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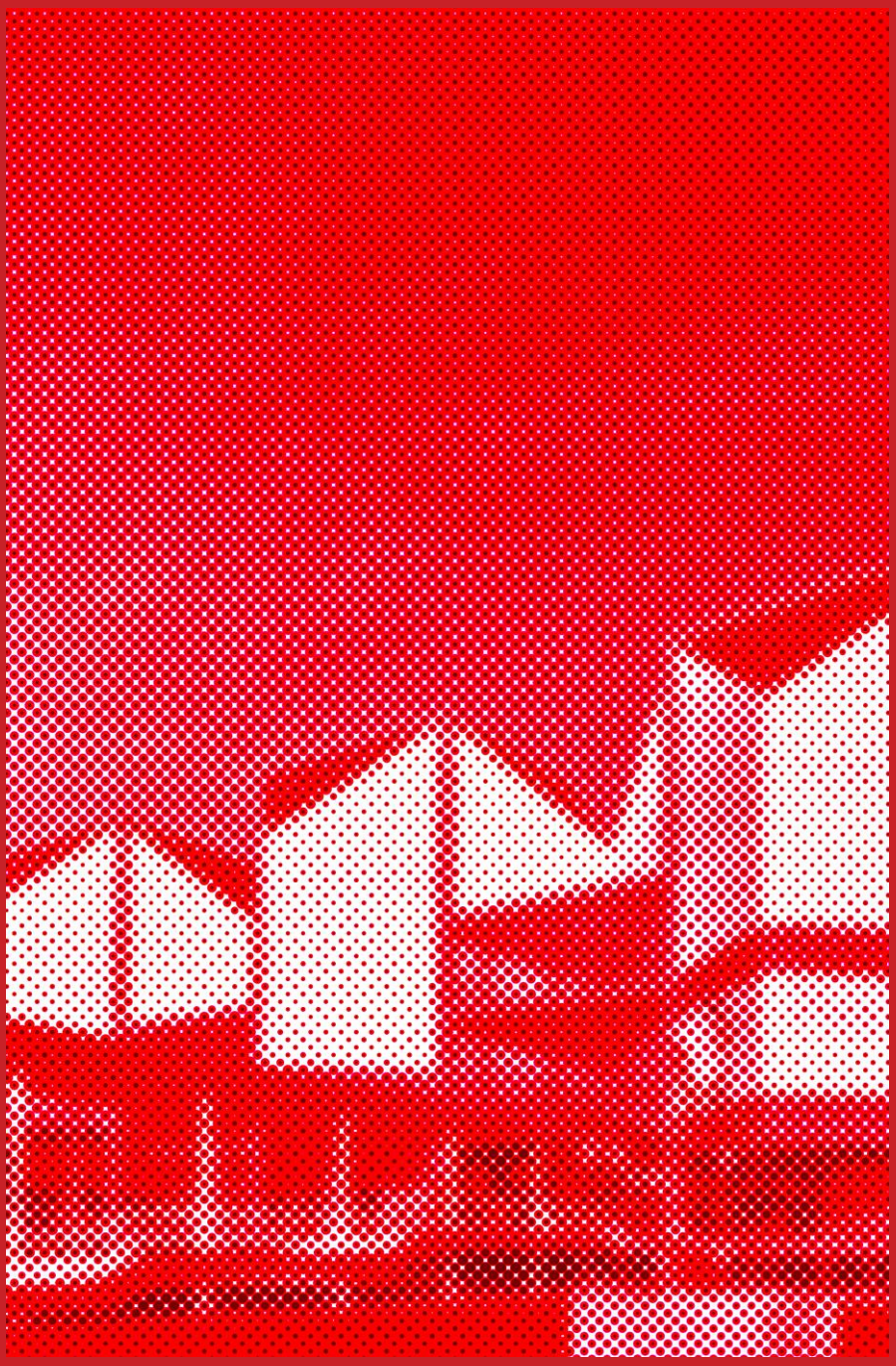

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SCOPE AND AIMS

The review is concerned with a multi-disciplinary approach to spatial, regional and urban planning and architecture, as well as with various aspects of land use, including housing, environment and related themes and topics. It attempts to contribute to better theoretical understanding of a new spatial development processes and to improve the practice in the field.

