elongated and narrow block of individual residences. The clear form of the strip vanishes in the south and fragments into the beginning of a new, dispersedly organized residential zone. The existence of only one block, consequential to land division, indicates a lack of transversal routes linking the hill to its surroundings and influences the perception of the residential area as a capsule between the rest of the hill and the part of the town developed in the plains.

The central zone, defined by Trebinje's spatial plan as a memorial park dedicated to Hercegovačka Gračanica, encompasses an area of approximately 20 ha, afforested by coniferous species characteristic for the region. Emphasizing significant elevated buildings using greenery is common throughout history. Contrasted with the karst environment, the green belt has an ecological and ambiental value, its only functions. There are no recreational or other facilities linked to green or park areas.

At the top of Crkvina is the complex of Hercegovačka Gračanica, which apart from the church, contains the Bishop's palace and an outdoor amphitheater. In the urban setting of Trebinje, apart from the primary, visual and symbolic role, the Hercegovačka Gračanica serves as a generator of a portion of urban activity which is not exclusively religious in character, and which is turned both towards the residents of Trebinje and tourists. Field observation and loose estimates give way to the conclusion that the Hercegovačka Gračanica complex is used more frequently by tourists, usually visiting Trebinje only in transit, than residents. The outdoor amphitheater, which uses the natural slope of the terrain and a panoramic view of the town as a distinctive backdrop, appears in the summer period as the centerpiece of urban activity in the complex.

JABLANICA HILL IN NOVI GRAD

Novi Grad belongs to the territory of Bosnia. The municipality of Novi Grad, including its urban zone, is predominantly mountainous. The northern part is at the foot of Mount Kozara, while the southern part is at the foot of Mount Grmeč. Flatlands (121 m.a.s.l.) open up in a narrow strip along the Sana and Una rivers, widening at the estuary and forming a peninsula, the western side of which is the Jablanica hill (142 m.a.s.l.; cca 4 ha). Up until the early 20th century, when the inundation wall was built, the flat ground was mainly unsuitable for buildings. The flood issue having been resolved, the modern-day central zone of the town was developed. That way, the Jablanica hill, a sort of an ending of the slopes of the western part of Novi Grad, was positioned as an urban element operating in the organization of the town structure (Figure 4).

The form of the hill manifests a certain geometric regularity, begging the question of its origin and role in the urban development of Novi Grad. There are assumptions, without scientific evidence and originating from oral tradition, which explain the form of the hill through the dislocation of the Una riverbed, hinting at the existence of an earlier settlement, older than the one located on the Kulsko Brdo hill (1280) on Jablanica.

The first material pieces of evidence of human activity on Jablanica are the remains of an Ottoman graveyard on the northern slope. The hill was owned by Mehmed-bey, who at the time governed the district of Novska (1790-1806), and entrusted a portion of his land to the Islamic community, intended for 'mezar' (Krešević, 1991), a type of Muslim graveyard, specific among other things for being formed on observation points (Krstić, 2010). A part of the graveyard has survived to date as a structure of sporadic tombstones. Up until the second half of the 20th century, Jablanica hill was outside the urban core, i.e. it was part of the natural boundary where the Ottoman, and later the Austro-Hungarian part of the town had developed.

After WW2, the industrial development increased the population of Novi Grad, as well as the urban area. With terrain configuration unsuitable for construction on one hand, and an inherited division and layout of town traffic routes on the other, Jablanica emerged as part of unexploited construction space surrounded by developed urban structures. The route of a regional category road adjoining the hill to the west has defined its current form and created a clear distinction between the Jablanica rise and the portion of terrain which that rise used to be part of.

The way Jablanica was formed is different from the ways that the physical or symbolic space of many towns developed hills or rises as primary urban-topographical elements. Based on available information, Jablanica and its immediate surroundings were not the original location of the first settlements in the territory of Novi Grad, and up until the 20th century its position did not have any major effects on the growth or fragmentation of the urban structure. In the 1960s, Jablanica, as a stretch of non-urbanized space, was attributed with symbolic meaning expressed through the monument dedicated to the 'Partisan Mother'. Although the area of Jablanica was defined as a memorial park in the planning documentation, from the aspect of its formation, structure and usage, it could be defined as a sort of a blend of 'redundant space', previously exploited land that was abandoned, and 'reserve', a portion of land which had been unexploited mostly due to inaccessibility (Clément, 2007). Today, Jablanica may fit McHarg's (1992) concept of 'natural spaces in towns', which satisfy the need for 'greenery and

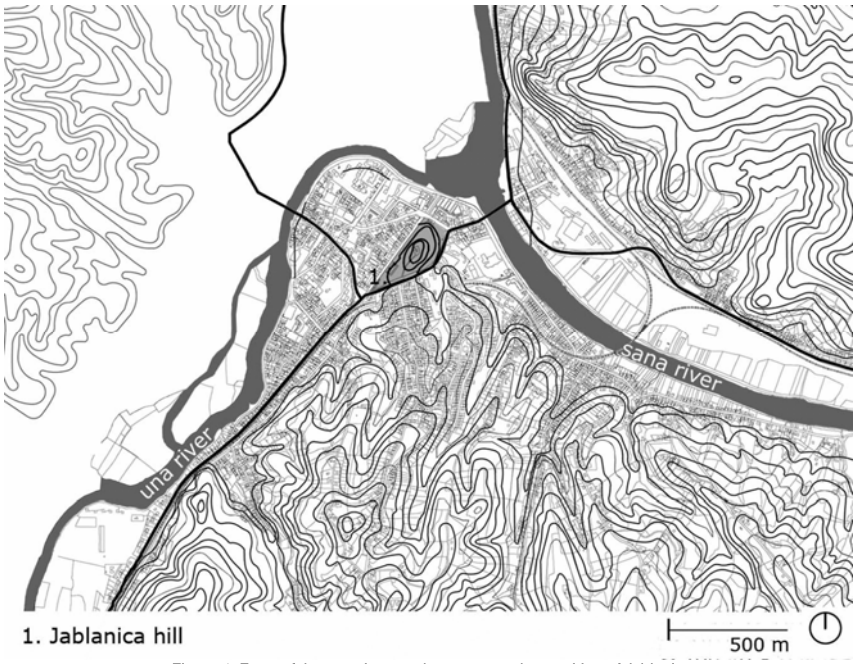

Figure 4. Form of the town in regards to topography, position of Jablanica.
Source: Isidora Karan

nature' in urban environments. Although it never emitted urban pulses, Jablanica has become an integral part of the identity of Novi Grad, incorporating traces of its urban evolution.

When examining the town map, Jablanica appears as a centrally positioned green zone. Clearly defined borders, varying topologies of immediate context and position in an organically developed matrix, make this zone seem as a dominant natural and urban unit. However, when crossing from the perspective of the map to the perspective of the urban space and the available visual field, the impact of Jablanica as a primary element diminishes, beginning to exhibit some negative characteristics. From the urban space, Jablanica is perceived as a barrier that physically separates the two parts of town, and as such participates in determining one's bearings within it. Jablanica cannot be visually registered as a unit and is seen in segments, its form often dissipating in the predominantly mountainous area of Novi Grad (Figure 5). From certain parts of town, including most of the center and river bank, visual contact is completely lost.

The central position of Jablanica contributed to the hill or its top being used as a medium to transmit symbolic messages, in this case through the structure of the monument to the Partisan Mother and the remains of the Ottoman graveyard. Mumford (2006: 8) says that in a certain sense the city of the dead is 'the predecessor, almost the heart of every living town', while Alexander (1977: 70) believes that the presence of the 'dead' among the 'living' is an incentive for the further life of a community and its urban environment. Today, the presence of a graveyard on Jablanica instinctively sends a message about the existence of past stages in the formation of the physical and demographic structure of Novi Grad, seen in a latent but intense way. Unlike the graveyard, in the period of its construction, the Partisan Mother monument was aimed to attribute the hill with meaning and to develop collective and urban identity.

The monument consists of a bronze statue of a mother, a relief with war scenes, and a granite cube with verses from a poem about WW2 holocaust. When built (1966), the monument was a symbol of the Yugoslav Resistance Movement, of the socialist dogma of brotherhood and unity and of SFRY (Socialist Federal Republic of Yugoslavia). The monument can only be seen by direct access – a sort of pilgrimage, implying the intensity of its past symbolic meaning. Following the fragmentation of SFRY, the civil war in Bosnia and Herzegovina, and the ensuing transition from socialism, monuments dedicated to the Resistance Movement, including the Partisan Mother, lost their symbolic meaning and were

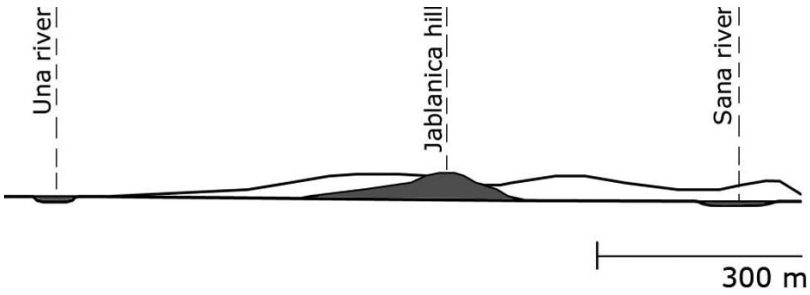

Figure 5. Visual quality of Jablanica in relation to the surroundings (section).
Source: Isidora Karan

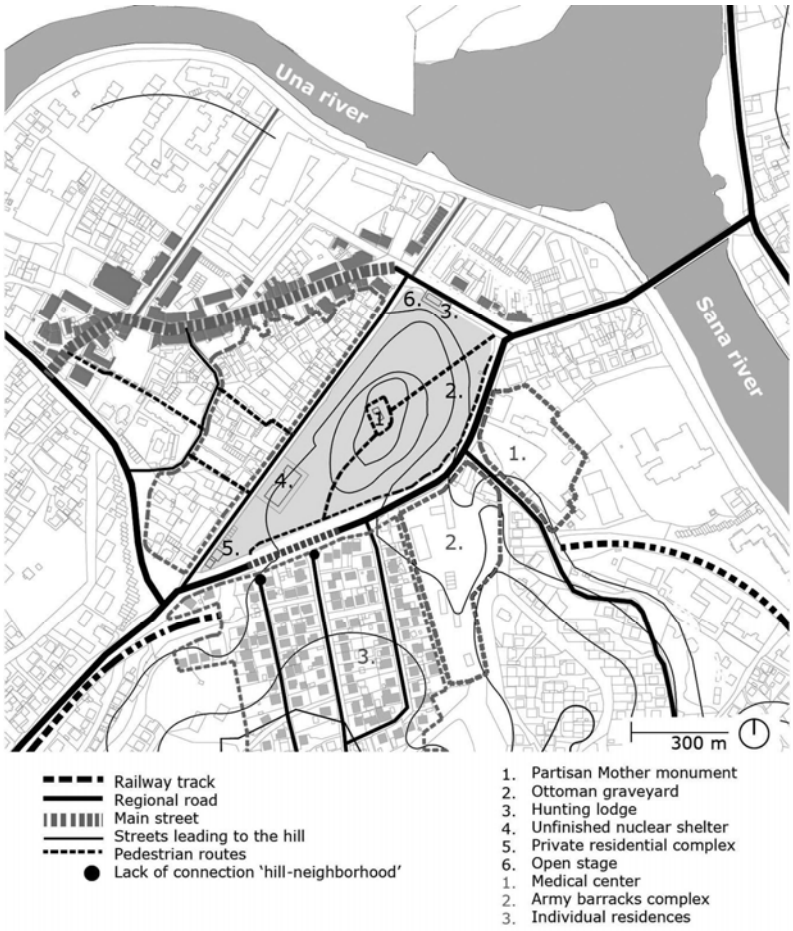

Figure 6. The relation of Jablanica, its immediate surroundings and the town center.
Source: Isidora Karan

transformed into 'negative cultural landscape' (Watson and Bentley, 2007). Unlike a certain number of monuments, previously damaged, dislocated or destroyed, the Partisan Mother monument did not sustain any physical damage, but ceased to exist at the given time frame in the map of the 'collective memory of the town' (Boyer, 2010). It became an isolated fragment of the time-space system, waiting for a favorable moment of its reintegration. The loss of symbolic meaning and role in the formation of collective identity was intensified by the fact that after 1992, the demographics of Novi Grad were altered by more than 30% (Municipality of Novi Grad, 2010).

Since Jablanica hill was planned to be a backdrop for the monument, there was a significant decrease in activities and the hill as a whole started to deteriorate.

The position of Jablanica can be said to be favorable for the development of urban activities; the hill is approximately 120 meters from the estuary, and on average 100 meters from the main street. Despite its favorable position, Jablanica has not been sufficiently integrated into the urban flows of Novi Grad (Figure 6). It appears as an introvert entity bypassed by the primary traffic routes, not generating any urban activity. Reasons for isolation and a usage level low in the

margins and only on 2% of the total surface of the hill can be found in: inadequate connection routes, both external and internal; the existence of comparable green zones, primarily the Una river bank; and insufficient appeal of the space.

There are no projected pedestrian routes between the main street and the western part of Jablanica, which are from 40 to 150 m apart. The only routes are two improvised trails. Similarly, in the street marking the western edge of the hill, approximately 400 m in length, there are no access points to the hill. This is indicative of a failure to recognize Jablanica as a potential for developing urban activity, and of its perception as a greenery backdrop for the monument.

The east side of Jablanica is defined by a regional road, essentially a huge barrier in urban space, one part of which is lowered in the terrain. That way, Jablanica is physically separated from the residential area which developed across the road. Poor connection of Jablanica to immediate and broader surroundings is accompanied by content of closed character – individual residences, army barracks complex, medical center – in its immediate vicinity.

Internal communication paths come down to two trails leading to the monument, and one peripheral, serving as a sidewalk for the regional road. The trails leading to the top were designed in such a manner to emphasize the monument or reach it as directly as possible. That way they activate and make available only a small portion of the surface. It is difficult for spontaneous, alternative trails to occur in the steep and unmalleable terrain. The reduced number of paths and their lack of basic elements of urban fixtures (lamps, benches, waste baskets, etc.) make Jablanica insufficiently attractive, and give out an image of unsafe space.

In the context of landscape design, Jablanica falls into the category of public spaces of high degree of selectivity, where people go because they choose to do so (Whyte, 1980). Loss of symbolic meaning, lack of elementary elements of urban fixtures, congregation of 'undesirable' individuals or groups and lack of safety have led to a significantly small number of people using the Jablanica area. Just like the presence of people draws in more users of public spaces (Gehl, 2010), in the same way the absence of people causes further scarcity of users of Jablanica.

There have been intermittent attempts at activating and developing the peripheral zones. The northern zone, shortest and most exposed to the urban core, has been supplied with additional content, such as a hunting lodge and an open stage – creating a sort of a street front, albeit uncoordinated. The western side of the hill has two objects of different typology and character: an unfinished nuclear shelter, and a private residential complex, built during the past decade, which does not contribute to urban activities and reflects the changes in the post-socialist city (Slavuj *et al.,* 2009).

SIMILARITIES AND DIFFERENCES: CRKVINA AND JABLANICA

The previous analysis and comparison of the results reveal the following points:

- Crkvina and Jablanica had different roles in the genesis of the original settlements of Trebinje and Novi Grad, respectively. Crkvina was determinative for the position of the first settlement in Trebinje, while Jablanica developed as a topographical element during the process of intensive expansion of Novi Grad. During urbanization, Crkvina was left at a peripheral position in regards to the built urban structure, while Jablanica has a central position in the town form. One explanation for this is their different topography, as well as Crkvina being approximately eight times the size of Jablanica.
- In regards to the urban tissue, both Jablanica and Crkvina are perceived as characteristic entities. In case of Trebinje, Crkvina is visually very dominant, and makes the town unique. Jablanica is recognizable as a separate, introvert entity because of its distinct borders separating it from the surroundings, having the role of a spatial barrier determining movement routes.
- The tops of both Crkvina and Jablanica were used as tools to promote collective identity and indicate that the territory belongs to a certain political regime, ideology or ethnicity. In that sense, the top of Crkvina, probably because of its longer urban tradition, has been used more intensely than the top of Jablanica. The arising physical structures on the tops of the two hills also speak of the characters of the towns and the periods significant to their urban and economic development, while the frequencies of transformation speak of the intensity of urban dynamics in general. Both hills are today defined as memorial parks, although the concept of a memorial park could be redefined.
- Crkvina evokes a sense of belonging, either individually or collectively, through its visually prominent position and strength of symbolic meaning apparent in the accumulated layers of history and the currently present symbolic meaning of the Hercegovačka Gračanica. Jablanica develops a sense of belonging based on the potential to evoke the primordial and necessary sensation of proximity of the individual to nature. Jablanica's isolation in the time-space system enhances our sense of genius loci.
- Regarding access, connection routes and urban activity, neither Crkvina nor Jablanica, regardless of their different positions and degrees of visual dominance in the urban tissue, are sufficiently integrated into their immediate surroundings and the town as a whole. The segregation problem, from all these aspects, is much more evident for Jablanica than for Crkvina.
- Crkvina and Jablanica fit the concept of heritage, which requires a symbiosis of natural and cultural heritage (Martín Ramos, 2008), maintaining local uniqueness and values, and potentially serving as a basis of the future urban evolution of their respective town (Bajić Brković and Milaković, 2011).

CONCLUSIONS

Whether being the origin of the genesis of the urban tissue or becoming part of it during the process of urban evolution, the element of hill participates in forming the image and urban identity of a typical town in Bosnia and Herzegovina, while the symbolism assigned to the hill in certain time periods takes part in forming the collective identity of the citizens. Apart from symbolic value, hills in urban spaces have significant environmental value.

The urban character of a hill, in regard to the scale of immediate and broader surroundings, is not recognized as such, and its urban potential is not sufficiently utilized. The first step towards a more intensive integration of the element of hill into the urban context is: improving existing ones and introducing new means of access and communication routes, introducing new content compatible to the natural ambient of the hill and forming the basis for the appearance of spontaneous urban activity.

In the case of Crkvina, this could be applied through introducing walking paths and perforating the residential zone; creating a connection to the riverbank of Trebišnjica; activating the central green zone; introducing new contents and differentiating the roads that lead to the complex of Hercegovačka Gračanica; creating a gradual perception of the space going from the bottom to the top, etc. For Jablanica, it could be applied through introducing pedestrian paths linking Jablanica to the main street and indirectly to the Una riverbank, which are the primary bearers of Novi Grad's urban activity; creating a physical connection between Jablanica and the residential block east of the regional road;

defining and activating the peripheral zone along with creating alternate paths leading across the hill up to the monument, etc.

The complex structure of the element of hill, which combines seemingly opposite categories of natural and urban, full and empty, active and inactive, symbol and antisymbol, represents significant potential for future development of the urban space and identity of towns in Bosnia and Herzegovina. Their detailed analysis, aimed at determining their existing and foreseeing possible influences on the immediate surroundings and the town as a whole, is a first step towards an attempt to intensify their urban, ambient and symbolic meaning, as well as their integration into the urban tissue and processes of the town.

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WHAT IS THE THRESHOLD IN URBAN REGENERATION PROJECTS IN THE CONTEXT OF URBAN IDENTITY? THE CASE OF TURKEY

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Cities are trying to adapt to the rapidly changing global trends by regenerating themselves. Approaches and practices of this regeneration are different in several countries. In big Turkish cities, particularly in the past decade, urban regeneration practices, processes and consequences have sparked several debates. The 'new' gained or converted spaces in the city are also significant in terms of their impacts on urban identity. In this context, this study aims to identify the impacts of urban regeneration, which occurred in historical city centres, on urban identity in the case of Turkey. The study determines general framework of urban regeneration and then defines a conceptual framework of urban identity. It focuses on urban regeneration projects in the case of Turkey. Then, the topic is explored through two case studies which are selected from Turkey, Istanbul and Bursa. The findings of the study indicate that there are several problematic aspects of urban regeneration. The findings also show that urban identity was ignored in urban regeneration projects, which caused significant breaks in the context of physical, cultural, historical and semantic continuity.

***Key words:** urban regeneration, urban identity, culture, neighbourhood, urban morphology, Turkey.*

INTRODUCTION

Cities are trying to be attuned to the rapidly changing global trends by regenerating themselves. In international forums, such projects of regeneration, their criteria and outcomes are often discussed; however, on the local level, particularly in the developing countries, these aspects are generally neglected. Therefore, such projects sometimes cause socio-cultural and spatial discontinuities in urban spaces. This study emphasizes the significance of urban identity which creates successful places and questions the sustainability of this identity in this process of regeneration. In the global market, cities have become assets to be marketed and in this sense, urban regeneration projects emerge as important opportunities to be utilized. In this context, these practices, which result in significant changes in social, economic and physical space, should be discussed in terms of their effects on urban identity as well.

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In this sense, the purpose of this study is to discuss the effects of frequently encountered socio-cultural and morphological discontinuities on these 'new' urban forms in the case of Turkey. The study firstly deals with the concept of urban regeneration. Then, based upon the approaches concerning urban identity, a conceptual study of coding is employed and the methodology is explained. Case studies are discussed and research findings are presented. Finally, debates are introduced to contribute to further studies.

URBAN REGENERATION IN THE CONTEXT OF URBAN IDENTITY

Recently there has been extensive literature on the concept of urban regeneration and its practical applications. The content of the literature does vary according to the scope and area of the study. But there are some basic principles that are common to most of them. These principles have the following in common: it is a consensus on possible outcomes of regeneration; it includes new paths and methods developed in order to resolve problems in declining urban areas in a coordinated way, and it is a comprehensive and integrated vision and action that is performed to constantly improve economic, physical, social, and environmental conditions (Urban Regeneration and Bursa Report, 2008). In this context Roberts (2000), puts several reasons for urban regeneration such as: to establish a direct link between physical conditions of a city and its social problems, to redevelop urban areas in accordance with new physical, economic, environmental, and infrastructural systems, to introduce an economic development approach, and to present strategies towards the effective use of urban areas. In parallel with these statements, the reasons for and forms of decay must be defined in order to formulate realistic strategies of urban regeneration. Urban decay can have physical, functional or geographical causes (Keleş, 2003). When urban regeneration is not evaluated in a holistic way, it results in discontinuities in the spatial and social context.

In historical development of urban regeneration, it is observed that the concept was assessed from several perspectives with different concepts concerning the aims and methods of urban regeneration. In this context, between the mid-19th century and the mid-20th century, urban regeneration was discussed in the framework of 'urban renewal' while in the 1960s and 1970s 'urban improvement' was introduced. Since the

1990s till today, the concept of 'urban regeneration' has been discussed. In this period, the process of urban regeneration has been shaped not only by the public and private sectors, but also by local governments, non-governmental organizations and several actors from different segments of society in a holistic approach which takes legal, institutional, organizational, monitoring and evaluation processes into consideration, in addition to physical, economic, social and environmental dimensions of the place. In urban regeneration, the opinion on utilization of public interest has become popular (Akkar, 2006). This principle is highlighted in the European Union's Regional Policies (2011), as diversity in cities is related to 'culture, identity, history and heritage'. It is emphasized that 'the core of cities were constituted by local inhabitants'.

Therefore, during the process of urban regeneration in a particular urban area, it is essential to analyse all the codes emphasizing urban culture and place in a precise way; in this sense, the form of intervention and its possible consequences should also be taken into consideration. This holistic approach plays an important role in maintaining the sustainability of urban identities which were city-specific and accumulated in time.

The concept of identity is a complex process and cannot be fabricated (Correa, 1983). Robins and Morley (1997) define the concept of identity as a distinctive characteristic and emphasize that identity is formed 'not through similarities but through differences'. According to Relph (1976), the relationship between a human and a place includes a dimension concerning attachment and the identity of the place). He explains this identity by using three components which are, physical structure, the activities provided and hosted by this structure and the meanings formed by the users in that place, in a particular time. Massey (1995) says that this complex process is also built through people's attachment to other place and through articulation of images of the past to the future, and is formed through several basic characteristics and social integration that help to define people in a group or society (Pol, 2002). Related to this theoretical background of identity, urban identity is a whole built by urban values of environment, history, society, culture, functions and space. In this context, urban identity is an indispensable part of a city which is on the turn of regeneration. Lalli (1992) says that it is possible to state major factors in evaluating urban identity: evaluation, continuity, attachment, recognition and commitment.

In summary, it can be said that urban identity is produced by interaction of factors of nature, human and built environment in a particular process. Different styles, policies, the use of construction materials and technology, and attitude towards the environment are significant factors in architectural language and identity. Components of identity concerning the human environment are integrated with cultural structure while on the other hand, the built environment also matters in purpose and typologies of use. In this sense, it is necessary to see urban identity from an environmental perspective and to evaluate it in physical, socio-cultural, historical and semantic dimensions. Particularly in historical cities, identity can often be identified via urban space and collective memory that is attached to the place. Morphological structure of the city provides the most convenient text of identity to read, which is based on the inseparable integrity between culture, economy and types and spatial design (Kubat *et al.*, 1994). The above mentioned urban parts inevitably include socio-cultural codes which have built the city. Morphological marks concerning urban space are made up with traces of spatial, socio-cultural and economic memory. Therefore, sustainability of this framework will provide the continuity of mentioned marks in the background. In urban regeneration projects, particularly concerning practices in historical and traditional urban places, the necessity for transferring these codes has gained importance

URBAN REGENERATION PROJECTS IN TURKEY

Turkey houses heritage both from the East and the West. This multiculturalism also played a significant role in Turkey's distinctive social, cultural and economic structure. Historical changes and accumulations of Turkey resulted in original reflections and representations. The globalisation process has also shaped this change. Although urban regeneration process in Turkey is similar to its counterparts in Europe, there are several differences that stem from distinct socio-cultural and economic structures. These differences caused different consequences.

State policies mostly aimed at improvement of infrastructure and provision of public services during the first years of the Turkish Republic (since 1923). Since the 1950s, due to changes in society, economy and technology, such policies had begun to consider urban aspects. Rapidly changing structure and increasing population of the country, particularly in big cities, caused new types of unplanned settlements. Building of highways brought radical changes in urban morphology. However, since the 1950s, new forms of settlements, such as squatter houses, apartment buildings and mass houses, occurred. There have been several periods from the 1950s until today in urban regeneration process. These periods have a wide range of transformations including, firstly, the industrialization and economic growth period, secondly liberal economy and globalisation period, and last the cooperation of local governments and the private sector period in which 'regeneration' was defined as strategy (Ataöv and Osmay, 2008). As Türkün (2011) indicates, increasing influence of urban coalition has become dominant since the 2000s. In addition to central and local governments, other actors and institutions have been cooperating with the real estate sector for the use of urban space. These practices have been strongly supported either by semi-private institutions or the private sector such as investors, land owners, consultants and media.

QUESTIONING THE URBAN IDENTITY THROUGH THE REGENERATION PROJECTS

In this part, the paper aims to consider the impact(s) of urban regeneration projects on urban identity, related to the concepts and processes mentioned above and in the case of Turkey. In order to make this consideration, the methodology is defined as follows.

Methodology

Although we mention how and to what extent the physical environment affects urban identity while at the same time providing cultural interaction, it is hard to put specific borders between the built, natural, social or perceptual environment. Without doubt, all the components have an effect on each other. In order to analyse and find some specific features of urban identity, the case studies are considered in two phases. The first phase serves to clarify the abstract concept of identity on an urban part scale. The sub-expansions of the concepts have been determined in order to make them tangible, while on the other hand searching for an answer to the question 'which kind of characteristics sustain the urban identity in order to follow it in regeneration projects?'. Parameters of urban identity and its components were analysed. Then these abstract concepts were converted into concrete elements in the case studies. A comparison method was used to evaluate the cases which comprise the second phase. In this comparison method, the cases were analysed before and after the regeneration projects (Table 1). The social reactions and the physical consequences in the case studies were described and then the backgrounds were analysed. Natural, built, perceptual and social environmental data are based on observation, documentation and analysing.

Description of the Case Studies

The aim of this paper is to analyse two different urban regeneration projects with their impacts on urban identity. In this context, the case studies were chosen according to their originalities in regeneration projects. The first case, Sulukule is located in the city of Istanbul, which maintains a distinguished position among the metropolises of the world with its location and cultural heritage of thousands of years. Istanbul was chosen as one of the cases where recent urban regeneration projects prominently occurred. One of these projects is The Sulukule Urban Regeneration Project which is located in the historical city centre and caused several disputes and debates concerning social aspects and urban identity. The second case, Doğanbey District is located in the city of Bursa, which has always been one of the prominent cities in Turkey with its geographical, cultural and historical identity. The case of Bursa was chosen because it demonstrates the socio-morphological discontinuity and it is a fine example of the spread of urban regeneration from a metropolis (Istanbul) to Anatolia.

The Sulukule Urban Regeneration Project, Istanbul: Social Identity Loss

The Sulukule neighbourhood, which is a UNESCO World Heritage Site, was called Edirnekapı and Sulukule during the Ottoman period. The neighbourhood was home to its Romani inhabitants since the 11th Century. Sulukule is also a significant urban area with its natural, historical, cultural and archaeological heritage (Figures 1, 2, 3). Since the conquest of Istanbul (1453), during the Ottoman times, Romani inhabitants of Sulukule engaged in music, dance and entertainment (Göncüoğlu, 2009). In the Republican period, the neighbourhood became famous for its 'entertainment houses'. The general characteristics of Sulukule were preserved until the 1960s (Foggo, 2007). Partial demolition occurred in the 1980s. The entertainment houses were closed down in the 1990s, due to the claims that Romani people were dealing drugs and engaging in prostitution (Somersan, 2007; Kentsel Dönüşüm Bilgi Platformu, 2013). Consequently, approximately 3,000 locals lost their jobs (Kocabaş and Gibson, 2011). Afterwards, 'the area has been denied access to basic municipal services such as transportation, sanitation and education and has been abandoned to its own fate' (Kentsel Dönüşüm Bilgi Platformu, 2013). The neighbourhood has since turned into a slum area. In this period, Sulukule's population decreased from 10,000 to 3,500 (Foggo, 2007),

Table 1. Parameters of urban identity and their consideration in the case studies

Criterias			Case Studies: Sulukule Renewal Project – Before			Sulukule Renewal Project – After			Doğanbey Regeneration Project – Before			Doğanbey Regeneration Project – After		
			absent	weak	strong	absent	weak	strong	absent	weak	strong	absent	weak	strong
Physical Dimension	Natural Environment	Climate and flora	x			x			x			x		
		Topography		x			x			x			x	
	Built Environment	Morphology (building island, parcel, street)			x		x				x	x		
		Typology (type, activation pattern, circulation patterns)			x	x					x	x		
		Topology (geometric form)			x	x					x	x		
Meaning and Perceptual Dimension	History	Social environment, historical buildings, continuity			x	x					x		x	
	Aesthetic and perceptional features	Figure-ground, topography , urban relationship, urban density, part-whole relation in urban space			x		x				x	x		
	Meaning	Collective memory, living style,place-attachment, familiarity			x	x					x		x	
Socio-cultural and Functional Dimension	Demographic features	Population, literacy, employment		x			x			x			x	
	Institutional features	Legal, administrative, economic, religious		x		x				x			x	
	Behavioral features	Continuity, social relationships Activities			x	x					x		x	

Figure 1. Istanbul city map; Historical city walls and Sulukule. Scheme: İ. Özbek Eren.

Figure 2. Sulukule general view, 2010. Photo: Gökhan Tan. Source: http://tr.habervesaire.com/haber/1887/

(Figure 4). The Law 5366 for Renovation, Protection, Cherishing and Use of Worn Historical and Cultural Immovable Properties (issued in 2005) provided the legal basis for the Municipality of Fatih, The Istanbul Metropolitan Municipality, and Mass Housing Administration Development of Turkey (TOKI) to sign a joint protocol and to implement the urban regeneration project. The following reason for regeneration was stated: 'the neighbourhoods have turned into slum areas with their deteriorated buildings'. The above mentioned authorities agree on a regeneration project called 'The Neslişah and Hatice Sultan (Sulukule) Neighbourhoods Urban Regeneration Project' in 2006 (UCTEA Press Statement, 2012; Fatih Belediyesi, 2013). The area covers approximately 90,000 m^2 in which there were 12 city blocks, 354 parcels and 22 registered monuments. The project was implemented on 46,091.19 m^2 net area (İslam, 2009).

In October 2006, the Municipality of Fatih authorized expropriating of 12 city blocks. In December 2006, the decision on 'immediate expropriating' was taken and after this, locals in Sulukule and the Chamber of Architects appealed to the court. The expert report included these statements:

> 'There is no conservation plan for the neighbourhood, 90% of the area is now UNESCO world heritage site. In this area, construction of 3-4 buildings has been allowed. The original morphology and street regime were changed and not conserved' (Dağlar, 2011).

Despite the objections of local inhabitants, academics, lawyers, non-governmental organizations and international institutions, the project was approved (UCTEA Press Statement, 2012; Sulukule Atölyesi, 2013) which led the formation of 'The Sulukule Platform' and 'Sulukule Association of Advancement of Romani Culture and Solidarity' in 2006. These activists developed an alternative development plan by introducing the slogan 'Another Sulukule is possible' in 2008 (Sulukule Atölyesi, 2013). This alternative project was both compatible with the Law 5366 and the principle of public good containing important values such as 'liveability, participation, value of use, equity, cultural life, conservation and development'. The project suggested regeneration of the neighbourhood without displacement of the locals. Although the project was presented to TOKI, the Municipality o Fatih, councils of conservation and renewal, it was rejected and not realised (İnce, 2012; Sulukule Atölyesi, 2013). Following that, despite the court decisions and reactions of public opinion, the implementation of the project continued and evictions and demolition began in May 2008.

One of the reasons that locals in Sulukule did not wish to leave the neighbourhood are these gradually strengthened relations with the neighbours and the feeling of attachment. Unit cost of the houses in the area was 3,500-4,500 TL/ m^2 (The Guardian, 2011), however owners were only paid 500 TL/ m^2 and evacuated houses were sold to the new owners who paid 10 times more (Kocabaş and Gibson, 2011). In other words, Romani people had to abandon their houses where they had lived for centuries (Dağlar, 2011). Only 10% of the residents were able to afford payments which will last 15 years. Others, who were unable to pay, were provided mass houses constructed by TOKI which are located 40 km away from the city centre (Kocabaş and Gibson, 2011). The debates on the project primarily focused on Romani inhabitants' networks of relations and the break of continuity within the area (Dinçer, 2009) (Figure 5).

Figure 3. A typical traditional Turkish house.
Source: Fatih Belediyesi, 2013.

Figure 4. General view before the project.
http://www.hkmo.org.tr

Figure 5. 'New' Sulukule houses from the same perspective in Figure 5, March 2014.
Photo: İ.Özbek Eren

Doğanbey Urban Regeneration Project, Bursa: Urban Image Loss

Bursa, with its geographical, cultural and historical identity, has always been one of the prominent cities in Turkey (Figure 6). Being one of the capitals of the Ottoman Empire, Bursa has always enjoyed its assets such as fertile lands, geography, historical and cultural accumulations, and its location on the historical Silk Road. It was also a commercial centre for the textile industries. During the first years of the Republic, this significance remained unchanged. In the 1960s, the city's population increased in parallel with urbanization processes in Turkey. In accordance with the globalisation process, the 1980s witnessed changes in Bursa's socio-cultural and spatial structure. After the 1970s, there have been significant changes in city's morphology and socio-cultural structure due to industrialization. In 1978, 'Historical, Natural and Archaeological Sites of Bursa' was officialy instituted in order to conserve The Bursa Plain from these changes. Despite efforts on city planning in the 1980s, urban sprawl has got out of control (Özbek Eren and Özeke Tökmeci, 2012). The Environmental Plan (with the scale of 1/ 100000) was issued in 1998; it helped to maintain urban development (Ataöv *et al.*, 2011).

In 2005 The Doğanbey Urban Regeneration project area was launched in the neighbourhoods called Doğanbey, Tayakadın, Kiremitiçi and Kırcaali, located nearby the historical city centre. The area was designed as Central Business District in 1993 due to its proximity to the historical city centre. Consequently, commercial activities increased; however, the Doğanbey Neighbourhood turned into a slum area within this commercial district (Özbek Eren and Özeke Tökmeci, 2012). Initial preparations for the project began in 2005. Finally on 28.11.2006, The Prime Ministry Mass Housing Development Administration and The Osmangazi Municipality signed a protocol on 'The Doğanbey Urban Regeneration Project'. The neighbourhoods Kiremitçi, Tayakadın, Doğanbey and Kırcaali (282,000 m² area) were declared as 'Urban Regeneration Area' (Urban Regeneration and Bursa Report, 2008) (Figures 7, 8). The apparent reasons for urban regeneration were that the area has no functions, it is economically in decline, and the infrastructure is in miserable condition. They are mostly detached buildings with 1-2 floors and gardens. Therefore it is hard to rehabilitate these buildings in accordance with modern housing conditions. In addition, joint-ownership, legal reasons, social problems, housing rights etc. prevented the implementation of the project. Because most of the locals are low-income dwellers, it was also not possible to regenerate buildings individually (Uyan, 2008). But according to Tosun (2007:136), 'the main reason for urban regeneration projects that are widely observed in the Osmangazi District, is that there is not enough space to implement new housing project as it is one of the oldest areas of settlement in Bursa'.

In the project, construction of 2,500 houses and 50,000 m² open spaces were assumed. In 2007, 4,300 title holders agreed on the project and demolitions began (Uyan, 2008; Urban Regeneration and Bursa Report, 2008). However, there have been several changes in the project. For instance, 23-floor buildings, which were not part of the original plan, were considered. The morphological structure changed 'from 75-100 hectare/person to 800 hectare/person with this new project' (Bursa Mimarlar Odası, 2010). The Doğanbey Project, which led to a change in urban identity, was later regarded 'as a mistake' by the former Minister of Environment and City Planning (Deniz, 2012). In a joint declaration, The Bursa Union of Chambers stated that: 'it is not an urban regeneration but an urban dividing. The

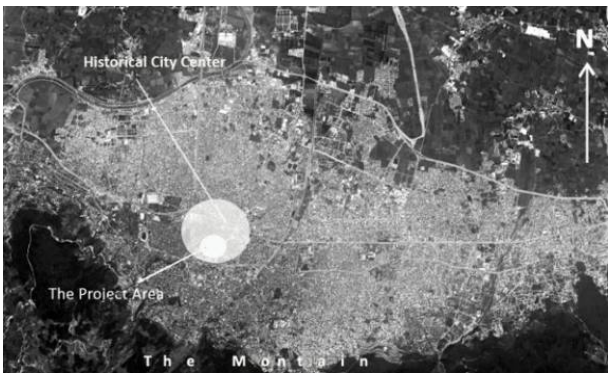

Figure 6. Bursa city general layout; Historical city centre and the project area. Scheme: İ. Özbek Eren

Figure 7. Tayakadın Neighbourhood before the demolition. Source: Urban Regeneration and Bursa Report, 2008

Figure 8. The project area and the morphological transformation, 2012. Source: Adapted from Google Earth.

Doğanbey Project is an irreversible mistake in the history of Bursa' (UCTEA Press Statement, 2010) and launched a photography competition with the theme 'TOKI's Smack on the City of Bursa' and discussed 'this disrespect to the city' (Ekinci, 2011) (Figure 9).

Analysis and the Summarized Results

Following the consideration of the background of both case studies, the impacts of the urban regeneration projects are explained above. In this context, the analysis is based on the comparison of urban identities of the cases, which is conceptualized in Table 1. This comparison involves previous and subsequent characteristics of the case studies and aims to state the impacts of the projects on urban identity. The urban characteristics of the case studies are conceptualized according to the methodology elaborated in the "Methodology" part.

The analysis of the case studies in Table 1 can be summarized briefly as follows:

The first case study Sulukule:

Before Sulukule Urban Regeneration Project the region had important potentials physically. The social environment and the historical background had a strong impact on the settlement's morphology and typology. The settlement's morphology had reflected these environmental influences. Due to Sulukule's history, people have a social memory that constitutes the social life and demographic character of the district. Residents and their families had known each other for a long time which provided a rich neighbourhood. These parameters also had a strong influence on the perceptual environment. Social and spatial continuity had constituted a strong image with an active street life. The collective memory among the Romani had a strong meaning for the people, which was the main characteristic of this region. This was not just for the Romani people but also for the city of Istanbul as an important component of its identity. The memories had either brought the people together or provided a strong image/ perception of the city.

Although the project has been going on, the physical and social impacts of the project could be seen either on the district or on people. The 'new' houses are low-layered like the old ones, although they are totally different in terms of pattern, colour and 'sense of place'. The historical urban tissue in Sulukule, original morphology of city blocks, road systems and street orders have been destroyed. Decisions on conservation planson the larger scale were neglected. Beginning with the legal agreements, the old residents have been forced to go to other places and most of them will not come back to their 'new' houses due to the prices. So the district is a pioneer as a 'different' and 'new' district in the city unlike the older one. Memories which belong not only to the region, but also to the city of Istanbul will be lost. In addition to this social break, principles of conservation in the neighbourhood were not considered. Buildings were constructed taking into consideration only the 'urban rent'. The expert report summarized all these concerns, such as physical changes in morphological structure, city blocks-parcels relations, typology of buildings, ratio of urban space and empty space. The report points out that the neighbourhood not only experienced a social identity loss, but also witnessed the loss of spatial identity. The project also ignored the fact that spatial traces, which were deleted from collective memory, can cause a society's alienation from its own history.