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EDITORIAL

Dear readers,

In this issue of *Spatium* we continue with publishing contributions, worked out, with one exception, by the authors from Serbia. The majority of articles report on the findings from the recent and/or current research projects, covering the following themes and issues: the phenomenon of the so-called ''socialist apartment'' in Yugoslavia; possibilities of introducing the concept of form into urban planning; an integrated approach to planning and protection of natural resource areas; and the land cover changes of the Broader Belgrade area. Two contributions go to comments on particular projects of architects Peter Eisenman and Ivan Antić, respectively. At the end of this issue an information has been enclosed on the international research project "Attractive Danube", carried out by the Institute of Architecture and Urban & Spatial Planning of Serbia, in cooperation with some twenty research partners and other participants.

Miodrag Vujošević
Editor-in-Chief

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DE- AND RE-STRATIFICATION OF THE URBAN TISSUE: PETER EISENMAN'S CITIES OF ARTIFICIAL EXCAVATION PROJECTS

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The study investigates the concepts of stratification, destratification and restratification of the urban tissue in Peter Eisenman's *Cities of Artificial Excavation* projects. The main thesis of the study is that Eisenman's *Cities of Artificial Excavation* performs a transgression of the three fictions on which classical and modern architecture were based by introducing narrative layers of non-classical fiction using strategies of relative destratification, that is, strategies of destratification and associated restratification of the urban tissue. This is a specific type of narrative de- and re-stratification based on a process, that is, on the concept of the disjunctive synthesis of real and imaginary or artificial narratives, which brings into question the traditional concept of (narrative) stratification, the concept of origin, the question of the beginning and end of a narrative line, and the question of true and rational, namely, the traditional line of influences of layers of the past on the layers of the present and potential future. For Eisenman, the layers of the present and potential future do not have to be based on the influences of fixed and unchangeable, *a priori* layers of the past. On the contrary, they have the potential to change the structure, meaning and significance of the layers of the past. In a wider context, this approach is related to poststructuralist perspectives that aim to break down the established mental structures of thinking and design and provoke different approaches to architectural and urban design, that is, different physical experiences, and the meaning and significance of the built environment.

***Key words*: stratification, destratification, restratification, Eisenman's *Cities of Artificial Excavation* projects.**

DE- AND RE-STRATIFICATION

The term stratification[2] is etymologically derived from the Latin words *stratum* (layer or cover) and *ficere* (make), which gives us *stratum + ficere* meaning to cover with a layer. "In the figurative sense, a layer needs a frame, a base material, or an additional layer in order to carry out the function of 'cover'" (Schultz, 2010).

In sociology the term "stratification is used to characterize a structure of inequality where (a) individuals occupy differentiated structural positions and (b) the positions are situated in layers (or strata) that are ranked hierarchically according to broadly recognized standards" (Durlauf and Blume, 2008). In political science, the concept of stratification refers to the "vertical structuring of the members of a society on the basis of socially relevant characteristics that influence the behavior of people toward each other" (Krämer in Schultz, 2010). Geology uses the term stratification to analyze and interpret the arrangement of different materials (Schultz, 2010). In most contexts, the layers below are treated as older, and those above as younger layers (Ule in Schultz, 2010). The order and composition of the layers contains information related to the development of certain geological formations. "The chronological component of the succession of sedimentary deposits and the process of a mechanical change of this stratification is an essential component of the definition" (Schultz, 2010). Archeology also highlights the chronological succession of each layer (of culture, society, settlement) in relation to the other layers. In psychoanalysis, there are different theories concerning the stratification of the human personality. Sigmund Freud developed the concept of the "writing pad" to explain the interaction between the layers of the conscious, unconscious and subconscious. Almost all of this research concentrates on investigating the influence of past layers on present layers, whereby the older layer (for example the unconscious layer in psychoanalysis) is treated

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[2] The interpretative key regarding the concept of stratification here is adopted from the theoretical framework constructed as a part of the research of Anne-Catrin Schultz on Carlo Scarpa in the book *Carlo Scarpa Layers* (Stuttgart - London: Edition Axel Menges, 2010), and it has been further developed by the author.

as immutable and universal. This situation is similar with regard to understanding the concepts of stratification in the context of architecture.

In the context of architecture, it is possible to speak about formal, representational, material, spatial, graphic, polychrome, tectonic, programmatic, narrative, conceptual and other forms of stratification. Spatial stratification, for example, refers to the succession of spatial sequences (Schultz, 2010). (For example, if we look at the dining room through the door and if the window with the flowers is behind the dining space, the space in between the wall with the door and wall with the window with flowers is the first layer, the space containing the window with the flowers is the second layer, and the landscape in the garden that can be seen through the window is the third layer. These zones "can be experienced simultaneously or are at least visible in the form of vistas and their effect is combined, as opposed to that of completely separated suites of rooms" (ibid.)). Material stratification corresponds to the geological meaning of this term (ibid.), and in opposition to the spatial stratification, which is defined by space in between layers, it refers to the superimposition of the layers of material of a certain element of architecture, that is, to the distribution of material plans side by side or on top of each other in a particular element of architecture (for example, a facade composed of brick, airspace, insulation, hollow clay block and plaster as different material layers). Just as the position and order of geological layers or strata says something about their age and their origin, the position and formulation of material layers or strata in architecture may contain information about their function (for example, load-bearing, decorative, illustrative or symbolic) and origin (ibid.). Narrative stratification refers to the layout or disposition of elements – certain forms of representation (material, stylistic, formal) that carry a message exposed in a given chronological, linear, cause and effect relationship (for example in the form of a decorative frieze on the facade of a building). Spatial stratification, as well as material and narrative stratification, serve not only to create space but also to formulate a certain atmosphere that links tradition and the past with the present. They make visible levels that chronologically follow each other, and "what was there earlier remains in existence like a kind of palimpsest and begins a communication with the newly added elements" (ibid.). The dominant approaches to research and design remain in the domain of unidirectional lines – the lines of influence of layers from the past on the layers of the present and the potential future.

Peter Eisenman toys with this line of research and construction of the role, sense and meaning of the narrative layers of the built environment. By introducing an artificial layer, he questions the truthfulness of the layers of the past and their *a priori* existence as unchanging and eternal, and points towards a line of investigation and influence of the layers of the present and potential future on the layers of the past. By analogy with numerous poststructuralist thinkers (such as Derrida, Benjamin and others) he brings into question the concepts of the origin, beginning and end of a specific line of narrative (and the wider event and process), as well as the linear and reversible concepts of narrative history, by introducing a narrative layer of non-classical fiction. The relationships between layers of urban tissue for Eisenman are not based only on the concept of stratification, but rather on the concepts of destratification and restratification.

With reference to the investigations of Gilles Deleuze and F**é**lix Guattari, the concept of layer in this study will refer to an "actualized system with homogenized components operating at or near equilibrium/steady state/stability" (Bonta and Protevi, 2006). The concept of stratification will refer to the processes of centralization, hierarchization, binarization, linear causality, segmentation and sedimentation of free movements of signs, particles of matter, bodies, territories, etc. The concept of destratification will refer to an intensification that produces a molecularization of matter, that is, to the decentralization and dehierarchization of signs, particles of matter, body, territory etc. By analogy with Deleuze's and Guattari's philosophy, I will make a distinction between the concepts of absolute and relative destratification. Relative destratification is about the movement of material into an assemblage, and absolute destratification is about reaching the plan of immanence, a condition of "unformed matter", in other words, it refers to a release of singularities or potentials from conditional ordering. Relative destratification is inseparable from a certain degree of restratification, a movement of transition and a new combination (of signs, particles) within a destratificated layer. It is a specific form of interweaving a content as well as an expression of different layers of the past, the present and the potential future, of different traces of culture, society and architecture. The main thesis of the study is that Eisenman bases his *Cities of Artificial Excavation* projects on the concept of relative destratification, that is, on the strategies of destratification and the accompanying restratification of urban tissue, namely, in the *Cities of Artificial Excavation* projects Eisenman performs a transgression of the three fictions on which classical and modern architecture were based by introducing narratives (narrative layers) of non-classical fiction using strategies of destratification and restratification. He thus shatters the strong logocentric discourse of Western culture, the tradition of priority, the notion of fixed and unchangeable origin and authoritative chronology, and catches the dominant/major narrative (of history) in the act of becoming minor, the narrative of the present (or even future) in the act of becoming the narrative of the past, and the real in the act of becoming imaginary or potentially artificial.