The Sulukule Urban Regeneration Project has caused an urban social identity loss. Romani people in Sulukule first found out about project and future demolitions of their houses from the press (Kocabaş and Gibson, 2011). This situation demonstrates that there is no participation of dwellers in the process. According to Kocabaş and Gibson (2011), the Sulukule Urban Regeneration Project 'was a catastrophe for local people'. As Uysal (2012) writes, the case is recorded as 'a cultural turn' in urban studies. In the neighbourhood, despite the destructive confrontation between the project and Romani subculture in terms of cultural sustainability, the government and municipalities defined a 'legitimate urban culture'. It was observed that the Sulukule Urban Regeneration Project, from its approval until its implementation, has not been compatible with the principles which should be considered in urban regeneration and regeneration projects. According to Zukin (1987), the concept of gentrification points out current social, economic and spatial conditions of urban centres which experience the process of restructuring. In this context, it can be said that there is a case of 'gentrification' in Sulukule, caused by the project. But this terminology is not preferred due to the legal background of this term, which has been discussed in the country. Consequently, the implementation of the project caused several breaks in urban way of life. Displacement of locals resulted in significant losses in urban, social, and cultural identity and the break of socio-morphological memory of the city.

The second case study Doğanbey:

Before the project, the neighbourhoods were physically rich in terms of urban morphology and typology. The forms of the houses and the street patterns were in harmony either with the rest of the city, or with the historical commercial buildings close to the area. Although the area itself was not defined as a historical site, its closeness to the site area made it a unique place. Some historical buildings in the area, such as mosques or fountains, were also important landmarks that enriched the region's identity. The old neighbours had known each other for a long time and this publicity had also enriched the identity. The region with its neighbourhood, street-building typology, place-attachment or morphological factors gave distinct identity to the region and also affected its perception.

Figure 9. General view from the Historical Clock Tower of The City.
Photo by İ. Özbek Eren, Şubat 2012.

After the project, front typologies and morphological orders of these new high blocks are totally different from the historical street tissue in the area. In the original structure of the neighbourhood, it was possible to observe historical continuity in terms of street design. However, it seems that these marks vanished after this new project because the area was considered only in a 'new' structure of settlement.

This change is not limited to this urban area, but a new image was also created in Bursa's urban identity. The project resulted in a historical-physical loss of urban identity. Before the project was implemented, the general image of Bursa was limited as a city that spread on the slopes of Uludağ, consisting of similar morphological language. After the project, it is now possible to see these new houses from any spot in the city. The project caused destruction of the street patterns and morphology in the area which used to demonstrate the continuity between the houses with gardens and the historical city centre. Some of the historical buildings were conserved. However, the fact that historical monument is only meaningful when surrounded by spatial and social design was ignored. The buildings have become mere 'objects'. The new area reduced the influence of historical city centre in the silhouette of the city. This new project mostly considered urban rent, rather than historical, morphological and cultural features. The original morphology has changed and this change has become a sociological and environmental threat for historical pattern in the historical city centre. In addition, although title owners were able to afford new houses, traditional relations of neighbourliness were dissolved.

DISCUSSION

Issues regarding urban regeneration projects in Turkey consist of several different dynamics. For example, as the report prepared by Bursa Chamber of City Planners indicated, the main problems of regeneration projects in Turkey can be summarized as Insufficiency of legislation, perception of the concept only as spatial transformation, inconsistence with planning legislation and upper scale plans, urban segregation, the perception of the concept as bulldozer renewal or as a fashion, negligence of urban identity and the implementation of projects mostly not in the areas of need but in the areas of urban rent' (Urban Regeneration and Bursa Report, 2008). Additionally, settlement density in Turkey is predominantly explained by two ratios, 'Floor Area Ratio' (FAR) and 'Base Area Ratio' (BAR), which causes several problems. Today it is known that urban regeneration projects can be successful only if they are developed in line with the approaches of strategic planning, cooperative and participative planning. Furthermore, they should include multiple actors and they should be operated by coalitions, consisting of multiple sectors, while feedback processes, also in accordance with the local context, should be anticipated. Regeneration projects should aim to close the gap between economically weak neighbourhoods and the rest of the city (Kocabaş and Gibson, 2011). In this perspective, it could be said that 'ad hoc generated identities of the new physical structures can bring the feeling of selflessness, alienation and other modes of urban pathology' in a longer period (Nedučin *et al.*, 2009:74). Lukić (2011: 56-66) supports this view by saying that the negative effects of gentrification are usually seen as social injustice, since wealthy, usually white, newcomers are recognized as 'improvement to' the neighbourhood, while its 'old' residents must move out on the account of increased rent prices and economic changes', while on the other hand it has positive effects which are better form and image of gentrified areas, and consequently the city centre itself, rising and maintaining attractiveness of a nearby environment, diversity and better quality of facilities, raising cultural and educational level of the population of that neighbourhood, increased standard of living, reduced crime rate, etc.

Urban identity has become significant in the rapidly changing dynamics of the 21st century in terms of place. It is, just like the cities themselves, built in time, and is a vivid and sustainable feature. In this context, urban regeneration practices are supposed to contribute to vibrant urban way of life, its continuity and the city's future prospects. In such a process, all actors should work in harmony and cooperation. The above mentioned integrity was not achieved so far in urban regeneration projects in Turkey. Consequently, they caused significant breaks/fractures in urban social life and morphology. These experiences should be re-evaluated as learnt lessons for upcoming projects.

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POPULATION DYNAMICS AND LAND COVER CHANGES OF URBAN AREAS

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In order to enable efficient management of spatial development of cities, it is essential to analyse changes in land cover, in the 'consumption' of the land surrounding cities and the attained rationality with respect to the use of already urban land (reflected in the urban population density). This paper provides an overview of the land cover changes in the period between 1990 and 2006, and the potential correlation between the dynamics of the total population change on the one hand, and the land cover change on the other. The initial hypotheses of this paper are: (1) occupation and sealing of productive soil in peri-urban zones is not proportional to the population dynamics of cities and their metropolitan areas; and (2) expansion of soil sealing in peri-urban zones is not significantly affected by the differences with regard to the natural surroundings and historical development of cities, nor by these cities being developed cities or cities in transition, capitalistic or post-socialist cities, etc. These hypotheses are tested and confirmed in the cases of three capital cities in South and Southeast Europe. Regarding the changes in population density, it can be concluded that central/inner-city municipalities became less populated, with sometimes very significant decrease in population density, but without any land cover change, which indicates 'depopulation'. At the same time, outer-city and peripheral municipalities also suffered a decline in population density, while their urban zones extended.

Key words: population development and dynamics, land cover change, Belgrade, Rome, Sofia.

INTRODUCTION

Spatial expansion of European cities has continued at the steady rate in the 21st century, albeit their generally decreasing population growth. In order to enable efficient management of spatial development of cities, it is essential to analyse changes in land cover, in the 'consumption' of the land surrounding cities and the attained rationality with respect to the use of already urban land (reflected in the urban population density). Further steps necessitate examination of the reasons behind these processes, and then controlling and directing urban development by means of applying appropriate policies and instruments of spatial development. This paper is focused on the first part of the problem and provides an overview of the land cover changes in the period between 1990 and 2006, and the potential correlation between the dynamics of the total population change on the one hand, and the land cover change on the other. The initial hypotheses of this paper, based on literature review presented in Chapter 2, are: (1) occupation and sealing of productive soil in peri-urban zones is not proportional to the population dynamics of cities and their metropolitan areas; and (2) expansion of soil sealing in peri-urban zones is not significantly affected by the differences with regard to the natural surroundings and historical development of cities, nor by these cities being developed cities or cities in transition, capitalistic or post-socialist cities, etc. These hypotheses are tested in the cases of three capital cities in South and Southeast Europe.

A brief analysis of land cover change within administrative areas, later performed at the level of administrative units at the local level ('municipalities') of case study cities - Belgrade, Rome and Sofia (Krunić, 2013; Krunić *et al.*, 2014), was conducted using: publicly available dataset from the European Environmental Agency, ESRI ArcGIS Basemaps/ESRI ArcGIS OnLine, official national statistics services and dataset obtained from TURAS project partners (www.turas-cities.org). The following spatial 'datasets' were acquired: soil sealing degree ranging from 0–100% in aggregated spatial resolution (100 x 100m), for the year 2006, urban morphological zones (UMZ data sets for the years of 1990, 2000 and 2006)

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and UMZ changes from 1990–2000 and 2000–2006, Corine Land Cover – CLC raster data sets for the years of 1990, 2000 and 2006, and CLC changes for the period 1990–2000 and 2000–2006 (EEA, 2013).

The following indicators were utilised: absolute (total) population, population size dynamics, population density (measured via the number of inhabitants per unit of artificial land area, that is, 'artificial surface'), structure of land cover by category (by Corine Land Cover – CLC classification), changes within the above land cover categories respectively, and ratio between total and artificial surface of the administrative units.

URBAN DEVELOPMENT OF CASE STUDY CITIES – AN OVERVIEW

The chosen case study cities of Belgrade, Rome and Sofia differ in terms of their geographical position and surroundings, historical development, and particularly in terms of the social and political system they have been intensively developing in since the mid-20th century. However, apart from the observed land cover changes, the common feature of the three cities is the fact they have been developing in the conditions of formally organised legal, spatial and urban planning systems, though with very different experiences regarding the implementation of planned urban development at the local administrative level. This problem was especially noticeable in the analysed period (Maksin-Mićić, Perišić, 2005; Montanari, Staniscia, 2012; RIMED Report 13, 2005). In addition, the three cities have also been researched within the TURAS project (www.turas-cities.org).

The City of Belgrade

Similarly to other post-socialist cities, the process of suburbanization in Belgrade started towards the end of the 1960s, and was intensively underway during the 1970s and 1980s, when the planned construction of new settlements on the outskirts of the inner city, the largest of these being Novi Beograd, was carried out. Almost simultaneously, during the 1970s, the process of deurbanization commenced, with decreasing demographic growth of the city centre and increasing demographic development and illegal/unplanned construction with low density in the peri-urban zone around the whole city (Grčić, 1993; Živanović Miljković, 2008; Spalević, 2010; Petrić, Krunić, 2013). Owing to these two parallel processes, Belgrade did not manage to maintain its compactness – from the year 2000 the dominating process had the characteristics of urban sprawl. Uncontrolled urbanization of Belgrade peri-urban zone is, according to Maksin-Mićić and Perišić (2005), a consequence of so-called 'ostrich attitude' urbanism – reluctance of city authorities and urban planners to solve the housing issues, occurring as a result of intensive population growth, by means of planned building of settlements with state-owned collective housing units, and preparation of planned building of lower-density settlements for the needs of private sector and population. Since 1990, fragmented and incomplete implementation of the housing reform contributed to a sharp drop in legally built residential units, as well as to a serious distortion of the housing market (Vujović, Petrović, 2007; Petrović, 2001). These authors believe that local planning authorities nearly collapsed, which led to a shocking upsurge in illegal construction. The introduction of real estate market, especially in the field of residential construction, marked by extreme economic crisis and high poverty of most inhabitants, had a negative effect on the city development and intensified illegal residential construction (Bojović, Borovnica, 1998; Simeunčević Radilović *et al.*, 2013). In addition, since the end of the 20th century, due to the general trend of moving the production and commercial activities from the city to the periphery, the new poles of development have been formed on the outskirts of the city, as well as in the metropolitan periphery (extremely attractive for agglomeration of business zones near the airport and along highways) (Miletić, 2010). More details about spatial dynamics in the analysed metropolitan area and differences between planned and actual development can be found in the research conducted by Samardžić-Petrović *et al.* (2013).

The City of Rome

The **City of Rome** represents a paradigmatic example of an originally compact city which has gained a more dispersed urban form. During the intensive population growth, there was a rapid expansion of the city around the compact centre during the 1960s and 1970s, but the form of the city remained compact until the early 1980s. In the period of stable population growth and its decline, urban growth was characterized by a rapid sprawl triggered by important socio-economic changes and deconcentration of the compact city, which also caused dramatic land use changes in suburban areas. Driven by massive speculation, the growth of the city was sustained by a strong house-demand from low-income workers only partially satisfied by the local government which strongly encouraged leapfrogging compact settlements developed within authorised local plans. Legal and sometimes spontaneous low-density settlements were also tolerated, creating a complex 'mosaic' landscape (Montanari, Staniscia, 2012). Montanari and Staniscia (2012) observe that the movement of economic activities from cores towards suburbs in metropolitan areas in Rome which took place in the 1991–2001 period was of small scale and scattered, due to feeble job growth and the continuing attractiveness of the city centre for many tertiary sector businesses. Gargiulo Morelli and Salvati (2010) analysed compact vs dispersed urban development on the example of Rome (NUTS 3 prefecture of Rome) in ten-year intervals from 1960–2006. They compared the differential impact of compact urban 'growth' and low-density 'sprawl' on land cover changes (LCCs) and their final effect on changing land cover relationships (LCRs). Conversion to urban land uses was carried out at the urban fringe in the 1960s and 1970s, while expanding progressively far from the city in the 1990s and 2000s. LCCs were found to be relatively different during the 'growth' (1960–1990) and 'sprawl' (1990–2006) phases. Overall, urban areas increased by 0.3% in the 'growth' phase, while only by 0.06% in the 'sprawl' phase. During the 'growth' phase, the land cover classes with the highest probability of being converted to urban uses were arable lands, annual crops, vineyards and pastures. During the 'sprawl' phase, olive grove, orchard and forest surfaces decreased as well, due to the development of low-density built-up areas and infrastructure. That is why Gargiulo Morelli and Salvati (2010) conclude that the victim in this phase might have been the entire 'Agro Romano' rural landscape.

The City of Sofia

A paradigm shift in city-building occurred in the 1960s, when the urban core was encircled by large housing estates. Sofia grew as a unified urban entity with a clear urban edge and managed to remain denser and more compact than other European cities in its surroundings. After the 1990s, changes with regard to urban development emerged (Hirt and Kovachev, 2006). The pattern of spatial development was characterized by growth both outside and inside the city boundaries. Urban sprawl took place in an uncontrolled fashion mainly along the road axes and on the outskirts of the city (RIMED Report 13, 2005). The most notable was the growth of an upscale, low-density, residential suburbia. While the population of metropolitan Sofia declined by 1% from 1991–2001, five districts (Vitosha, Ovca Kupel, Bankya, Pancharevo and Vrabnitsa) experienced growth of population in the peri-urban areas beyond the urban edge established during the socialist period (Hirt and Kovachev, 2006). Slaev (2012) believes that the explanation for this lies in a spectacular boom of the housing

market in the first decade of the new millennium. He points out (Slaev, 2012; 2013) that in the 2000 – 2011 period new housing construction was realized mainly within the compact city, and, to a lesser extent, in peri-urban zones, predominantly in their southwest districts. The quick rise of the post-socialist tertiary sector, growth of small-to-medium local private businesses and, most recently, the emergence of large-scale Western chains occurred across the city and, since the 1990s, shifted from the city centre to peripheral areas. Post-socialist changes, aggressive post-1992 policy of restitution and the subsequent emergence of land as a market commodity substantially reconfigured open spaces in Sofia. Since 1990, Sofia lost 15% of all the public green spaces in the city. In 2003, green spaces were protected by a moratorium on new construction in public parks (Hirt and Kovachev, 2006).

RECENT TRENDS IN POPULATION AND SPATIAL DEVELOPMENT OF CASE STUDY CITIES

The results of the conducted analysis and respective comments about the following demographic and spatial features and processes are given: population dynamics, population density, land cover structures and land cover changes. The analysis covered the period 1990–2006, with respective and necessary estimations according to the statistical data about population, provided by the official national statistical authorities.

Trends in the population development

Population of the **City of Belgrade** increased moderately in the analysed period (Table 1). The most significant rise in population size (measured by 1991–2006 change ratio) was recorded predominantly in peripheral municipalities: Grocka (120.4), Barajevo (120.2), Novi Beograd – central area (118.2), Čukarica (116.5) and Palilula (107.7). Contrary to this demographic trend, a significant decrease ('depopulation') was recorded in three inner-city municipalities (Stari Grad – 78.5, Vračar – 83.1 and Savski Venac – 89.3), as well as in the municipality of Zemun (88.5) and peripheral municipality of Mladenovac (95.5).

Population of the **City of Rome** suffered a mild decline in the observed period. The most significant growth in population size was recorded primarily in some peripheral municipalities: EUR (115.8), Ostia (112.1) and Delle Torri (109.0). The opposite demographic trend, i.e. considerable 'depopulation', was recorded in all inner-city municipalities, especially in San Giovanni (86.1), Prenestino (86.5), Nomentano-San Lorenzo (87.2), Prati (87.8) and Monte Verde (89.2) (Table 2) .

Table 1. City of Belgrade – population development and spatial changes

	Municipality	Population Change Ratio 2006*/1991	1990		2006	
			Population Density (inh/ha)	Artificial/ Total Area Ratio	Population Density* (inh/ha)	Artificial/ Total Area Ratio
1	Zvezdara	102.2	78	0.50	75	0.53
2	Obrenovac	105.5	17	0.10	18	0.09
3	Voždovac	98.4	63	0.17	51	0.20
4	Zemun	88.5	55	0.21	37	0.28
5	Lazarevac	101.6	19	0.08	16	0.10
6	Barajevo	120.2	34	0.03	17	0.07
7	Vračar	83.1	271	1.00	225	1.00
8	Grocka	120.4	20	0.11	23	0.12
9	Mladenovac	95.5	24	0.07	22	0.07
10	Palilula	107.7	58	0.06	43	0.08
11	Čukarica	116.5	35	0.27	45	0.26
12	Novi Beograd	118.2	44	0.15	48	0.16
13	Sopot	101.4	15	0.05	15	0.05
14	Stari Grad	78.5	152	0.85	119	0.84
15	Rakovica	105.6	68	0.45	61	0.53
16	Savski Venac	89.3	33	0.96	29	0.96
	Mean	*103.3*	*62*	*0.32*	*53*	*0.33*

**Estimated population*

Table 2. City of Rome – population development and spatial changes

	Municipality	Population Change Ratio 2006/1991	1990		2006	
			Population Density (inh/ha)	Artificial/ Total Area Ratio	Population Density (inh/ha)	Artificial/ Total Area Ratio
1	Centro Storico	94.1	93	0.98	87	0.98
2	Parioli	93.0	100	0.96	93	0.97
3	Nomentano-San Lorenzo	87.2	105	1.00	91	1.00
4	Monte Sacro	91.6	97	0.23	79	0.26
5	Tiburtina	97.6	82	0.46	70	0.52
6	Prenestino	86.5	230	0.84	218	0.77
7	Centocelle	91.0	113	0.60	92	0.67
8	Delle Torri	109.0	65	0.26	58	0.31
9	San Giovanni	86.1	202	0.90	174	0.90
10	Appio Claudio	97.9	89	0.55	79	0.61
11	Appia Antica	93.2	85	0.36	82	0.35
12	EUR	115.8	36	0.22	39	0.23
13	Ostia	112.1	45	0.27	47	0.29
14		0.0				
15	Arvalia	91.5	456	0.59	475	0.52
16	Monte Verde	89.2	42	0.29	34	0.31
17	Prati	87.8	85	0.76	76	0.74
18	Aurelia	98.7	86	0.24	75	0.27
19	Monte Mario	98.3	97	0.14	90	0.15
20	Cassia Flaminia	101.3	40	0.19	38	0.20

Similarly to the City of Belgrade, a moderate rise in the population of the **City of Sofia** was noted. The population size most significantly rose in some central municipalities (e.g. Poduyane – 143.6), but mostly in southern peripheral municipalities: Ovcha Kupel (137.5), Vitosha (135.7) and Bankya (130.2). As opposed to this trend, some inner-city municipalities (e.g. Sredets – 77.3, Oborishte – 85.4 and Vazrazhdane – 89.2) went through a substantial 'depopulation', as well as north-eastern peripheral municipality of Kremikovtsi (53.6) (Table 3).

Table 3. City of Sofia – population development and spatial changes

	Municipality	Population Change Ratio 2006*/1991	1990		2006	
			Population Density** (inh/ha)	Artificial/ Total Area Ratio	Population Density* (inh/ha)	Artificial/ Total Area Ratio
1	Sredets	53.6	136	1.00	105	1.00
2	Vazrazhdane	77.3	138	1.00	123	1.00
3	Oborishte	85.4	132	1.00	113	1.00
4	Ilinden	89.2	104	1.00	99	1.00
5	Serdika	94.9	33	0.72	35	0.69
6	Poduyane	95.3	53	0.93	78	0.92
7	Slatina	95.8	45	0.91	49	0.92
8	Izgrev	96.9	73	1.00	71	1.00
9	Lozenets	97.2	54	0.77	64	0.83
10	Triaditsa	97.6	80	0.82	76	0.85
11	Krasno selo	98.0	128	1.00	129	1.00
12	Krasna Polyana	98.2	87	0.68	83	0.69
13	Nadezda	98.5	73	0.46	70	0.46
14	Iskar	101.0	46	0.56	44	0.58
15	Mladost	102.4	80	0.75	72	0.81
16	Studentski	110.4	80	0.65	100	0.66
17	Lyulin	114.8	126	0.43	121	0.44
18	Vitosha	119.7	18	0.18	22	0.19
19	Ovcha Kupel	127.6	38	0.24	43	0.29
20	Bankya	127.8	9	0.17	10	0.18
21	Pancharevo	130.2	12	0.05	13	0.05
22	Vrabnitsa	135.7	36	0.25	38	0.28
23	Novi Iskar	137.5	12	0.11	11	0.12
24	Kremikovtsi	143.6	10	0.16	6	0.15
	Mean	*103.5*	*67*	*0.62*	*66*	*0.63*

**Estimated population, ** Data for the year 1992*

Soil sealing and development of the UMZ

According to the provided digital data, the total analysed area[4] of the City of Belgrade covered 3223.2 km^2. Less than 21% of soil, according to the data from 2006, was to some degree sealed by anthropogenic impervious materials. Only about 4.5%, or less than 145 km^2 of the city`s soil was highly sealed. Although the data about the UMZ for Belgrade were not officially provided, they were reconstructed using the same UMZ methodology (ETCTE, 2013). The UMZ of the City of Belgrade was changed and extended by the index of 122.1!

The total analysed area of the City of Rome covered 1285.8 km^2. The data from 2006 reveal that 46% of soil was to a certain extent sealed by anthropogenic impervious materials. More than 230 km^2, i.e. about 18% of the city`s soil, was highly sealed. Overall, the UMZ of the City of Rome extended by the index of 108.1.

The total analysed area surface of the City of Sofia was 1342.7 km^2. Only about 26% of soil, according to the data from 2006, suffered a certain degree of sealing by anthropogenic impervious materials. Additionally, only about 12%, or 161 km^2 of the city`s soil was highly sealed. Overall, the UMZ of the City of Sofia was slightly extended, by the index of 102.7.

Land cover changes

Municipalities with the largest share of artificial surfaces (ratio between the total area of the municipality – TA and total artificial surfaces – AS) in the City of Belgrade in 2006 were inner-city municipalities: Vračar (1.00), Savski Venac (0.96) and Stari Grad (0.84). Contrary to this, artificial surfaces in the peripheral municipalities occupied less than 10% of the total land: Sopot (0.05), Barajevo (0.07), Mladenovac (0.07), Palilula (0.08) and Obrenovac (0.09). During the observed period, land cover of the City of Belgrade slightly changed in favor of artificial surfaces. CLC land cover changed in the general process of transition from 'natural' land cover to artificial surfaces. In total, artificial surfaces covered about 13% more in 2006 than in 1990, at the expense of agricultural areas which decreased by 2%. In terms of the dynamics of land occupancy ('antropogenisation'), considerable changes took place in general, and particularly in the following municipalities: Barajevo (233.3), Zemun (133.3), Palilula (133.3), Lazarevac (125.0), Rakovica (117.8) and Voždovac (117.6). A certain 'deantropogenisation' was detected in the municipality of Obrenovac (90.0) due to the recultivation of the previous ore exploitation areas. (Table 1, Figure 1 and Figure 2)

The data about land cover in 2006 for the **City of Rome** show that the inner-city municipalities of Nomentano-San Lorenzo (1.0), Centro Storico (0.98), Parioli (0.97) and San Giovanni (0.90) had the greatest share of artificial surfaces. In contrast, less than 30% of the total land in peripheral municipalities was occupied by artificial surfaces: Monte Mario (0.15), Cassia Flaminia (0.20), EUR (0.23), Monte Sacro (0.26), Aurelia (0.27) and Ostia (0.29). Land cover of the City of Rome slightly changed in favor of artificial surfaces. In the year of 2006 artificial surfaces covered about 1/3 of the total area. Similarly to Belgrade, CLC land cover changed in the general process of transition from 'natural' land cover to artificial surfaces. In total, artificial surfaces covered about 8% more in 2006 than in 1990, while agricultural areas decreased by more than 4%. In terms of the 'antropogenisation', there were substantial changes in general, but particularly in the following municipalities: Delle Torri (119.2), Tiburtina (113.0), Monte Sacro (113.0), Centocelle (111.7) and Aurelia (112.5). A certain "deantropogenisation" was noticed in the municipalities of Arvalia (88.1) and Prenestino (91.7) (Table 2, Figure 3 and Figure 4).

[4] Differences between the total analyzed area of the cities and areas acquired by rasters can be observed. 'Raster area' is bigger, due to the principle that any part of the pixel covered by vector must be calculated as the whole pixel in the total sum.

Municipalities with the largest share of artificial surfaces in the City of Sofia in 2006 were inner-city municipalities of Poduyane, Slatina, Ilinden, Izgrev, Krasno selo, Oborishte, Sredets and Vazrazhdane, with artificial surfaces coverage up to 92–100%. Contrary to this, artificial surfaces in peripheral municipalities occupied less than 20% of the total land: Pancharevo, Novi Iskar, Kremikovtsi, Bankya and Vitosha. Regarding the land cover of the City of Sofia, there was a minor change in favor of artificial surfaces. Artificial surfaces accounted for only about 1/5 of the total area in 2006. CLC land cover changed in the general process of transition from 'natural' land cover to artificial surfaces. In total, artificial surfaces coverage in 2006 was only about 3% higher than in 1990, at the expense of agricultural areas which, in total, decreased by 2%. With respect to the dynamics of 'antropogenisation', considerable changes occurred in general, but principally in the municipalities of the outer-city and periphery: Ovcha Kupel (120.8), Vrabnitsa (112.0), Novi Iskar (109.1), Mladost (108.0), and Lozenets (107.8). A relatively modest rate of 'deantropogenisation' was noticed in the municipality of Kremikovtsi (93.8) (Table 3, Figure 5 and Figure 6).

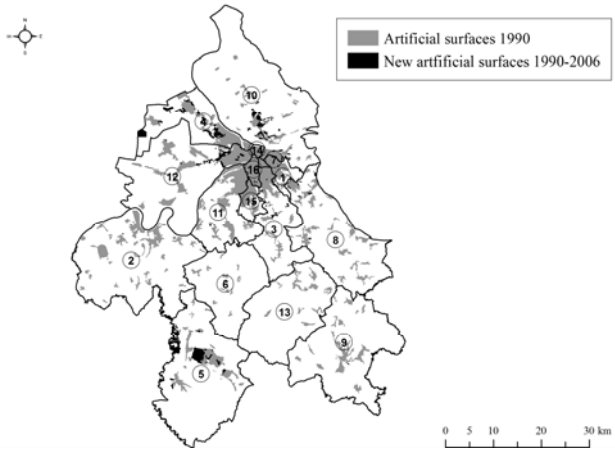

Figure 1. City of Belgrade – Artificial surfaces and land cover change (1990–2006)

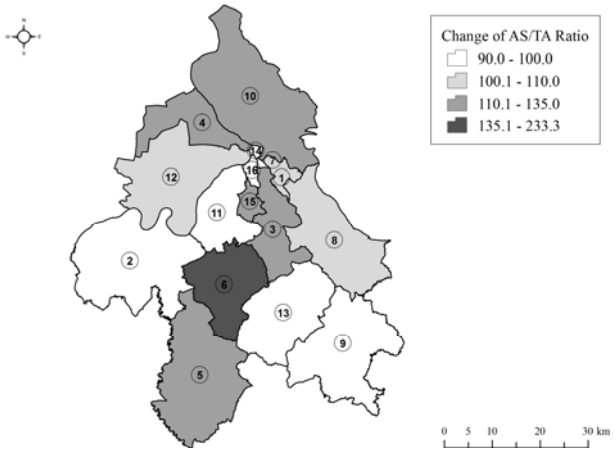

Figure 2. City of Belgrade – AS/TA ratio of administrative units (1990–2006)

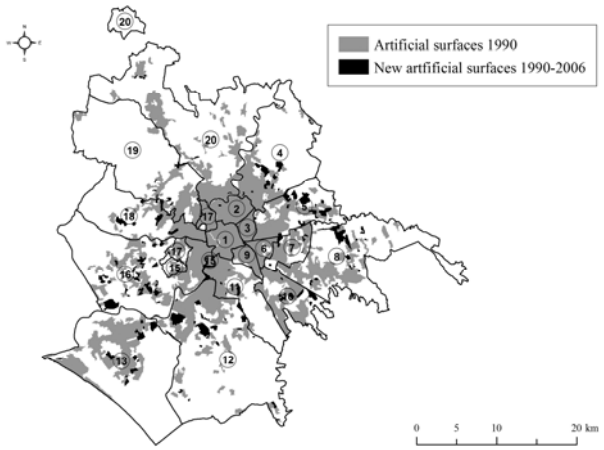

Figure 3. City of Rome – Artificial surfaces and land cover change (1990–2006)

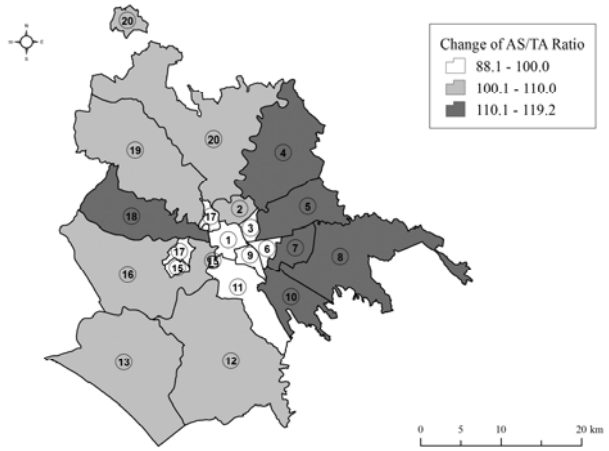

Figure 4. City of Rome – AS/TA ratio of administrative units (1990–2006)

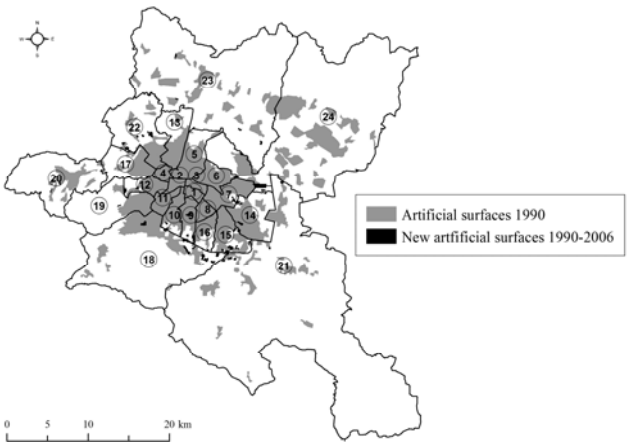

Figure 5. City of Sofia – Artificial surfaces and land cover change (1990–2006)

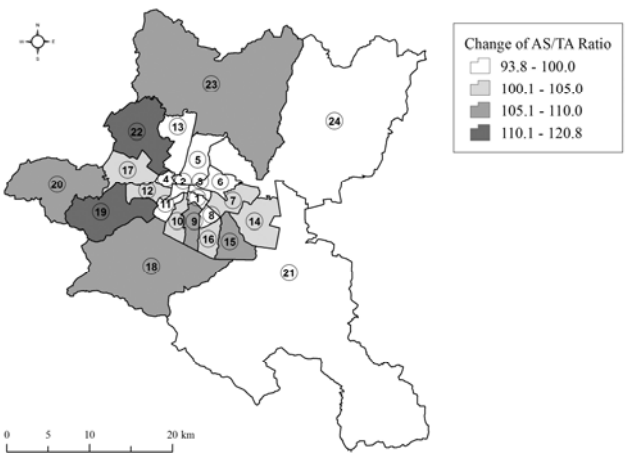

Figure 6. City of Sofia – AS/TA ratio of administrative units (1990–2006)

Population density change

Regarding the population density of the **City of Belgrade** in the year 2006, here measured by ratio between the total population and total artificial surfaces area (inhabitants/ha), the most populated were inner-city municipalities Vračar (225) and Stari Grad (119), whereas the lowest densities were observed in the peripheral, relatively 'rural' municipalities: Sopot (15), Lazarevac (16), Barajevo (17), Obrenovac (18), Mladenovac (22) and Grocka (23). During the observed period and in relation to land cover changes (1990–2006), population density considerably increased in the municipalities of Čukarica (128.6), Grocka (115.0) and Novi Beograd (109.1). Contrary to this, a substantial drop in population density was observed in most municipalities where high 'antropogenisation' was detected: Barajevo (50.0), Zemun (67.3), Palilula (74.1), Voždovac (81.0) and Lazarevac (84.2). It is important to note that population density also decreased in the inner-city municipalities of Stari Grad (78.3) and Vračar (83.0), without land cover change, thus indicating 'depopulation' (Table 1, Figure 7).

The highest population density in the **City of Rome**, in 2006, was registered in the inner-city municipalities of Arvalia (475), Prenestino (218) and San Giovanni (174), while the least populated were peripheral municipalities of Monte Verde (34), Cassia Flaminia (38), EUR (39) and Ostia (47). Related to land cover changes, population density slightly increased in the following municipalities: EUR (108.3), Ostia (104.4) and Arvalia (104.2). On the other hand, most municipalities with high 'antropogenisation' experienced a considerable fall in population density: Tiburtina (85.4), Monte Sacro (81.4), Centocelle (81.4) and Monte Verde (81.0). In addition, population density also decreased in the inner-city municipalities of Centro Storico, Parioli and Nomentano-San Lorenzo, without land cover change, which indicates "depopulation" (Table 2, Figure 8).

The highest density in the **City of Sofia** in 2006 was present in some inner-city and outer-city municipalities (Oborishte - 113, Lyulin - 121, Vazrazhdane - 123 and Krasno selo - 129). Extremely low densities were observed in the peripheral municipalities: Kremikovtsi (6), Bankya (10), Novi Iskar (11) and Pancharevo (13). Consequently, during the observed period and related to land cover changes, the population density noticeably increased in the municipalities of the outer-city and periphery: Poduyane (147.2), Studentski (125.0), Vitosha (122.2), Lozenets (118.5), Ovcha Kupel (113.2) and Bankya (111.1). Quite the opposite trend, i.e. a significant decline in population density, was

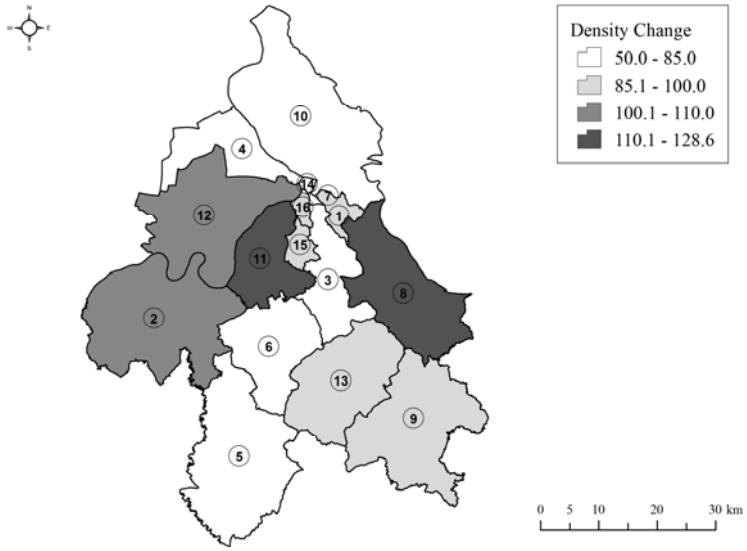

Figure 7. City of Belgrade – Population density changes within administrative units (1990–2006)

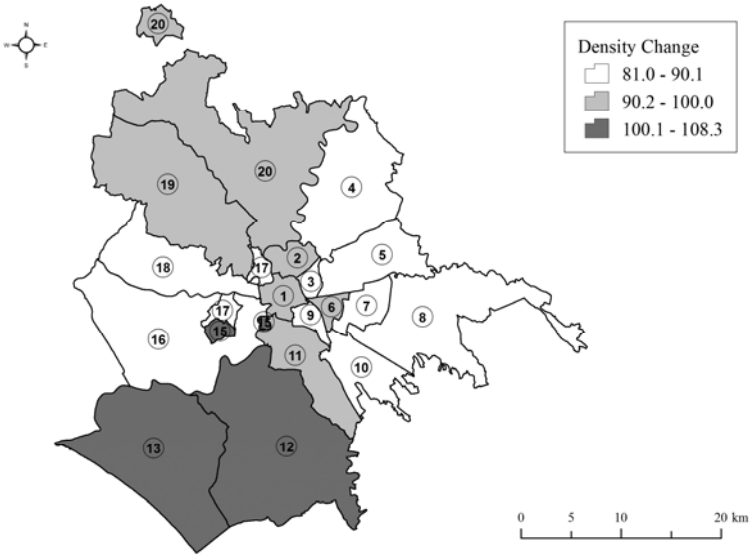

Figure 8. City of Rome – Population density changes within administrative units (1990–2006)

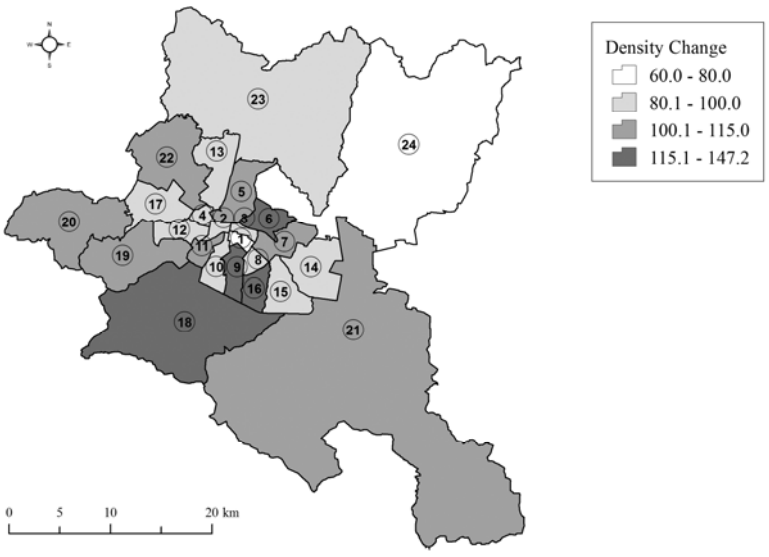

Figure 9. City of Sofia – Population density changes within administrative units (1990–2006)

present in the majority of municipalities, particularly in Kremikovtsi (60.0) and Vazrazhdane (89.1), and also in the inner-city municipalities of Sredets (77.2) and Oborishte (85.6), without land cover change, thus indicating 'depopulation' (Table 3, Figure 9).

BRIEF DISCUSSION – CONCLUDING REMARKS

Relevant references, as presented in *Urban development of case study cities – an overview*, suggest that there exists no clear cause and effect relationship between the expansion of soil sealing in peri-urban zones and differences with regard to the natural surroundings and historical development of cities, nor due to these cities being developed cities or cities in transition, capitalistic or post-socialist cities etc. Nevertheless, it can be concluded that different factors caused similar trends in soil sealing in peri-urban zones in the case study cities.

There are some differences between the respective sizes of the administrative areas of case study cities: the City of Belgrade (3223.2 km^2), the City of Rome (1286.1 km^2) and the City of Sofia (1342.9 km^2). Belgrade has the smallest urban area, or UMZ, in comparison to its administrative area (183.5 km^2, i.e. 5.7%). Likewise, although Sofia has a larger administrative area than Rome, its urban area (259.1 km^2, i.e. 19.3%), or UMZ, is significantly smaller than in the case of Rome (398 km^2, i.e. 31%).