Narrative in this study is understood: (1) as a form of representation bound by sequences, space and time, function and historical citations; (2) as a structure, a particular way of combining parts to make a whole; (3) as a process of narration or story-telling, the process or activity of selecting, arranging and rendering the "material of the story" (in this case the layers of the city and architecture, the material aspects of architecture that carry some kind of message, function, sense and meaning) in order to achieve specific, time-bound effects on the observer, but also (4) as a story, discourse or ideology. "A narrative requires a narrator and a reader in the same way in which architecture requires an architect and a viewer. A narrative, therefore, is not only

the content of the story that is narrated, or the way in which it is interpreted by readers, but also the way in which it is structured and presented to an audience by an (authorial) entity, a writer, a film-maker, the curator of an exhibition or [in this case] an architect"[3] (Psarra, 2009). The relationship between narrative structure (on the conceptual, formal and spatial level) and perceptual experience, i.e., between the field of abstract relations and the physical experience of the architectural space, and all of them towards the formation of cultural mechanisms of "power" is the essential aspect of this study. How the transgression of narrative stratification of architecture is performed on the abstract level of formal and spatial relations, how it is perceived in the physical, cultural and social space of embodied experience, and how it conceptually and perceptually affects both man and society are the key questions in this study. Let us turn now to Peter Eisenman's *Cities of Artificial Excavation* projects.

PETER EISENMAN'S *CITIES OF ARTIFICIAL EXCAVATION*

Cities of Artificial Excavation comprises a series of projects that architect Peter Eisenman developed on various locations between 1978 and 1988 based on a critique of the three fictions on which Western classical and modern architecture were based: the *fiction of reason*, the *fiction of representation* and the *fiction of history* (See: Eisenman, 2004).

The *fiction of representation* is the fiction of representing already valued architecture or parts of architecture. Renaissance buildings (buildings that essentially aim to revive classical culture – Roman and to a lesser degree Greek), for example, acquired their value by using historical references, historical citations, or certain valuable historical elements of classical architecture (such as the use of classical rows or typology of architecture). "The *message* of the past was used to verify the *meaning* of the present" (ibid.). In other words, narratives of the past were considered eternal, universal and unchangeable. Modern architecture on the other hand moved away from the Renaissance fiction of representation by asserting that architecture should not represent another architecture, but should instead embody its own function (ibid.). With the deductive conclusion that form follows function, modern architecture considered that buildings should express their function, i.e. manifest the rationality of the processes of their production and composition (ibid.). This reduction to pure functionality was not abstraction, but an attempt to represent reality (ibid.). (For example, a simple column without decorative elements, such as a base and capital, closely resembles a real column – a column as a load-bearing element more than a classical column, that is, it expresses more clearly its function as a load-bearing, structural element of architecture.) Thus, while the fiction of the representation of Renaissance architecture referred to the representation of an already valued architecture, the fiction of representation of modern architecture was based on the representation of reality or functionality. The functional aims of modern architecture thus replaced the "orders" of the classical composition of Renaissance architecture as the starting point for architectural design. In other words, the idea of function in modern architecture was put as a proposition of origin or as a self-evident starting point analogous to the typology and historical citations of Renaissance architecture (ibid.). Indeed, Eisenman's architecture opposes the fiction of representation of classical and modern architecture, rejecting the need to refer to historical citations and typologies on the one hand and functionality on the other, that is, transgressing the original fixed starting point for architectural design, or, in other words, transgressing the existence of the (architectural) origin. Eisenman's architecture is directed not only towards the expressible, metric, measurable, visible, linear, rational and real, but more towards the inexpressible, non-metric, immeasurable, invisible, non-linear, irrational, and even artificial.