Certain differences are also observable with regard to the population changes. Population of the **City of Belgrade** increased moderately, in total, by the index of 103.3. The most significant increase in population size was recorded predominantly in peripheral municipalities, while a significant decrease was observed in inner-city municipalities. Contrary to Belgrade, population of the **City of Rome** slightly decreased in total, by the index of 96.6. Again, the most significant increase in population size was noted primarily in some peripheral municipalities. In contrast to this demographic trend, all inner-city municipalities suffered a significant 'depopulation'. Population of the **City of Sofia** also increased moderately, in total, by the index of 103.5. The population size most notably rose in some central municipalities, whereas some inner-city municipalities, as well as the north-eastern peripheral municipality, experienced 'depopulation' to a considerable extent.

There were also differences in the dynamics of spatial changes. Namely, while the UMZ of Belgrade extended for about 33 km2, the UMZ of Rome and Sofia extended for about 30 km2 and 7 km2 respectively. It is interesting to note that spatial dynamics of the UMZ or respective artificial surfaces have accelerated after the year 2000 in the cases of all three cities. Development of the UMZ of all three cities was a dynamical process which differed throughout the observed period. There was an obvious correlation between the sealing degree and the intensity of human activity.

Land cover pattern also changed, concurrently with the UMZ development and dynamics. Artificial surfaces development corresponded with the UMZ changes and dynamics. In all three cases, artificial surfaces were mainly developed at the expense of agricultural areas. By using CLC land cover classification it was not possible to track changes inside artificial surfaces, i.e. in the cities' urban tissues.

Occupation and sealing of productive soil in peri-urban zones was not proportional to the population dynamics of the cities. Regarding the changes in population density, it can be concluded that central/inner-city municipalities became less populated, with sometimes very significant decrease in population density, but without any land cover change, which indicates 'depopulation'. At the same time outer-city and peripheral municipalities also suffered a decline in population density, while their urban zones extended (in cases where high 'antropogenisation' was detected).

Further extension of urban zones and "filling" within the existing urban block has been observed since 2006 in all three cities. Detected trends in land cover changes and population dynamics should be taken into account when planning and developing both central and peri-urban city areas. Apart from further research of causalities in land cover changes, successful management of cities necessitates understanding of the citizens' preferences concerning the surroundings they live in (Petrić, 2013) on the one hand, and interests of investors, local authorities and other subjects of overall urban development on the other.

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THE TERRITORIAL COOPERATION POLICY OF THE EU WITH THE COUNTRIES OF SOUTH EAST EUROPE: AN INTERIM EVALUATION

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During the programming period 2007–2013 the Cohesion Policy of the EU was adopted and the policy of territorial cooperation with third countries was implemented. Within this framework, the EU co-finances (through the European Regional Development Fund, the pre-accession instrument and the instrument of European Neighbourhood Policy) a series of cross-border, interregional and transnational cooperation programmes in Southeast Europe. The South East European countries are eligible for all these programmes, but the only programme that includes all countries in the region is the South East Europe Programme 2007–2013. The aim of this study is to conduct an interim evaluation of these programmes and present suggestions for the new programming period for the Cohesion Policy 2014–2020. Section 2 describes the EU policy of territorial cooperation with non-EU countries. Section 3 reviews the framework of EU policies and programmes fostering regional integration and territorial cohesion in Southeast Europe. Section 4 presents the area, aim, objectives and priority axes of the programme, while Section 5 offers an assessment of the implementation and effectiveness of the programme. Section 6 also includes some critical observations and policy proposals.

***Key words:** European Union, South East Europe, Regional Integration, Cohesion Policy.*

INTRODUCTION

Territorial cooperation (cross-border, interregional or transnational cooperation) is an important driving instrument for economic and social integration among different countries. This is of great importance for the fragmented space of Southeast Europe. For the countries of the region, which are characterized by small internal markets, inefficient cross-border infrastructures and to some extent trans-border political tensions and conflicts, the elimination of the economic and political 'border-effect' will enable the interaction of the integration between regions or sub-regions belonging to different countries and strengthen the stability of the whole area (Petrakos, 2001). Cross-border trade and investment activities, which promote economic interdependence and political stability between neighbouring states, need a proper institutional framework and a policy supporting cross-border infrastructure, custom facilitations, business cooperation, technology transfer, human resource development and economic, social and territorial cohesion (Kotios, Galanos, and Roukanas, 2010). There are supplementary reasons in favour of regional economic integration in Southeast Europe (Wittkowski, 2000).

To reduce the cost of adaptation and to enable the smooth harmonization between the socio-political and economic systems of the countries in Southeast Europe and those of the West, the EC has developed and, since 1989, applied a number of support measures (Kotios, 2001a and 2001b). In order to assist the transition countries of the Balkans, the EC first implemented the Phare and OBNOVA programmes, since 2000 the CARDS Programme and since 2007 the Instrument for Pre-Accession Assistance (IPA) for countries engaged (candidate or potential candidate countries) in the accession process to the EU (Kotios *et al.*, 2010). For the countries of East Europe (and the Mediterranean countries), the EU applies the European Neighborhood and Partnership Instrument (ENPI), which is the successor of MEDA and Tacis. The aim of the IPA, but also of the ENPI instrument, is to provide financial assistance and support for transition and institution-building, cross-border cooperation, regional development, rural development and human resource development. The EU's cross-border cooperation policy supports the beneficiary countries in the area of cross-border cooperation between themselves, with the EU Member States or within the framework of cross-border or interregional or transnational actions. This policy is part of the new European Territorial Co-operation Objective for the programming period 2007–2013 and seeks the full participation of non-Member States in the Southeast Europe area that benefit from the external Pre-Accession Assistance and the European Neighbourhood Policy funding (Thoidou, 2011, Foutakis and Thoidou, 2009).

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The EU's territorial cooperation policy in the macro-region of Southeast Europe includes bilateral or multilateral cross-border cooperation programmes as well as transnational cooperation programmes. The South East Europe (SEE) Programme Area is the most important of these, with the largest cooperation area, and the only transnational programme with such a large number of non-EU countries. The SEE Programme consists of 16 countries with a total population of ca. 200 million people. Half (eight) of the participating countries are member states of the EU, one is an acceding country (Croatia), three are candidate countries (FYROM, Montenegro and Serbia), two are potential candidate countries (Albania, Bosnia and Herzegovina) and two are countries participating in the European Neighbourhood Policy (Moldova and Ukraine). The large number and the diversity of the participating countries and areas, as well as the complexity of the programme due to the funding from different instruments, differentiate it from other territorial programmes.

Table 1. Eligible countries and regions of the SEE Programme

Eligible Country	Eligible area
Albania	Whole territory
Austria	Whole territory
Bosnia-Herzegovina	Whole territory
Bulgaria	Whole territory
Croatia	Whole territory
FYROM	Whole territory
Greece	Whole territory
Hungary	Whole territory
Italy	Lombardia, Prov. Autonoma Bolzano/Bozen, Prov. Autonoma Trento, Veneto, Friuli-Venezia-Giulia, Emilia Romagna, Umbria, Marche, Abruzzo, Molise, Puglia Basilicata
Republic of Moldova	Whole territory
Montenegro	Whole territory
Romania	Whole territory
Serbia	Whole territory
Slovakia	Whole territory
Slovenia	Whole territory
Ukraine	Chernivetska Oblast, Ivano-Frankiviska Oblast, Zakarpatska Oblast, Odessa Oblast

Source: European Commission, 2010

THE EU POLICY OF INTERNATIONAL TERRITORIAL COOPERATION

The objectives and strategies of territorial cooperation programmes (territorial cooperation) should correlate to the superior goals set by the EU under the policies of enlargement (enlargement) and good neighbourliness (good neighbourhood) developed with the countries of Southeastern Europe, the Mediterranean Basin and the Black Sea. Also, the framework of objectives and strategies of the individual programmes is directly related to the objectives and strategies of the cohesion policy for 2007–2013 (European Commission, 2010).

In particular, the territorial cooperation programmes may contribute to territorial cohesion with a view to the harmonious development of the whole EU (Article 174 TFEU). During the programming period 2007–2013, the strengthening of territorial cohesion was adopted as a distinct third goal – the goal of territorial cooperation. The aim is to strengthen cross-border cooperation through joint local and regional initiatives, strengthening transnational cooperation through actions that are conducive to the integrated territorial development associated with the Community's priorities and strengthening interregional cooperation and the exchange of experience at the appropriate territorial level (see Article 2 of Reg No1083/2006 of the Council of the EU).

Article 6 of the ERDF Regulation (Regulation 1080/2006 of the EU Council) defines the thematic priorities for assistance in cross-border, transnational and interregional cooperation. Sustainable cross-border territorial development activities are pursued in the fields of economy, society and environment, with priority programmes encouraging cross-border business (SMEs, tourism, culture, cross-border trade), reducing isolation through improved access to all types of networks and supporting links between urban and rural areas and the development of common infrastructure in the fields of environment, health, culture, tourism and education. In addition, the thematic priorities are the promotion of legal and administrative cooperation, the integration of cross-border labour markets, local employment initiatives, gender equality and equal opportunities, training and social inclusion and sharing of human resources and RTD facilities.

The thematic priorities of transnational cooperation include the creation and development of scientific and technological networks and the enhancement of regional RTD and innovation, the establishment of networks between higher education and research institutions and SMEs, technology transfer between RTD facilities and international centres of RTD excellence, the twinning of technology transfer institutions and the development of joint financial engineering instruments for supporting RTD in SMEs, water management, energy efficiency, risk prevention and environmental protection activities with a clear transnational dimension. Also included are the protection and management of river basins, coastal zones, marine resources, water services and wetlands; prevention of fires, droughts and floods, the promotion of safety of navigation and protection against natural and technological hazards and the protection and improvement of natural heritage in support of socio-economic development and sustainable tourism activities to improve access to transport and telecommunications services and the quality of these services, when such activities have clear transnational dimensions; border sections of trans-European networks; improved local and regional access to national and transnational networks; improved interoperability of national and regional systems, promotion of advanced information and communication technologies, strengthening polycentric development at transnational, national and regional level with a clear transnational impact; creation and improvement of urban networks and urban–rural strategies to tackle common urban–rural difficulties; conservation and promotion of cultural heritage and the strategic integration of development zones on a transnational basis.

To enhance the effectiveness of regional policies for interregional cooperation, the focus is on innovation and the knowledge economy, the environment and risk prevention, exchange of experience concerning the identification, transfer and dissemination of best practice including sustainable urban development, studies, data collection and monitoring and the analysis of development trends in the Community.

The above objectives of cross-border, regional and transnational cooperation are promoted in third countries that are candidates or potential

candidates for membership through the Instrument for Pre-Accession Assistance (IPA; Reg. 1085/2006) and to countries of the Mediterranean basin and Eastern Europe through Neighbourhood and Partnership (ENPI). This collaboration aims to promote good neighbourly relations, strengthen stability, security and prosperity in the mutual interest of all countries and promote harmonious, balanced and sustainable development (Article 9, Regulation 1085/2006). It also provides financing programmes for the development of regional policies to prepare candidates for membership regarding the implementation of cohesion policy and the development of human resources in regional policy and to support rural development policies. Neighbourhood and Partnership programmes fund bilateral and multilateral transnational and cross-border cooperation (Article 6, Regulation 1638/2006).

Transnational cooperation (South - Eastern European Space and Mediterranean Basin) is pursued by choosing strategic projects aimed at the promotion of common development prospects of these two spatial units. The thematic priorities set, in terms of transnational cooperation, include environmental protection, combined with the strengthening of the development of coastal areas and islands of the Mediterranean; improving accessibility and interoperability through the transport systems and advanced information and communication technologies; management of water and protection from risks (prevention of environmental and technological risks); research and technological development and transfer of technology and the management of cultural heritage in the spatial aspects of migration, mobility and social participation.

CURRENT EU POLICIES AND PROGRAMMES FOSTERING REGIONAL INTEGRATION AND TERRITORIAL COHESION IN SOUTH EAST EUROPE

Regional initiatives and cooperation in the Balkans, which emerged only at the end of the 1980s and over the course of the 1990s (Lopandic, 2001), have been linked to three processes:

The first wave of Southeast Europe cooperation initiatives appeared over the period 1988–1992, directly resulting from the dissolution of the Eastern Bloc and the Council for Mutual Economic Assistance. There was an urgent need to replace these organizations by new modes of interstate cooperation, in order to help integration into the European Community. So the Central European Initiative (November 1989), the Black Sea Economic Co-operation (June 1992) and the Central European Free Trade Area (CEFTA; December 1992) were launched.

The second wave of Southeast Europe's cooperation initiatives is linked to the former Yugoslavia's disintegration and the end of the war in Bosnia-Herzegovina, and the need to redefine the pattern of mutual relations in the region, as well as in the wider Balkan area (Conference of Southeast European Countries, 1996; Royaumont Process, 1996).

The third wave, which led to the current status of the area, started after the war in Kosovo with the Stability Pact for SEE. The Stability Pact, adopted at the International Conference of Cologne on 10 June 1999, was the first comprehensive regional approach to SEE by the international community (Kotios, Galanos, and Roukanas, 2010). The Pact was a long-term programming framework for cooperation, not just one more autonomous international institution. It aimed at mobilizing and co-ordinating existing agencies in the international community. Regional economic integration in SEE was one of the most important aims of the Stability Pact. The Trade Initiative of the Stability Pact focused its efforts on the liberalization and facilitation of trade through the reduction and elimination of tariffs and non-tariff barriers to trade in the SEE region. Further aims of the Trade Initiative of the Stability Pact were the accession of all SEE countries to the WTO and the signing of Stabilisation and Association Agreements (SAAs) with the EU in order to promote trade and investment cooperation between the EU and the SEE region. Regional integration in the region was an essential condition for closer relations between the Western Balkan countries and the EU, and therefore a part of European conditionality (Bechev, 2006; Papadimitriou, 2001; Sklias and Roukanas, 2007).

Infrastructure, in the sense of roads, railways, waterways, airports, energy and telecommunication, is considered a further key factor in facilitating cross-border trade cooperation among SEE countries and economic growth in the region.

The Stability Pact processes, the Regional Approach for the Western Balkans and the New Neighbourhood Policy of the EU have resulted in closer transnational cooperation in the region and in more intensive regional and territorial integration. Table 2 summarizes the current status of the institutional relations between the EU and the countries of the SEE Programme area, as well as the main regional agreements in the fields of politics, trade, investments, transport, energy and environment.

Concerning territorial cooperation, in 1994 the EU implemented a programme for cross-border cooperation (CBC) between countries in Central and Eastern Europe and member states of the Community within the framework of the Phare programme (Commission Regulation No 1628/94 of 4 July 1994). In the period 1995–1999, stronger coherence between the INTERREG and the CBC Programme was achieved. The EU's cross-border cooperation initiative was extended to encompass cooperation between the CEECs and the New Independent States (NIS). The Credo programme aimed at supporting cooperation between 'east–east' border regions and contributing to economic development in these border areas.

The new target of Territorial Cooperation of the Cohesion Policy 2007–2013 has enhanced and enlarged the scope of the territorial cooperation both within the EU and with non-EU countries. The new generation of territorial cooperation programmes consists of four kinds of programmes (see Table 3): transnational, interregional, multinational and bilateral cross-border cooperation.

The current territorial cooperation programmes relevant to the countries of the SEE region are:

- The SEE Transnational Programme, which includes all countries in the region.
- The MED Transnational Programme, with partners from 13 countries, including Greece, Italy, Slovenia, Albania, Montenegro, BiH and Croatia.
- The IPA Adriatic IPA, a multilateral cross-border cooperation programme, which covers regions in eight SEE countries (Greece, Italy, Slovenia, Albania, BiH, Montenegro, Croatia and Serbia).
- The ENPI CBC Med Programme for multilateral cross-border cooperation. Part of the new European Neighbourhood Policy, it reinforces cooperation between the eight EU Mediterranean countries and six Arab countries, including the Palestinian territories.
- The multilateral Black Sea CBC programme, with participation from Bulgaria, Greece, Romania, Moldova and Ukraine.
- Bilateral CBC Programmes for all 16 countries which are partners of the SEE Programme.

Table 2. The relations between EU and SEE countries and regional initiatives in SEE

	Stabilization and Association Agreement	**Candidate Status**	**European Neighbourhood Partnership**	**Eastern Partnership**	**CEFTA Membership**	**Regional Cooperation Council**	**Western Balkans Investment Framework-WBIF**	**South East Europe Transport Observatory-SEETO**	**Energy Community**	**Regional Network of Accession-RENA**
Croatia	Into force (2005)	Acceding country (2013)			-	+	+	+	+	+
Montenegro	Into force (2010)	Candidate			+	+	+	+	+	+
Serbia	Into Force (2012)	Candidate			+	+	+	+	+	+
FYRoM	Into force (2004)	Candidate			+	+	+	+	+	+
Albania	Into force (2009)	Potential candidate			+	+	+	+	+	+
BiH	Signed (2008)	Potential Candidate			+	+	+	+	+	+
Kosovo	-	Potential candidate			+	UNMIK	+	+	+	+
Moldova			Partnership and Cooperation Agreement	Association Agreement (under negotiation)	+	+	-	-	+	-
Ukraine			Partnership and Cooperation Agreement	Association Agreement (under negotiation)	-	-	-	-	+	-

Table 3. Membership of the SEE countries in Territorial Cooperation Programmes

Counties	**Transnational Cooperation Programmes**		**Multilateral CBC programmes**			**Bilateral CBC Programmes**	**Interregional Cooperation-INTERREG VI C) (29 countries)**
	SEE Programme	MED Programme	Adriatic IPA CBC (8 countries)	MED ENPI CBC (14 countries)	Black Sea Basin (8 countries)	Cooperation with:	EU + Norway and Switzerland
AT	+					SI, SK, CZ, HU, GE, IT	+
BG	+				+	GR, RO, FYROM,	+
GR	+	+	+	+	+	IT, CY, BG, FYROM, AL	+
HU	+					SI, SK, CZ, AT, RO, HR	+
IT	+	+	+	+		SI, AT, GE, FR	+
RO	+				+	BG, MD, UA, HU, RS	+
SI	+	+	+			AT, HR, HU, IT, GE	+
SK	+					RO, HU, AT, CZ, PO	+
AL	+		+			MN, KO, FYROM, GR	
BiH	+		+			HR, MN,RS	
MN	+	+	+			HR, AL, BiH, RS	
HR	+	+	+			RS, BiH, MN, HU, SI,	
FYROM	+					GR, AL, BG, KO	
RS	+		+			HR, BiH, MN	
MD	+				+	RO, UA	
UA	+				+	RO, MD, PO, HU, SL, BL	
Total Budget (EU + national co-financing)	277,160 Mio Euro	263,025 Mio Euro	288,955 Mio Euro	173 Mio Euro	28, 118 Mio Euro (ENPI)		321 Mio Euro (ERDF)

THE SOUTH EAST EUROPE TRANSNATIONAL COOPERATION PROGRAMME

Main characteristics of the programme area

The Southeast Europe area comprising the 16 heterogeneous partner countries is one of the most diverse areas in Europe (Figure 1). This diversity refers to a complex mosaic of existing specific political, economic, cultural, religion, ethnical, social and historical characteristics of the participating countries and regions (European Commission 2010) – countries with different historical experiences, transition stages, development levels and systemic organization. The region consists of countries which are characterized by a variety of stages of institutional relations and proximity to the EU. Additionally, there are disparities and diversities in infrastructure, cross-border connections, technological development, administrative and institutional structures and relations with neighbouring countries. This great diversity, in conjunction with the lack of spatial cohesion and the fragmentation caused by new states offers the foundation for cross-border cooperation and territorial cohesion policy.

The programme area is characterized by strong divergence in national and regional development. The western regions of Italy and Austria and some regions in Greece are the richest in the programme area and dispose better factors of competitiveness. The poorest regions are in the western Balkans and in eastern countries such as Moldova and Ukraine.

For territorial cooperation and cohesion, factors related to topography and territorial structures are very important. Topography determines territorial cohesion and accessibility, and therefore the cross-border infrastructure. The establishment of new countries and of new frontiers has upset pre-existing relations, created new spatial entities, prolonged external borders and put up new obstacles for economic and territorial integration. Since 1990, the area has undergone fundamental political, social and economic changes. Through successive enlargements of the EU, Austria, Slovenia, Slovakia, Hungary, Romania and Bulgaria have become part of unified Europe. The dissolution of Yugoslavia was accompanied by the creation of new independent states. These changes altered the physiognomy of the programme area and made the border situation more complex. The management of the new border complexity is an important aim of the territorial cooperation policy (Vujošević, 2007).

Figure 1. South East Europe (SEE) Programme area
Source: (South East Europe Transnational Cooperation Programme, 2014)

Objectives and priority axes of the Programme

Through intensification of regional and cross-border economic cooperation, the SEE countries can expect more intra-regional market integration, increasing returns and economic growth. The implied regional increase in trade and investments can enforce the dispersal of ideas, know-how and technology and greater understanding between people. It can also support political cooperation and contribute to political stability in the region. Further expected effects of regional and cross-border cooperation in SEE include the promotion of spatial integration and revitalization of remote areas, as well as more employment and better social development in these areas. This is the general aim of the Transnational Co-operation Programme South East Europe, as part of the new European Territorial Co-operation Objective for the programming period 2007–2013. The SEE Programme concentrates on a limited number of priority areas in line with the European strategies for growth and sustainable development (Lisbon and Gothenburg strategies): Innovation, Environment, Accessibility and Sustainable Urban Development. These priority areas constitute the four priority axes of the programme (Table 4). The priority axes of Accessibility and Environment have a stronger transnational dimension than the priority axes of Innovation and Sustainable Urban Development. The four priority axes are specified and instrumentalized in 13 areas of intervention.

Financial resources

The total budget of the SEE Programme is 277.16 million Euro and is co-financed by EU funding instruments (ERDF, IPA and ENPI) and by national public funding (Table 5). There is no private funding because the beneficiaries of the programme are public authorities and public entities. The EU contribution is about 85% of the total budget. The European Regional Development Fund (ERDF) is the main funding source for the programme. It has a total available ERDF budget of Euro 206.7 million for the 2007–2013 period. The financial resources provided are significantly higher than was the case for the predecessor programme, INTERREG IIIB CADSES 2000–2006.

Table 4. Objectives, priority axes and areas of intervention

Global objective	Specific objectives	Priority axes (P)	Areas of Intervention (AoI)
Improvement of the territorial, economic and social integration process and contribution to cohesion, stability and competitiveness through the development of transnational partnerships and joint action on matters of strategic importance	1. Facilitation of innovation, entrepreneurship, knowledge economy and information society through concrete cooperation action and visible results	P1: Facilitation of innovation and Entrepreneurship	1. Develop technology & innovation networks in specific fields 2. Develop the enabling environment for innovative entrepreneurship 3. Enhance the framework conditions and pave the way for innovation
	2. Improvement of the attractiveness of regions and cities taking into account sustainable development, physical and knowledge accessibility and environmental quality through integrated approaches and concrete cooperation action and visible results	P2: Protection and improvement of the environment	4. Improve integrated water management and flood risk prevention 5. Improve prevention of environmental risks 6. Promote cooperation in management of natural assets and protected areas 7. Promote energy and resource efficiency
		P3: Improvement of accessibility	8. Improve co-ordination in promoting, planning and operation for primary & secondary transportation networks 9. Develop strategies to tackle the 'digital divide' 10. Improve framework conditions for multi-modal platforms
		P4: Development of transnational synergies for sustainable growth areas	11. Tackle crucial problems affecting metropolitan areas and regional systems of settlements 12. Promote a balanced pattern of attractive and accessible growth areas 13. Promote the use of cultural values for development
	3. Foster integration by supporting balanced capacities for transnational territorial cooperation at all levels	P5: Technical assistance to support implementation and capacity building	14. Secure the core management for the implementation of the programme 15. Implement accompanying activities to support the generation and implementation of high quality, result oriented transnational projects and partnerships

Source: European Commission, 2010

Table 5. Financial resources of the SEE Programme

Priority Axes	EU-ERDF (a)	National Public Funding – EU Members (b)	Total (a+b) (c)	IPA (2010-13) (d)	National Public Funding IPA Countries (e)	Total (d+c) (f)	Total (c+f)	IPA 2007-2009	ENPI-total	TOTAL
P1 Innovation	44,051,157	7,773,734	51,824,891	3,366,922	594,163	3,961,085	55,786,066			
P2 Environment	56,739,828	10,012,911	66,752,739	4,336,743	765,307	5,102,050	71,854,789			
P3 Accessibility	43,160,834	7,616,618	50,777,452	3,298,872	582,154	3,881,026	54,658,478			
P4 Sustainable Growth	50,338,329	8,883,234	59,221,563	3,847,463	678,964	4,526,427	63,747,990	10,436,461	2,200,000	
P5 Technical Assistance	12,401,497	4,133,832	16,535,329	1,650,000	291,176	1,941,176	18,476,505			
TOTAL	206,691,645	38,420,329	245,111,974	16,500,000	2,911,764	19,411,764	264,523,828	10,436,461	2,200,000	277,160,289

Source: European Commission, 2010 (Own Calculation)

The implementation of the Programme

After four calls 121 have been approved. Regarding the thematic distribution of the projects, Figure 2 shows the division of the approved projects over the four priority axes. The distribution of projects over the priority axes PA1, PA2 and PA4 is rather equal concerning the number of projects. The number of projects in the axe PA3 (Accessibility) is smaller. The division of partners over the priority axes varies. PA3 projects have the most partners (589) and PA1projects the fewest (405).

There is a rather balanced distribution of the priority axes over the countries (Table 6 and Figure 3). All countries are involved in all priorities. Some countries have a strong concentration in one PA (Slovakia and Croatia in PA3); others are underrepresented in some other axes (Austria in PA4, Slovakia and Albania in PA1, Moldova in PA3 and PA4).

Another interesting point of the project evaluation is its geographical scope. Table 6 summarizes the division of partners over t he priority axes and participating states. EU Member States have the stronger

participation (ca 80% of the project partners). Most member states have an average contribution. Italy has the stronger contribution and Slovakia the weakest. Of the IPA countries, Serbia and Croatia participate most strongly in the programme. The contribution of FYROM and BiH is the weakest among the IPA countries. Of the ENPI countries, Ukraine participates more than Moldova.

Concerning the distribution of lead partners, Italy has the stronger position, followed by Greece, Austria, Hungary and Slovenia. Bulgaria, Slovakia and Romania are not strongly involved as lead partners, scoring below average.

The picture is very different for some countries when one relates the number of lead partners and project partners to the population. Table 7 shows that Italy scores below average in having projects with a lead partner. On the other side, Slovenia scores much higher than average. Greece, Hungary and Austria score average or above average on all aspects, both in number of lead partners and project partners and also when related to population.

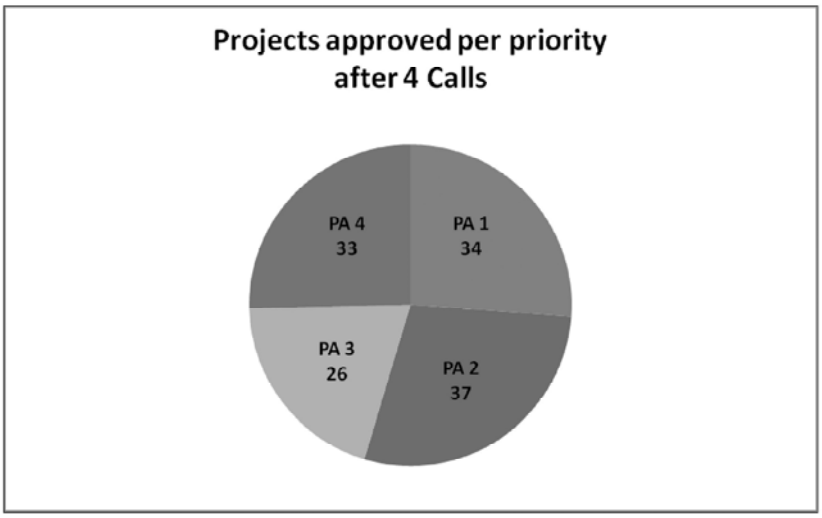

Figure 2. Division of the approved projects over the priority axes (PA) after four calls
Source: South East Europe, Transnational Cooperation Programme, 2013, (Own Calculation)

Table 6. Division of partners over the priority axes and participating countries after 4 calls

Priorities Axes	AT	BG	GR	HU	IT	RO	SI	SK	AL	BiH	MN	HR	FYROM	RS	MD	UA
Innovation-entrepreneurship	35	37	42	45	69	46	32	10	6	11	6	20	6	34	3	9
Environment	73	49	58	57	80	62	45	19	16	12	13	36	8	44	6	8
Accessibility	65	47	50	66	89	48	42	41	16	8	15	45	9	35	1	12
Sustainable Growth areas	28	42	45	51	84	60	46	21	14	8	6	23	6	33	1	7
total	201	175	195	219	392	216	165	91	52	39	40	124	29	146	11	36

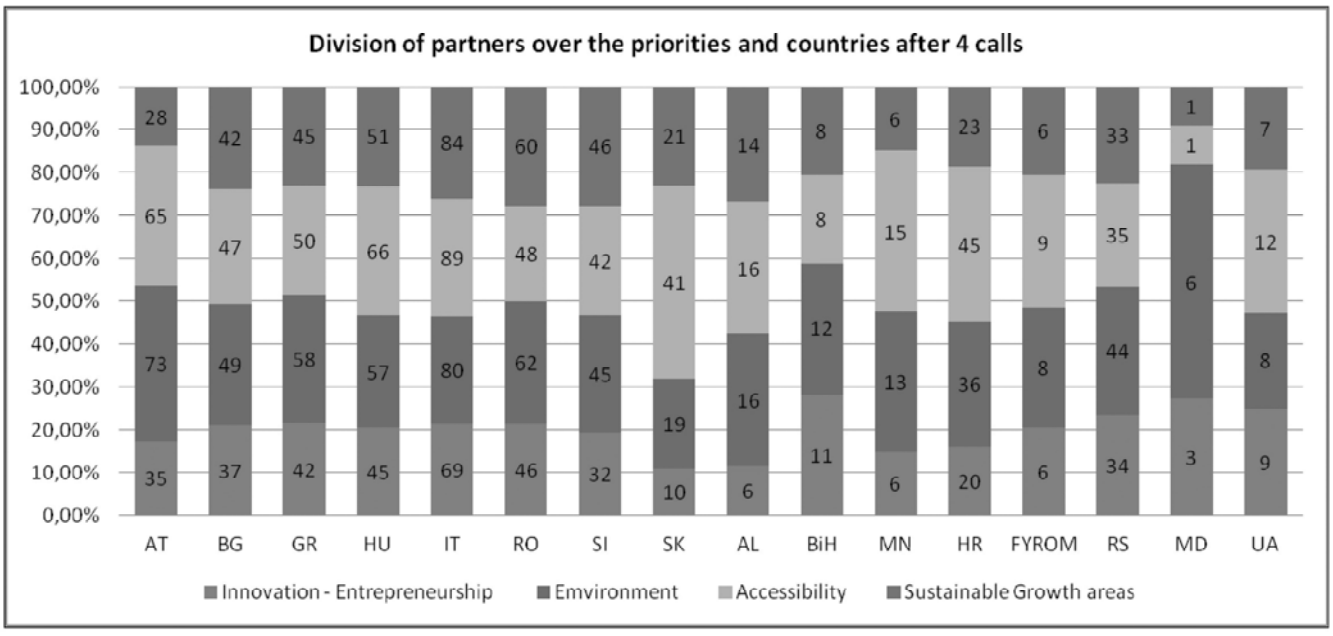

Figure 3. Division of partners over the priorities and countries after four calls
Source: South East Europe, Transnational Programme, 2013, Own Calculation

Table 7. The geographical distribution of lead partners in actual numbers and numbers per million habitants after 4 calls

COUNTRIES	LEAD PARTNER	Population (millions)	LP/million population	PARTNERS	Project partners/million Population
AT	17	8.4	2.0	201	23.9
BG	1	7.3	0.1	175	23.9
GR	17	10.8	1.6	195	18.0
HU	17	9.9	1.7	219	22.1
IT	44	60	0,7	322	5,3
RO	7	19	0.3	216	11.3
SI	15	2	7.5	165	82.5
SK	3	5.4	0.5	91	16.8
AL	0	3.6	0	52	14.4
BiH	0	3.8	0	39	10.2
MN	0	0.625	0	40	64
HR	0	4.3	0	124	28.8
FYROM	0	2	0	29	14.5
RS	0	7.1	0	146	20.5
MD	0	3.5	0	11	3.1
UA	0	44.8	0	36	0.8
TOTAL	121	192.5	0.6	2061	10.7

Source: South East Europe, Transnational Cooperation Programme, 2013, Own Calculation

Table 8. Distribution of EU funding over priority axes and intervention areas

PRIORITIES	Number of projects All calls	ERDF	IPA	ENPI	EU FUNDING (ERDF+IPA+ENPI)	% of projects	% of total EU Funding
1.1	7	11,030,443	1,018,902	106,722	12,156,067	5.8	5.3
1.2	13	18,276,753	1,938,860	0	20,215,613	10.7	8.9
1.3	11	17,013,360	2,183,029	0	19,196,389	9.1	8.8
Total 1	31	46,320,556	5,140,791	106,722	51,568,069	25.6	23.0
2.1	5	13,279,700	1,217,326	0	14,497,026	4.1	6.4
2.2	10	17,170,819	2,641,459	100,350	19,912,628	8.2	8.8
2.3	6	11,333,719	875,154	0	12,208,873	5.1	5.4
2.4	13	18,894,249	2,164,182	0	21,058,431	10.7	9.4
Total 2	34	60,678,487	6,898,121	100,350	67,676,958	28.1	30.0
3.1	11	21,136,419	1,112,341	105,076	22,353,836	9.1	10.0
3.2	8	9,691,070	1,583,358	108,240	11,382,668	6.6	5.0
3.3	6	14,249,066	2,809,662	166,345	17,225,073	5.0	7.6
Total 3	25	45,076,555	5,505,361	374,661	50,956,577	20.7	22.6
4.1	11	18,979,461	1,664,324	0	20,643,785	9.1	9.1
4.2	9	15,997,177	1,618,891	0	17,616,068	7.4	7.8
4.3	11	15,359,327	1,445,604	0	16,804,931	9.1	7.5
Total 4	31	50,335,965	4,728,819	0	55,064,784	25.6	24.4
TOTAL EU Funding	121	202,411,563	22,273,092	491,733	225,176,388	100	100

Source: South East Europe, Transnational Cooperation Programme, 2013, Own Calculation

Table 8 shows that there is rather an equal split in EU funding over the priority axes and the areas of intervention. PA2 (Environment) absorbs 30% of the total funds, but is the only axe with four areas of intervention. The highest percentage of the distributed funds in the area intervention 3.1 (Improve integrated water management and flood risk prevention). The weakest contribution is in the areas of intervention 3.2 (Develop strategies to tackle the 'digital divide'), 1.1 (Develop technology and innovation networks in specific fields) and 2.3 (Promote cooperation in management of natural assets and protected areas).

MAIN RESULTS OF THE PROGRAMME

The main results and the output indicators of the SEE Programme may be considered very sufficient (Ecorys 2011; and 2012). The programme motivated and involved more than 2000 beneficiaries in 121 projects, more or less covering all eligible countries and regions and all priority axes. It promotes cooperation and dialogue among different types of countries (member states, IPA and ENPI countries). All important public institutions (ministries, regional and local authorities, universities, research centres and NGOs) participate in the approved projects, and in this way they build a wide network of cooperation in the region. The exchange of experiences, the dialogue between representatives from different nations and cultures, the solution of cross-border problems and the creation of alliances have increased the transnational added value of the programme. Through partnership, exchange of good practices, innovative and integrated approaches, institutional changes and harmonization, the projects are contributing to transnational integration and supporting national policies in the fields of innovation, investment, environment, accessibility, and urban and regional development. The programme enables harmonization of structures and the tackling of common problems. It also enables candidate, potential candidate and associated countries to become familiar with EU funds and procedures and helps them prepare for accession. It is difficult to assess the exact output of the programme and its contribution to transnational cooperation because very few projects are finished. For better integration of the SEE countries, it is necessary to encourage better involvement of IPA and ENPI countries and the implementation of macro-regional strategies and projects.

The programme management system is

working properly, but there are some problems in implementation, such as complex procedures, delays in contracting, complicated procedures for the funding of IPA and ENPI countries and different first-level control processes in each country (Ecorys, 2012). Changes of partnership, budget reallocation and project extensions have a negative influence on the implementation.

Different levels of experience, knowledge, cultures and technical backgrounds cause delays in contracting and starting projects. The most experienced member states have stronger participation as lead partners. The financial crisis has had a negative impact on ensuring national co-financing and the involvement of stakeholders forms the administration and the economy.

CONCLUSIONS AND RECOMMENDATIONS

The SEE Programme is the most complex transnational programme in Europe. The programme covers the largest cooperation area of all programmes and promotes the cooperation of sixteen (16) very diverse countries. The above analysis has shown that the programme motivated and involved more than 2000 beneficiaries in 121 projects. But certain countries, especially IPA and ENPI countries have a weak contribution. The countries which are involved in most projects are Romania, Hungary, Italy, Bulgaria, Greece, Slovenia, Austria, Croatia and Serbia. Regarding the thematic scope of the programme, the presentation of the projects demonstrated a rather balanced allocation of the projects over the four priority axes. In general, the bodies of the programme management system are working well and the results of the programme are as expected. There is an important added value in transnational cooperation and geographical links.

According to the proposals and policy recommendations of the European Commission for the Cohesion Policy 2014–2020, transnational cooperation programmes will continue to exist in order to strengthen cooperation by means of actions conducive to integrated territorial development linked to the Union's cohesion policy priorities and its strategy of smart, sustainable and inclusive growth (Europe 2020). Transnational cooperation may cover regions from third countries covered by the external financial instruments of the Union, such as ENI and IPA (Article 3 of draft ETC regulation). The thematic objectives shall be concentrated on a maximum of four objectives and the investment priority for transnational cooperation is the 'development and implementation of macro-regional and sea-basin strategies (within the thematic objective of enhancing institutional capacity and an efficient public administration)' (Article 6 of draft ETC regulation).

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REGIONAL CHARACTERISTICS OF INDIVIDUAL HOUSING UNITS IN SERBIA FROM THE ASPECT OF APPLIED BUILDING TECHNOLOGIES

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Individual housing units in Serbia have been studied from the aspect of applied technical solutions. Analyzed data have been collected during a field research in accordance with the current administrative regional division, and they represent a basis for definition of regional typology of individual housing units. Characteristic types of objects of each region's typology have been further analyzed. Upon these analyses regional characteristics of individual housing units regarding applied construction types, building technologies and materials have been defined and presented.

***Key words:** individual housing units, regional characteristics, typology, building technology.*

INTRODUCTION

The basis for the research presented in this paper has been defined throughout several projects conducted by the team of faculty members and associates from the Faculty of Architecture in Belgrade. These projects have resulted in the establishment of the research methodology for creating the national typology of residential building stock. Part of the data collected in the process of defining the national typology serve as the basis for the research of the influences of regional characteristics on the characteristics of individual housing units from the aspect of applied building technologies. The term *individual housing unit* equals to the term *family dwelling* and refers to buildings that in their composition have mostly one and at most four independent residential units within a singular building.

The theoretical basis of this research lies in theories of regionalism. The paper establishes the thesis that through analyses of regional characteristics such as climate, geography, relief, and demographics, but also including historical, economic, political and cultural aspects, one can examine the connections of architecture of the region's individual housing units, its applied technology, construction and materials.

RESEARCH METHODOLOGY

The chosen methodology upon which the typology was developed is the one presented within the international project TABULA[2], which was defined for Serbia through a research project of Energy Efficiency of buildings (Jovanović Popović *et al.*, 2011). This methodology defines characteristic building types, by construction period and performances related to architecture and urban design (layout on the lot or within a building development, the relations to the surrounding buildings, etc). The total number of 21 types is defined. In order to obtain relevant data for the typology, an independent, expert statistical survey was designed. The data required for the typology were defined and questionnaires were prepared in cooperation with the experts. The study considered questions related to the utilization of lofts and basements, types of windows, volumetric characteristics of the buildings, and the percentage of window surfaces on the facades. The survey utilized the existing administrative division of Serbia into 6 regions (without Kosovo), defined as: East, West, Central, Southeast, North Serbia and Belgrade. The in-field inventory of the buildings was planned as two-fold. The first stage included approximately 6,200 buildings; there were 432 starting points; 16 buildings were entered against each starting point. The second stage included approximately 1,200 buildings. The first stage (Phase A) contained general-type questions that did not necessitate direct contact with the tenants, whereas the second stage (Phase B) was more detailed and required the tenants' cooperation.

Part of the results (related to individual housing units) of this thorough and significant research have been published recently (Jovanović Popović *et al.* 2012). Some of the

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[2] TABULA - Typology Approach for Building Stock Energy Assessment, http://www.building-typology.eu/

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primary data analyses dealing with building characteristics are considered very important for the research presented in this paper:

- most of the residential block construction took place after World War II and lasted until the 1980s, when more than a half of the total residential building stock in Serbia was built,
- most common type of dwelling in Serbia is the detached single-family house, which comprises almost 90% of the total building stock, taking into account the *number* and not the *area* of the buildings.

Among other general conclusions from the survey are those that refer to the insufficient level of applied thermal insulation (84% of buildings lack any thermal insulation in walls, 87% in roofs), number of incomplete facades, or most common window type (wide or narrow double-window casings, over 50% older than 30 years).

In addressing the issues of regionalism, the research relies on the reference literature, from Vitruvius and architecture defined by geography (Petrović, 2002), Bernard Rudofsky's theory of unrehearsed regional architecture created by anonymous authors (Rudofsky, 1976), including the modern set of practices incorporated in Vincent Canizaro's book (Canizaro, 2007).

REGIONAL CHARACTERISTICS

West Serbia

The region of West Serbia is composed of three districts: Mačva, Kolubara and Zlatibor (the largest district in Serbia), and represents the most diverse among all analyzed regions in terms of its climate, geography and demographics.

Characteristics of the region

This region is characterized by low population density, ranging from 44.45 inh/km² in Zlatibor district to 91.12 inh/km² in Mačva. Depopulation is one of the fundamental problems in this region, as a consequence of contemporary lifestyle and economic and political conditions (last census showed depopulation rate of 13.6%). Rural settlements are dominantly prevailing in all districts (around 95% of the total number of settlements are rural).

The relief of the region ranges from low fertile land around rivers in Mačva district, to a slightly hilly landscape of Kolubara district and mountainous landscape of Zlatibor, which is rich in woods and wood material, used as a significant element of local regional architecture. Consequently, climate also differs throughout the region. Temperate continental climate is prevailing in Kolubara region, while mountainous climate is characteristic for Zlatibor district and Pannonian climate in Mačva, with large temperature variations throughout the year. From these differences in relief and climate regional differences in local architecture have emerged. Therefore, the architecture of individual housing units in Mačva resembles the architecture of Vojvodina, while regional characteristics of Kolubara district are similar to those in Central Serbia. The district of Zlatibor has certain predispositions that significantly affect local architecture – climate conditions and abundance of wood as local material. However, small building density of this district led to the lost of representatives of this mountainous building types in the overall survey data.

Processed data analysis

Most (48.43%) of the surveyed buildings were built during the 1970s and 1980s, followed by the period between 1946 and 1970 (23.62%). The 1990s were characterized by reduced intensity of construction (11.36% of the total number of buildings was built then), and less than 5% of residential buildings were built in the first decade of the 21st century. In all construction periods, type of the free-standing house is absolutely predominant. From totally 21 theoretical types 12 were identified in the region of West Serbia, and the predominant one is shown in Figure 1.

Figure 1. Representative of some of the predominant individual housing unit types in West Serbia region (statistically), a free standing house built in the 1970s

Collected data analysis - building characteristics

Greater variety in building types and difference between urban and rural buildings, as well as greater sensitivity to local conditions is present in buildings dating from the first half of the 20th century. Regional characteristics in terms of building technologies and applied materials are obvious in older buildings, but since the 1960s almost all local features of town and country houses in the region have been lost. Although examples of apparent local influences exist throughout the region, their number is irrelevant for the survey data. Older buildings in rural areas display variations of wattle and daub constructions, while town houses from the same periods are built of solid materials. Brick wall of 38cm thickness is the most common type of solid wall for construction in the first half of the 20th century. Although timber is an omnipresent local material, no timber houses appear in the data specimen. However, timber is in vast use as a secondary building material, as well as the predominant material for roof construction. The inner-story floors and ceiling construction towards the attic in older houses is also mostly wooden. Buildings from the second half of the 20th century were built mostly of brick, while in the 1970s and 1980s cellular clay blocks and *Siporex* blocks came into wider use. The floors are usually full concrete slabs, or a variation of semi-prefabricated structures with clay block infill. Over the last few decades of the 20th century, there was sporadic application of insulating materials within façade walls, but most buildings do not meet current requirements in terms of thermal comfort.

Central Serbia

Central Serbia includes four districts: Šumadija, Moravica, Rasina and Raška.

Characteristics of the region

This region contains 1,035 settlements, of which 24 are urban, which indicates evident domination of rural settlements. Highest population density in this region is in Šumadija district (121.8 inh/km²).

This region has a rich history. It was the territory of the first Serbian state in the 9th century, and the center of the medieval kingdom. Under the Ottoman Empire it was the central merchant road between Asia Minor and Bosnia and a main Ottoman merchant center in Europe.

Relief of this region is not compact but interspersed with many valleys, bends and gorges which enables deeper breakthrough of air masses in their directions and causes climate of temperate continental characteristics, except in the mountains (Kopaonik). Also, the Pešter limestone plateau, in the altitude of up to 1200 m, has a distinctive micro climate, characterized by very cold winters (Ducić, Radovanović, 2005). The lowest temperature in Serbia, -39.5°C was recorded here.

As the survey results show, the most intensive period of construction overlaps with the period of economic and production development of this region, from the end of World War II (WWII) until the 1990s. Favorable geographic position and relief caused the development of the main road route through Serbia (Ibarska magistrala), which influenced the further development of rural settlements and their transformation into small towns (Spasić and Petrić, 2006). Rich cultural history and development of several tourist centers (like Kopaonik and Vrnjačka Banja) also contributed the rapid development and building activity in the entire region.

Processed data analysis

In consequence of World War I (WWI) and WWII, as well as the fact that the region was even more rural in the past, there were less than 7% of buildings identified as dating before 1945. In terms of construction periods, the prevalence rate indicates that most buildings in the region were built between 1946 and 1970, but the most active period of construction was the following decade (24%).Construction activity in the following periods depicts the overall historic and socio-economic circumstances in Serbia, and it drops to approximately 17.5% and continues to decrease. Free standing units prevail in all periods of construction. In this region 13 types of single-family houses were identified, and selected types are shown in Figures 2a and 2b.

Figures 2a. and 2b. Representatives of the least (a) and the most (b) common individual housing unit types in Central Serbia region (statistically): (a) a house built in 1905 (b) a house built in 1955

Collected data analysis- building characteristics

The traditional construction solutions (rammed earth, post and petrail, logs, etc.) can be found in an insignificant number of buildings and were hence excluded from the survey. Among houses dating from the first half of the 20th century elements of style can be found, which are being preserved by contemporary reconstructions. Massive type of construction is prevailing in all periods of construction. Walls are predominantly made of brick (thickness ranging from 25-45 cm) and clay blocks. Roof construction is wooden, with clay roof tiling. Construction of inter-story floor slabs varies from wooden (found in houses built before WWII) to massive concrete or semi-prefabricated concrete and clay block slabs. Characteristic form of lofts, known as *karatavan* is found in older houses, characterized by the slab construction made of wood beams and planks covered with soil above and straw and plaster ceiling below. Loft area formed in this way can be used for storage, but usually has no function except to create a buffer zone towards the roof construction and improve thermal comfort. Windows are wooden with two single-pane sashes in a wide casement and wooden blinds. Also, compact floor plan and low ratio of façade openings characterizes houses from all construction periods and is even more expressed in newly built houses. Houses built before1980s do not have any thermal insulation, and since then its application started modestly. Also, a significant number of houses used for dwelling, mostly built after 1980s, do not have the finished façade.

Southeast Serbia

Southeast Serbia includes five administrative districts: Nišavski, Toplički, Pirotski, Jablanički and Pčinjski district.

Characteristics of the region

Southeast Serbia is characterized by low density, with climax in Pirot (only 33.4 inh/km^2). Throughout the region villages are predominant over cities (1,465 villages in total), and they are grouped close to the main district centers (Niš, Prokuplje, Pirot, Leskovac and Vranje).

The relief of this region is compact, and as in most parts of Serbia continental climate is prevailing, with the exception of the cities of Niš and Leskovac, which have the characteristics of steppe climate (Ducić and Radovanović, 2005).

The development of regional architecture of the area is influenced by rich historical past. This is a region that for centuries constituted the main transit route, linking the west of the continent to its south and southeast, and on to Asia. Today, this equally important connecting transversal, through which a highway E-75 overpasses, contributes to the specific economic development of the region in which the third largest city in Serbia, Niš, is located. In this region also, the conditions for the construction of new individual dwellings have been created after WWII, and although a large number of units was built before, many destructive wars and unstable history of the country had caused their destruction. Years of active construction of the housing stock of Yugoslavia, including this region, is the period of its growth, economic and political power, and is considered to be after 1946 (especially after the fifties and early sixties when the rate of industrial growth and rapid development of Yugoslavia was among the fastest in the world) (Štraus, 1991), until the 1990s and the disintegration of Yugoslavia.

Processed data analysis

Most of the surveyed buildings were built in the period between 1946 and 1970 (even 82%). Much less objects were built during the 1990s (10%) because of the unstable political and economic situation in the country, similar to the period of WWI and WWII (only 8.2%). As much as 49.8% of analyzed houses are found in the rural environment, which explains significant presence of single family houses (even 86.19%) in the analyzed model and confirms the region's rural character. From totally 21 theoretical types 19 were identified, and their representatives are shown in Figures 3a and 3b.

Figures 3a. and 3b. Representatives of the least (a) and the most (b) common individual housing unit types in Southeast Serbia region (statistically): (a) a house built before 1918 (b) a house built in 1958

Collected data analysis- building characteristics

The traditional individual housing units in the rural environment of the region, built before the 1950s, were so-called *čatmare*. The construction of these objects was a combination of wooden skeleton (such as in post-and-petrail buildings) and earth infill, by traditional building technique such as wattle-and-daub. Although construction of houses in these traditional ways gave way to massive construction after WWII, these houses still exist and some are in exceptionally good condition.

The main material in massive construction for walls was brick and other clay products, dominantly for walls, but also for slab construction. Floor construction is very similar to those in other regions of Serbia, at first made from wooden structures, and later from the new types of concrete slabs or ribbed structures (including complex ribbed structures such as *Avramenko* ribbed slab, mostly used in construction of larger multi-family buildings). Windows are dominantly wooden, with exterior blinds, and of rather small size. Also, as in other regions, thermal properties of houses built after the appearance of first thermal regulations are not satisfying, and often have no thermal insulation applied.

East Serbia

This region occupies the area of five administrative districts: Podunavski, Pomoravski, Braničevski, Borski and Zaječar district.

Characteristics of the region

The region is characterized by the rivers of Danube and Morava to the northern and western edge, the Carpathian mountain range in central, and the Negotinska Krajina depression in the far southeast of its territory.

Most districts (except Podunavlje district) have low population density (around 56 inh/km^2) due to specific economic and geopolitical situation. The region is predominantly rural in character, with many villages and only 20% percent of the urbanized territory.

Continental climate prevails on the whole territory of the region. The exception is Negotinska Krajina, where due to the specific geographic location and impact of the surrounding mountain ranges, climate takes form of a special local character, manifested through extreme temperatures throughout the year. Precipitation is uniform throughout the year, with a slight increase in intensity during spring and summer (Ducić and Radovanović, 2005).

The richest parts of the territory in terms of history and culture can be found along the watercourses of the Danube, where there are numerous remains dating from Roman, and even from the prehistoric period (back to 6,500 BC). The formation of the first Slavic settlements dates from the early 5th century. The culmination of immigration and settlement construction is associated with the formation of the first Serbian state (end of the 5th century). Since then, turbulent history was first characterized by constant struggle for dominance over this territory between Serbs, Hungarians and Bulgarians, and then the rule of the Great Ottoman Empire (from the 15th until the late 18th century). The liberation from the Turks and the proclamation of the Serbian government finally came in 1867.

Processed data analysis

Most houses (35%) were built between 1946 and 1970, while the least represented were the houses built before 1919 (mere 0.20%). Also, construction intensity in family housing decreased dramatically since 1980s, which explains the overall data that more than 90% of all units were built before 1990.With regard to the defined housing typology, free standing houses have the absolute prevalence in the region (98.65% of the sample). Most buildings of this type are clustered around major cities. From totally 21 theoretical types 13 were identified in this region, of which selected types are shown in Figures 4a and 4b .

Figures 4a. and.4b. Representatives of the least (a) and the most (b) common individual housing unit types in East Serbia region (statistically): (a) a house built after 2001 (b) a house built between 1946 and 1970

Collected data analysis – building characteristics

Similar to the previous region, traditional building techniques, such as post-and-petrail with wattle and daub infill, characterized houses built before WWII, especially in rural areas., of which some are still in good condition and partially used for living. Later on, dominant building material becomes brick, used for massive wall construction (25-38 cm thick), and replaced by hollow clay blocks in the last few decades. Also, regarding the inter-floor slabs, in older houses wooden construction was widely used, with characteristic earthen infill in the floor to roof slab, forming the characteristic form of attic construction, present also in other regions of Serbia. These constructions are also replaced by reinforced concrete slabs as well as semi-prefabricated constructions with hollow clay infill. The façade openings are mostly double sashes with single panes, which, although outdated, can be considered much more efficient than the classic single sash window. Most buildings, regardless of the period of construction, still have no, or very little thermal insulation applied.

Vojvodina

Geographically, this area is divided by rivers Danube, Sava and Tisa into Srem, Banat and Bačka districts, which are further subdivided.

Characteristics of the region

Terrain is mostly low-altitude, with the exception of two mountainous elevations: Fruška Gora in the north of Srem and Vršački Breg to the south-east of Banat. The region's wealth in rivers, the Danube water potential and the possibility of a strategic alliance with the dominant points of Europe, have enabled its continuous development. Also, large amounts of clay impose its use for the construction purposes. It is important to note that, although the second largest city in Serbia, Novi Sad, is located in Vojvodina, rural settlements prevail in relation to the urban ones.

A moderate continental climate prevails in Vojvodina. Disposition of precipitation has the characteristics of the Central European, Danubian regime with an uneven monthly distribution. The southeastern wind *košava*, northern and southern winds are typical for this area.

The region is rich in history that dates back to the Paleolithic period. Throughout history it has been under the rule of the Kingdom of Hungary, the Ottoman and Austro-Hungarian Empire. It is during the last one that the planning organization of urban and rural

settlements was set, which caused the emergence of typological group of row houses. Another crucial period which clearly influenced the shaping of regional architecture in Vojvodina is its constitution as the Socialist Autonomous Province by the Yugoslav Constitution of 1974. Throughout this period, after WWII to the 1980s, an increase in the number of constructed objects is noted.

Processed data analysis

The main characteristic that distinguishes housing units of Vojvodina from the other regions is a significant percentage of row houses (15.53%). This has emerged as a direct result of regional influences, the already mentioned urban planning of the Austro-Hungarians. The other significant characteristic is the fact that far more objects than in the other regions were built before 1919 and in the interwar period (24.14% that exist today). However, most of the surveyed buildings were built in the periods between 1946 and 1980 (even 79%). This is a direct consequence of the already explained socio-economic situation in that period. From totally 21 theoretical types all 21 were identified in Vojvodina (representatives shown in Figures 5a and 5b).

Figures 5a. and 5b. Some of the least (a) and the most (b) common individual housing unit types in Vojvodina region (statistically): (a) a house built in 1990s (b) a house built in 1925

Collected data analysis- building characteristics

Buildings built in the earlier periods (before 1919 and until WWII) were constructed by traditional building techniques and materials such as rammed earth (rammed clay) and unbaked loam brick, mainly in rural environment but also in urban ones. In this, the connection to the region's natural aspects and its traditional architecture is visible. As much as 31% out of Vojvodina's present housing stock accounts for houses built in traditional techniques using rammed earth or unbaked brick (less frequently, baked brick). These houses are single-story, with the attic space that was not used for living, with the ceiling made from wooden structures and rammed earth on top, similar to the characteristic attic form of *karatavan* in Central Serbia.

After WWII, changes in materials are evident. The most common material in this period is baked brick, and later hollow clay block. Floor constructions to unheated roof are still made from wooden structures, but from the 1970s the new types of concrete slabs or ribbed structures are used. The most common material for roof covering is tile, flat pepper-tile on buildings dating before 1945 and grooved tile on the newer ones.

Generally, thermal insulation is applied on houses built in last 20 years, but could be traced even earlier, with the subsequent installation of thermal insulation in older buildings that were built after 1945 with massive brick walls. The ones built earlier, with clay and adobe walls have good thermal storage capacity, and natural regulation of indoor moisture, and therefore do not need additional insulation for achieving satisfactory thermal comfort.

Belgrade

Belgrade is an independent territorial unit of local government consisting of 17 municipalities. In this research it is singled out as an independent region for its specific political, cultural, economic and social development, and because of that its regional characteristics of architecture and construction methods cannot fully be identified with any other region in Serbia. There have been previous researches of Belgrade building stock (Jovanović Popović *et al.*, 2007), but they were mostly dealing with buildings for collective housing.

Characteristics of the region

Today the city is a center of political power, culture, tourism and international transportation hub. The average population density is 508.87 inh/km^2. The climate of this area is moderate continental (with the strong periodical *košava* wind), and its relief is diverse.

The oldest traces of settlement in the Belgrade area date from the Neolithic period (7,000 years BC). Its strategic position in the Balkans, on the banks of rivers Sava and Danube, has led to the development of numerous turbulent historical moments. Belgrade was first mentioned as a fortified settlement *(Singidunum)* in 279 BC, and later it was an edge city of the Byzantine Empire. Serbian rule over Belgrade begins in 1284. Finally, Belgrade became the capital of Serbia since the establishment of the Kingdom, in 1882.

What distinguishes Belgrade from other five regions is the strong influence of architectural styles and movements in all of its periods of construction, affecting significantly the individual housing architecture. In the beginning of the 20th century architecture was based on ideas about the revival of the nation. The period after WWI can be considered as a period of intensive building. Changes that occurred much later, after WWII, during the 1960s, caused by high economic growth and the inflow of money in the former Yugoslavia, are evident. This resulted in a sudden increase in construction, with the main objective of achieving multiplicity and high capacity of new objects. The state began to invest in large-scale projects, building new parts of the city, like New Belgrade. It is inevitable that the Conference of Yugoslav architects in Dubrovnik (1950), which marked the end of socialistic style domination (Štraus, 1991), was a crucial point for the development of author-based architecture of the 1960s. In the following period (1970s) of false economic prosperity of Yugoslavia, with a large number of foreign borrowings (Štraus, 1991), one can analyze mature critical position facing the elements of traditional values in Serbian architecture.

Last observed period covered by this survey is the period after the disintegration of Yugoslavia in the 1990s and important political changes in Serbia after 2000. This interval is marked by numerous social, political and economic instabilities in the country.

Processed data analysis

Free standing units also prevail in Belgrade region (95.61%). The largest number of units was built between 1946 and 1970 (31.03%), while number of buildings built in the next three decades is similar (around 17% per each). Only 0.31% of survey specimen is dating before WWI, and another 12.22% from the inter-war period, which is direct consequence of the turbulent and devastating history. In the last decade only 6.27% of units were built, which can be explained by the unfavorable socio-political and economic situation, but also by the fact that large number of individual housing units is being replaced by multifamily

buildings. From totally 21 theoretical types 15 were identified, of which the most common is shown in Figure 6.

Figure 6. The most common individual housing unit type in Belgrade region (statistically): a free standing house built between 1946 and 1970

Collected data analysis – building characteristics

The main difference between characteristics of Belgrade region in terms of construction techniques and materialization compared to other regions is that massive building techniques are used throughout all periods of construction, including the oldest ones. Here not only brick (which still prevails), but also stone and concrete massive construction assemblies appear. Inter-story slabs found in older houses are mainly concrete ribbed and wooden, while in the last few decades concrete slabs and partially prefabricated slabs with clay block infill dominate. Roofs are dominantly pitched, with wooden construction and clay coverings, and flat roofs are rare even in cubic form houses (pitched roof is hidden behind wall endings). In houses built before the 1990s windows are mostly wooden with two single-pane sashes in a wide casement or double single-pane sashes with exterior blinds, while newer houses have thermal glazing in PVC or wooden single frames. Since 1980s thermal insulation can be found sporadically applied, but units with satisfying thermal properties are still rare.

CONCLUSIONS

Based on the analysis of selected building types and characteristic of place several key conclusions can be drawn. Natural aspects of the regions significantly influenced the building technology and materialization until the period of massive housing construction in the post war periods. Since then, unification of construction technologies and applied materials is omnipresent. By the statistical data, in this period (1946-1980) the greatest part of Serbian individual housing stock was built. Typology analyses show that the most common type of individual housing units is the free-standing house, while row houses exist in negligible number in all regions, except in Vojvodina.

Throughout all regions, the dominant building material is brick, used for massive wall construction (usually 38 cm thick), replaced by hollow clay blocks in the last few decades. Wooden construction for inter-floor slabs is widely used in older houses, replaced by reinforced concrete slabs as well as semi-prefabricated constructions with hollow clay infill in later periods. Roof construction is wooden almost in all cases, with clay roof tiling. Windows are rather small in size, with the assembly made of wooden double sashes with single panes and exterior blinds. Nowadays, this type is replaced by thermal insulating glass with diverse frame structure. Most buildings, regardless of the period of construction, still have no, or very little thermal insulation applied.

By tracing theories of regionalism in architecture (from Vitruvius statement that architecture is originally defined by geography to contemporary theories in which regionalism is defined by borders of region) this paper comes to conclusion that in the presented regions of Serbia, in addition to geographical features, the historical, economic and cultural aspects had the most profound effects on the regional characteristics of the architecture of individual housing units in Serbia. But those influences are most visible on those houses built until WWII, when it appears that architecture was more defined by place.

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EVALUATION OF THE CAPACITY DEVELOPMENT OF ACTORS WITHIN PARTICIPATORY PLANNING PROCESS

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This paper focuses on measuring the capacity development within the participatory planning process of formulation of development strategy. It starts with the discussion of how individual, collaborative and governance capacities became a part of collaborative and consensus planning, and continues with proposing the mixed method approach. Quantitative methods have been used to measure the level of satisfaction/dissatisfaction that participatory approach had on the actors. Evaluation has shown significant increase in actors' capacities during the planning process. Qualitative methods aim to reach understanding of the actors' perception of the results of the participatory planning process they were engaged in. Local actors recognized results as the following: opportunity for gaining a new knowledge, understanding of problems, importance of information and cooperation exchange, recognition of 'others', capability for evaluation of plans, understanding of different roles and responsibilities, importance of team work and bundling of knowledge from different sources in problem solving, and collective action and interaction. Thus, the participatory planning holds potential as a continual process of developing the capacities of actors.

***Key words:** capacity development of actors, participatory planning, mixed method approach.*

INTRODUCTION

One of the first examples of the participatory planning in Serbia is the City of Niš Development Strategy (plan). The planning process was carried out under the SIRP UN-HABITAT Programme in 2007/08. This process served as a practice case study for measuring development of participants' capacities. Capacity development was monitored on a selected group of actors. It was analyzed based on the assessment of the training and workshops, and later through the actors' statements.

Why do we pay attention to capacity development? Since 2000 a huge number of aid programs were implemented in Serbia, and most of them with the main goal to foster capacity development. Except a small number, the majority of the planning professionals were excluded from these initiatives. Almost 10 years later, Vujošević (2010) finds the overall situation characterized by the 'lack of policies, necessity to renew the collapsed strategic thinking, research and governance and to introduce new development policy approach'.

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With this in mind, this paper represents an effort to answer some of the opened research questions within the field of the actors' capacity development in the participatory planning process.

PARTICIPATORY PLANNING APPROACH

Collaborative planning/governance has adopted the planning approach which emphasizes learning, interdependency of actions, as well as the relation between short-term and long-term effects (Healey, 1997). In its ideal form it is realized through the application of strategic planning characterized by participation. As Vujošević (2004) puts it, participatory planning is 'based on the principles of balanced division of governance and planning power, decentralization and subsidiarity'.

Participatory planning process is a process where planners, politicians, administration and public mutually learn. Within the given environment, a value system of an individual evolves as a social construct – it is formed through exchange, acceptance of other forms of knowledge, types of experience and different ways of informing. One of the preconditions for an effective participatory planning process is that participation cannot be introduced without prior capacity building of the actors through ensuring required level of understanding, knowledge and skills.

Forester (1999) finds participatory planning processes to transform and change relations and identity of the actors (through capacity development, changes in behavior and development of networks), problems and priorities, as well as perception of values and results of a planning process. Within the participatory process actors learn about each other. They change themselves and create new relations as the basis for their further mutual work. The final goal of the exchange and acceptance of ideas, knowledge and skills is to enable their practical application.

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The author was Municipal Support Coordinator and Project Manager for the Niš Development Strategy under SIRP UN-HABITAT Programme in Serbia (2005-2009).

The participatory planning process aims at feasible agreements, but there are also some other meaningful results which could be obtained – a planning process could have an impact on changes regarding actors and actions, establishment of new relations, new practice, new ideas. The promotion of participation aims at drawing attention to differences, understanding of the others and their possibilities in shared environment, where the agreement on common values is desirable (Forester, 1999). The changes manifested in the development of capacities and social relations are perceived as a result of learning. Participation leads to knowledge enhancement and as such represents an instrument of capacity development.

Table 1. Capacity development through collaborative planning

Individual capacities	Collaborative (institutional) capacities	Governance capacities
– knowledge and ideas – skills – problem understanding – implication of actions – understanding of others – creative ideas – self-knowledge ability – cooperation skills – initiative skills	– strengthening discussion capability – communication and cooperation establishment skills – conflict solving – respecting the others – planning – developing and evaluating plans – coalition building – understanding different roles and responsibilities	– bundling of knowledge from different sources in problem solving and option management – collective action and interaction

Note: Adapted from Forester (1999), Healey (2004, 2007), Innes & Booher (2003, 2004)

CAPACITY DEVELOPMENT IN PLANNING

The processes of socialization and communication in planning encourage participants to identify a subject of common interest, recognize positions of their own interest and interest of the others, define problems and goals, use and improve their knowledge, reflect and manage different proposals, create ideas how to turn the proposed solutions into practice (Healey, 1997). Capacity development of actors/institutions is considered – in addition to the behaviour changes and network development – as the most important effect of learning in participatory planning (Forester, 1999). The process of learning through capacity development affects the creation of new environment where the actors cooperate in a way in order to solve problems, prevent conflicts and act more effectively. At the same time, capacity development does not include only skills and practical experiences, but it covers broader domains that include new topics and ideas, as well as establishment of a governance culture (Healey, 2006).

Within the literature on the capacity building within planning, there is a significant interest in the dimensions of individual capacities (Forester, 1999; Argyris, Schon, 1996; Foster-Fishman *et al*, 2001; Booher, Innes, 2004); institutional, collaborative, relational – also known as social – capacities (Healey, 2004; Innes, Booher, 2003) as well as capacities of a community to steer its development – governance capacities (Innes & Booher, 2003; Healey, 2007). However, it should be mentioned that the capacities should not be treated as an absolute, but as a relative quality (Innes, Booher, 2003).

Capacity development (of an individual, organization, institution or a governance system) through collaborative planning is possible to achieve if an organized, innovative and adaptable environment is created (Innes & Booher, 2003). The precondition for that is to propose the ground rules of the collaborative planning processes, which include collaboration and dialogue between different actors and stakeholders, and implementation of collective actions that are in line with public interest issues and policies.

The paper presents an analysis of a case study on actors' capacity development within the participatory planning process. The intention was to isolate and measure the development of individual, collaborative and governance capacities. Individual capacities come first because capability of a system depends on the capacities of an individual with her/his knowledge and ideas, skills, problem understanding, action implication, understanding of others (and their interests) in a process which enables them to broaden their knowledge through collaboration. Collaborative capacities are being developed through collaborative planning where the enhancement of the capability for discussion helps addressing the conflict of interest. Collaborative capacities can be skills of individuals to develop new knowledge, but also the good communication skills, knowledge about possible conflicts, having the respect for others, understanding how to plan and evaluate programmes and plans, how to build coalitions, and how to understand different roles and responsibilities. Finally, governance capacities are characterized by collective action and interaction of different actors, using the knowledge and professional competence of all actors in problem solving or management of possible options.

MIXED METHOD APPROACH

The mixed method approach to data collection and analysis is applied, which aims to 'better connect research to the people being studied and to better help address their concerns' (Sanford *et al*, 2013). What this means is that the research is based on both deductive and inductive considerations. Deductive considerations relate to the theory of communicative rationality and are subjected to empirical scrutiny by being translated into operational terms (Bryman, 2012), in this case participatory planning. With this in mind, the research is directed towards investigating if and how the participative planning process affects the actors' capacity development. The findings should confirm or reject the given hypothesis and therefore deductive circle would be completed. However, the confirmation of the hypothesis does not completely fulfill the aim of this research which also seeks for the framework that could examine the extent and nature of the capacity development of actors. In other words, it also seeks for the qualitative enquiry of the relation capacity development – participatory planning. Therefore, in terms of the epistemological considerations, this research looks for both understandings and explanations which can be reached through mixed method approach (Sanford *et al.*, 2013).

Nevertheless, the critiques related to mixed method approach are concerned that oppositely different epistemological grounds cannot provide a study that responds to the criteria of social research. However, the goal of mixed method research is 'not to replace either of these approaches but rather to draw from the strengths and minimize the weaknesses of both single research studies' (Johnson & Onwuegbuzie, 2004). Quantitative methods in this research have been used to measure the level of satisfaction/dissatisfaction that participatory approach had on the actors, as well as to address the nature of changes occurred as a result of the capacity development (or lack of development), while qualitative methods aim to reach understanding of the actors' perception of the results of the participatory planning process they were engaged with.

ACTORS

Capacity development within the process of developing the plan was followed in the group of actors which participated in the process. The sample consisted of about 30 participants i.e. those who were continuously and directly involved in the planning process – members of the Working Group, Working Team and Development Council. The Development Council was the project management board, consisting of representatives of political parties, city boroughs and NGOs. The Working Group consisted of representatives of the Mayor's office, local administration and public enterprises, the Economic Chamber, financial and banking sector, NGOs, media and public institutions, with the task to provide professional support. The members of the Working Team were professionals from the University of Niš and the City Planning Institute.

A wider group of important stakeholders was identified by the participants themselves. These included the representatives of public enterprises, small and medium enterprises, banks, professional associations, cultural and sport organizations, civic associations, distinguished individuals. They are not included in this analysis.

EVALUATION MODEL

The evaluation model was based on the application of principles aiming at collaborative capacities' adaptability assessment. The principles for assessment of collaborative capacities' adaptability enable evaluation of measurable and non-measurable effects. Those are usually achieved agreements, establishment of new relations and institutionalization of practice, rules and behaviours initiated in such processes (Innes & Booher, 2000, 2003). The overall criteria consist of the process and outcome criteria of collaborative planning. This research relies on the principles of the research of American planners J. E. Innes *et al.* (2006), who – on the basis of empirical research – proposed the framework for evaluation of collaborative planning. Subsuming their reflections, Innes & Booher (1999a) point out at the process and result (outcome) criteria of the collaborative-consensus planning. The following are considered as quality and Important results of collaborative planning: achieving high quality agreements, better chances of their execution, measurable and non-measurable results, establishing the principle of inseparability between process and outcome of planning, learning and change.

The application of qualitative and quantitative indicators served to monitor changes in capacity development. In this case, the quantitative indicators open the possibility to examine and measure certain parameters, but not a complete, in-depth understanding of complex social and individual behaviour changes characteristic for participatory process within the local context. When the goal is to define the quality and character of participation as well as the way it is used, this research uses qualitative indicators.

Table 2. Proposed model of indicators for capacity development evaluation

Quantitative indicators/output indicators	Qualitative indicators/outcome indicators	Qualitative indicators/impact indicators
– establishing new social structures / institutions (forums, networks, workshops) – number of actors directly participating in planning process – frequency / repetition of meetings and workshops – number of meeting participants – distribution of key conclusions	– common values acceptance level – level of willingness of individuals to cooperate in the accomplishment of group tasks – new insights and exchange of new insights on problems – developing innovative strategies – changes in relations between the actors – building trust within the group – establishing mutual understanding – enhancing quality and quantity of the data used by participants – change of practice in participating organizations – new networks and relations	– new values and communication standards – cooperation between organizations and representative groups

The contribution of participation is expressed within the following dimensions: consideration of the variety of interests, confirmation of and 'ownership' over the decisions made, enhanced effectiveness, understanding of issues, strengthening of capacities, better information flow, and more. The choice of indicators is based on the given dimensions. Within development programmes, the indicators are mainly used for monitoring and evaluation as: output, outcome and impact indicators (Čolić, 2009). The output indicators refer to the visible and externally recognizable results, while the outcome indicators represent a 'real proof that the process makes a difference' (Čolić *et al.*, 2014). The impact indicators, on the other hand, are in line with the long-term effect. Those indicators are presented in the Table 2.

The capacity development in the participatory planning process was analyzed on the basis of assessment of the training and teamwork in the workshops, assessment of capacity development (evaluation of changes) and statements of the participants.

Trainings and workshops

The learning process needs to be supported by the training and workshops that involve actors, as the possibility for the application is not preconditioned. In this chapter the assessment of the trainings and teamwork in the workshops is presented. The statements of participants have informative role, and their main purpose is illustration and understanding of the process, but they are not subject of overall evaluation.

The training itself represents an initial point of change of behavior of the actors as well as the improvement of the capabilities to apply the knowledge. Preparatory trainings were performed on the topics of communication, conflict management and participatory planning (Čolić *et al.*, 2008:133). Comparison of the results points out at the most significant elements of the capacity development, which refer to the increase in the knowledge and skills, the level of understanding of matters and the level of the improvement at work.

Additionally, the first part of the workshops were specialised technical training sessions that contained the method to face each step of the process, which was then applied in participatory workshop (Čolić *et al.*, 2008:134). The specialised trainings included: SWOT analysis, territorial marketing, budgeting, prioritization, and the EU project formulation (Čolić *et al.*, 2008:122). The workshops were evaluated by the actors. They covered the topics of actor's perceptions of the level of understanding of the workshops, useful elements and inputs that might affect their current practice, their previous experience and skills, insights into the possibility to improve the participatory process, and more. The dimensions that were recognized as the most significant are: 'teamwork', 'presentation of different examples', 'practical assignments', 'practice as the way to learn', 'active participation', 'discussion and interaction of opinions', 'possibility for practical engagement with the new skills'.

Evaluation of the actors' capacity development

Evaluation of changes on the level of capacity development on two occasions provides the data through the following indicators: common values acceptance level; level of willingness of individuals to cooperate in the accomplishment of group tasks; increased knowledge and understanding of the process; new insights and exchange of new insights into problems; developing innovative strategies; changes in relations between the actors; building trust within the group; establishing mutual understanding; enhancing quality and quantity of the data used by participants; change of practice in participating organizations; new networks and relations; new values and communication standards; cooperation between organizations and representative groups.

In order to provide the validity of the comparative analysis the quantification of the participant's responses is presented as a numeration of alternatives (0, 1, 2, 3), but also in percentage form. This part of the research was conducted after the draft plan was made (after six months of working together with the actors), and then six months after the plan has been adopted. Table 3 provides an overview of the changes in attitudes of actors towards the given indicators.

Table 3 shows the following:

- An average value of increase in actors' capacities was marked with 73%;
- Analysis indicates the simultaneous importance of: Individual capacities – increased knowledge and understanding of the process (83%) and the level of willingness of individuals to cooperate in the accomplishment of group tasks (79%); Collaborative capacities – establishing mutual understanding (79%), common values acceptance level (78%) and the new values and communication standards establishing (78%); and Governance capacities – new networks and relations (72%) and cooperation between organizations and representative groups (72%);
- After the first evaluation the data has shown that the capacity development rates from 1.93 to 2.35, and the next evaluation has shown the different numeration of the categories. Increased knowledge and understanding of the process was marked with 2.48 (83%), and compared to the previous evaluation it increased by 10%. Changes in relations between the actors increased by 19%. Significant change represents the support for the developing innovative strategies, which increased by 18%. The highest rates are the level of willingness of individuals to cooperate in the accomplishment of group tasks (increased by 5%), establishing mutual understanding (increased by 22%) and common values acceptance level (increased by 10%). Building trust within the group, together with the changes in relations between the actors, represents the lowest marked dimension on the whole scale, increased by 5%. Final stages of the planning process show decrease in the dimension of the insights and exchange of new insights into problems from 64% to 59%, enhancing quality and quantity of the data used by participants from 78% to 70%, as well as the influence on change of practice in participating organizations from 77% to 65%. This was expected since the planning process was finished.

Table 3. Evaluation scale for the capacity development changes

Indicators/dimensions	19/07/2007.		28/05/2008.	
	a.m.	%	a.m.	%
common values acceptance level	2.32	77%	2.33	78%
level of willingness of individuals to cooperate in the accomplishment of group tasks	2.22	74%	2.37	79%
increased knowledge and understanding of the process	2.25	75%	2.48	83%
new insights and exchange of new insights into problems	1.93	64%	1.96	59%
developing innovative strategies	1.96	65%	2.29	76%
changes in relations between the actors	1.83	61%	2.14	72%
building trust within the group	1.96	65%	2.03	68%
establishing mutual understanding	1.86	62%	2.37	79%
enhancing quality and quantity of the data used by participants	2.35	78%	2.10	70%
change of practice in participating organizations	2.32	77%	1.96	65%
new networks and relations	2.12	70%	2.15	72%
new values and communication standards	2.12	70%	2.33	78%
cooperation between organizations and representative groups	2.12	70%	2.15	72%
	Average value 73%			

Although the numerical statements do not represent the absolute values, quantification has been used to measure the level of satisfaction that participatory approach had on the actors – its' increase and decrease, as well as to address the nature of changes that occurred.

Actors' statements

As part of the same survey the actors expressed their opinion on the way how they see the results of the participatory effort. The gained practical experience proved to be an impetus and encouragement for their views.

Local actors recognized results as the following: opportunity for gaining a new knowledge, understanding of problems, importance of information and cooperation exchange, recognition of 'others', capability for evaluation of plans, understanding of different roles and responsibilities, importance of team work and bundling of knowledge from different sources in problem solving, and finally, collective action and interaction. In the following chapters they are grouped as individual, collaborative and governance capacities.

As an important result of the process the new '... knowledge about strategic plan ...', and '... the possibilities of financing the implementation of the plan ...' has been recognized. Through the opinion that the participatory process enabled '…focus on urban issues…', an overview of '…the weaknesses (economic, institutional and governance…', but as well '…the opportunities for solving the problems…', the understanding of the problems has been shown. One of the interviewed actors recognized this as '… amended philosophy of thinking about the development of the city …'. The importance of information and cooperation exchange has been expressed through the following view: '…cooperation of individuals and institutions enabled exchange of data and increase in knowledge…'.

Increased capacities for dialogue have been recognized through '…better understanding of common attitudes and different opinions…' and '…communication improvement…'. Establishment of cooperation contributes to it, and one of the interviewed actors saw it as '…one of the most important results…' because '… some did not even know each other, and here they were working together in the common interest …'. The process enabled '…connection of the people interested in city development…', '…gathering wide team of experts, different institutions, which usually work in separated, sector manner, and in

the future, while working on implementation of the plan, they will commonly contribute to city development…'. Involvement of '…others…' – '…kids, students, youth, marginalized groups…', means recognition and respect of 'others' as well. Regarding the conflict resolution it was noted that '…instead of quarrelling, the political parties have finally started to think uniquely about problem solving …'. One of the interviewed actors stressed that the result of the process is '…confirmation of the statement that strategic planning is prerequisite and the right way for dynamic urban development…', the method that enables '…defining of proper measures…', '…base for urban planning, sector strategies and action plans…'. The process enabled building of coalitions and understanding of different roles and responsibilities while '…focusing organizations and institutions on each other…', and '…initiating the creative process in which the priority is not political belonging, but legitimacy and building of citizens' trust…'.

Ability to bundle knowledge from different sources has been recognized through '...establishment of the team of actors with different qualifications, who commonly deliberate and work on strategy implementation...'. The process itself '...connected people, strengthened the awareness of the need for common, synergic work... ', and '...led to different thinking on city future...'. Collective action and interaction enabled '...the start of depoliticization of urban governance...'.

The qualitative inquiry into the actors' perceptions of the results of the participatory planning aims to engage with the in-depth understanding of how they (actors) perceive the changes in their capacity development, but also how they recognize the different types of capacities. Initial stages of the research point out the improvement of the individual and collaborative capacities of actors, while later stages highlight better understanding of the governance capacities too.

CONCLUSIONS

This research represents an example of applying the mixed method approach to the evaluation of the capacity development changes within the participatory planning process of the formulation of Niš Development Strategy. The outcomes of this particular case confirm the generally accepted principle on how the participatory process increases actors' capacities. Besides the initial step of the trainings, by far most of the capacity development was achieved through the team and group work under participatory engagement.

Evaluation has shown increase in actors' capacities during the planning process by 73%. This research also aims at understanding the nature of capacities. Apart from the individual capacities, the analysis looks at the collaborative and governance capacities that are developed and enhanced through the collaborative strategic planning and represent a precondition for the urban governance. Results have shown that the actors gained new knowledge and ideas about the development. They improved the communication and conflict resolving skills, and upgraded the group decision making. They also understood the benefits of the team and group work and the importance of exchange of information and different knowledge, the significance of diversity of opinions and attitudes, the value of consensus and the possibility for public dialogue.