The *fiction of reason* is the fiction of privileging the rational as true. Whereas representation (of historical "citations") was seen as a simulation of the meaning of the present through the message of antiquity, reason was a simulation of the meaning of truth through the message of science[4] (ibid.). The truth was reduced to reason and rationality. "If an architecture looked rational – that is, if it represented rationality – it was believed to represent truth" (ibid.). The values were thus based on the concept of rationality, or causality (for example, in modern architecture it was expressed through the maxim that "form follows function"). As Eisenman states, "nothing had really changed from the Renaissance idea of origin. Whether the appeal was to a divine or natural order as in the fifteenth century, or to a rational technique and typological function, as in the post-Enlightenment period", this fiction "ultimately amounted to the same thing – to the idea that architecture's value derived from a source outside itself" (ibid.). Indeed, that which was outside itself was what was *a priori* and uncritically accepted and applied in architectural design as true, rational and valued. Eisenman thus questions not only the fixed and unchangeable origin or starting point (the fiction of representation) in architectural design, that is the fixed message and meaning, but also the issues of truth and reason.

The *fiction of history* refers to the fiction of the linear, cause and effect temporality of narrative history. From Antiquity to the Middle Ages, time was perceived as unchanging and eternal, atemporal and cyclically repeatable. "In the mid-fifteenth century the idea of a temporal origin emerged, and with it the idea of the past. This interrupted the eternal cycle of time by positing a fixed point of beginning" (ibid.). But the pursuit of the origin of a time turned, paradoxically, to a time-bound concept of history as a source of timelessness (ibid.), and the atemporal. By the nineteenth century this process of historical change was seen as dialectical (ibid.). With dialectical time came the idea of the *zeitgeist*, a cause and effect rooted in a presentness that aspired to eternity (ibid.). In its polemical rejection of the history that preceded it, the Modern Movement attempted to "build" a different concept of time from that which is rooted in the eternal and universal. "In seeing itself as superseding the values of the preceding architecture, the Modern Movement substituted a universal idea of relevance for a universal

[3] The word order in the listing has been changed in relation to the original text.

[4] This fiction was strongly manifested in twentieth-century architecture, but in fact achieved greatest prominence during the Enlightenment.

idea of history, analysis of program for analysis of history" (ibid.). The spirit of time in modern architecture was seen as contingent on the present rather than as absolute and eternal. Eisenman sees the concept of time not as eternal and atemporal, reversible, extensive time, but rather as temporal, irreversible, intensive time.

How does Eisenman make the transgression of these three fictions in specific *Cities of Artificial Excavation* projects? How does Eisenman raise questions about the issues of the origin and starting point, truth and reason, and the atemporality of eternal and unchangeable time (of history/narrative)? In other words, how can we read the projects of *Cities of Artificial Excavation* as space-time concepts of the destratification and restratification of different urban layers, that is, as space-time concepts of disjunctive synthesis of different narratives of the (unrealized, possible or purely fictional) past, present and potential future?

Take, for example, the design for *Cannaregio West* (1978), which was planned to be built on the Cannaregio site in Venice. The project is based on three elements or three narrative layers that are brought into superposition: (1) the grid of Le Corbusier's Venice Hospital project that was intended to be built on the same location; (2) red objects of different scales composed of elements in the form of the letter L; and (3) a diagonal cut – line in the ground.

The grid of Le Corbusier's unrealized Venice Hospital project is articulated as a series of voids – holes in the ground, embodying the absence or emptiness of rationality, the absence of a potential (unrealized) past and the presence of artificiality. It is a narrative of non-classical fiction that represents a transgression of the fiction of representation (referring to the unrealized object) and the fiction of reason (referring to the absence of rationality – of the modernist grid as a rational form).

The red objects composed of elements in the form of the letter L (based on the variations of Eisenman's House 11a) appear in three different scales: the first is about five feet in height – smaller than a man, the second is the size of a house, and the third is twice the size of the second object, that is, larger than a house. The objects are not positioned above the ground, but in places cut into the ground, suggesting the play between the superficial and the repressed, the conscious and the unconscious, the figure and the ground. On closer inspection it is possible to see that these objects contain nothing. They are not *functional*. They are lifeless, solid blocks adjacent to the context, adjacent to the grid of Le Corbusier's unrealized Venice Hospital project. They represent a transgression of the fiction of representation of modern architecture (based on the representation of functionality and anthropomorphic measures as the initial starting points). Moreover, the play with elements in the form of the letter L is a play of additions and subtractions, that is, the fragmentation of the cube as the ideal, rational, closed form. The cube is thus broken up and experienced as something that can be unfolded in any direction, as an unfinished form caught in the processes of addition and subtraction, processes based not only on *logos*, but also on *nomos*, that is, the interweaving of repressed, unconscious (below ground) discourse which breaks up the strong logocentric order.