This case has also shown the importance of trainings, especially when the new methods/instruments are to be tested. But for changes of capacities, the practical experience through common work is needed, because it represents the basis for exchange of knowledge, while dialogue is an incentive for scrutinizing the actions that provide new insights and innovation. This is the field of participatory planning, which holds potential as a continual process of developing the capacities of actors.

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BERLIN MITTE: ALEXANDERPLATZ AND FRIEDRICHSTAßE. URBAN AND HISTORICAL IMAGES

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Berlin Mitte is one of the most interesting parts of the city, located in the core of Berlin where every corner and stone can tell a story. Mitte, the cultural center of Berlin is also known as the political and economic hub of Berlin. This paper explores the urban and historical image of two important parts of Berlin Mitte district: Alexanderplatz and Friedrichstaße. Friedrichstraße, as the main shopping and business street in this area, was planned with great attention by Prussian authorities, while the area around Alexanderplatz grew up randomly and its streets did not follow any special urban patterns. All potential international investors wanted to come to Friedrichstraße after the fall of the Wall, while Alexanderplatz was not so attractive to them. Many famous architects took part in numerous competitions regarding urban planning reconstructions of the famous Alex throughout the 20th century. These two areas of the Mitte district, Alexanderplatz and Friedrichstaße, are very important for contemporary Berlin and both areas have different problems.

***Key words:** architectural history, urban history, Alexanderplatz, Friedrichstraße, Berlin Mitte, Berlin, post-Wall Berlin.*

INTRODUCTION

Both a western and eastern European city, Berlin is situated in the heart of Europe, 70 km from the Polish border. The city, with around 3.4 million inhabitants, is the largest in Germany and has been the new capital since 1991. During the 20th century the city endured many changes: the 1918 revolution and the successful Weimar period in the 1920s, then the Nazi takeover in 1933 which was followed by the darkest period in Berlin's whole history, the destruction of the city during World War II, followed by the division of the city in 1945 (after World War II Berlin was divided into two cities after the agreement between the Allies in 1949; the Berlin wall divided the city into West Berlin and East Berlin from 1961) and its reunification in 1990 after the Wall fell down.

After reunification, Berlin experienced a new period of urban redevelopment in which many new buildings were constructed, with the former center of East Berlin, Berlin Mitte, being the district with the highest number of buildings sites. The commercial sector developed very fast, especially at Potsdamer Platz, where new offices, luxury apartments, cinemas and restaurants emerged. Once empty land, Potsdamer Platz turned into the biggest building site in Europe, and became home to a new $5 billion business and entertainment center, the 16 building Daimler-Benz/Debis complex and Sony's European headquarters (Till, 2005).

Among the many new projects from that time, some of the most important are the new parliament buildings and federal government complex, the reconstructed historical Reichstag, a number of new embassy buildings and extensive financial and corporate headquarters. All this is a consequence of the relocation of power from Bonn to Berlin (Whyte, 2007). Mies van der Rohe, Alvar Aalto, Le Corbusier, Walter Gropius, Norman Foster, Frank Gehry, Arata Isozaki, Rafael Moneo, Renzo Piano, Rem Koolhaas and Richard Rogers are some of the famous architectural names who left their signature on Berlin.

Berlin has the status of European center of arts and design. Since Berlin's traditional cultural center was in the area around Unter den Linden Boulevard, and this part of the city fell on the East Berlin side of the wall, the West Berlin authorities created new cultural institutions in their part of the town. In order to compensate for this absence, the Deutsche Opera was created as the equivalent of the State Opera, whereas Mies van der Rohe's New National Gallery served as their alternative to the old national museums which were left in the east side of the city. After the unification, all these institutions were kept (Arandjelovic and Bogunovich, 2014).

New Berlin simplicity of Hans Stimmann

According to Till, 'in 1991 the Berlin Senate created a new position called city architect and appointed Hans Stimmann to handpick expert commissions that judged the numerous architectural and development competitions in the city' (Till, 2005: 45). Stimmann had immense power during the period of reconstruction in the emerging new Berlin and was known for supporting a planning approach of critical reconstruction, called the 'new simplicity'. This position was something new in Berlin and announced changes in the urban development of the city. Both a trained architect and powerful bureaucrat, Stimmann wanted to regulate building materials, the sizes of parcels and to control all forms of new urban development, whilst also promoting a contemporary vision of Berlin as a traditional European city. Stimmann aimed to promote an architectural style that resembled old Berlin, high restrained stone buildings without curved surfaces. He was also responsible for the Pariser Platz redevelopment, as well as the reconstruction of Friedrichstraße (Goldberger, 1995). Many of the new projects in Berlin

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really reflect these ideas. The offices in the Friedrichstraße area are a good example of that, all having the suggested roofline.

BERLIN MITTE

Berlin is one of the most vibrant modern cities and Mitte is an important part of it. Since reunification, Berlin has become the epicenter of the contemporary art scene. During World War II Mitte was the most heavily destroyed city district with 54% of the housing destroyed (Cobbers, 2011); it is also the location where the city division was most apparent. Mitte hosts Berlin's government offices and is home to the monumental Reichstag building. The spectacular strip of federal government buildings on the River Spree bank spreads north from the Reichstag building. This complex includes the Federal Chancellery, a monumental 36 meter high Federal building that contains the Chancellor and state Ministers' offices, as well as conference and cabinet rooms. The building stands in the middle of the governmental buildings complex. Then, there is the Paul Löbe building hosting the offices for members of parliament, and also the Marie Elisabeth Lüders building right across the river. The master plan for the complex of governmental buildings was made by architects Axel Schultes and Charlotte Frank from 1997 to 2000. Their task was to reconstruct the whole area around the meander of the Spree, an area previously destroyed during WWII. The only building left after the WWII destruction was the Swiss Embassy. With this new concept, this part of the Tiergarden regained importance. There is empty space between the Chancellery and the Löbe building. This space was planned for the Forum building, the building planned for the public, and the only building not realized after the master plan by Schultes and Frank.

Most of the recently built corporate buildings are located on sites of the former East-West Block confrontation, Potsdamer Platz and Friedrichstraße, part of the Mitte district.

There are many historical attractions located in Mitte. First and foremost is the famous Berlin landmark, the Brandenburg Gate, built between 1788 and 1791 at Pariser Platz in the neighborhood of the Reichstag and the federal parliament complex, reconstructed and reopened again in 1989 after the fall of the Wall. Heavily damaged in World War II, the Brandenburg Gate was the only object left at the historic Pariser Platz, at the end of Berlin's impressive boulevard Unter den Linden.

Mitte, a 50 km^2 district located in the core of the city, is the most densely populated Berlin district with a population of approximately 320,000 citizens (the translation of the German word Mitte is center or middle). Mitte is rich in green space, which covers around 17% of the district´s surface. The huge Tiergarden, an important element of the city, is also part of the Mitte district (OECD, 2003).

Mitte is famed for its culture scene rich with numerous trendy cafes, movie theaters, art galleries and institutions, and has been compared to the New York art district SoHo. The art scene emerged from renovated historical residential blocks in Mitte. Some of the most well-known are Hackesche, Sophien and Gips Höfe (Till, 35). Mitte is also home to the prestigious and traditional cultural institutions in Berlin, such as the Schauspielhaus, the Deutsches Theater, the Staatsoper and all five great museum buildings located in the Museum Island. The oldest museum is the Schinkel's Altes Museum built in the mid-1820s, while the newest one is the Pergamon Museum completed in 1930 (Whyte, 2007). Humbolt University, situated in Mitte on Unter den Linden boulevard, is the oldest University in Berlin (1810).

Mitte, the first area to be gentrified after reunification, is characterized by its fusion of 18th and 19th century apartments, new modern buildings and GRD Plattenbauten objects. One of the examples of the old-new fusion is the five-story building of the Koch Oberhuber Wolff Gallery in Brunnenstraße, built in 2009 (this area of Brunnenstraße was the first area to be reconstructed after the Wall came down). The unusually colorful façade is a mix of aluminum and glass surfaces and is situated between two older houses. What was once a post war gap, today is an effective modern fusion.

One of the symbols of the post-wall artistic transformation that occurred in Mitte is the Tacheles Art House, situated on the corner of Oranienburger Strasse and Friedrichstrasse. This city area was a Jewish quarter in the past (this building was a former department store). This

Figure 1. The building of Koch Oberhuber Wolff Gallery in Brunnenstraße in Berlin Mitte.
Source: Biljana Aranđelović

Figure 2. The Tacheles Art House in Berlin Mitte.
Source: Biljana Aranđelović

Mitte neighborhood is known as the art district and includes Auguststrasse, Linienstrasse and Sophienstrasse. During the 1990s the Tacheles building was squatted in by artists and turned into a cult art place. After negotiations with the city council, a deliberate decision was made to conserve the partially crumbling façades and the dilapidated original staircase in their condition of decay. Around 60% of the building is currently used by tourists (Richter, 2010). There are future plans for the Tacheles building reconstruction which are all connected with commercial business usage.

Two very important parts of the Berlin Mitte district are Alexanderplatz and Friedrichstaße.

FRIEDRICHSTRAßE: THE HISTORY AND RECONSTRUCTION

The Friedrichstadt area urban renewal, with Friedrichstraße as its central core, aroused much less public attention and discussion than the Potsdamer Platz renewal process. The first capital reconstruction projects started in 1996, before the Daimler complex construction works at Potsdamer Platz began. Contrary to the huge public polemics that followed the Potsdamer Platz reconstruction process, the redevelopment process in Friedrichstradt area went without any great problems and was finished relatively quickly. One of the reasons for this is that the East Berlin Magistrat had already started with negotiations on several projects before reunification. Not all of the initial projects from that period were realized in the end, but this definitely sped up some of them.

Elizabeth Strom in *Building the New Berlin* writes about Friedrichstadt as 'one of the older parts of the city, added during 17th and 18th century expansions of the urban core where much of the old inner city was long dominated by two-storied apartment houses and then, during the 19th century, developed much more intensively with five to six-storied buildings, rear houses, and side wings. As Berlin became an increasingly important financial and industrial capital following Germany's 1871 unification, Friedrichstadt, and in particular Friedrichstraße, emerged as the center of tertiary economic activity. Although the southern part of Friedrichstadt, located in the district of Kreuzberg, is still characterized by a mixture of residential and commercial uses, the heart of the area, and the part of the neighborhood most under redevelopment pressure now, had long lost its residential character' (Strom, 2001:200).

The Friedrichstadt area didn't have the fame of Alexanderplatz as there was a lack of open spaces which would attract more visitors to come and enjoy the boulevard. The only exception was the Gendarmenmarket square. The fusion of apartments with business buildings was featured in this area, as the urban policy of the GDR demanded. Even with this, all international developers and clients who were planning to come to Berlin after the reunification wanted to have their offices in this area. To have an address in Friedrichstraße was very prestigious and the demand for offices was enormous. Demand by international investors to build only in this area resulted in making Friedrichstraße the most expensive real estate in the whole of Germany for a couple of years after unification.

One of the reasons for the great popularity of Friedrichstraße is its centrality, as it lies between Alexanderplatz and Potsdamer Platz, two very important city points. Also, the street is connected with more than one underground line, thus easily reachable from other parts of the city. Not less important is the fact that several national ministries are located in the neighborhood, which made this street very attractive after the capital was moved from Bonn to Berlin, bringing together all the power and administration that this demands. The important French department store company Galleries Lafayette wanted to build a block in this street.

The capacity of the city officials to control and direct development has been limited. One of the reasons for this is that this area has been the subject of some of the most legally complicated property claim issues in the city. The development of Friedrichstadt has been determined by the changes in national laws regarding expropriated property restoration to its former owners.

As with other parts of the inner city, this area was also mostly neglected by the GDR government. This situation was present until the 1980s when the national building authorities began to pay attention to inner city reconstruction. The national government made an ambitious plan for Friedrichstraße reconstruction as soon as the Wall fell down. One of the most attractive locations for the renovation was the famous Grand Hotel, located on Friedrichstraße and Under den Linden. This location, now called Friedrichstadt Passage, embraced a monumental three-square-block complex with numerous cafes, an office complex, stores and a theater, all connected by elevated sidewalks along the narrow streets. With this, the new Berlin's downtown was born. Hans Stimmann, the city architect in charge of the urban development in the post-wall period, made some recommendations, an urban guide, for Friedrichstadt competitions with the aim of developing a physical profile similar to the Berlin of the past. Accordingly, he suggested building materials and maximum heights that would be in the harmony with the rest of the city structure. One of the city center development requirements concerned the typical Berlin traditional block, a mix of commercial and residential use. The inner city development needed to include 20% housing (Strom, 2001).

One of the main contemporary Berlin tourist attractions of this area is the Checkpoint Charlie, the former border crossing between the two divided sides during the period from 1961 to 1990. The Checkpoint Charlie had a historical role in the divided city as the main entrance and the departure point to East Berlin for non-Germans, diplomats and journalists who had permission to enter East Berlin on a day visa. Today, at this former Berlin border stands a huge luminous box, an art project entitled Ohne Titel/Without Title made by artist Frank Thiel in 1998, commissioned by the Department for City Development. The Department's aim was to make art projects at the seven former borders in

Figure 3. Art project Ohne Titel/Without Title at Checkpoint Charlie in Berlin Mitte.
Source: Biljana Arandelović

Berlin. The Checkpoint Charlie was one of them. This project of light boxes with dimensions of 3.20 x 2.5 m is definitely the most successful of its kind and attracts the biggest number of tourist (Dickel, 2003).

ALEXANDERPLATZ: THE HISTORY AND RECONSTRUCTION

Alexanderplatz has been changed many times during its history. This pedestrian quarter is separated from the rest of the area by wide streets and a network of underground pedestrian tunnels made to connect the square with the train station and the buildings across the surrounding streets. With the exception of the two Peter Behrens buildings from the 1930s, the square is surrounded by typical DDR fifteen-story office buildings. The highest structure in Berlin, built in 1968, is the 368 m high Television Tower standing behind the train station. This structure, designed by Hermann Henselmann and Jörg Streitpart, is not only dominant in Alexanderplatz, but is also visible from almost every part of Berlin. It was the peak project of the New International architecture of the Alexanderplatz area in the 1960s and is the most important landmark of the former East Berlin. The purpose of its high structure, which is impossible not to be seen from almost all central parts of the town, was to remind those in West Berlin that they were surrounded by the East German State (Cobbers, 2011).

The iconic Alexanderplatz is one of the major city squares named to honor Alexander I, Tsar of Russia on the occasion of his Berlin visit. The square, known for short as Alex, is an important part of Berlin's history. During the second half of the 19th century Alexanderplatz was transformed into a significant transit junction and shopping area. The S-Bahn, the surface rail network, was constructed in 1882 while the underground was constructed in 1913.

In the post war period it became a typical socialist urban square and was considered to be the center of East Berlin. In November 1989 it was the place of important demonstrations. Here at the square, people gathered under the famous Weltzeituhr (the World Time Clock constructed in 1969 was a popular meeting point in East Berlin and showed the time in major world cities).

Alexanderplatz was a symbol of life in DDR, a favorite place to hang out, but after the fall of the Wall, it lost its significance. As a result, a lot of restaurants popular in the East Berlin era were closed and the central square fountain was left dry because of the lack of maintenance funds. After the unification, things changed when it became a gathering place for punk rockers. Over half of all crimes reported in Mitte happened in the area around Alexanderplatz (OECD, 2003).

Figure 4. Television Tower at Alexanderplatz in Berlin Mitte.
Source: Biljana Aranđelović

Figure 5. Mural Unser Leben at Alexanderplatz in Berlin Mitte.
Source: Biljana Aranđelović

One of the remains of East Berlin is the Unser Leben (Our Lives) mural on the façade of The Haus des Lehrers (House of Teachers, Department of Education) located in Alexanderplatz. This mural is the work of famous DDR Socialist Realist artist Walter Womacka and was made in 1964. Here, as in the other Socialist Realist art works, the communist society is glorified and various demonstrations of ordinary people's lives in the DDR are displayed. This monumental mural is well preserved today after being restored in recent years (Treeck, 1999).

After the fall of the Wall, Alexanderplatz, considered as one of Berlin's most important centers, was redeveloped, together with other areas of Berlin. This redevelopment included the former department store Centrum Warenhaus, the largest department store in the DDR, which has now been transformed by modernization. The reconstruction of well-known buildings such as the Stadt Berlin hotel (a 123 m tall hotel), the Haus des Lehrers (The House of Teachers), The House of Travel and the publishing house building (today Berliner

Zeitung) had the aim of making this square competitive with West Berlin.

An important figure in the Alexanderplatz urban development was Senator Hassemer, who did not prioritize Alexanderplatz projects immediately after the unification. Actually, until the end of 1992, there was no mention of Alexanderplatz in the city newspapers or official Senat for Urban Development publications. As written in *Urban Renaissance Berlin: Towards an Integrated Strategy for Social Cohesion and Economic Development*: 'Many of the buildings around Alexanderplatz had been headquarters for GDR Kombinate and associations, the property of which was administered by the THA Treuhandanstalt after reunification. As some Alex properties were sold as part of a large business package, the THA had almost total autonomy in determining property ownership patterns at Alexanderplatz. There were seven major private investors controlling the real estate at Alexanderplatz. Most of these investors bought properties from the Treuhand. In three cases, West German businesses bought out entire East German enterprises, and the property at Alexanderplatz was part of the package. The West German retailer Kaufhof entered into a partnership with the GDR Centrum-Warenhaus, with its flagship store at Alexanderplatz, just before currency union in 1990 and later took over the chain' (OECD, 2003:209).

Berlin Senator Hassemer played an important role in Alexanderplatz urban development projects in the period after unification. His idea was organizing a planning competition for the area, similar to the one held at Potsdamer Platz, where architects would be invited to bring their ideas for Alexanderplatz development. The difference with the planning process at Potsdamer Platz was that here, the major area investors were included as part of the competition jury. This idea was to avoid possible negative public discussion and the embarrassment that happened in Potsdamer Platz when the investors were not satisfied with the final results and commissioned other architects to the projects. The Alexanderplatz competition involved 14 invited architects in 1992.

'The winning scheme, by Kollhoff & Timmermann, envisages nine towers, each 150 meters high, which emerge from podium buildings that conform to the so-called Berlin line, namely city blocks of five to six stories with cornices at thirty meters. This is a compromise between the desire to reassert the street pattern and the spatial qualities of the old city, as in Friedrichstrasse, and the desire of the investor for high blocks and large rental incomes' (Whyte, 2007: 225). The chosen project invoked huge public controversy as too many high-rise building were planned by Kollhoff and most of the investors changed their plan. None of the owners were in a hurry to build the skyscrapers as the real estate market was declining. Part of the project has been realized, but the urban redevelopment process for Alexanderplatz has not yet been completed.

CONCLUSIONS

The nucleus of East Berlin before the Wall came down, Alexanderplatz, is a large public space surrounded with tall office buildings and the Television Tower, also enclosed by widespread typical East Berlin apartment complexes. It is definitely an area whose future development was not easily defined by the city planners. For some people, the lack of a clear idea for Alexanderplatz development is the main reason why this area never attracted investors in the way that Potsdamer Platz or Friedrichstraße did.

During the period when Berlin was divided, Alexanderplatz was a famous attraction for East German tourists coming to Berlin. After the unification, when West Berlin became reachable, the role of Alexanderplatz changed a lot. At the same time, when Potsdamer Platz and Friedrichstraße greatly changed their look, Alexanderplatz stayed more or less the same, with some adaptations and reconstruction, but was definitely far away from being competitive with Potsdamer Platz and Friedrichstraße, both previously on the same side of the Wall. Alexanderplatz is one of the rare central Berlin spots that look familiar to the visitors who haven't been to Berlin for a long time. We can conclude that keeping the old look is not always a bad decision and that it might bring positive effects. What the future development of Alexanderplatz will bring to Berlin citizens, and who will prevail in the corporate high-rise struggle, only time will tell.

Friedrichstraße, the other Berlin hotspot in Mitte, has a different problem. As many major projects were completed at the end of the 1990s, when the real estate request in Berlin had fallen drastically, many buildings remained half empty. This consequently led to investors facing the problem of much lower rents than originally anticipated. In addition, some residents that had rented the spaces earlier (one of them being the French department store Galeries Lafayette) were asking for lower rent as they knew that investors would not want to gamble with losing them. A good example of this is the Friedrichstradt Passage, where almost half of the space was not rented, much less than investor projections. The problem of real estate in Friedrichstraße is just one of many problems in Berlin.

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TEACHING METHOD: 'INTEGRATIVE URBAN DESIGN GAME' FOR SOFT URBAN REGENERATION

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Urban regeneration is challenged by contradictory process of globalization. This double-sided process can enrich local communities or leave them at margins of global society. Regarding globalization, most authorities claim that urban planning and design are in paradigm crisis. The crisis is an announcement for paradigm shift that is in contemporary theoretical and conceptual frameworks. They give hope for the 'light at the end of the tunnel'. Their common groundings are: 'soft and hard infrastructure'; 'agencies and structures'; 'power to'; 'new rationality', 'common sense'; 'communicative action'; and 'integrative development'. The purpose of the research is to discuss possibilities of teaching method 'Integrative urban design game' for soft urban regeneration, elaborating it with respect to the crisis in specific context of building bridges among academia and local communities regarding various teaching approaches. The method was innovated at the Faculty of Architecture in Belgrade and tested in Bač community. The hypothesis is that the method provides soft infrastructure for urban regeneration in local communities. The research will result in a form of principles the game should be grounded on, using participative mimicry model of present and future place for overcoming paradigm crisis. Methodological approach is based on theoretical comparison, case study, and questionnaires among stakeholders.

***Key words:** innovative methods in teaching and training; urban regeneration; local community.*

INTRODUCTION: GLOBALIZATION AND URBAN PARADIGM CRISIS

Global society is colored by plural and multidimensional networks that reflect two sides of globalization: inclusive and exclusive (Печујлић, 2003; Castells, 2000). According to Castells, being out of the network is like living in a 'local cage' without any opportunity to revel in positive aspects of globalization. This new kind of network is both a main threat and an opportunity for local cultures and communities. They can be enriched or become victims of global cultural, economic, and social melting pot (Castells, 2000; Castells, 2004). Double-sided globalization process produces positive impacts such as cultural, economic, social development and innovation, as well as negative ones such as segregation, social, cultural, and economic degradation (Castells, 2004). As urban space is a product of wider social one (Lefebvre, 1991), the process of globalization is reflected in urban life and urban paradigms.

With regard to globalization, most authorities agree that we are now in urban paradigm crisis, and according to Kuhn, the problems outreach the known and solid theories (Kuhn, 1970). The main issue is that globalization shrinks spatial-temporal dimension mixing different rationalities, paradigms, cultures, and societies. The varieties of rationalities we are facing are with open questions of their hierarchy, legality, and ethical integration. According to Vujošević (2004), there are many rationalities such as instrumental, quasi-instrumental, communicative, quasi-communicative, collaborative, ecological, political, etc. The specific problem is in local capacity building regarding raising knowledge for soft infrastructure in urban regeneration using innovative teaching methods with regard to tailor-made process according to local community urban regenerating profile. Therefore, urban experts should work on margins of their profession, covering different disciplines in finding solutions for Castells' 'new rationality' (Castells, 2004), Forester's, Harevey's, and Jacobs's 'common sense' (Forester, 1989; Harvey, 2007; Jacobs, 1992), and Habermas' 'communicative consensus' (Habermas, 1984). This requires new methods in teaching to provide future young experts with knowledge and skills to 'turn on' right paradigm at 'appropriate time' empowering local communities to tackle with globalization. Here, I refer to 'power to' rather than 'power over' (Dovey, 1999). This kind of empowering should be provided by professionals who know how to transfer new knowledge to practitioners, initiating positive change.

'New rationality' is a process of integrating universal and particular values /rationalities/ into coherent unity. Nowadays, this process of modernization is possible by creating 'project identity' and establishing means for achieving it. According to Castells, 'project identity' is a process where individuals and atomized societies become subjects and bonded communities with specific identities based on vision, aims, and strategies to achieve it (Castells, 2004). Castells (2004) and Giddens (2003) believe that an individual or a group is characterized by lack of specific identity or self/awareness in contrast to subjects, agents, and agencies. Regarding local

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communities, 'project identity' needs participation, inclusiveness, and developing Healey's 'soft infrastructure' for overcoming barriers in open communication. Soft infrastructure is a network of agents and agencies that enable participative process to flow in visionary direction towards common sense (Healey, 1997). Common sense is a kind of new unity that is achievable using soft infrastructure for Habermas' 'communicative consensus' (Habermas, 1984). Communicative consensus is a notion in line with integrative rationalization of community. This means the space of intersubjectivity, where all rationalities can be clarified and understood to bond them into common sense or new rationality with added value as glue for all the others.

Therefore, this research will discuss different urban paradigms to define their integrative potentialities for urban regeneration. This will be a topic of first section, where systematization of the integrative elements will result in positioning new betterment in urban regeneration. Also, the comparison of various paradigms will be used to prove that integrative urban regeneration can be 'a light at the end of the tunnel'. If this is proven, then innovative methods in teaching and training are needed to create 'new rationality'. I believe that innovative methods must be integrative, dynamic, and inclusive to provide Castells' 'project identity' (Castells, 2004). Also, the methods should favor a process of place making, providing Haeley's 'soft infrastructure' (Healey, 1997), 'glocal places,' and 'glocal identity' (Mrđenović *et al.*, 2011a; Reeves, 2005). This will be the topic of the second section, where the process and results of 'Integrative urban design game'[2] will be presented (Mrđenović, 2010a). The results will be analyzed using case study as well as questionnaires among stakeholders. Also, it will discuss impacts that the method had in developing 'soft infrastructure' with definition of its principles. The principles should enable the game's applicability in different urban contexts and provide development of academic curricula.

INTEGRATIVE URBAN REGENERATION: 'LIGHT AT THE END OF THE TUNNEL'

There are various systematizations of paradigms and traditions in urban regeneration. For this research, comparison between Hall's and Reeves' is relevant because they find sustainability elements for urban regeneration in each of the paradigm. Hall categorized them according to dominant rationality they use: (1) 'garden city concept', (2) 'vision of regional city', (3) 'monumental tradition of city planning', (4) 'modern city', (5) 'people build for themselves', (6) 'a city of infinite mobility', (7) 'theory in urban planning and theory of planning', and (8) 'regeneration of inner cities – sustainable city' (Hall, 2002:8). On the other hand, Reeves' categorization is slightly different: A) 'economic paradigm,' B) 'physical,' C) 'public administration,' D) 'social,' E) 'environmental,' F) 'collaborative,' and G) 'sustainable' (Reeves, 2005:39). Both systematizations are relevant for the research, and interrelations among them will be established to define integrative aspects of each[3]. The following paragraphs will give a short description of the paradigms to point out similarities and differences between them.

According to Hall, the first tradition is related to the Howard's concept of Garden City, indicating that urban regeneration is based on humanity, new social justice, and economic and administrative autonomy. Garden city represents a network of cities that are established outside the traditional one. They multiply according to principles of 'three magnets' in the moment when the number of citizens reaches 30,000 inhabitants. 'Self-multiplication' of Garden City is similar to Geddes' organic and emerging city that led to Regional planning. Geddes said that cities should emerge organically and autonomously with uniting lines among built and natural environment (Geddes, 1915). These conceptions emphasize urban regeneration characteristics that are related to new self-sufficient developmental areas, efficient transport system and strong connection with nature. Both Garden and Emerging City are instrumental and incremental. In other words, they develop Healey's soft and hard infrastructure and their self-sufficiency is a key element of sustainability. The main failure of Garden City's implementation is its political dimension. Decentralization accepted at that time was declarative, and not implemented in practice. Therefore, built Garden Cities were more rural areas strongly dependent on the central city.

In contrast, 'Monumental tradition' is related to great reconstructions of cities. Hall described two opposite examples: reconstruction of Paris by Haussman and Barcelona by Cerda. Both of them treat existing built environment; however, the first is centralistic and instrumental in approach while the second is democratic and open. Unlike Cerda, the 'citizens build by themselves' paradigm follows extreme democracy and is mostly related to Alexander's thoughts of emerging cities (Alexander, 1979). Also, it is pretty anarchistic and solely bottom-up, without any connection instrumental rationality and Geddes's uniting lines. In my opinion, it is wrong to connect this paradigm with Healey's collaborative one. However, it has influenced sustainability concept mostly in 'Ideal type of Sustainability'. According to Baker (2006), there are several types of sustainability with regard to the philosophical roots that they follow: ecocentric or anthropocentric. Therefore, Baker (ibid.) made differences between four types: (1) Ideal, (2) Strong, (3) Weak, and (4) Pollution control.

On the other hand, a city of infinite mobility, theory in planning, and theory of planning are paradigms characterized by positivistic and instrumental approach, trying to define complete planning theory. They are mostly connected with functionalistic, administrative, and system approach. Hall's 'Sustainable city' is the youngest paradigm, mostly based on inner city regeneration. It promotes a conception of 'Compact city' (Jenks *et al*, 1996), trying to avoid city sprawl integrating built environment with nature: human with citizen. Sustainability interconnects all those previously described. Nevertheless, the presented traditions have elements of sustainability; Hall makes distinction with sustainability tradition, emphasizing 'inner city development.'

Reeves' categorization is more common among scholars. He makes typology based on several criteria: (1) period when the paradigm emerged (which is not that common with Hall's), (2) promoted aims, (3) vocabulary, (4) assumptions, and (5) conceptions of space and place (Reeves, 2005). Therefore, 'Economic paradigm' is related to economic progress, economic space, strategic policies, clustering, and town expansion (Ibid.). The 'Physical one' manages physical development through blue prints, promoting health, economy, convenience, and beauty. The main assumption of this tradition is that architect-professional is dominant, working in Euclidean space where order and beauty are most important (Ibid.). The 'Public administration paradigm' is based on efficiency and effectiveness of planning agencies similar to Faludi's 'Planning theory' (Faludi, 1984). Planning agencies deal with institutional and virtual space where networks are most important and policies are measured by performance management (Reeves, 2005).

The 'Social approach' aims to integrate physical planning to policy making to solve social problems (Ibid.). Therefore, it represents an attempt to overcome blueprint approach in the

[2] 'Integrative urban design game' is an innovative method, applied at the Faculty of Architecture in Belgrade and in Bač community, altogether two times (Mrđenović, 2010a).

[3] The reason I have chosen these categorizations is that they are mostly used among academics.

process of urban regeneration. Environmental paradigm' aims to protect natural environment from degradation and protectors of nature, providing better conditions for poor and vulnerable inhabitants. They work in green, open, and protected space with an attempt to affect the policy-making process (Ibid.). 'The collaborative paradigm' develops consensual and communicative approach. Professionals deal with plural society and variety of stakeholders, building bottom-up consensus by social learning. The conception of space is multidimensional, shared, and socially made, with multiple meanings (Ibid.). 'Sustainable paradigm' aims to shape future places and spaces taking responsibility for economic, social, natural, built, and institutional development. A conception of space is global, local, and glocal, integrating plural meanings in holistic manner (Ibid.). Table 1 presents the systematization and assessment of previously presented paradigms regarding the type and level of integration that they provide in urban regeneration.

Table 1: Interrelations between paradigms with regard to urban regeneration

Urban design, planning and regeneration paradigm								
Hall's typology	Garden city concept	Vision of regional city	Monumental tradition	Modern city	People build for themselves	City of infinite mobility	Theory in urban planning and theory of planning	Regeneration of inner cities – sustainable city
Reeves' typology (connection to Hall)	Collaborative, Social, Economic, Environmental, Physical	Collaborative, Social, Economic, Public administration, Environmental, Physical	Physical, Economic, Social	Physical, Public administration	Collaborative, Environmental	Physical	Physical, Public administration, Social	Sustainable paradigm
Type of integration	Integration of all developmental sectors (economic, social, environmental). Institutional horizontal and vertical integration, Developing soft and hard infrastructure	Integration of all developmental sectors (economic, social, environmental), Institutional horizontal and vertical integration, Developing hard infrastructure	Vertical integration, Top – down, Developing hard infrastructure	Vertical integration, Top – down, Developing hard infrastructure	Horizontal integration, Building trust, Bounding type of social capital, Developing soft infrastructure	Physical by traffic 'uniting lines', Developing hard infrastructure	Intersectoral and interdisciplinary integration, Network of planning agencies, Instrumental, Top-down, melting pot, Developing hard infrastructure	Integration of all developmental sectors (economic, social, environmental). Institutional horizontal and vertical integration, Developing soft and hard infrastructure, Developmental social capital, Building partnerships
Level of integration	Multidimensional, Physical towards environmental, Economic and social	Multidimensional, Physical towards environmental, Economic and social	Multidimensional, Economic towards social, Built and natural environment	One- sided	Two dimensional, Social towards environment	One-dimensional, sectoral	One-dimensional with multiple communication channels	Multidimensional,Habermas' communicative-argumentative consensus, Integrative space and place
Type of the process	Visionary, Strategic	Visionary, Strategic	Visionary, Blueprint	Utopist, Blueprint	Project oriented	Visionary, Blueprint	Project oriented, Blue print	Visionary, Strategic, Project oriented
Dominant type of rationality	Instrumental, Top-down towards collaborative, Environmental	Instrumental, Top-down towards collaborative, Political, Environmental	Political, Positivistic, Quasi – instrumental	Positivistic, Instrumental, Political, Normative	Quasi-collaborative, Environmental	Positivistic, Instrumental, Political	Positivistic, Instrumental rationality	Castells'and Baudrillard's 'New rationality', Instumental and collaborative, Habermas' communicative rationality
Type of identity	Reminiscence identity of place	Emerging identity of place	Monumental identity, City Beautiful	New identity of emancipated modern man in Modern city	Identity of social space	Identity of great designs	Identity of efficiency and effectiveness of planning agencies	Project identity of place and local community, Glocal identity

Source: Author

Type of betterment as a subject of urban regeneration

Table 1 shows the interconnections between different approaches in urban regeneration related to favored urban paradigm. We can conclude that Hall's and Reeves' comparison shows that the sustainable paradigm has been always present. The main issue is that it was practiced fragmentarily throughout history, until the study 'Limits to Growth' has been done. As sustainability is a concept whose implementation varies due to cultural and socioeconomic specificities, the comparison is relevant for making difference between the betterment notions as a subject of urban regeneration. In line with this, the betterment was more or less 'sustainable' in particular paradigm, and reached its full meaning of integration starting from the study 'Limits to Growth' until today. In my opinion, it would be risky to narrow sustainable urban regeneration only to 'inner city development', because the integration can be achieved using various old or innovative concepts and methods. Here, we can see that the sustainable notion is in crisis regarding the methods that we need to implement it in different contexts. Therefore, the core of the research will assess the new teaching method: 'Integrative urban design game' as an open play that enables integration of differences using different methods from artistic towards scientific. To continue with presenting the method, it is needed to position betterment in Halls' and Reeves' view.

Table 1 categorizes betterment as a subject of urban regeneration (Mrđenović *et al.*, 2011a). This systematization is crucial for: (1) Positioning the betterment notion in regard to urban paradigms; (2) Considering a risk related to low level of participation when stakeholders are not aware of their interests, which is very common in Serbian context (Bajec, 2009); and (3) Dealing with confrontation of hidden interests and powers, that is the other side of participation issue in Serbia (Nikezić and Đokić, 2007). In line with this, Vujošević (2009: 27) claimed that Serbia is in something like '[...] hybrid society [...]' where '[...] mobilization of bias [...] is still present and [...] new forms of professional and political communication and interaction should be established'.

It is obvious that sustainable urban paradigm has most integrative elements for urban regeneration (Table 1). It provides developmental social capital, integrates all developmental sectors and levels of governance, and integrates rationalities into Habermas' 'communicative consensus' providing 'communicative rationality' (Habermas, 1984). Developmental social capital is defined by Woolcock and it favors the process of capacity building from bounding, linking and partnership making (Woolcock, 1999). This type of social capital is supported by the UN and the World Bank. Also, it provides Habermas' communicative rationality and Castells' project identity for local communities and places. 'Communicative rationality' is not a Modern one and instrumental, but is created in the Habermas' space of intersubjectivity (Habermas, 1984).

In the space of intersubjectivity, individuals enter into communication on equal bases. This means that individuals must become subjects; and if they are not able to do it by themselves, they need capacity-building process. Castells makes distinction between individual and subject. Individual is a person with weak and frustrated identity. This frustration is a result of the contradictory process of globalization. On the other hand, subject has developed identity based on his or her project, including personal vision and strategies to achieve it. Castells believes that this is the only way for us to overcome globalization cultural melting pot and develop colorful diversity of identities (Castells, 2004). The emancipation and capacity building are crucial for betterment in sustainable urban regeneration.

The capacity building is a process of developmental social capital. It ensures that weaker becomes stronger in practice of 'power to' (Dovey, 1999) by overcoming barriers in communication. According to Healey (1997), it requires development of 'hard and soft infrastructure' that will ensure the principles of sustainability (UN, 1992). Also, 'soft infrastructure' is crucial for capacity building because it uses different kinds of social arenas (workshops, trainings, discussions, presentations, etc.) where creativity is one of the main pillars for open communication. According to Landry (2005), cities need creative milieu to tackle with globalization and urban paradigm crisis. Landry (2005: 133)claims that: '[…] creative milieu is a place […] that contains the necessary preconditions in terms of 'hard' and 'soft' infrastructure to generate a flow of ideas and inventions'.

In that manner, 'soft infrastructure,' creativity, and art provide light at the end of the paradigm crisis tunnel. I share Baudrillard's belief that art, based on esthetic science, can solve ethical problems in the integration of plural identities. Also, according to Forester (1989), Elin (2004), Harvey (2007) and Jacobs (1992), creativity and art provide 'common sense' in plural society that is desperately needed for multidimensional integration, project identity, and glocal places. Therefore, soft methods are needed for starting an integrative urban regeneration. This is why further research will be narrowed to soft urban regeneration as a first cycle towards integrative one.

Regarding the above-mentioned crisis, several questions emerge: How to ensure development of soft infrastructure? What methods in teaching and training architects and urban designers should be used to ensure ethical integration? What is the role of professionals in sustainable urban regeneration? These questions will be further discussed in the following section. I stand on the position that we need to develop some kind of dynamic model that '[...] is a base for creative milieu where different social arenas stands for 'soft' and planning agencies for 'hard' infrastructure.' (Mrđenović, 2011b: 311)

PRINCIPLES OF 'INTEGRATIVE URBAN DESIGN GAME'

The discussion in the previous sections led towards questions about overcoming paradigm crisis using integrative approach in sustainable urban regeneration process. As shown in Table 1, integration is present in all urban paradigms. However, only sustainable one integrates different rationalities, values, and interest in ethical manner using Habermas' 'communicative consensus' for 'communicative rationality.' Also, the research leans on Baudrillard's belief that problems in ethics should be solved in esthetic. Therefore, art and creativity represent the light that can overcome urban paradigm crisis building 'common sense' in social arenas and Healey's 'soft infrastructure.' Furthermore, sustainability integrates instrumental and collaborative paradigm, enabling clarification of different rationalities. The clarification is possible by using various methods and techniques in different social arenas. This section will discuss 'Integrative urban design game' (Mrđenović, 2010a), an innovative teaching and training method used twice in workshops and trainings with students at Faculty of Architecture in Belgrade and with stakeholders in Bač settlement on different topics of urban regeneration process. The impact of the method will be measured by case study and questionnaires among participants.

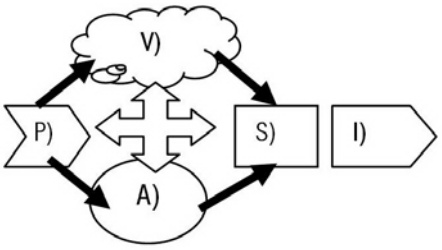
'Integrative urban design game' overcomes barriers of classical game theory using art and Habermas' communicative consensus in developing 'soft infrastructure' in an integrative manner. Classical game theory is a rational, mathematic theory based on competitive win-lose process and zero sum results (Pavličić, 2010). It favors gaining singular interests of subjects and organizations. On the other hand, urban regeneration deals with complex public problems that need consensual 'added value'

to develop partnerships between public, private, and civil sector. In line with this, sustainable urban paradigm is visionary, strategic, and project-oriented, ensuring Castells' project identity and development of glocal place (Table 1). Sustainable regeneration process builds up communicative win-win solutions, and according to Agenda 21, its realization is dependent on local context. Sustainability is a paradigmatic concept that is developed through tailor-made processes for each community (Reeves, 2005; UN, 1992). Therefore, there is no strict model that can be applied globally, indicating that innovative and smart solutions are needed. Clustering between faculties and local communities is crucial for innovation and making change happen (EU, 2010).

With regard to clustering, 'Integrative urban design game' is a teaching and training method that is dynamic, innovative, and sensitive to context, using art to overcome win-lose solutions in classical game theory. It unites different rationalities, paradigms, methods, and techniques to perform tailor-designed process for urban regeneration. Tailor-designed process depends on local characteristics, presence of ambient values, stakeholders' profile, and level of local capacity. Therefore, the method is interrelated to the urban regeneration strategic path (Figure 1) as well as to chosen singular methods and techniques.