The third element of the *Cannaregio* project is a diagonal cut – a line in the ground, which links with the existing urban axis of Venice's bridges (the Ponte dei Scalzi and the Ponte dei Tre Archi). The diagonal line is thus, as Eisenman states, the topological axis of symmetry for the objects, but also a physical cut in the surface of the earth (Eisenman in Bedard, 1994). It suggests the existence of another layer, something "inside" that cannot forever be suppressed, thus performing a transgression of the fiction of reason.

Using the strategies of relocation, that is, destratification of the existing urban tissue by inserting the grid of the unrealized Venice Hospital project and restratification of the destratified tissue by the processes of condensation (placing objects of different scales), displacement and overlapping (of Le Corbusier's grid and the grid of red objects), and diagonal cutting, Eisenman plays with the temporality of narrative. By superposing layers of the unrealized past on layers of the present and the potential future, creating an interplay between the real and the imaginary or artificial, that is, the layers of the conscious, subconscious and unconscious, Eisenman undermines the tradition of priorities and the authoritative chronology and hierarchy of elements. This is not just a transgression of the fiction of representation and the fiction of reason, but also a transgression of the fiction of the temporality of narrative history. It is the construction of a space of potentiality, or of immanent unpredictability and disjunctivity.

Alternatively, we can take the plans for a residential block developed and realized between 1980 and 1986 on a site enclosed by Kochstrasse, Friedrichstrasse, Charlottenstrasse and the Berlin Wall in the Friedrichstadt suburb of Berlin. In this project, Eisenman (the Eisenman/Robertson Architects) builds spaces expressing the disjunctive synthesis of different narratives, ideologies and discourses by superposing: (1) the narratives of memory – represented in the traces of the absent city wall of the eighteenth century, the foundation walls of nineteenth-century Berlin, the remnants of the twentieth-century grid projected upwards in the vertical walls of the existing buildings, and traces of the Berlin Wall; and (2) the narratives of anti-memory represented by the Mercator grid – an artificial grid inserted into the existing urban tissue of the city. In this context, the anti-memory is not the opposite of memory, but rather an "other" to the narrative of memory understood in the conventional sense of the term. By introducing an artificial grid, we could say that Eisenman undermines the ground plane on which so much of Enlightenment history is based. Not only is the fiction of history (the fiction of linearity, the existence of the fixed starting point and origin) disrupted, but so too is the fiction of representation (by the lack of classical references and modernist functionality), as well as the fiction of reason (by the introduction of an illogical, irrational component within the urban tissue). We are dealing here with the creation of a location of intensive overlapping and erasure by strategies of destratification and restratification of the existing urban tissue, in which traces of (an artificial) past change the content and expression of the layers of the present and, *vice versa* the artificial layers change the

content and expression of layers of the past.[5]

Finally we shall take the example of the unrealized *Chora l work* project for a garden in the La Villette park in Paris (1985-1986), which represents a still more developed phase of Eisenman's investigation of *Cities of Artificial Excavation*. The project was developed in collaboration with Jacques Derrida. The urban layers which are superposed are: (1) the urban tissue of the La Villette in 1867; (2) the urban layers of Paris in 1848, when walls were built at this location; (3) the urban layers of Paris at the time of Tschumi's La Villette project; and (4) the layers of Eisenman's *Cannaregio* project.

What is new here in relation to the types of transgression of the fiction of representation and the fiction of reason is the construction of a special kind of space made possible primarily by a unique type of transgression of the fiction (of temporality and spatiality) of history. Namely, Tschumi's *La Villette* park project and Eisenman's *Cannaregio* project contain traces of the absent grid of Le Corbusier's Venice Hospital project; furthermore, the chosen site in Paris and the *Cannaregio* site in Venice were also both once abattoirs. In other words, all three layers (Tschumi's *La Villette* park project, the location of the park La Villette in Paris and Eisenman's *Cannaregio* project) contain certain common elements.

Thus, "site A contains the absence of location B and C; site B the absence of A and C, and so on. Each site has the absence of the other sites as a trace – in one sense the memory and in another the future. The viewer will always have presence, memory and immanence [...]" (Eisenman in Kipnis and Lesser, 1997).[6] We thus have here a play on the direction or course of narrative which shatters any tradition of priority or authoritative chronology. This play between the past, the future and the present (of the narrative layers of the site) can be expressed in different achronological times. As Derrida states:

> Let me be specific about the idea of different times. We are talking about La Villette in 1867, when an abattoir occupied the site of the park, about Paris in 1848, before the abattoir, when the walls of the city occupied the site, and about Park in 1968. We are also talking about the time of Tschumi, the time of Venice and the future: the superposition of Tschumi with the past suggests a trace of the future. Now, let's talk more about place. Each site will contain, through superposition, a part of the other sites, as well as the notion that A, B and C are one site at a different scale. The three can thus be read as a whole, as a unity – as A with pieces of B and C, B with pieces of A and C, etc. Each site speaks of another place at another scale of activity, so there is also the site of Cannaregio, which was itself the site of an abattoir, as well as other places which operate parenthetically. (Ibid.)

"Finally, [...] we can say that each site is a tissue of three layers, in which tissue 1 interacts with tissue 2 at another site, and so on. [...] These three tissues superpose and interact with each other so that if you pull one tissue out of site A, it interrupts sites B and C. There is thus neither time nor place, but analogy" (ibid.). This is not about the relationship between the figure and the ground, or the question of origin, but something that might be called a tissue of free-floating signifiers. This is a special kind of building of a receptacle, that is *chore*, as a field of vectors of directions rather than dimensions and metric determinations, as a field of open intervals, disjunctive diversities or becomings. In this field we hear only the resonance of different texts (urban layers), like a piece of music (hence one of the possible inspirations for the title of this project *chora l work*, in translation "a work composed of L elements for a *choir* – a musical ensemble of singers"), which are superposed onto or under each other in a seemingly impossible, unrepresentable topology – a surface that is impossible to see but is possible to hear, a surface that echoes with the internal reflection of many resonant layers. What we have here is the creation of an invisible layer in which all other layers reverberate without knowing which comes before and which comes after.

CITIES OF ARTIFICIAL EXCAVATION AS A FIELD OF IMMANENCE

Using destratification and restratification strategies for the urban layers of the suppressed, imaginary or artificial past, present and potential future, Eisenman thus builds a *quarry* rather than a *palimpsest*, a kind of intertext (i.e. intertextuality) rather than a collage-montage text, that is a special kind of textuality whose integral elements are not only the outer, *real* elements of the text but also those artificial elements which Eisenman calls *graft*.

> As opposed to a collage or a montage, which lives within a context and alludes to an origin, a graft is an invented site, which does not so much have object characteristics as those of process. A graft is not in itself genetically arbitrary. Its arbitrariness is in its freedom from a value system of non-arbitrariness (that is the classical). It is arbitrary in its provision of a choice of reading which brings no external value to the process. But further, in its artificial and relative nature a graft is not in itself necessarily an achievable result, but merely a site that contains motivation for action – that is, the beginning of a process. (Eisenman, 2004)

Unlike a palimpsest based on the overlapping of a surface, which even if it was previously hidden or erased, still exists as a grain and even as a permanently readable trace of a previous text, the operation of scaling by condensation and displacement of the *quarry* erases successive inscriptions. The palimpsest, like Freud's "writing pad" produces traces as outputs that should be integral elements of the following layers. They are inaccessible to inputs, moderation, modulation or diminution (Whitehead, 2009). This requires a passive model of memory, i.e. memory that is not subject to revision or re-transcription. In Eisenman's *quarry*, the artificial layers modify the past layers, breaking the tradition of hierarchy and chronology and, we could say, making an active model of memory possible.

As Eisenman states, the "trace is unconcerned with forming an image which is the representation of a previous

[5] The interweaving of "grids" is analogous to the *moiré effect* in painting (Francois Morellet *4 double grids: -1+1, -2+2*, 1961) or to *feuillete* in music (Arvo Pärt, *Festina lente* for example). For the investigation of the relation between Eisenman's grids and *moiré effect* in painting see: Yve–Alain Bois, "Surfaces", in Bedard, op.cit., 1994.