Common methods and techniques such as thematic workshops, analysis of social context, space-syntax, mapping, diagrams, simulation games, cognitive maps, urban morphology, etc. support only some of the sustainable urban regeneration dimensions and its rationalities. The main innovation of 'Integrative urban design game' is to integrate them into visionary and strategic process according to local specificities. In the following, I will present the process and results of the method, applied twice in Bač settlement. The first application was in the workshop: 'Participative Approach in the Shaping of Public Space – the Bač Fortress and Its Suburbium' (Mrđenović, 2010b). The second one was in the workshop: 'Integrative Urban Design in Regeneration of Bač Settlement.' The purpose of this method was to (a) develop and integrate different types of rationality in the community using tailor-made regeneration process and (b) achieve quality place through a creative game (open play).

The method was clarified in the key segments of the process, using argumentative and expert methods. In this way, it created the future image of the place through its spatial visualization, using three-dimensional and two-dimensional



P – Preparation,
V – Visioning,
A – Analysis,
S – Aims, Strategies, Measures,
I – Implementation

Figure 1. Phases of the process in integrative space and place making. (UN-Habitat, 2005)

Figure 2: Process of developing soft infrastructure using 'Integrative urban design game.' Photo archive of the 'Workshop: Participative Approach in Design of Public Space of Bač Fortress Street, 2010'

presentations, drafts, drawings, and text, as well as different expert methods of polling, interviewing, context analyses, morphological analyses, and collaborative methods that support argumentation (different diagrams such as problem tree and tree of aims and measures). The essence of the method was establishment of 'soft infrastructure' and integration between different types of rationality, as well as between the phases of the regeneration process (Figures 2 and 3). The assessment regarding the level of developed soft infrastructure will be presented in the conclusion. To support the assessment, a presentation of facts acquired from questionnaire will be shown in the following text.

The research will now continue with presenting basic facts for measuring development of soft infrastructure in Bač settlement, acquired from the questionnaires among relevant stakeholders of Bač Settlement and among students. The questionnaire for stakeholders

contained three sections: a) opinions about sustainable urban regeneration, b) opinions about urban design, and c) opinions about understanding and willingness to participate in the 'Integrative urban design game in future.' The questions reflected community's capacity to deal with soft infrastructure and urban regeneration as well as to assess the willingness towards routine in urban regeneration practice. The respondents varied according to their profession, experience, and age. Among the respondents, 28.57% were in the sector of economy (tourism or management), 14.28% in environment (energy efficiency or protection of natural resources), 14.28% in law, 21.42% in media and culture, 7.14% in the protection of cultural heritage, 7.14% in civil engineering, and 7.14% in other areas.

According to the results, 50% of economists characterized the 'Integrative urban design game' as integrative regarding different sectors of urban regeneration. The other 50% saw it as artistic, spatial-technical, and rich in regeneration options. Among the heritage protectors, 100% saw the game as integrative regarding different sectors of urban regeneration. All the lawyers thought of it as strategic-planning, similar to civil engineers, others, and environmentalists, the latter adding the spatial-technical dimension. From media and culture, 66.66% saw it as strategic-planning and 33.34% thought of it as integrative regarding different sectors of urban regeneration and as being rich in regeneration options. More than three quarters of all respondents (78.57%) stated that they would participate more intensely in the process in the future because they believed the method would provide better solutions for urban regeneration in Bač. On the other hand, 7.14% had the opposite attitude, and 14.28% were uncommitted. The prevailing thinking among all stakeholders was that the following are positive sides of the method:

a) Creating a common vision for urban regeneration;
b) Variety of ideas for possible solutions;
c) Building trust among various stakeholders in the community;
d) Creating partnerships for implementation; and
e) Developing an urban design framework.

However, 92.86% saw a lack of knowledge regarding contemporary approaches to urban design and urban regeneration as the main obstacle for implementation of the method in Bač community. Only a few of them (7.14%) partly believed that resistance to change could be an obstacle. According to previously presented report, I conclude that the method provides development of soft infrastructure.

Figure 3: Process of developing soft infrastructure using 'Integrative urban design game.'
Photo archive of the 'Workshop: Integrative Urban Design in Urban Regeneration of Bač Settlement, 2011'

Questionnaires for students examined the novelty of the method in teaching as well as the level of accepted new knowledge and skills[4]. The results showed that the students had medium level of knowledge and skills about the topic before the workshop. Also, they believed the workshop was interactive and enabled them to acquire new knowledge and skills in a short period of time (7 days) using disciplinary, interdisciplinary, collaborative, argumentative, and creative methods and techniques through discussion, open communication, argumentation, and evaluation in iterative manner. Their suggestions for improvements were regarding the pace of the workshop, as they believed it should be less intense. Also, they thought that all topics regarding integrative urban regeneration were covered; however, some of the students committed more time to specific one, which is related to the pace of the workshop. All of them highly believed that they will use the acquired knowledge and skills in their future study or professional work. It was found that:

- 100% of the students thought the workshop and the method was encouraging;
- 71.42% of them believed the process was informative, inspirational, interesting, and encouraged thinking;
- 57.14% of them pointed out its novelty, clarity in presenting, mastery, and discussion;
- 42.85% of them thought that it was pleasant;
- 14.28% thought that it was fascinating.

Also, they emphasized creativity, team work, complexity, and its harmonious structure (Mrđenović, 2011c). The case study and questionnaires provided a base for conclusions in defining principles for 'Integrative urban design game.'

[4] 7 out of 10 students were willing to complete the questionnaire.

Before summarizing the results of 'Integrative urban design game' and defining its principles, it is important to emphasize its main characteristics. The purpose of the method is to develop soft infrastructure and quality of integrative place through a creative game using the mimicry model of present and future urban space. The novelties of the method are:

- Using, adopting, and improving available methods in urban design for soft urban regeneration;
- Innovating tailor-made methods in development of soft infrastructure;
- New combination of known methods in the process;
- Their integration into mimicry model of future glocal urban place.

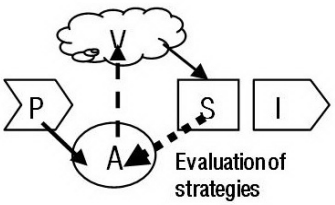
As a method, it implies a continual and iterative process in development of social creativity, as well as its rationalization towards new unity, common sense, and glocal identity of place towards integrative urban regeneration. The outcomes of the game are used in local community for developing local urban instruments, such as Plan of detail regulation, Improvements of Master Plan, etc. (Mrđenović 2010b).

According to findings, 'Integrative urban design game' has exhibited good results related to the principles of sustainable paradigm in urban regeneration. Also, the results show its excellence as a teaching and training method towards development of soft infrastructure for urban regeneration in local communities, and curricula development, as similar workshops and trainings were repeated in academic teaching (Table 2).

Principles (rules) on which the game should be grounded are as follows:

- Dynamic and iterative approach;
- Using visual, logical, argumentative, technical, creative, collaborative, and instrumental methods and techniques according to specific urban context;
- Creating framework, such as mimicry model of present and future urban space for encouraging good spirit, and positive atmosphere for integrating different rationalities towards common sense and communicative rationality;
- Creating space (creative milieu) for building partnerships and strong clusters among faculties, local communities, and institutions in public, private, and civil sector.

Table 2: Success of the method related to those presented in Table 1

Urban design, planning and regeneration paradigm		Integrative urban design game - achievements
Hall's categorization	Regeneration of inner cities – sustainable city	YES Both workshops and trainings treated existing built environment in line with Compact city concept and sustainable urban regeneration.
Reeves' categorization (connection to Hall)	Sustainable paradigm	
Type of integration	Integration of all developmental sectors (economic, social, environmental). Institutional horizontal and vertical integration, Developing soft and hard infrastructure, Building partnerships	YES The method enabled multidimensional integration and development of soft infrastructure using art and creativity (Figures 2, 3, main findings from questionnaires). The method builds partnership among Faculty, Municipality of Bač, local and regional institutions through initiating new collaborative projects.
Level of integration	Multidimensional, Habermas' communicative-argumentative consensus, Integrative space and place	YES The method created and clarified visions, strategies and measures in inclusive manner (local and regional stakeholders, students) using communicative consensus. Some of the measures are included in future local implementation plans. (Mrđenović 2010b)
Type of the process	Visionary, Strategic, Project oriented	YES The method went through tailor made path of strategic planning as it is presented below. 
Dominant type of rationality	Castells' and Baudrillard's 'New rationality', Instrumental and collaborative, Habermas' communicative rationality	YES Participants reached communicative consensus and 'New rationality' (Figures 2, 3).
Type of identity	Project identity of place and local community, Glocal identity	YES The method enabled glocal identity according to specificity of each ambient in the settlement (Figures 2,3).

Source: Author

CONCLUSIONS

With regard to globalization, most authorities agree that we are now in urban paradigm crisis, and according to Kuhn, the problems outreach the known and solid theories (Kuhn, 1970). The main issue is that globalization shrinks spatial-temporal dimension mixing different rationalities, paradigms, cultures, and societies. The varieties of rationalities we are facing are with open questions of their hierarchy, legality, and ethical integration in urban regeneration process.

Therefore, the research discusses different urban paradigms to define their integrative potentialities for urban regeneration. The first section gives systematization of the integrative elements and results in positioning new betterment in sustainable urban regeneration. Sustainable paradigm has always been present. However, as sustainability is a concept whose implementation varies due to cultural and socioeconomic specificities, the betterment is more or less 'sustainable' in particular paradigm, and has reached its full meaning of integration starting from the study 'Limits to Growth' until today.

In regard to above-stated, research shows that the sustainable notion is in crisis regarding the methods that we need to implement it in different contexts. Also, the comparison of various paradigms proves that integrative urban regeneration can be 'a light at the end of the tunnel'. Therefore, innovative methods in teaching and training are needed to create 'new rationality'. Those methods must be integrative, dynamic, and inclusive to provide Castells' 'project identity' (Castells, 2004). Also, the methods should favor a process of place making, providing Haeley's 'soft infrastructure' (Healey, 1997), 'glocal places,' and 'glocal identity' (Mrđenović *et al.*, 2011a; Reeves, 2005) (Table 1).

The second chapter studies the case of 'Integrative design game' in Bač community as a new method for integrative processes in urban regeneration in order to define its principles for applicability in various contexts. The purpose of the method is to develop soft infrastructure and quality of integrative place through creative game using the mimicry model of present and future urban space. The novelties of the method are: using, adopting, and improving available methods in urban design for soft urban regeneration; innovating tailor-made methods in development of soft infrastructure; new combination of known methods in the process; their integration into mimicry model of future glocal urban place (Figures 2, 3).

According to findings the method provides soft infrastructure in the process of urban regeneration. Stakeholders emphasized positive sides of the method: creating a common vision for urban regeneration; variety of ideas for possible solutions; building trust among various stakeholders in the community; creating partnerships for implementation; and developing an urban design framework. On the other hand: 100% of the students thought the workshop and the method were encouraging; 71.42% of them believed the process was informative, inspirational, interesting, and emanated thinking; 57.14% of them pointed out its novelty, clarity in presenting, mastery, and discussion; 42.85% of them thought that it was pleasant; 14.28% thought that it was fascinating.

As a method, it implies a continual and iterative process in development of social creativity, as well as its rationalization towards new unity, common sense, and glocal identity of place towards integrative urban regeneration. It is shown that the method can develop soft infrastructure towards Habermas' communicative consensus, new unity and Castells' project identity (Table 2) if it follows these principles: dynamic and iterative approach; using visual, logical, argumentative, technical, creative, collaborative, and instrumental methods and techniques according to specific urban context; creating framework, such as mimicry model of present and future urban space for encouraging good spirit, and positive atmosphere for integrating different rationalities towards common sense and communicative rationality; creating space (creative milieu) for building partnerships and strong clusters among faculties, local communities, and institutions in public, private, and civil sector.

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ASSESSMENT OF THE CAPACITY OF THE NATIONAL ECOLOGICAL NETWORK ELEMENTS FOR ROAD CONSTRUCTION AND OPERATION

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Road construction and usage have a wide range of direct and indirect negative effects on protected areas. The impact of state roads on protected areas in Vojvodina was reviewed in this article, based on the orientation values of habitat loss and secondary negative effects originating from traffic functioning. Results of the assessment indicate that the use of existing roads constructed on habitats within the national ecological network exceeded the capacity of individual PA-protected areas (e.g., in case of Straža Natural Monument). Recorded capacity overflow on other PAs occurs solely as a consequence of overlapping between protected areas and areas of influence of roads routed along the borders of protected areas (which is the case with Slano Kopovo Special Nature Reserve and Selevenjske pustare Special Nature Reserve). The aim of this article is to show that even with the smallest values of the parameters related to the width of roads and critical distance from the habitat, the vulnerability of certain core areas of the national ecological network is evident.

Key words: Vojvodina Province, protected areas, state roads, habitat loss.

INTRODUCTION

Biodiversity preservation and ecosystem protection represent the prerequisite for maintaining the functionality of biosphere and its structural elements. Damaged and/or degraded ecosystems as entireties have decreased tolerance towards environmental changes (Noss, 2001). In areas where the market increasingly swallows up space (contributing to the shaping of the form and functions according to a profit-based logic), one of the main causes of the changes in the environment is land use modification so the protection policy should significantly influence spatial development programmes and consequently land management (Lisec and Drobne, 2009, EEA, 2010, Balestrieri, 2013). Construction and usage of roads have a broad spectrum of both direct and indirect ecological impacts. Compared to other types of infrastructure, the construction and usage of roads causes most changes in environmental conditions in areas which are several times greater than the surface of the traffic corridor itself. The numerous adverse impacts, which are more visible in paved roads and which proportionally increase with the frequency of traffic, mainly occur synchronously (Trombulak and Frissell, 2000, Szabados and Kicošev, 2006). The degree of impact on the population depends on the characteristics and behaviour of particular species, the physical properties of the road and accompanying infrastructure, characteristics of road transport and spatial configurations regarding the surrounding landscape (Coffin, 2007). Traffic is considered to be one of the main causes of populations' decline in many endangered species (Jaarsma *et al.*, 2006). Roads routed on the edge of wetlands cut through the migratory pathways of animals, separating them from key survival resources: drinking water or breeding habitats (Szabados and Panjković, 2009). Habitat fragmentation caused by construction and usage of roads has a wide range of negative impacts on plant and animal communities. These were observed for mammals (Oxley *et al.*, 1974, Lankester *et al.*, 1991, Clarke *et al.*, 1998, Huijser and Bergers, 2000, Ćirović and Kureljeušić, 2012), certain bird species (Develey and Stouffer, 2001, Clevenger *at al.*, 2003, Stojnić, 2004), insects (Vermeulen, 1994, Bhattacharya *et al.*, 2003) and herpetofauna (Pantelić, 1995, Hels and Buchwald, 2001, Aresco, 2005). The most probable cause of regional extinction of species such as the badger (*Meles meles*), is mortality caused by road kill (Lankester *et al.*, 1991, Clarke *et al.*, 1998). The edge effect (change in quality of the environment, microclimate parameters, noise, illumination, etc.) can span up to a few hundred meters on both sides of the road (Gilbert *et al.*, 2003, Seiler and Folkeson, 2006, Brugge *et al.* 2007, Beckerman *et al.*, 2008, Hagler *et al.*, 2009) which, along with the cumulative environmental effects associated with other forms of land use (Willard and Marr 1971,

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Godefroid and Koedam, 2004) causes changes in the composition and structure of communities (Farmer, 1993, Forman and Deblinger, 2000) and may result in the destruction of existing ecosystems (Coffin, 2007).

Traffic emits at least 40 different types of pollutants (HEI, 2010), a large fraction of which settles within a 100-200m wide strip along the roads (Roorda-Knape *et al.*, 1998, Zhu *et al.*, 2002, Gillbert *et al.*, 2003), downwind from 500m (Zhou and Levy, 2007, Suzuki and Brauer, 2012), up to 800m (Reponen *et al.*, 2003). About half of the amount of emitted particle matter deposits within a 100-150 m wide strip (Hitchins *et al.*, 2000), and a significant portion of this amount settles in the area of up to 50m (Tiitta *et al.*, 2002). The negative effects of traffic must include the sensitivity to lighting, noise and vibration. The impact of these factors on wildlife depends on species biology (type of locomotion, diet, reproduction, etc.) along with significant differences in the distance from the emission source in the horizontal and vertical directions. Research on birds (e.g. Palominoa and Carrascal, 2007) indicates that the impact area is 300m away from the main road.

Even though the majority of scientific articles in the field of environmental protection refer to impacts of roads with average frequency above 10,000 vehicles/day, ecological research indicates that local roads can cause significant damage to habitats (Forman *et al.*, 2003, Van Langeveld *et al.*, 2008). Roads with a traffic frequency of 500 vehicles/day may function as a sink to certain species inhabiting the nearby habitats, while negative effects of traffic noise were recorded already at the frequency of 200 vehicles/day (Mumme *et al.*, 2000).

MATERIALS AND METHODS

The impacts of state roads on protected areas in Vojvodina were analysed in this article, by assessing both the endangerment of these areas based on classes of orientation values of habitat loss (by direct occupation of the area) and the secondary negative effects of traffic related to sedimentation of emitted pollutants. Remaining secondary negative effects related to traffic impact (noise, vibration, lights etc.) were not taken into consideration in this assessment. The establishment of protected areas enables the protection of spatial units that have more or less preserved natural conditions necessary for the survival of endangered organisms (Kicošev and Szabados, 2007). Their integration into the national, regional and continental networks represents one of the priority tasks of modern conservation biology (Hannah *et al.*, 2002). At the European Union (EU) level it is carried out under the 'Natura 2000' project (Hicks *et al.*, 2011), by designating special areas for conservation of habitats and species (Special Area of Conservation) and areas for conservation of birds (Special Protection Area). On a country level, this is being achieved by establishing national ecological networks (Kicošev *et al.*, 2011). The primary goal of the establishment of the national ecological network in the Republic of Serbia is the protection of habitats and migratory areas of protected species, but it also has an important role in general biodiversity conservation, protection of environment quality and sustainable development of the areas (Kicošev *et al.*, 2013).

The determination and design of areas as potential elements of the ecological network is carried out by the use of the 'Ecological Network' module of the Electronic database that is being operated by the Institute for Nature Conservation of Vojvodina Province (INCVP). These sites are regularly included into the spatial and urban plans (Kicošev *et al*, 2013). Since the officially designated list of habitats and ecological corridors outside the protected areas (that will become an integral part of the ecological network) didn't exist during the research period undertaken for the purpose of this article, the potential overlap of these elements with the road infrastructure was not considered. Classes of orientation values were obtained by using absolute and relative values of habitat loss. These were defined for the Appropriate Assessment (AA) of projects for the purpose of conservation of the Natura 2000 EU ecological network. Absolute and relative values of habitat loss were determined using an expert methodology (Lambrecht and Trautner, 2007) originating from Germany, which has advanced the furthest in quantifying the potential endangerment of habitats. The part of the mentioned methodology which refers to relative habitat loss is used in this article. The methodology was selected due to its compatibility with the purposes of preservation of the functionality of the national ecological network. According to the current practice in Serbia, the clearly defined rules of spatial planning have established a more effective arrangement of contents (e.g. infrastructure) in accordance with the sensitivity and capacity of the area, as well as a better acceptance of the obligations of business entities related to nature protection. In contrast to this approach, most of the other countries in the EU are resolving the problems of habitat loss usually 'case by case'. Table 1, which is used to determine the potential loss of habitat by the impact of road infrastructure, represents an adaptation of this methodology in accordance with the specifics of the protected areas in Serbia. Since habitat types selection (that would become the core areas of the Natura 2000 network in the future), is currently on-going in Serbia, the data for the core areas of the NEN were used to represent the vulnerability. The adaptation of the original tables by Lambrecht and Trautner (2007) has been done based on the available data on the range of values of habitat surface (work in progress by INCVP). Apart from this, the national Red List Assessment of Habitat Types of Serbia also hasn't been adopted. The Red List would have a significant importance in the determination of levels of relative habitat loss and classes of orientation values. Therefore, changes in Table 1 are possible upon the establishment of the Natura 2000 in Serbia.

The potential threats to habitats generated by secondary effects of traffic were assessed by the analysis of the available published data on the effects of pollutant deposition. In order to be able to apply the obtained results of this assessment, the analysed effects of roads on habitats are related to the pollutant deposition in the environment, disregarding the type of vehicle as an emission source. Analysing the documentation of Public Enterprise 'Roads of Serbia' related to the EIA-environmental impact assessment studies of the construction of certain sections of E-75, E-80 and E-763 state roads, it was found that up to a certain distance away from the road, nitrogen dioxide and benzene concentrations (calculated according to the Merkblatt über Luftverunreinigungen an Straßen, MLuS 92 model) exceeded the maximum allowed values, prescribed by the Ordinance on Thresholds, Emission Measuring Methods, Criteria for Establishing Measurement Points and Record Keeping (Official Gazette of the Republic of Serbia 54/92, 30/99 and 19/06). With an

Table 1. Relative habitat loss and classes of orientation values (Adaptation of: Lambrecht and Trautner, 2007)

Relative loss	Level	Classes of orientation values*						
		1	2	3	4	5	6	7
≤0.1%	I basic	0	0.01	0.1	0.5	1	5	10
≤0.5%	II middle	0	0.25	2.5	5	25	50	250
≤1%	III high	0	1	5	10	50	100	500

**Orientation values are divided into 7 classes, the surfaces NEN core areas are given in hectares (ha)*

average annual daily traffic frequency in the range of 8,500-21,000 vehicles/day and prevailing winds with speed between 1.5-4.5m/s, the obtained results show that the predicted exceedance of the thresholds was detected up to the distance of between 6 and 110m away from the road edge (mean value of 50-60m), without calculating the cumulative effects. These results can represent a basis for determining the negative impacts of public roads, in case the effects of long-term exposure of habitats to traffic pollution are also taken into consideration, which is one of the requirements of the Appropriate Assessment. Considering the modelling results and using the above-mentioned references about sedimentation of emitted pollutants (according to which the minimum recorded relevant distance from the road is 100m), 50-60m and 100-110m can be used as referent values for determining the negative impact of traffic on habitats, depending on the habitat type and vehicle frequency. According to the aforementioned data, 50m represents the shortest distance up to which significant concentrations of pollutants were measured. Therefore, the planning of roads along habitats at a lesser distance would result in a loss of the affected segment over time. For roads with average annual daily traffic of 10,000 vehicles, greater distances (100-110m) have to be set up, depending on the habitat sensitivity. For example, in case of the roads with high traffic frequency next to sensitive habitat types (e.g. wetlands) basic value of distance should not be less than 100m and it should be possible to make more precise calculations by using additional impact factor (equation 1).

The selection of roads, for which data was collected, has been done on the available data from the documentation of PE 'Roads of Serbia' in the period of 2008-2012, in correlation with the 'Counting the Traffic on State Roads of the Republic of Serbia' reports. Based on the available data on average annual daily values for traffic frequency, the values for the average eight-year volume of traffic on certain sections inside and also within the impact zone of the protected area were obtained. Since no available data exist for particular roads, the periodically collected continuous seven-day traffic counts were used, which are the monitoring results of 'Road Center of Vojvodina' PLLC in the period of 2011-2012. The roads, on which traffic frequency was monitored, were classified into six classes according to the intensity of traffic (Table 2). According to the data from Table 2, almost half of the roads transecting the protected areas belong to class 2, with an average annual daily traffic frequency of 2,000-4,000 vehicles (roads with a relatively low level of traffic load). However, in some cases (Straža Natural Monument, Table 4) the construction of such roads itself represents a significant threatening factor for protected area.

Table 2. Road classification

PA Classification		
Class	P (ha)	No. of PA
1	0-10	0
2	10-100	2
3	100-500	9
4	500-1,000	5
5	1,000-5,000	6
6	5,000-10,000	6
7	10,000 up	3
Total		31

Table 3. Classification of protected areas

Road classification		
Class	Traffic intensity	Number of roads
1	1,000-2,000	8
2	2,000-4,000	23
3	4,000-6,000	9
4	6,000-8,000	3
5	8,000-10,000	7
6	more than 10,000	1
Total		51

The data on the protected area borders and the natural values were acquired from the Electronic database of the Institute for Nature Conservation of Vojvodina Province. The core areas of the national ecological network (protected areas) were divided into seven classes based on their area size (Table 3). According to Table 3, the lowest number of roads (2) is transecting or passing next to the protected areas that have the smallest surface in the range of 10-100 ha (fragments of natural habitats). However, this does not mean that their endangerment is negligible, because Straža Natural Monument, where a significant habitat loss was recorded due to road construction (Table 4), belongs to this category. The protected areas whose borders are located more than 50 meters away from the existing state roads were excluded from the classification. Route sections of the roads were digitalised based on the available ortho-photo imagery and high resolution satellite images from Google Earth Pro programme. This service also provided the calculation of the data on the distance of roads from the borders of protected area, the location related to different parts of the PAs and also the length of the route inside the PAs and within the impact zone of the given area. The minimum values for road carriageway width (7m for main, and 6.5m for regional roads and roads transecting the protected areas) were used to calculate the absolute loss of habitats. Graphical presentation of impact areas was obtained by transferring geographic data from GIS applications onto a satellite layer (Google maps) by reprojection and conversion. The borders of the possible impact strips were obtained by geoprocessing the vector elements of the protected areas in shapefiles (*.shp), with a defined 50m buffer zone around a single vector (PA and road borders). Data obtained by projecting the impact areas have a high level of precision, because the borders of the PAs were used as a basis, which were determined by digitalising cadastral maps in scale 1:2500 in ArcGIS 10 software package.

The calculation of total relative habitat loss caused by road construction and usage is done by the following equations developed for the purposes of this assessment [1]:

$$\Sigma Gr[\%] = (\Sigma Gu * 100) : P_{zp} \quad [1]$$

$$\Sigma Gu[ha] = Gi + \Sigma Gs$$

$$\Sigma Gs[ha] = G_{50} * d_u$$

ΣGr = the total relative habitat loss (%)

P_{zp} = the surface of the protected area

ΣGu = total habitat loss caused by road construction and usage (ha)

Gi = habitat loss by road construction (ha)

ΣGs = total loss of habitat due to secondary effects caused by road usage

G_{50} = minimum value of habitat loss, calculated up to the distance of 50m from the road (ha)

d_u = additional impact factor on the protected area of a given road section

$d_u = f$ (traffic intensity on a given road section, road position in relation to the landscape, presence of endangered species, route interference with migratory corridors, habitat sensitivity on environmental impacts etc.)

For the purposes this article, the adopted value $d_u = 1$, then $\Sigma Gs[ha] = G_{50}$

RESULTS AND DISCUSSION

Results

Based on the analysis of maps obtained in this assessment, it was found that state roads are located in the vicinity of 22 protected areas and intersect the area of 12 out of 41 protected areas. The routes of 55 roads are located in the impact zones of protected areas. Relative habitat loss caused by the overlap with the network of state roads is shown in Table 4. Habitat loss based on the ratio of the road surface compared to the surface of Straža (NM) Natural Monument (0.67%) is classified into the group of 0.5-1%, which implicates a high level of risk. A 0.37% habitat loss in Titelski breg (SNR) Special Nature Reserve implies a middle level of risk (0.1-0.5%), while the rest of protected areas belong to the group with basic level of risk (0.1-0.5%). Considering the fact that the local road covers another 0.57% of Straža NM, the total area occupied by roads is 1.24%. The calculation results indicate that the existence of road surfaces already causes capacity exceeding on Straža NM, without the impact area (4.85%) taken into consideration. By adding those areas to the absolute habitat loss, the exceedance of capacity is determined on Titelski breg SNR (2.83%), while Fruška gora (NP) National Park (0.52%), Ludaško jezero SNR (0.60%) and Karaš-Nera (LEF) Landscape of Extraordinary Features (0.64%) are classified as areas with high level of risk.

Table 4. The relative habitat loss by overlapping roads and impact areas with protected areas

Protected area	Pzp (ha) *COV*	Road (old category)	Road (new category)	Traff. Intens. (av.day.yr.)	Ls-zp (m)	Ps (ha)	Gi (%)	P50 (ha)	G50zp (%)
Gornje Podunavlje	19604.99 *7*	R101:0778	II-107	3592	1000	0.65	0.02	5.00	0.39
		M17.1:0373	IB-16	1998	5450	3.81		27.25	
Fruška gora	25393.00 *7*	M18.1:0398	II-121	1743	3900	2.73	0.07	19.50	0.52
		R116:1041	II-123	nad	3380	2.20		16.90	
		R130:1216	II-313	nad	8210	5.34		41.05	
		M21:0438	IB-21	9188	960	0.67		4.80	
		M21:0439	IB-21	9188	4230	2.96		21.15	
		M21:0440	IB-21	9188	3710	2.60		18.55	
		M21:0441	IB-21	9188	1870	1.31		9.35	
Kovilj.-petrov. rit	5895.31 *6*	M22:0507	A-1	12767	2300	1.61	0.03	11.50	0.20
Jegrička	1193.19 *5*	R104:0870	II-112	nad	100	0.07	0.05	0.50	0.41
		R104:0871	II-112	nad	40	0.03		0.20	
		M22:0501	A-1	5935	60	0.04		0.30	
		M22.1:0580	II-100	4573	90	0.06		0.45	
		R120:1089	II-102	3607	130	0.08		0.65	
		R122:1127	II-114	2681	230	0.15		1.15	
		M7:0312	IB-12	7485	320	0.22		1.60	
Kamaraš	267.96 *3*	M22.1:0563	II-100	1732	10	0.01	0.01	0,05	0.07
		M22:0493	A-1	5189	30	0.02		0.15	
Ludaško jezero	846.33 *4*	M22.1:0565	II-100	2366	600	0.42	0.08	3.00	0.60
		M22:0495	A-1	5229	420	0.29		2.10	
Straža	67.61 *2*	M7.1:0333	IB-18	2658	650	0.46	0.67	3.25	4.85
Deliblat. peščara	34829.32 *7*	R115:1037	II-134	nad	6240	4.06	0.01	31.20	0.09
Rusanda	1159.98 *5*	R113:1021	II-116	2220	260	0.17	0.02	1.30	0.11
Karaš-Nera	1541.27 *5*	R115:1037	II-134	nad	1970	1.28	0.08	9.85	0.64
Ritovi d.Potisja	3010.67 *5*	M7:0312	IB-12	7485	260	0.18	<0.01	1.30	0.04
Titelski breg	496.00 *3*	R110:0992	II-129	2025	2810	1.83	0.37	14.05	2.83

Legend:
nad - no available data; Pzp - protected area surface; COV-classes of orientation values; Gi - habitat loss by road construction; P50 - the surface of the impact area calculated up to the distance of 50m from the road; Ls-zp - length of the road intersecting the protected area; Ps – threatened surface of protected area; G50zp - relative habitat loss caused by roads and their impact area

Total relative habitat loss is shown in Table 5. Apart from the road impact within the protected areas, it includes the impact areas located up to 50m away from the borders of PAs which are (to smaller or larger extent) overlapping with them. It is evident that capacity exceedance is occurring on Bagremara SNR (1.11%), Kamaraš (NaP) Nature Park (1.33%), Slano Kopovo SNR (2.43%) and Selevenjske pustare SNR (1.89%). An interesting fact is that the capacity exceedance on Slano Kopovo SNR and Selevenjske pustare SNR occurs only as a result of overlapping of road impact areas, whose routes are located along the border of the protected areas. Based on total relative habitat loss Karaš-Nera LEF (0.94%), Fruška gora NP (0.65%) and Jegrička NaP (0.6%) are classified as areas with high level of risk.

Table 5. The total relative habitat loss

Protected area	Pzp (ha) *COV*	Road (old category)	Traff. Intens. (av.day.yr.)	Ps (ha)	Gi (%)	P50 (ha)	G50zp (%)	Pou50 (ha)	Gou50 (%)	ΣGr (%)
Gornje	19604.99	M17.1:0373	1998	3.81		27.25		osr		
Podunavlje	*7*	R101:0778	3592	0.65	0.02	5.00	0.39	1.93	<0.01	0.41
Fruška gora	25393.00	M18.1:0398	1743	2.73		19.50		0.80		
	7	M18:0394	2089	osr		osr		9.50		
		R116:1041	nad	2.20		16.90		osr		
		R107:0932	2194	osr	0.07	osr	0.52	0.70	0.06	0.65
		R130:1216	nad	5.34		41.05		5.11		
		M21:0438	9188	0.67		4.80		0.65		
		M21:0439	9188	2.96		21.10				
		M21:0440	9188	2.60		18.55		osr		
		M21:0441	9188	1.31		9.35				
Kovilj.-petrov. rit	5895.31 *6*	M22:0507	12767	1.61	0.20	11.50	0.20	osr		0.40
Jegrička	1193.19	R104:0870	nad	0.07		0.50		0.70		
	5	R104:0871	nad	0.03		0.20				
		M22:0501	5935	0.04		0.30				
		M22.1:0580	4573	0.06	0.05	0.45	0.41	osr	0.14	0.60
		R120:1089	3607	0.08		0.65				
		R122:1127	2681	0.15		1.15				
		M7:0312	7485	0.22		1.60				
Kamaraš	267.96	M22.1:0563	1732	0.01		0.05		2.02		
	3	M22:0493	5189	0.02	0.01	0.15	0.07	1.32	1.25	1.33
Ludaško jezero	846.33	M22.1:0565	2366	0.42		3.00		4.65		
	4	M22.1:0566	8058	osr	0.08	osr	0.60	0.25	0.58	1.26
		M22:0495	5229	0.29		2.10		osr		
Obedska bara	9820.00 *6*	R121:1112	nad	osr	*	osr	*	28.45	0.29	0.29
Slano kopovo	976.45	R114:1032	nad					12.15		
	4	M3:0170	3366	osr	*	osr	*	11.55	2.43	2.43
Straža	67.61 *2*	M7.1:0333	2658	0.46	0.67	3.25	4.85	2.45	3.62	9.15
Karađorđevo	4184.24 *5*	M18:0390	1913	osr	*	osr	*	1.80	0.04	0.04
Bagremara	117.58 *3*	M18:0391	2951	osr	*	osr	*	1.30	1.11	1.11
Deliblat. peščara	34829.32 *7*	R115:1037	nad	4.06	0.01	31.20	0.09	1.95	<0.01	0.10
Selevenjske	677.04	M22:0494	5101					5.30		
pustare	*4*	M22.1:0565	8058	osr	*	osr	*	12.25	1.89	1.89
Carska bara	4726.00 *5*	R110:0992	2509	osr		osr		19.45	0.41	0.41
Palić	712.36	M22.1:0568	nad					2.65		
	4	M24:0644	nad	osr	*	osr	*	3.00	0.79	0.79
Rusanda	1159.98 *5*	R113:1021	2220	0.17	0.02	1.30	0.11	0.95	0.08	0.21
Karaš-Nera	1541.27	R115.1:1039	nad	osr		osr		osr		
	5	R115:1037	nad	1.28	0.08	9.85	0.64	3.45	0.22	0.94
Ritovi d.Potisja	3010.67 *5*	M7:0312	7485	0.18	<0.01	1.30	0.04	3.45	0.12	0.20
Titelski breg	496.00 *3*	R110:0992	2025	1.83	0.37	14.05	2.83	5.00	1.01	4.21

Legend:
osr - outside of the scope of research; nad - no available data; Pzp - protected area surface; COV-classes of orientation values; Ps - threatened surface of protected area; Gi - habitat loss by road construction; P50 - the surface of the impact area calculated up to the distance of 50m from the road on protected area; G50zp - relative habitat loss caused by roads on protected area and their impact area; Pou50 - the surface of impact area of roads outside of the protected area; Gou50 - relative habitat loss caused by impact area of roads outside of the protected area;
Gr - the total relative habitat loss

Total relative habitat loss is shown in Table 5. Apart from the road impact within the protected areas, it includes the impact areas located up to 50m away from the borders of PAs which are (to smaller or larger extent) overlapping with them. It is evident that capacity exceedance is occurring on Bagremara SNR (1.11%), Kamaraš (NaP) Nature Park (1.33%), Slano Kopovo SNR (2.43%) and Selevenjske pustare SNR (1.89%). An interesting fact is that the capacity exceedance on Slano Kopovo SNR and Selevenjske pustare SNR occurs only as a result of overlapping of road impact areas, whose routes are located along the border of the protected areas. Based on total relative habitat loss Karaš-Nera LEF (0.94%), Fruška gora NP (0.65%) and Jegrička NaP (0.6%) are classified as areas with high level of risk.

Comparing the data from Table 3 (COV-classes of orientation values) with the data from Tables 4 and 5, a significant difference in the number of threatened core areas of the national ecological network within certain classes could be observed. The difference between the total number of potentially threatened areas (Table 3) and the analysed areas (Tables 4 and 5) is related to the threatened parts of habitats due to the different position of the roads compared to the borders of the area (the maximum considered distance is 50m). Along the one-third of the total core areas belonging to the classes 3 and 6, roads were registered at the distance up to 50m (Tables 3 and 5), while at the core areas of class 7 a significant potential impact exists from all of the three recorded roads (Tables 3, 4 and 5). Compared with the total of 31 (Table 3), more than a third of the core areas (12) are threatened by the direct road transecting of habitats (Table 4). While analysing the core areas from class 3, only two (Table 4) out of the total of 9 areas (Table 3) are threatened by the direct transect. It is a significant fact considering that the size of the core areas of class 3 is quite small (100-500 ha), therefore a larger number of roads transect could cause significant habitat loss.

Discussion

The application of the approach by Lambrecht and Trautner considers only the habitat loss by direct occupation of the area. This article goes a step further attempting to consider the secondary negative effects of traffic resulting from pollutant sedimentation. For the analysis, only the minimum values of the distance from the roads were used, for which the probability of loss of the threatened part of habitat is near one, due to deterioration of environmental quality. The value of 1% (as the maximum acceptable habitat loss) should be considered for the area of Vojvodina, because the remaining fragments of natural habitats under the current conditions are barely enough to provide the proper functionality of the ecological network.

Research results regarding protected areas are the basis for determining the possibility of road construction in relation to the total capacity of the area. In addition to area capacity, restrictions on road construction and the usage of roads depend on the traffic volume of a given road section, road position in relation to habitat types and landscape elements, the existence of endangered animal species on the area of direct impact, route interference with migratory corridors, habitat sensitivity on environmental impacts, etc. In such cases, area protection measures may include speed limitation, construction of noise barriers, planting of protective vegetation (in a way to exclude the disruption of the overtaking visibility of roads) as well as application of other planning and construction solutions that contribute to the habitats and species protection, while maintaining the security of traffic functioning. However, when the capacity of a protected area is exceeded, or a habitat of a particularly endangered species exists nearby, it is necessary to find an alternative solution for the design of the road outside of the protected area.

The analysis of the satellite images indicates that the area between roads and protected areas is mainly covered by arable land. In cases where the sections of roads are in the vicinity of the protected area, it is necessary to consider the possibility of establishing shelterbelts on a safe distance, away from the road corridor. In addition to their role in noise mitigation, decrease in pollutants concentration and wind protection, complex structured shelterbelts (with a specific ratio of grass and shrub vegetation), may represent habitats to species of cultural landscapes, and can have the role of ecological corridors too.

When planting of high vegetation (tree plantation) is prohibited due to the ecological features of the landscape (e.g. steppes or meadows), compliance with the recommended distances from the borders of protected areas is essential. The construction of new roads in the impact zones of protected areas requires the establishment of cooperation between the sectors of transport, agriculture, forestry and nature conservation. It is necessary to determine the areas needed for the establishment of shelterbelts, by buying land from private owners or interchanging land in private and public ownership. A systematic approach is needed in the process of spatial planning to integrate the goals of natural values preservation.

CONCLUSIONS

The aim of this article is to show that even with a minimalistic approach (using the smallest values of the parameters related to road width and critical distance from the habitat), the vulnerability of certain core areas of the national ecological network is evident. For a detailed analysis of losses for each given habitat type, a more precise data will be used related to the subject of this research. This includes information on the sensitivity of habitat on different disturbances, landscape elements in the immediate vicinity, the occupation area of the road infrastructure (width of road area, related facilities, etc.). When assessing the impacts on species, it is necessary to use data on their sensitivity to noise, vibration, lighting, etc. In the process of constructing new roads, the construction of ancillary facilities, retention ponds, borrow pits etc. must also be taken into consideration. The application of principles from this article in nature conservation and spatial planning practice could help in a more effective arrangement of road network elements in accordance with the sensitivity and capacity of the area. The result of analysis obtained by overlaying the road infrastructure and protected areas can be used for determining the possibilities of road construction and operation related to the total capacity of the area, characteristics of natural habitats and traffic. Upon the valorisation of future core areas of the Natura 2000 network and the designation of the Natura 2000 in Serbia, classes of orientation values could be changed. Taking into account that habitat type approach is one of the key elements when dealing with the Natura 2000 network, the use of relative habitat loss and other criteria given in the article should be further tested and developed.

When the application of the conservation measures cannot prevent habitat degradation, threats to endangered species and ecosystem destruction, it is necessary to find an alternative solution for designing road routes at the appropriate distance from the areas under protection. One of the key factors of sustainable development is the integral approach in land use along with the consideration of all alternative options. A detailed traffic analysis for assessing the impact on a protected area of a given road section that lacks available data requires the establishment of continuous monitoring of traffic intensity on the sections which are located in the impact zone of the areas inside the national ecological network. Preparation of projects in this field could represent the basis for the development of habitat assessment methodology, needed for the Appropriate Assessment of

building construction or any other works and activities in the impact zone on protected areas. Construction of new roads in the impact zone of protected areas also requires the establishment of cooperation between the sectors of transport, agriculture, forestry and nature conservation. A systematic approach to this problem represents a way for the implementation of the existing strategic planning documents and the current legislation (that deals with the protection of natural values) into the plans of each given sector.

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MODELLING SHAPE OF ARCHITECTURAL STRUCTURE - ELLIPTIC HYPERBOLOID OF ONE SHEET

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The combination of straight lines of constructive elements and curved contours of structural shapes is always challenging in the engineering practice. The 2nd order surface – elliptic hyperboloid of one sheet (ELHY) provides such combination. Given that in the architectural surroundings, arts, or other scientific fields ELHY is less common, than the other representatives of the same family of ruled surfaces, it is worth of attention and research. Here presented constructive geometry approach resulted in Auto CAD application for generating 3D wire-frame and triangulated net model of ELHY surface and some examples of structures – prototypes of structural shapes, designed by using ELHY fragments.

***Key words:** elliptic hyperboloid of one sheet (ELHY), 3D geometric modelling, structures, Auto CAD application.*

INTRODUCTION

The study of architectural shapes revealed that geometric surface of the 2nd order – hyperboloid of one sheet, has been well known and very common architectural shape ever since the 19th century and still is. In 1890s, famous Russian engineer Vladimir Shukov constructed first lattice – hyperboloid shaped structure, tower in Polibino, Russia. The other aspect of employment of hyperboloid was provided in 1957 by architect Eduardo Torroja (Antuna, 2010), applying concrete shell for the water tank Fedala Reservoir, in Morocco. Later, this kind of surface has become recognizable around the world in industrial architecture (power cooling towers), or in high special purpose structures.

At the end of 20th and the beginning of the 21st century, the hyperboloid steel lattice structures have been 'clothed' with glass either outside or inside and brought some other functionalities. Thus, the *Corporation Street Bridge*, designed by arch. Hodder & Partners, in the central part of Manchester (England), is horizontal communication made of steel and glass. On the other hand, very tall buildings, such as Aspire *Tower*, also known as Torch Hotel, built for the Asian Games in Qatar in 2006 and designed by Hadi Simaan and AREP architects, exhibits combinations of concrete core and outer steel mesh structure, with high-tech illuminations.

Modern architecture and computer modelling of the 21st century brought some innovations, regarding this surface. Thus, dynamic shapes have been employed in projects of *Al Masdar Headquarters* in Abu Dhabi, by A. Smith and G. Gill architects; *BMW Welt*, 2007 in München, by arch. Wolf D. Prix and Copp Himmelblau corporation etc. (Vrančić, 2010)

All the mentioned structures are examples of the hyperboloid of revolution surface. Although elliptic one sheeted hyperboloid (ELHY) is the representative of the same family of hyperboloids, it is significantly less common and familiar architectural shape than hyperboloid of revolution. Very tall high-tech building, *Canton tower* in Guangzhou, China, is one of the rare representatives of lattice structures, presenting the important characteristic of ELHY, characterized by straight lines, as generatrices of the architectural shape.

The main goal of this manuscript is to offer designers a tool i.e. computer application and examples of prototypes of ELHY structures to stimulate its wider application in building environment.

3D MODELLING OF ELHY

When discussing the ELHY surface, the aspects of its generating, or modelling are of particular importance. One straight line, i.e. generatrix is ruling along three straight directrices generating the surface. These three directrices are skewed, finite lines d_1, d_2, d_3, presented in Figure 1. For the easier constructive treatment, d_1, d_2, d_3 are presented

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as diagonals, or edges of the sides of the prism ABCDEFGH (Čučaković, 2008). Likewise, three directrices r_1, r_2, r_3, of the other system of generatrices are inscribed in the sides of the same prism. Orthogonal projections of d_1', d_2', d_3', onto the plane normal to d_1, were used for constructing spatial positions of generatrices. In such settings, projections of the generatrices are radial lines through point $D \equiv d_1'$, which intersect directrices d_2' and d_3' in points 1'-15'.

Since this surface has two systems of generatrices, the same procedure was applied for parallel directrices r_1, r_2, r_3, of the opposite sides of the prism ABCDEFGH, in the second system of ELHY generatrices (Figure 1).

In order to visualize the surface constructed 'inside' auxiliary prism, ELHY is cut with two planes, parallel to the prism's base ABCD, symmetrically towards the center of the surface, deriving two identical ellipses (Dragović, 2013).

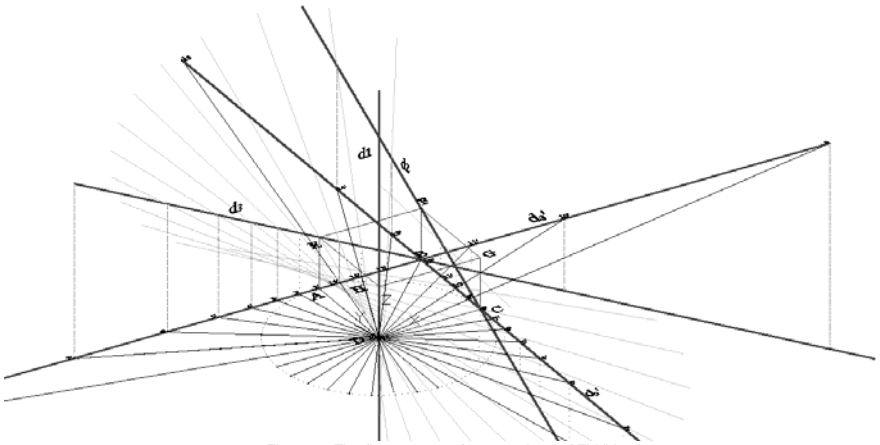

Figure 1. The first system of generatrices of ELHY

Auto CAD application for the modelling of ELHY surface

The relevant relation of the ELHY surface and its asymptotic cone (Dragović, 2013), where one asymptotic cone is mutual for infinite number of ELHY surfaces, affected creative approach to CAD application (written in *Auto Lisp*), for modelling both the wire-frame net and triangulated surface model of ELHY. In this non-standard approach, the circular sections of ELHY were considered as the surface generating curves.

Hence, asymptotic cone of ELHY is given with generating curve k_{as} and vertex V, where the centre point $C \neq V$. The center O of the ELHY surface is identical to the vertex V of its asymptotic cone. Besides, generatrices of ELHY are parallel with generatrices of its asymptotic cone. Base curve k of ELHY has to satisfy the condition $r_k > r_{as}$ (Figure 2).

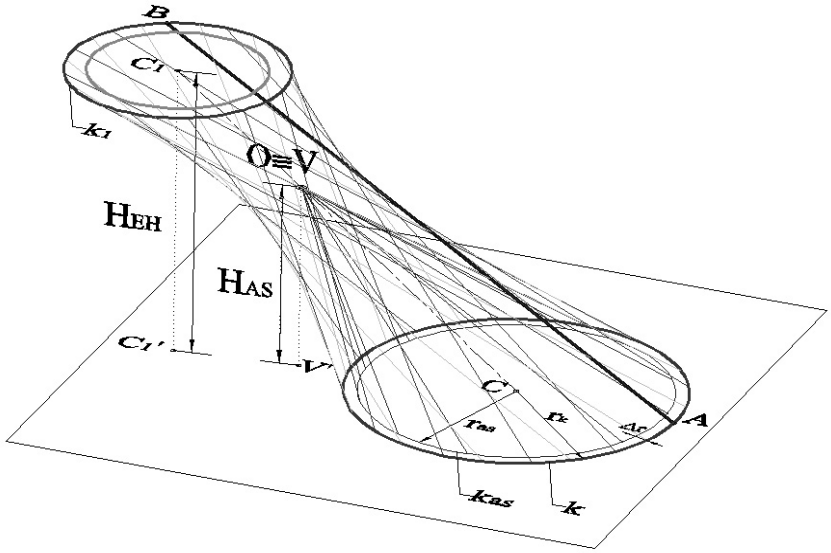

Figure 2. The disposition of geometric parameters for ELHY

The first part of the application for obtaining the net of ELHY's generatrices, has two options (construction modes) given in algorithm in Figure 3, requesting below listed responses:

a) *Left side algorithm option:*

- construction mode - 1 (circle),
- selection of the circle – k_{as}, or k, drawn in WCS (World coordinate system),
- confirmation whether the selected circle belongs to asymptotic cone, or to ELHY,
- V' position (orthogonal projection of vertex V) in WCS,
- asymptotic cone height - H_{AS} (z coordinate of V),
- radius difference Δr of the circles (k, k_{as}),
- ELHY height - H_{EH} and
- generatrices number – n.

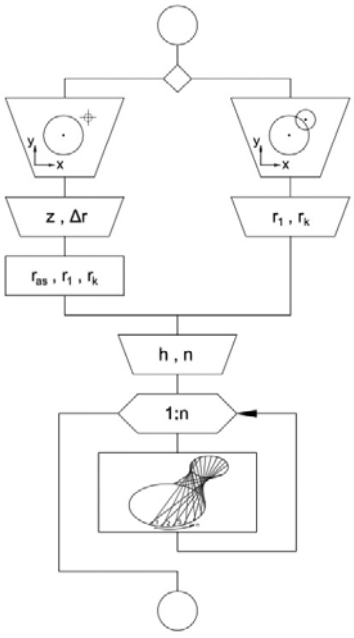

Figure 3. Algorithm for CAD application

b) *Right side algorithm option:*

- construction mode: 2 (circles)
- selection of the base (k) and top (k_1) circles, drawn in WCS,
- selection of the start point (A) and end point (B) of generatrix in WCS,
- ELHY height - H_{EH} and
- number of generatrices – n.

The results are symmetrical or asymmetrical shapes of ELHY nets. It must be noted that when setting the starting parameters, the spatial prediction of ELHY shape is very important (Dragović, 2013). This includes setting of: circles - cross sections of ELHY, i.e. H_{EH} (mode 2); start (A) and end (B) points of generatrix (mode 2), etc.

Both options of CAD application offer export data file for creating ELHY triangulated surface model (Figure 4), as well as the sets of circular sections, incorporated in the net of generatrices. Benefits of the structure triangulation concerning various unfavourable influences, such as snow, wind, temperature decrease, etc., were confirmed in various studies (Nenadović, 2010).

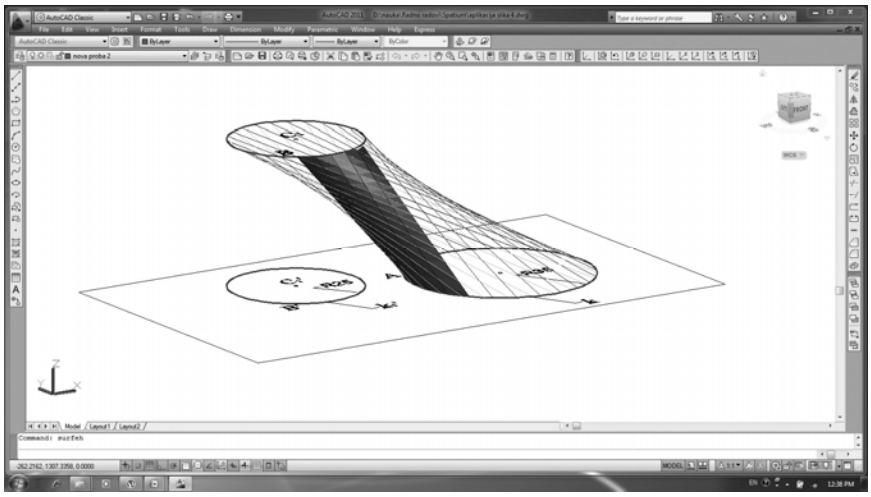

Figure 4. Generating process for triangulated surface model of ELHY (option "a") in Auto-CAD

PROTOTYPES OF HYPERBOLOID STRUCTURES

Bearing in mind the property of ELHY, related to straight lines – generatrices of the surface, the possibilities of their use in appropriate structural (building) systems, applicable in architectural design and practice, have been considered (Nestorović, 2000). In such a way, strained cables of prestressed thin concrete shells, as well as guidelines for the elements of mesh structures (carrying construction, or facades) could represent skewed ELHY lines.

Regarding this, here are presented geometrical models of structures – prototypes of architectural shapes, offering both possibilities: thin shells and meshes.

Prototypes of structures – combinations of thin concrete shells

Shells with curved edges

In the following prototypes, fragments of the main shape - ELHY are cut out from the solid model of surface by Boolean operations between ELHY and two stellated pyramids (6-pointed star) derived 6 saddle shaped fragments – shells.

The element of structure - saddle shaped fragment of ELHY, is incorporated in triangular, square and pentagonal scheme, obtaining 3D model, presented in Figure 5. Structures contain supplementary planar elements, according to the system of wedging of ELHY.

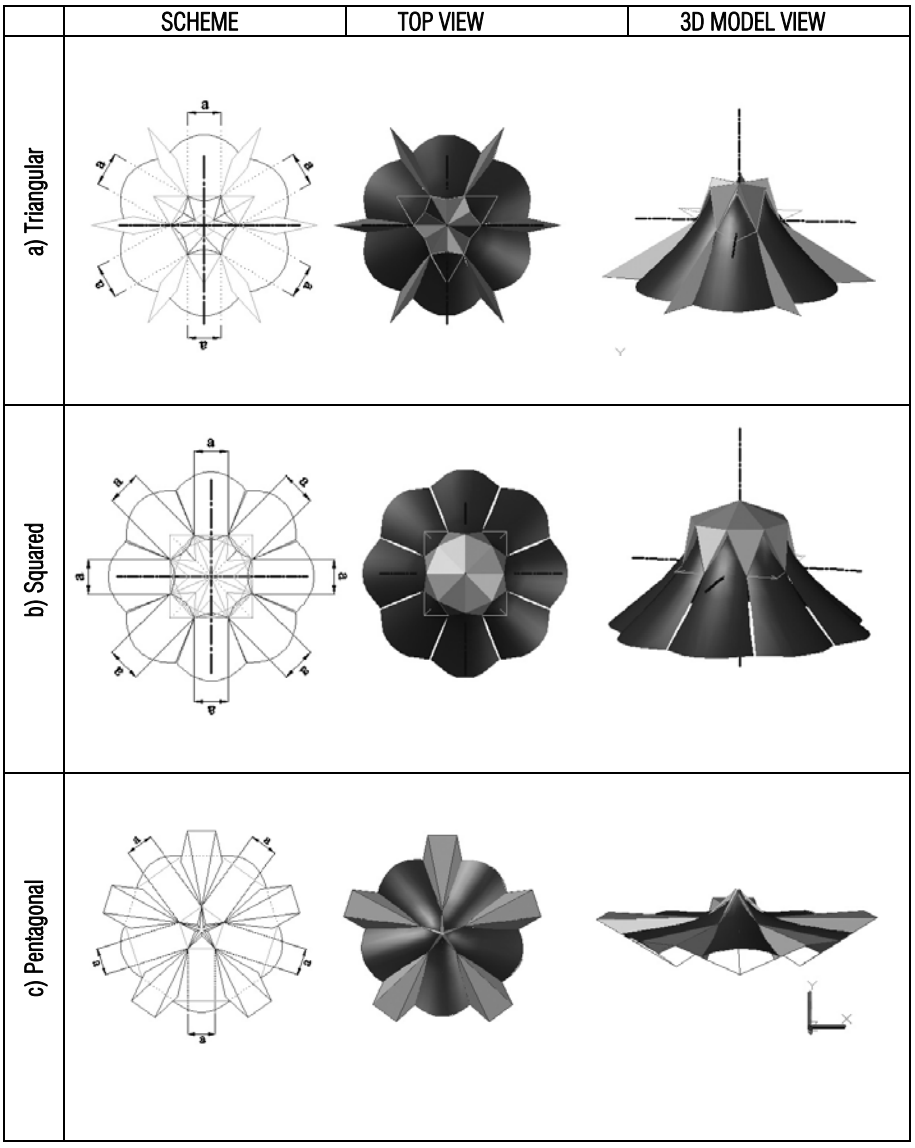

Figure 5. Fragments of ELHY incorporated in three polygonal schemes

Shells with straight edges and circular sections

ELHY belongs to a group of surfaces with three planes of symmetry and two sets of circular sections being related to the planes of symmetry (Dragović, 2013). This property enables surface slicing in fragments adjustable to various structures containing rotational symmetry (Jadrešin-Milić, 2008). Using slicing method of ELHY, with two symmetrically positioned planes (with respect to the plane of symmetry φ_1) through chosen generatrices of the surface and two circular sections, a fragment of the surface can be obtained (Figure 6), adequate for combinations in polar array patterns.

The elements of the structure - ELHY fragments, are incorporated in the triangular, square and pentagonal scheme (Figure 7), forming 3D model. Following the same principles, structures contain supplementary planar elements.

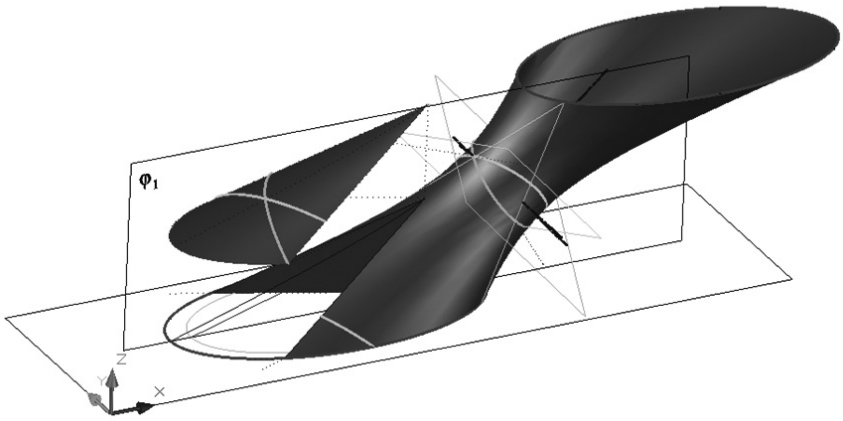

Figure 6. Fragment of ELHY with two straight edges

Mesh structure models

This part of our study discusses several issues: employment of diagrid structural system and triangulation, as well as, revolving and twisting with double curved surface:

- ELHY, although containing straight generatrices, is actually a double curved surface. This property makes it possible to employ diagrid (triangular-grid structures with diagonal support beams), as structural system in design of buildings, which has its attractive and practical values (Volner, 2011). One of these properties was reported by Boake (2013:578) in his article stating: 'Buildings whose diagrids support more curvilinear forms tend to use triangulated windows as these more easily adapt to the shape'.

- With respect to ELHY, our study also deals with 'spiral', or 'twisted', shapes in order to follow modern trends in architecture. Namely, it can be noticed that in the past decade numerous tall spiral/twisted buildings have been built worldwide. One of the remarkable examples of 'stepped twisters' (according to Vollers, 2009) is *Gakuen spiral tower* in Nagoya, built with all the characteristics of modern high rise design. Its facade has triangulated configuration of protruding wings (Vollers, 2009). When it comes to 'revolver' sub-category of generating the surface (Ibid.) the elliptic one sheeted hyperboloid can be employed.

Two systems of generatrices and circular sections derive triangular net – mesh structure. Double curved surface is tessellated with flat panes, where geometry of diagrid structures fits. Diagrid optimization for tall buildings was reported by Moon (2007) and Boake (2013), whereby the building's elementary geometry is prism like.

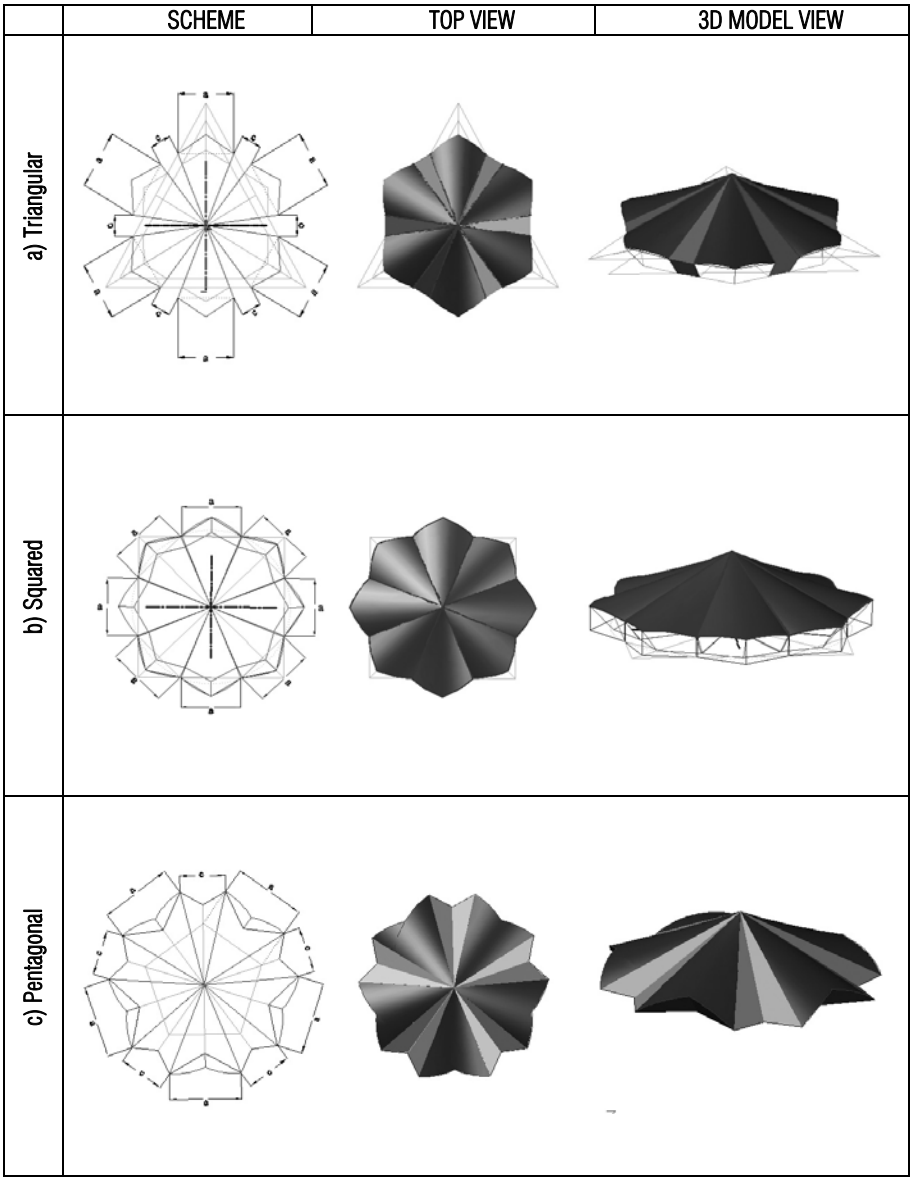

Figure 7. ELHY fragments with straight edges, incorporated in three polygonal schemes

Since ELHY cross sections are ellipses (perpendicular to the inner principal axis) and hyperboles (sections containing inner principal axis), the other possibilities of mesh grid are also acceptable.

Two prototypes of ELHY shapes, presented in Figure 8 (top view, front view and 3D model), are 3D triangulated surface structures modelled in Auto CAD application.

CONCLUSIONS

Practical engagement of ELHY shape in modern engineering design (architecture, civil engineering, art, science, etc.) should follow important geometric characteristics of the surface itself. Bearing in mind that the surface itself is curved but with the straight lines as generatrices, it seems likely to expect its employment in imaginative structures in a variety of patterns.

ELHY-shaped 3D model structures, presented and designed in Auto CAD software application, combining straight lines and circular sections in triangular net, can provide a variety of possibilities in modelling of structural shapes.

Such structures could be viewed from several aspects: objects dimensions, applicable constructive systems, functionality, energy efficiency and cost-effectiveness. Casale *et al.* (2013) showed such opportunities when it comes to the shape of hyperbolic-paraboloid, a close 'relative' of ELHY. The possibilities of 'transformation' of ELHY into the form of a folded structure (Nestorović, 2000; Šekularac, 2012) could be of interest in the further study of this interesting geometric shape and its implementation in modern architectural design.

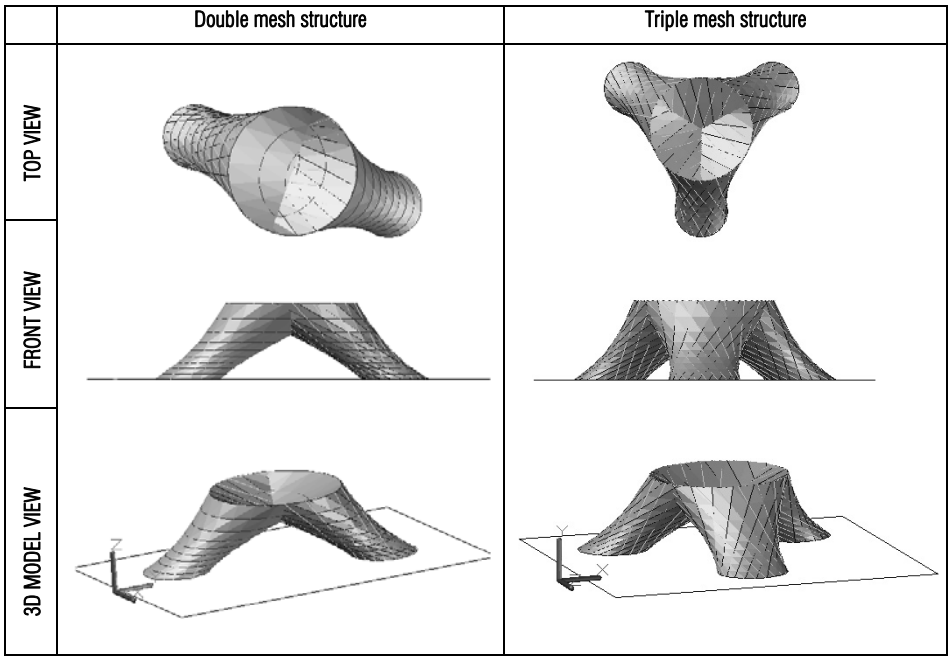

Figure 8. Two types of mesh structures ELHY shaped

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RANDOM CURDS AS MATHEMATICAL MODELS OF FRACTAL RHYTHM IN ARCHITECTURE

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The author Carl Bovill has suggested and described a method for generating rhythm in architecture with the help of random curds, as they are the mathematical models of unpredictable and uneven groupings which he recognizes in natural shapes and in natural processes. He specified the rhythm generated in this way as the fractal rhythm. Random curds can be generated by a simple process of curdling, as suggested by B. Mandelbrot. This paper examines the way in which the choice of probability for every stage or level of the curdling process, and the number of stages in the procedure of curdling, affect the characteristics of the obtained fractal object as a potential mathematical model of rhythm in the design process. At the same time, this paper examines the characteristics of rhythm in architecture which determine whether the obtained fractal object will be accepted as an appropriate mathematical model of the observed rhythm.

***Key words:** Fractal Rhythm in Architecture; Random Curds; Curdling; Unpredictable and Uneven Grouping; Naturalness.*

INTRODUCTION

Numerous studies have shown that fractal objects which belong to the class of random fractals can be successfully used to describe, manipulate, and simulate a lot of natural shapes and processes (Avnir *et al.*, 1998; Feder, 1988; Mandelbrot, 1982; Peitgen, 2004; Voss, 1988). Random curds are fractal objects belonging to the class of random fractals, which, according to Bovill (1996:92), represents a 'disconnected set of points that has a clustered characteristic'. Bovill (1996) took random curds as the mathematical models of natural rhythm, or natural distribution, and described the procedure of transferring this rhythm from a model to the rhythm in architecture, thus achieving the variation in architectural compositions similar to random clustering of matter in nature, such as, for example, the clusters of stars and galaxies (Mandelbrot, 1982). The author defined the rhythm, or the random and uneven distribution of similar elements generated in this way, as the fractal rhythm, or fractal distribution.

A lot of authors have studied the potential of some geometric objects, such as planes and space curves and surfaces, and concepts, such as the concept of cellular automata (CA), to support the generative processes in the field of architectural and urban design (e.g. Petruševski *et al.*, 2009; 2010). This paper continues the studies in the same direction, and examines the possibility of using fractal geometry as a design tool in the exploration of architectural and urban forms.

Various studies have been conducted in environmental psychology in order to research the influence of natural and built environment on people (e.g., Hartig *et al.*, 2003; Kaplan and Kaplan, 1989; Kaplan, 1995; Purcell *et al.*, 2001; Parsons, 1991; Ulrich, 1993; Van den Berg *et al.*, 2007). They have revealed that people give a greater preference to natural features and that natural features in our environment have a favorable effect on the psychological and physiological condition of people. However, modern urban life has reduced the opportunity of exposure to natural features, which, as scientists assume, can have long-term negative consequences. According to Joye (2006; 2007), we can mitigate this negative trend, at least partially, if we use the shapes and principles of fractal geometry, as the 'geometry of nature' (Avnir *et al.*, 1998; Mandelbrot, 1982) in architectural and urban planning and design.

Random fractals, as well as deterministic fractals, are the objects of fractal geometry, resulting from the constructional procedures which are usually recursive. But the process of the construction of random fractals includes a component of randomness, so the algorithms for their construction are nondeterministic. Thus, with deterministic or exact fractals, the same pattern is repeated in new iterations or with every change of scale, so here we can talk about the exact self-similarity. On the other hand, when it comes to random fractals, the invariability through different scales is statistical; namely we don't have the exact, but the statistical self-similarity and because of it, every magnified section looks similar to, but not exactly the same as the global pattern from which it is extracted (Mandelbrot, 1982; Voss, 1988). According to Voss (1988), the important thing here is the fact that the aforementioned feature of the statistical self-similarity represents the central characteristic of fractals in nature.

Certain studies have proved that the thing responsible for the visual feature of naturalness, sometimes ascribed to certain fractal objects, is the very component of randomness which is included into the process of generating such objects. The authors Peitgen *et al.* (2004:425) incorporated the component of randomness into the process of generating a deterministic fractal set, also known as the Koch curve, expecting to get a 'realistic natural shape'. The obtained fractal curve had the same fractal dimension as the exact

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Koch curve, but, according to the authors: 'the visual appearance is drastically different; it looks much more like the outline of an island than the original snowflake curve' (*ibid.*:425). Similarly, comparing the exact Koch curve and a random Koch curve, Taylor and Sprott (2008:119) emphasized that the former was not sufficiently similar to natural shapes, because 'the exact repetition of patterns creates cleanliness rarely found in natural forms'. On the other hand, the authors claimed that, owing to a certain measure of randomness, that 'artificial look' could be avoided with the latter curd and a 'more natural-looking fractal' could be obtained. (*ibid.*:119) Another important thing is that in some studies of aesthetic preferences across fractal objects, this feature, the so-called *naturalness*, appears as a significant correlate of greater preferences (Richards, 2001). Also, Bovill (1996:6) observed that in its shapes and in the way it changes over time, nature shows a certain measure of randomness, i.e. the right measure of predictability and randomness, or 'the mixture of order and surprise'. So, according to him, using random curds, which already have the component of randomness or 'surprise' in themselves, as a design tool, the randomness could be included into the design process, which is one of the ways to ensure that buildings are in sympathy with their natural surroundings.

RHYTHM IN ARCHITECTURAL COMPOSITION

The elements, units, or motifs of an architectural composition which are identical or have similar features or a similar role in the composition, are responsible for the experience of the visual rhythm in an observer because of their multiple appearances in the same or modified form (Arnheim, 1974; Ching, 2007). When we mention the visual features of elements, we think of their size or position, as much as of the distinctive quality of their shapes and surfaces, e.g. the colour or hue, texture, transparency, etc. In Figure 1, in multiple occurrences of the observed element, which clearly represents a single element on the specific scale of observation or at a given level of organization (for example, a facade panel or a floor tile), characterized by specific visual features (e.g. colour or shape), the actual values of its visual features are either repeated, or modified (in other words, they can be either identical or more or less distinct from element to element), thus generating a specific visual rhythm.

Since the topic of this paper is how to generate rhythm in an architectural composition, as part of the design process, then the concept of the value of visual features here won't refer to any possible value that the mentioned feature can theoretically have, but only to the specific value determined in advance for a specific observed case of rhythm generation in an architectural composition (e.g. if we take the windows on a front wall as the elements whose multiple appearances create the visual rhythm, then the specific values of the majority of visual features, e.g. heights and widths, or sill elevations, will be determined depending on the function of the inner space, story height, window type, etc.).

RANDOM CURDS AS MODELS OF RHYTHM

Random curds can be produced by a simple process of *curdling* (Mandelbrot, 1982). It is a cascade process, which results in contraction and, according to Mandelbrot (1982:84), it originated from the attempt to 'mimic reality by purely geometric means'.

To create these fractals we need a 'grid or lattice, made of intervals, squares, or cubes, each divided into b^E subintervals, subsquares, or subcubes; b is the lattice base' (*ibid.*:210), where E equals 1, 2 or 3, for intervals, squares, or cubes, respectively. Curdling, or random clustering is achieved by a sequence of binary random choices which decides the later fate of each of b^E subintervals, subsquares, or subcubes. With the 'probability $p<1$, the subinterval 'survives' as part of a precurd; otherwise, it dies off' (*ibid.*:211). With the 'surviving' intervals, squares, or cubes, we continue to the next stage of the cascade. By selecting the probability of the event for every stage of the process, as well as the number of stages, we can get a model of random clustering of elements, with desired characteristics. The probabilities $p=1/2$, 1/3, 2/3, etc., may be simply obtained by tossing a coin or a dice.

Number of Values of Visual Features

The values of a visual feature of an architectural element are determined in advance for each particular case of rhythm generation, in accordance with the specific role that the observed element plays in an architectural composition, or with other specific requirements. If the rhythm is generated with the help of random curds, then the number of determined values is very important.

Namely, if the number of determined values is two, one random curd can be the mathematical model of the rhythm, because a random curd on every scale of observation also consists of subintervals, subsquares, or subcubes, which can be in only one of these two conditions: 'survives' – 'does not survive', and the binary relation 'empty-full', or 'exists -does not exist' can be translated into 'this one exists - that one exists', so that each of the two possible conditions in the process of rhythm generation will be an analogue for one value of a visual feature of an architectural element. In Figure 2, we can see a random curd, generated in the process of curdling through two stages, with 4^2 subsquares in every stage. Each subsquare is in one of the two possible conditions.

If the number of determined values is greater than two, we suggest overlapping two or more random curds, provided they have the same size and number b^E of subintervals, subsquares, or subcubes.

If we overlap two random curds, then each of b^E subintervals, subsquares, or subcubes (on the given scale of observation) can occur in one of the four possible conditions: one curd 'survives', the other curd 'survives', both curds 'survive', neither curd 'survives'. Thus, by overlapping two

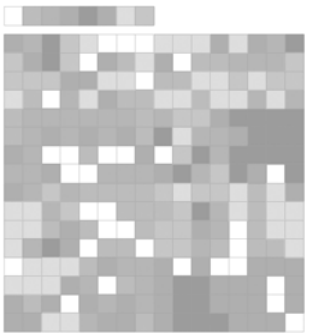


Figure 1. Multiple occurrences of elements in the same or modified form

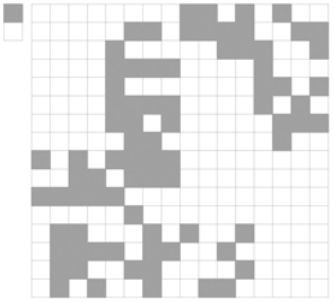


Figure 2. Mathematical model for rhythm of two values of visual features

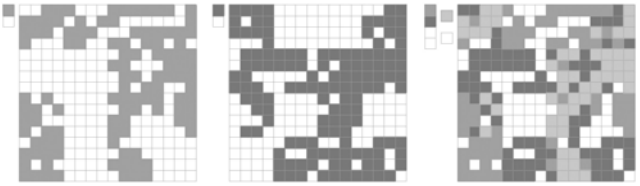


Figure 3. Mathematical model for rhythm of four values of visual features

random curds, we can obtain the mathematical model for those cases of the rhythm of the visual features of architectural elements where the number of the determined values is four. In Figure 3, we overlapped two random curds generated in the process of curdling through two stages, with 4^2 subsquares, each in every stage, and with the probability of 3/4 in the first stage and 2/3 in the second one.

Similarly, if we overlap three random curds, then each of b^E subintervals, subsquares, or subcubes (on a given scale of observation) occurs in one of the eight possible conditions. Thus, by overlapping three random curds, we can obtain the mathematical model for those cases of the rhythm of the visual features of architectural elements where the number of the determined values is eight. For example, the elements in eight colours in Figure 1 are arranged with the help of three overlapped random curds, generated in the process of curdling through two stages, with 4^2 subsquares, each in every stage, and with the probability of 3/4 in the first stage and 2/3 in the second one.

Therefore, the number of the determined values of visual features is important here, because by overlapping two or more random curds, we can get the mathematical models for rhythm generation in architectural compositions only for the cases where that number is equal to the number of all possible different outcomes for the overlapped random curds. Namely, if the number of overlapped random curds is marked with *n*, then the number of different possible outcomes, marked with R is equal to the sum of the number of combinations of *n* elements of the first class, second class, etc, to the *n*-th class, plus one (one refers to the outcome when all the overlapped subintervals, subsquares, or subcubes are those that 'don't survive'), which can be mathematically expressed as:

$$R = \binom{n}{0} + \binom{n}{1} + \binom{n}{2} + \ldots + \binom{n}{n} = (1+1)^n = 2^n \quad (1)$$

Here, the subintervals, subsquares, or subcubes which 'do not survive' are treated the same, for all curds. Namely, they are treated as 'empty' or 'neutral', i.e. as such entities whose presence does not affect the outcomes.

When we use the mathematical model obtained by the described overlapping of two or more random curds as a design tool, the way we treat the overlapping of the subintervals, subsquares and subcubes which 'survive' is important for the final appearance of the generated rhythm. So, overlapping can cause 'the loss' of the initial value and the appearance of a new value, as shown in Figure 3, where the overlapping of two colours, blue and red for example, results in the third one - purple. In this case, the newly synthesized value is actually a sort of the median of the initial values and, as such, it is possible in the situations when the initial values are of the same kind, and mutually comparable on some scale of values.

Also, if we have, for example, some dimensional visual features, the values of which could be 'summed' in some way, this new value could possibly be the visual equivalent of their 'sum'. In Figure 4, which shows an irregularly perforated surface, we used three overlapped random curds as a mathematical model, generated in the process of curdling, through two stages, with 4^2 subsquares, each in every stage, and with the probability of 1/2 in both stages. Their subsquares which 'survived' were an analogue for the circular openings of the same size, but in three different positions in relation to the centre of the subsquare. The subsquares, on which two or three circular openings overlapped, were treated in such a way that the overlapped openings were replaced with the appropriate larger circular openings, as the visual equivalents of their 'sum'.

In addition to the described situation when we obtained a new value by overlapping the initial values (two colours gave the third one, or two smaller openings gave a larger one, etc.), which could be mathematically expressed as: a+b=c, there is also a possible approach where the initial values are not replaced with a new value, but retain their initial features even after overlapping, and remain visually present, which could be expressed as: a+b=ab.

First we overlapped two random curds, as shown in Figure 5a, and then three, as shown in Figure 5b, generated in the process of curdling through two stages, with 4^2 subsquares, each in every stage. Then we used the obtained model to

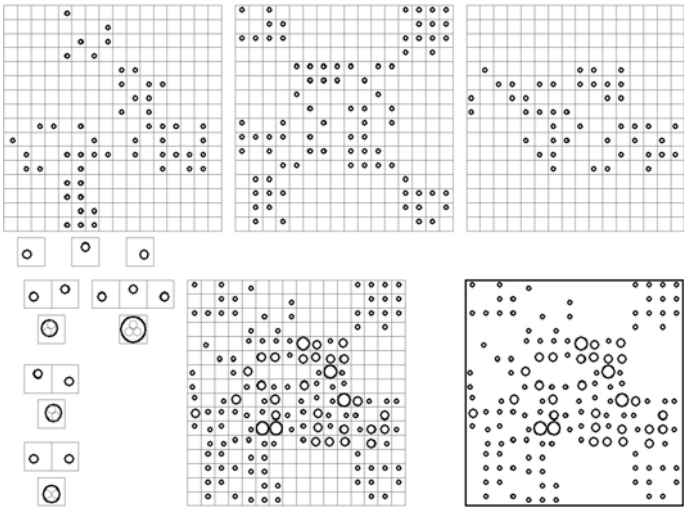
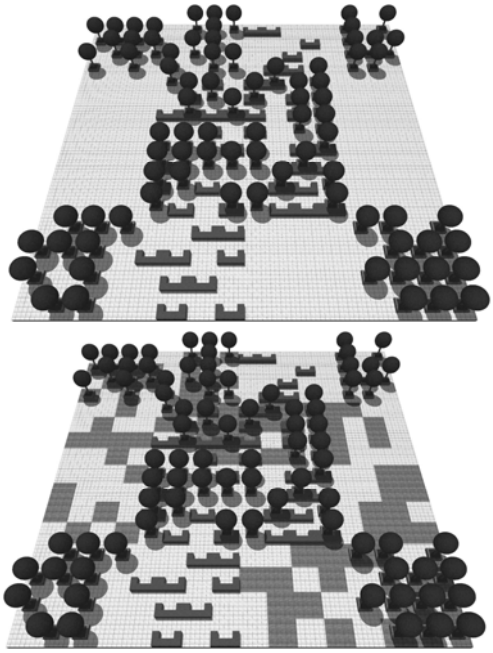


Figure 4. Perforated surface generated by means of three overlapped random curds



Figures 5a. and 5b. Distribution of the elements (trees, benches and floor tiles) of an imaginary park

distribute the elements of an imaginary park, so that the curds represented the analogues for the following elements: a tree, bench, or grey floor tiles. The 'empty' fields with all three curds were an analogue for white floor tiles.

Probability for Each Stage

The chosen probability for each stage of the generation process in the procedure of curdling is important because the presence or occurrence of the fields which 'survive' or 'do not survive' depends on it. Since we are talking about probability, the actual occurrence more or less approaches the expected occurrence. A different probability can be chosen for each stage of the process. For example, in Figure 3, we generated two random curds, with 4^2 subsquares, each in every stage, in the process of curdling through two stages, with the same probability of surviving: 3/4 in the first stage and 2/3 in the second one. The probability of a field to survive after the second stage was 3/4 x 2/3=1/2, which means that in both attempts, the expected number of the surviving fields was 256/2=128. The actual number of the surviving fields was 111 for the first curd, and 129 for the second one. It is important to emphasize that the possibility of prediction refers only to the number, but not to the distribution of the surviving fields, so the obtained curds with the same probability in the process and with the same number of stages can differ significantly in the visual sense, although they can have the same actual number of the surviving fields.

Also, when overlapping two or more random curds, the probability of possible outcomes depends on the individual probabilities for each overlapped random curd, and it equals the product of these individual probabilities. For example, in Figure 3, the probability of each of the four possible outcomes of the model obtained by overlapping two curds was 1/2 x 1/2=1/4.

The following question can be asked now: does the order of the 'phasic' probabilities somehow affect the characteristics of the obtained model, and thus the final appearance of the generated rhythm if we have the same number of stages in the process, the same 'phasic' probabilities which give the same final probability, and the same number of the expected surviving fields? In order to determine this, we generated two random curds, as shown in Figure 6, in the process of curdling through three stages, with the same phasic probabilities, but in a different order.

The order of the probabilities for the first curd was as follows: 3/4 for the first stage, 2/3 for the second one, and 1/3 for the third one. The probability that a subsquare would survive after the third stage was 3/4 x 2/3 x 1/3=1/6. Therefore, the expected number of the surviving subsquares was 4096/6=682. At the end of the process, 656 subsquares actually survived. The order of the probabilities for the second curd was as follows: 1/3 for the first stage, 2/3 for the second one, and 3/4 for the third one. The probability that a subsquare would survive after the third stage was the same as with the first curd; namely, it was 1/3 x 2/3 x 3/4=1/6. The expected number of the surviving subsquares was also 682. At the end of the process, 698 subsquares actually survived.

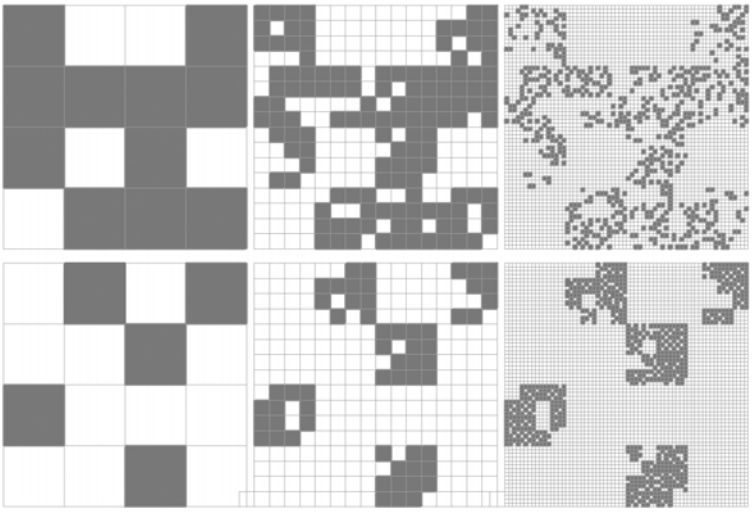


Figure 6. Two random curds generated with the same phasic probabilities, but in a different order

Comparing the order of probabilities for each stage of the generating process, and the final distribution of the surviving subsquares (and bearing in mind that the final amounts of the surviving subsquares with these curds were approximately the same), we could notice the following: that the first random curd, whose probabilities were reduced with every stage, looked 'sparser' compared to the other one, whose probabilities increased with every stage, because the total amount of the surviving fields was spread over a larger total surface even in the first stage. On the other hand, because of the preference for a smaller probability even in the first stage, the further procedure with the second random curd was limited to a smaller total surface, which later resulted in a higher concentration of the surviving subsquares, so the zones with the surviving fields looked denser or more compact.

At this point we can conclude that the characteristic of clustering will be more expressed in objects if we chose smaller probabilities of surviving in their initial stages, and here the first stage is especially significant in relation to subsequent stages. Because of this density, the boundaries between the surviving subsquares from the previous stage become more visible, so the visual presence of a geometric system in the process, i.e. the regular grid or lattice, is more emphasized, which can cause these curds and, further, the generated rhythm in architecture, to look less 'natural'.

Number of Stages

The number of stages in the process of curdling is important because the amount of the surviving subintervals, subsquares, or subcubes is reduced, compared to the initial amount, in every next stage of the generating process of this type of fractals. Namely, they cluster and group on a surface which gets smaller and smaller, whereas the distances between the surviving fields increase. Thus, the value of the fractal dimension decreases from one stage to another, and can be calculated using the 'box-counting method' for different stages of the process (Bovill, 1996; Mandelbrot, 1982). Also, the size of subintervals, subsquares, or subcubes decreases with every next stage, while their number increases at the same rate.

Here we can ask the next question regarding the use of these fractal objects as a design tool: can we reach a random curd, as a potential model of rhythm with the desired characteristics regarding the number and size of subintervals, subsquares, or subcubes, and regarding the desired relation of the two possible conditions 'survived – didn't survive', through a different number of stages of the process, and will the preference for the smaller or larger number of stages affect the characteristics of the obtained random curd, and even further, the features of the generated rhythm in architecture? For example, if we need a random curd as a mathematical model for paving a floor (dim. 20x20m) with tiles (dim. 30x30cm), in two colours, so that the presence of one colour

is significantly smaller than the presence of the second colour (e.g. in the ratio of 1:8), then we can take a random curd with 64x64=4096 squares as a potentially appropriate model, where 1/9 of the squares should be the squares which survived all the previous stages. We can obtain such a model by generating a random curd in the process of curdling through three stages, where the probability that the subsquare will survive is 2/3 in the first stage, 1/2 in the second stage, and 1/3 in the third one. After the third stage, the probability will equal to the one we need, 2/3 x 1/2 x 1/3=1/9. In order to get 64 x 64 subsquares in the third stage, the grid, or raster should have 4^2 subsquares, each in every stage. However, the desired model can also be obtained by generating a random curd in the process of curdling through two stages, where the probability that the subsquare will survive is 1/3 in the first stage, and also 1/3 in the second one. After the second stage, the probability will also equal the one we need, 1/3 x 1/3=1/9. In order to get 64 x 64 subsquares in the second stage, the grid, or raster must have 8^2 subsquares, each in every stage.

In Figure 7, we can see two random curds, both of which had the same number and size of subsquares in the final stage, as well as approximately the same number of the surviving subsquares: the first one - 436, and the second one - 417 (the expected number of the surviving subsquares was 4096/9=455 for both of them).

Comparing these two curds, we can observe a difference in the way in which the surviving squares are clustered because of the different number of stages. Namely, in order to have the same probability of the surviving fields after the final stage, with the first curd (the one generated through three stages) the probabilities of surviving are greater for the first and the second stage, so the 'clustering of matter' is more gradual, and the 'surviving matter' looks sparser; it spreads over a larger basic surface. Whereas, for the same reason, in the second case (the curd generated through two stages), the probability in the first stage is smaller, and even as early as that, the clustering of matter, or the concentration of the further process on a smaller total surface, is greater. This connection between probability and concentration is described in the Section *Probability for Each Stage*.

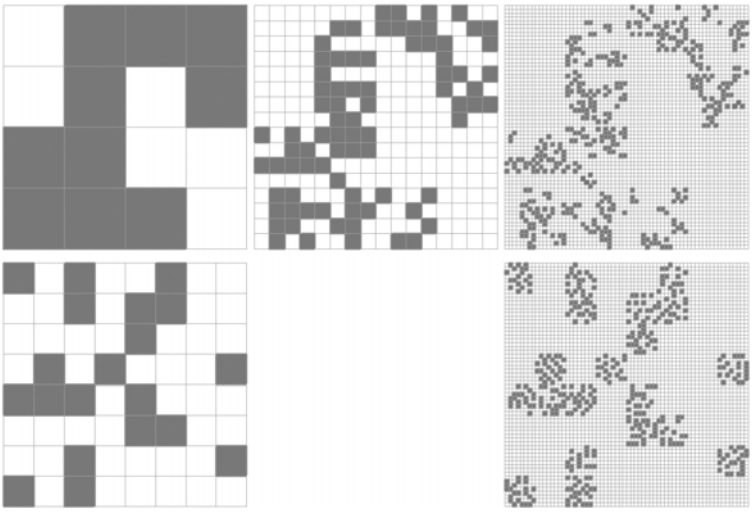


Figure 7. Two random curds generated through a different number of stages of the process

CONCLUSIONS

Random curds may be accepted as a design tool in architecture, with certain limitations. The limitations in the use of these fractal objects refer to the fact that they are generated in the process which is nondeterministic, so they have a component of randomness. Also, the process of curdling (the word derived from the verb *curdle*) (Mandelbrot, 1982) necessarily leads to an irregular distribution, unequal density, to a large concentration in certain sections, whereas some other sections remain completely 'empty'.

Certain characteristics of models, such as the size and number of subintervals, subsquares, or subcubes, can be determined in advance, in such a way that they completely correspond to the requirements of the program. Also, the relation between the presence of different elements, and the characteristics such as sparsity or density, or greater or smaller visibility of the regular grid or lattice, can be controlled and predicted to a certain extent, with the proper selection of the number of stages and probabilities for each stage. However, the exact position, or distribution of the surviving fields, cannot be predicted. It is only possible to repeat the process until we get the model whose distribution of the surviving fields, for example, best meets the requirements and suits the needs of a specific case. Also, sometimes only one segment of the generated curd can be taken as a model. In that case, it is possible to select the segment from the whole curd whose shape and the layout of the surviving fields would best suit the needs (Figure 8).

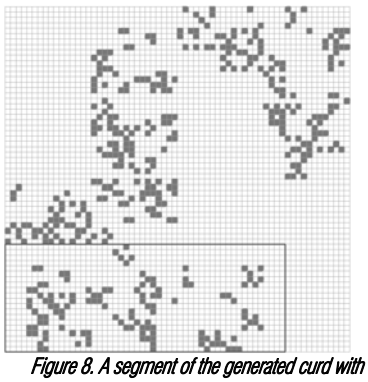


Figure 8. A segment of the generated curd with desirable shape and the layout of the surviving fields

Since the values of visual features of architectural elements are usually conditioned by a great number of requirements and limitations relating to different aspects of architecture (purpose, materialization, construction, social and natural context, etc.), (Ching, 2007), and on the other hand, since they often represent the groups of units which require the similar or identical treatment for the observed level of spatial organization, the following question can be asked: in what situations and to what extent can random curds be used as mathematical models in the design processes?

We will give only a general answer to this question here: because of the aforementioned random, unpredictable and uneven distribution of elements with the clustering tendency, random curds can be used as a design tool in the situations when the values of visual features are not strictly conditioned by various requirements and limitations placed before an architectural element (e.g. the layout of the floor tiles, or façade elements in several colours, as shown in Figure 1, where the issue of rhythm is sometimes reduced only to the visual aspect of the composition), or in the situations when the uneven distribution with the clustering tendency is not only acceptable, but also desirable. Such a case is shown in Figures 5a and 5b, where the component of randomness gives the distribution of the elements the wanted 'natural look', and on the other hand, the clustering of the elements (trees, benches, 'empty' fields) creates different microambients on the observed surface of a park, which can represent the framework for performing different activities, suit different users, and potentially satisfy different needs.

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Technical Report

MONITORING SPATIAL PATTERNS OF URBAN DYNAMICS IN AHMEDABAD CITY, TEXTILE HUB OF INDIA

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Urbanisation refers to the physical growth of urban region with the increase in the population due to either migration or amalgamation of peri-urban areas into cities. India, with 31.5% (377 million) urban population as per 2011 census, has been experiencing the global trend of increasing urbanisation. Urbanisation process involves changes in land uses and enhanced consumption of energy, which contribute significantly to the global warming. This necessitates developing effective urban planning strategies with the regular monitoring of landscape dynamics. Availability of temporal data of the earth's surface acquired through space borne sensors helps in mapping and monitoring landscape. Spatial metrics aid in quantifying the urban structure and patterns of urban growth. In this context, the current research reports of urban growth (urbanization and urban sprawl) in Ahmedabad, based on the temporal land use dynamics considering four decades remote sensing data with gradient analysis and spatial metrics. Urban land use dynamics, in terms of both patterns and quantities, were studied using Shannon Entropy index and select spatial metrics for the study area with 10 km buffer (from administrative boundary). This provided insights into the pattern of urban development and its complexity. Results indicate that Ahmedabad city has rapidly grown from 3.2 % to 14.58 % in the period from 1975 to 2010. Spatial metrics highlight that the core area of the city (which is the core financial area) has grown into a compact single urban class, whereas the outskirts have dispersed urban patches. This analysis helps the regional planners and decision makers in advance visualisation of urban patterns for sustainable planning of the city with basic amenities and infrastructure.

***Key words:** spatial analysis, remote sensing, land use, spatial metrics, urbanisation, urban sprawl, Ahmedabad.*

INTRODUCTION

Rapid urbanisation leads to the haphazard physical growth of urban areas due to rural migration or peri-urban concentration into cities. This process drives major changes in the land use pattern of the region. Structural changes in the landscape alters the functioning of the ecosystem, which affects the sustenance of natural resources (Orville *et al.*, 2000) and human livelihood (Grove and Burch, 1997). The dispersed growth of urban pockets is referred to as sprawl and is an urban characteristic feature (Ebrahimpour- Masoumi, 2012). Urban sprawl, a consequence of development of urban areas under influence of various factors such as social and economic etc., is increasingly becoming a major issue in many metropolitan areas (Ji *et al.*, 2006; Miljković *et al.*, 2012; Ramachandra *et al.*, 2012a). Urban sprawl is the development of small urban settlements in the periphery or the sub-urban areas and these areas are devoid of any basic amenities (Adhvaryu, 2010; Kundu and Roy, 2012; Ramachandra *et al.*, 2012a). Accurate and timely information on the extent of urbanisation and the rate of growth is required in order to avoid the negative impacts on human habitat, which is of utmost concern to urban planners, civil engineers, environmentalists etc. (Mesev *et al.*, 2001; Ramachandra *et al.*, 2012b). This necessitates understanding the dynamics of urban structure with its functions (Lu *et al.*, 2004; Lu and Weng, 2007). Planners need to monitor the patterns of growth to understand and assess the future demand of urban land while balancing other land uses and providing basic amenities.

Conventional surveying techniques are expensive, time consuming and inherently biased in sampling that hinders the understanding of urban phenomena. This has led to an increased interest in spatial research using temporal remote sensing data with Geographic Information System (GIS) techniques (Herold *et al.*, 2002; Sudhira *et al.*, 2004; Dewan *et al.*, 2009). Remote sensing data with digital processing techniques helps to detect and monitor urban dynamics (Zhang *et al.*, 2002; Ramachandra *et al.*, 2012a). Temporal remote sensing data aids in understanding the changes in the landscape using change detection (Tang et al., 2005). Spatial metrics aid in quantifying the urban structure and patterns of urban growth (Macleod and Congalton, 1998). The spatial metrics are advantageous in capturing inherent spatial structure of landscape classes based on shape, size, centrality, etc., (Herold *et al.*, 2003; Sudhira *et al.*, 2004; Bharath *et al.*, 2012a). Complex measures of urban form were identified based on density, proximity, concentration, centrality, nuclearity, clustering and continuity (Galster *et al.*, 2001). Spatial metrics have aided

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in characterizing the landscape (O'Neill *et al.* 1988; Turner *et al.*, 2003; Li and Wu, 2004; Bharath *et al.*, 2012b), including urban growth studies (Civco *et al.*, 2002, Bhatta *et al.*, 2009; Ramachandra *et al.*, 2012a).

Shannon's entropy, a measure of uncertainty, is useful to quantify the urban sprawl in terms of spatial quantity (Sudhira *et al.*, 2004; Bharath *et al.*, 2012a). It has often been used as a measure of disaggregation and aggregation. (Jat *et al.*, 2008). Now there are 48 cities in India with more than one million inhabitants (as per 2011 census, http://censusindia.gov.in). Quantification of urbanization pattern and sprawl in all cities through temporal remote sensing data would help in planning sustainable cities and towns. This research is aimed at quantification of urban process in one of the growing metropolitan textile city, Ahmedabad. The spatial analysis has been carried out for Ahmedabad city administrative boundary with 10 km buffer to account for the regions in peri-urban area experiencing urban sprawl. Temporal land use and land cover (LULC) analyses are performed to understand the distribution and dynamics of land use classes. Shannon's entropy and spatial metrics with urban land use dynamics helped to assess the urban process quantitatively and qualitatively.

STUDY AREA

Ahmedabad is the seventh largest metropolitan city in India with population of approximately 7.2 million in 2011 (4.5 million in 2001). The city is located in the northern part of Gujarat and on the bank of River Sabarmati at 23°00'N, 72°40'E, at an elevation of 53 m. Ahmedabad (Karnavati or Amdavad) was the capital of Gujarat from 1960 to 1970 and later the capital was shifted to Gandhinagar. It is the financial and economic hub of Gujarat dominated by textile industries, also known as the 'Manchester of India' (Ahmedabad City Development Plan, 2013). The average temperature of the city ranges from 36°C to 43°C (in summer) making the region more hot and dry, and 15°C to 23°C (in winter). The average rainfall is about 1017 mm. The vigorous growth of the city's economy led to its GDP (Gross Domestic Product) of 59 billion USD in 2010. The administration of Ahmedabad is controlled by the Ahmedabad Municipal Corporation (AMC, http://www.egovamc.com). During the last two decades the city has attracted many foreign investments making Gujarat one of the few economically developed states of India.

MATERIALS AND METHODS

Data

Landsat satellite images of Ahmedabad were acquired for different time periods from Global

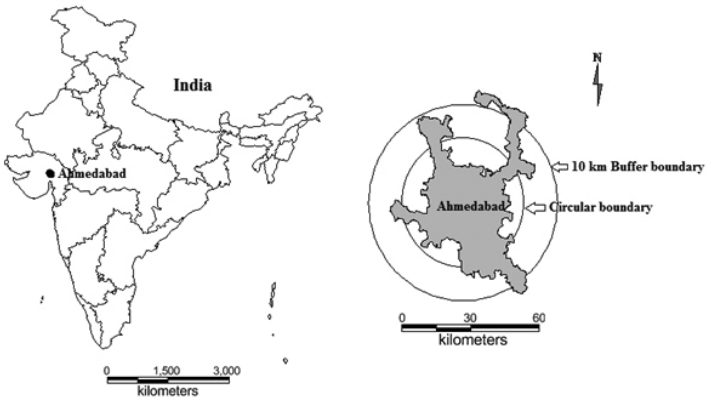

Figure 1. Study region

Table 1. Data used

Data	Year	Purpose
Landsat Series Multispectral sensor (57.5m)	1975	Land cover and Land use analysis
Landsat Series Thematic mapper (28.5m)	1990, 2000, 2010	
Survey of India (SOI) toposheets of 1:50000 and 1:250000 scales		To generate boundary and base layer maps.
Field visit data – captured using GPS		geo-correcting and generating validation dataset

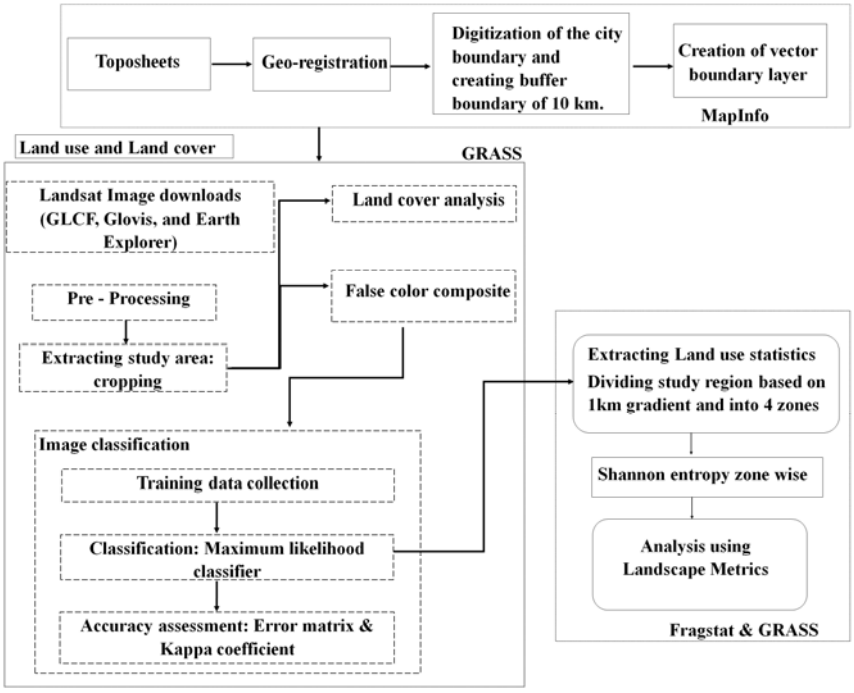

Figure 2. Procedure outline

Land Cover Facility (GLCF, http://glcf.umiacs.umd.edu/data), United States Geological Survey Earth Explorer (USGS, http://landsat.usgs.gov). Table 1 provides the details of the data that were used in the study. Survey of India (SOI) topographic maps was used to generate base layers and administrative boundaries. City administrative boundary was digitized from the city administration map. Ground control points to register and geo-correct remote sensing data were collected using handheld pre-calibrated GPS (Global Positioning System), Survey of India topographic maps, and Google earth online data (http://earth.google.com) as outlined in Figure 2.

Pre-processing

The remote sensing data obtained were geo-referenced, geo-corrected and cropped pertaining to the study area – Ahmedabad administrative area with 10 km buffer. Landsat satellite data were resampled to 30 m in order to maintain uniformity in spatial resolution across all temporal data.

Land Cover analysis

Land cover analysis was performed to understand the changes in the vegetation cover during the study period. Normalised Difference Vegetation Index (NDVI) was computed for assessing the extent of vegetation cover. NDVI values range from -1 to +1. Very low values of NDVI (-0.1 and below) correspond to soil. Zero indicates the water cover. Moderate values represent low density vegetation (0.1 to 0.3), while high values indicate thick canopy vegetation (0.6 to 0.8).

Land use analysis

False colour composite (FCC) of remote sensing data (bands – green, red and NIR), was generated to visualise the heterogeneous patches in the landscape. Training data were digitized and then loaded to pre-calibrated GPS. The training data were chosen so as to cover at least 10% of the study region and uniformly distributed throughout the study region. Field investigations were carried out to collect the attribute information of these training polygons. The signatures were also digitized as polygons with the help of Google Earth. Land use categories (in table 2) were classified using supervised classifier based on Gaussian Maximum Likelihood Classifier (GMLC) algorithm with the help of training data (60% data were used for classification).

GMLC is considered as one of the superior classifiers as it uses various classification decisions using probability and cost functions (Duda et al., 2000). Land use was computed through open source program GRASS - Geographic Resource Analysis Support System (http://wgbis.ces.iisc.ernet.in/grass). Out of the total generated signatures 60% were used in classification and balance, 40% were used for validation and accuracy assessment of the classified data. Classes of the resulting image were recoded to form four land-use classes. Accuracy assessment to evaluate the performance of classifier (Ramachandra et al., 2012a) was done through a confusion matrix and comparison of kappa coefficients (Congalton *et al.*, 1983; 1991; 2009).

Zonal Analysis

As most of the definitions of a city or its growth are defined in directions, hence it was considered appropriate to divide the study region into four zones [as Northeast (NE), Southwest (SW), Northwest (NW) and Southeast (SE)] based on directions considering the central pixel (Central Business district).

Gradient Analysis

Each zone was divided into concentric circles of incrementing radius of 1 km from the centre of the city. This analysis helps in visualising the urbanisation process at local levels and understanding the agents responsible for changes.

Shannon's Entropy (Hn)

Shannon's entropy given in equation 1 was computed for each zone to understand the growth of the urban area in specific zones and to understand if the urban area is compact or divergent. Shannon's entropy explains the urban process by characterising the growth either as concentrated / aggregated or sprawl (Sudhira *et al.*, 2004; Ramachandra *et al.*, 2012c).

$$H_n = -\sum_{i}^{n} P_i \log P_i \quad (1)$$

Where Pi is the proportion of the built-up in the i^{th} concentric circle and Hn ranges from 0 to log n. If the distribution is maximally concentrated, the lowest value zero will be obtained. Conversely, if it is an even distribution among the concentric circles, then the value will be maximum of log n.

Computation of spatial metrics

Spatial metrics are helpful to quantify spatial characteristics of urbanising landscape. FRAGSTATS (McGarigal and Marks,1995) was used to compute metrics (details of the metrics are in Bharath *et al.*, 2012b), which include Number of patches (Built-up) (NP), Patch Density (PD), Largest patch Index (Built-up) (LPI), Normalised landscape shape Index (NLSI), Area-Weighted Mean Shape Index (AWLSI), Edge Density (ED), Clumpiness Index (CLUMPY) and Aggregation Index (AI).

RESULTS AND DISCUSSION

Land cover

The pre-processed temporal remote sensing data were used to derive the land cover of the region using NDVI. Table 3 lists the temporal (1975-2010) dynamics of vegetation cover in Ahmedabad. The results of the analysis show that the percentage of vegetation cover has drastically reduced to almost half in past four decades, with an increase of area under non-vegetation (buildings, open space, water etc.). Land use analysis was performed to understand the status of various classes in the region.

Table 2. Land use categories

Land use class	Land uses included in the class
Urban	This category includes buildings and all paved surfaces and also mixed pixels having built up.
Water bodies	Tanks, lakes, reservoirs, canals.
Vegetation	Forest, cropland, nurseries.
Others	Rocks, quarry pits, open ground, un-metaled roads.

Table 3. Vegetation cover (based on NDVI)

	Vegetation (%)	Non-vegetation (%)
1975	49.78	50.22
1990	39.96	60.04
2000	29.87	70.13
2010	24.73	75.19

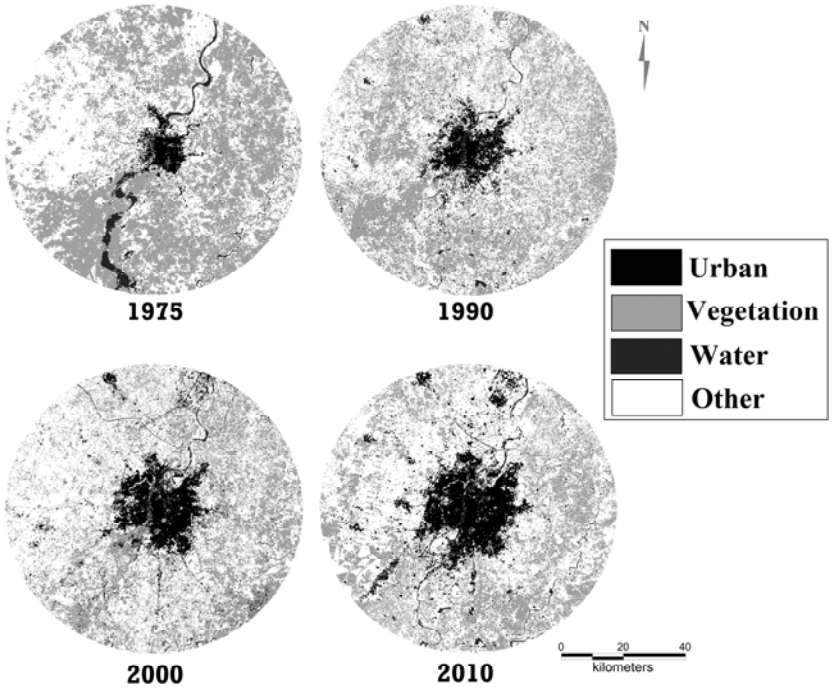

Figure 3. Temporal land use

Table 4. Land use dynamics in Ahmedabad

	Built-up (%)	Vegetation (%)	Water (%)	Others (%)
1975	3.2	45.4	2.8	48.54
1990	7.13	36.7	1.2	54.9
2000	9.41	32.6	1.44	56.5
2010	14.58	24.34	1.59	59.49

Table 5. Overall Accuracy and kappa statistics

Year	Overall Accuracy (%)	Kappa
1975	72	0.4130
1990	98	0.6109
2000	79	0.7558
2010	87	0.8079

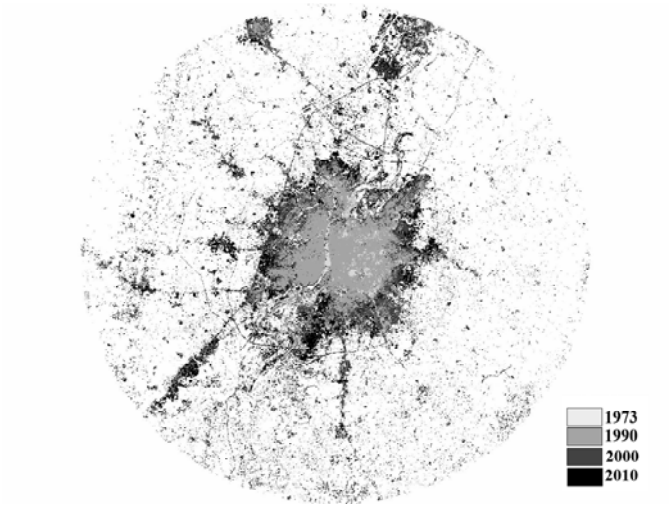

Figure 4.Urbanisation process during 1975- 2010

Land use

Figure 3 depicts the results of the temporal land use analyses based on GMLC. Table 4 lists the land use statistics, which indicates the decline of area under vegetation to about 24% from 45%, and the increase of the urban impervious class from 3% to about 14%, which is more than 400 times during four decades. Table 5 depicts the overall accuracy and kappa statistics of the analysis. Higher overall accuracy is an indicative that the derived land use information is in agreement with the ground conditions.

Figure 4 illustrates the spatial increase in urban pixels during the last four decades based on the temporal classified images pertaining to urban land use class. Assessment of land use dynamics helps in understanding the trends of urban expansions. This illustrates the maximum growth in south-east and north-west directions and mainly in the gradients near the centre. Minimal growth or marginal growth compared to central gradients is seen in buffer zones and on the periphery.

Shannon's entropy (Hn)

Figure 5 depicts Shannon entropy direction-wise, from 1975 to 2010. The values close to 0 in 1975 indicate that there was a compact growth, but the values have increased temporally to 0.3 indicating the tendency of sprawl or fragmented outgrowth. This highlights that the region is experiencing land transformation from centric growth to multi-dimensional fragmented growth. This growth might create more concentrated unconnected patch growths, leading to haphazard development without basic facilities, thereby impacting the local environment.

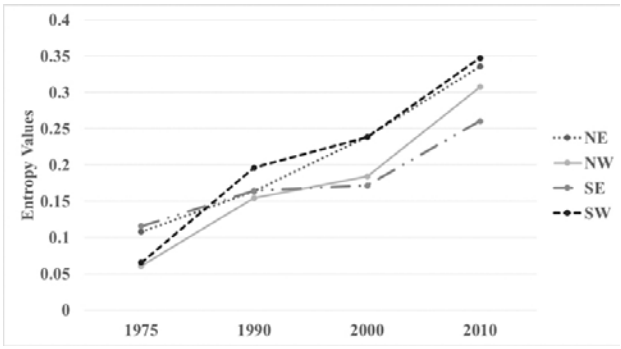

Figure 5. Shannon's entropy

Spatial Metrics

Spatial metrics computed circle-wise for each zone are discussed next.

Metrics based on patch characteristics. Number of patches (NP) Patch density (PD) and Largest Patch Index (LPI) were computed to understand the urban dynamics. NP indicates the number of built-up patches in a landscape through the quantification of urban impervious patches in the landscape. It indicates the level of fragmentation and/or clumpiness in the landscape. Reduced number of patches shows that the patches are combining to form a single class patch (Bharath *et al.*, 2012b, Saura *et al.*, 2007). Patch density, analogous to number of patches, measures the patch concentration in an area. As the number of patches increases, patch density increases representing higher fragmentation, and vice versa (Wu, 2004). LPI is a measure of patch dynamics in the landscape and quantifies the size of the patch in the landscape and its extent (Ibid.). Results indicate the process of aggregation in the core or central business district compared to the periphery and the buffer zones. Globalisation and the reforms in the industrial sector during 1990s witnessed a spurt in urban growth, which is evident from the occurrence of large number of urban patches surrounded by other land uses. Subsequent urban growth witnessed consolidation of fragmented patches with lower patch density and larger urban patch to form clumped urban pockets in all directions by 2010. Specifically, patches in Northwest and Southeast zones had clumped towards a single patch growth at the outskirts and even at the buffer zone.

Metrics based on shape characteristics. Area Weighted Mean Shape Index (AWMSI), Normalised Landscape Shape Index (NLSI) and Edge Density (ED) were computed to understand the urban pattern based on shape characteristics. AWMSI metric computes the average shape of patches considering the weighted average of patch areas so that larger patches are weighed higher than smaller ones (McGarigal *et al.*, 2002). The results of this metric reveal that during 2010, the core area or the city centre has lower values indicative of regular clumped shapes such as square, circle etc., while outskirts and buffer regions have higher values that can be attributed to a fragmented landscape with irregular patch distributions. During 1970 and 1990s, patches were evenly distributed and were clumped with simple shapes. NLSI represents the normalised value of the shape of the class or patch under consideration. This index provides a simple measure of class aggregation or clumpiness through measure of the shape as complex or simple (Ramachandra *et al.*, 2012a). Results show that in 1990 the buffer zones show the signs of urbanization with fragmented and complex shapes of growth, especially the gradients from 11 to 17. Further towards 2010, the core or the city administrative region (until gradient 7) show a clumped patch forming single dominant land use with little scope for further urbanization. City outskirts and also buffer region are experiencing dispersed growth or sprawl.

Edge density (ED) computes the total number of edges present in a landscape. The increase in the number of patches in a landscape would increase the edges, and compared to a clumped growth would show lesser edge density (Fauth *et al.*, 2000; Botequilha-Leitao *et al.*, 2006; DiBari, 2007; Rehm and Baldassarre, 2007). If ED is 0, then it indicates that the landscape has one single edge/class, or else the increasing values indicate the mixture of land use present in the landscape. Results show a trend of increasing edge densities in the periphery and the buffer zones; post 1990 there has been a steady increase in the gradients 7 to 17 which form the outskirts in NE and SW in 2010 indicating higher degree of fragmentation. Lower edge density in the surroundings of CBD indicates that the urban growth has taken a toll over other land uses and is in the process of clumped single patch formation.

Metrics based on contagion. Clumpiness Index (CLUMPY) and Aggregation Index (AI) were calculated. Clumpiness index measures patches' aggregation or clumpiness (O'Neill *et al.*, 1988) of the overall urban patches. Clumpiness ranges from -1 to 1 where Clumpy = -1, when urban patches are maximally disaggregated, Clumpy=0 when the patch is distributed randomly, and Clumpy tends to 1 when urban patch type is maximally aggregated. Aggregation Index gives the similar indication as clumpiness. Values close to 1 at the centre in 2010, when compared to 1975 and in 1990, show the simple clumped growth at the centre and the values close to 0 are indicative of the random patch growth at the outskirts and buffer regions. Clumpiness index clearly indicates the disappearance of other land uses at the centre, and growing urban dominance at the city periphery (gradients 7 to 17) and the buffer region, which highlights that the region has to be monitored for appropriate planning to avoid haphazard growth. The aggregation index shows a similar trend as the clumpiness index indicating a single homogeneous patch at the central part of the city, whereas the outskirts are with urban fragmented patches.

Principal Component Analysis (PCA) was performed considering spatial metrics (area, shape and contagion), computed zone wise for each circle (Figure 6) and aided in assessing the patterns of urbanisation while prioritizing spatial metrics. PC 1 (Principal Component 1) explains 52.42% variance is positively correlated to metrics NP, LSI and ED, and negatively correlated with Pland LPI and AI. PC1 represents fragmentation of the landscape (circles 10 to 26), evident from metrics (NP, and ED). PLAND, LPI and AI of Circles 1 to 9 lie in the negative plot with low correlation to PC1. These metrics indicate the presence of larger size patch representing aggregated or clumped growth. PC 2 has a percentage variance of 26, with positive loadings for circles 3 to 9, which are in the process of getting clumped.

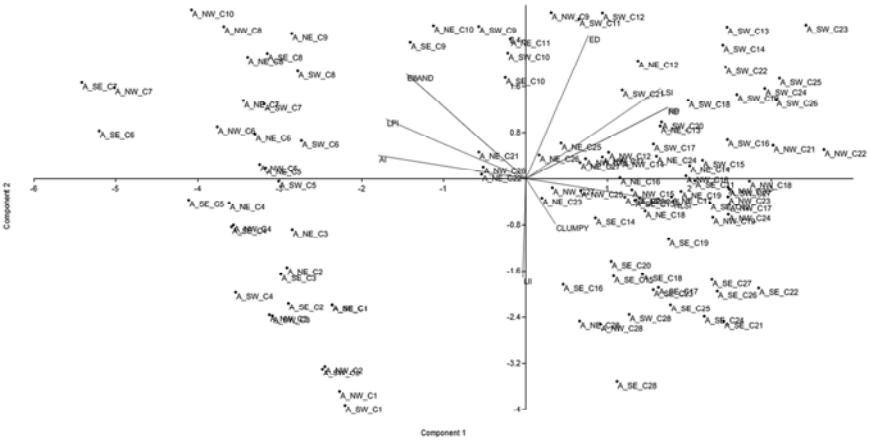

Figure 6: PCA of spatial metrics during 2010 (Note: A: Ahmedabad, Directions: NW, NE, SW, SE, concentric circles of incrementing 1 km radius: C1 to C 28)

CONCLUSIONS

Urban dynamics research provides vital clues for evolving appropriate land use policy for sustainable management of natural resources. In this paper, an attempt is made to quantify and qualitatively describe the patterns of urban growth. Measures of capturing the pattern of growth using entropy, density, clumpiness, and shape will help in the better city planning and facilitate basic amenities and infrastructure. The urban built-up area in the study region (Ahmedabad City with buffer) has increased by more than five times from 1975 to 2010. The fastest growing period was 2000-2010, when urban built-up area increased its spatial extent by 163%. The spatial expansion did not take place equally in all directions. The outward sprawl in the SW and NE directions is higher compared to other zones. Shannon's entropy and spatial metrics helped in understanding the form of urban sprawl and its spatial pattern. Increased values of entropy show the tendency of sprawl in all directions. Urban sprawl is taking place continuously at a faster rate in outskirts and buffer regions. Spatial metrics have been found to be effective in determination of urban sprawl and its spatial distribution. The pattern of growth has drastically altered the shape of the city that has evolved from simple shaped growth at the core to fragmented complex growth at outskirts.

Spatial metrics analysis through gradients helped in understanding the relationship of sprawl with causative factors. This approach is useful for the regional planners and authorities to understand and determine spatial patterns of urbanisation. PCA helped in prioritizing spatial metrics for better elucidation. Results show that the core or the city administrative region (until gradient 7) with a clumped patch forms single dominant land use and little scope for further urbanisation. City outskirts as well as the buffer region are experiencing dispersed growth or sprawl. Temporal remote sensing data and gradient based spatial metrics analyses were useful in understanding the dynamic phenomenon of rapidly urbanizing landscape.

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