[6] The sentences are here put in the present time in opposition to the original text written in future time.

architecture or of social customs and usages; rather, it is concerned with the marking – literally the figuration – of its own internal processes" (Eisenman, 2004). The trace "signals the idea that there is a reading event [...] trace signals the idea to read. [...] It signifies an action that is in process. In this sense a trace is not a simulation of reality; it is a dissimulation because it reveals itself as distinct from its former reality. It does not stimulate the real, but represents and records the action inherent in a former or future reality, which has a value no more or less real than the trace itself" (ibid.).

Hence, while the palimpsest preserves traces as unchanged and timeless, the *quarry* shows that traces of the past are not eternal and unchanging, but are interwoven with layers of the present and the potential future in such a way that the layers of the present and the potential future have potential to change the structure, sense and meaning of layers of the past. While the palimpsest preserves a linear, causal chain of events, a linear concept of narrative temporality, the *quarry* seeks to present a non-linear, irreversible temporality of narrative. This is thus not about investigating layers (or texts) of the past and changing theirs meaning by displacing them in different contexts, but about changing the actual content, structure and morphology (of content and expression) of the layers of the past with traces and layers of the present and the potential future. It is about building a special field of potentiality, a field of immanence, by means of relative destratification, or a combination of destratification (inscription of the new traces in the stratified layers) and restratification (their re-inscription).

The attention of the viewer is in this way drawn away from the act of representation to the ways in which the object is constructed and conceived, that is, conceptualized. In opposition to traditional representational architecture, whose form has its referent in the human body, the vernacular environment, a previously formed classical system of meaning, an atemporal layer of the past or a specific functionality, Eisenman builds a form that reveal a complex matrix of disciplinary procedures and institutional apparatuses (Hays in Bedard, 1994). By strategies of destratification and restratification, and we could also say defamiliarization or estrangement (introducing, for example, a *graft* as a narrative of non-classical fiction, and also by condensation, displacement and scaling), Eisenman lays bare the processes of the object's production and the mechanisms of its representation, which thus become part of the content of its architecture and not merely its expression. The viewer is thus displaced from a stable, static or passive position of contemplation, and encouraged to take an active position, reflecting critically on the architectural environment, the institutional apparatuses and the mechanisms of the architectural work's production.

CONCLUSION

Using strategies of destratification and restratification of the existing urban milieu, relocation of real and imaginary/artificial urban layers, and condensation (placing elements in different, specified scales), Eisenman achieves a transgression of the three fictions (the fiction of representation, the fiction of reason, and the fiction of history) on which classical and modern architecture were based. In other words, by bringing narratives of memory and narratives of anti-memory, real and imaginary or artificial (*graft*) narratives, and narratives of classical and non-classical fiction (arbitrary and timeless, without *a priori* origin, sense and meaning, or non-representational, non-true, non-linear)[7] into synchronic relationship, Eisenman's *Cities of Artificial Excavation* projects transgress the language of classical and modern architecture. This results in the understanding of an urban tissue not as a palimpsest but as a *quarry*, not as a place of stratification, but as a field of immanence, a field of communication between incompatible elements of "narrative". In addition, narrative layers are not mutually independent or indifferent to each other. They break through each other in a certain sense, register each other and change their content and meaning using strategies of relative, rather than absolute destratification. While absolute destratification would lead to the virtualization of narrative layers, to the absolute instability, unpredictability, non-sequentiality and non-directionality of a narrative, and the simultaneous existence of the past and the future in the present (to which the *Chora l work* is the closest), relative destratification is about movement within the actual allowing relatively unpredictable directions, logical and alogical relations. In Eisenman's case, it breaks down the established mental structures of thinking and design, and puts into question (linearity, influence, truthfulness, hierarchy of) existing and/or artificial layers of the past in relation to the layers of the present and potential future. Eisenman's strategies of destratification and restratification followed by the introduction of narrative layers of non-classical fiction are thus directed not only toward the provocation of different approaches to architectural and urban design, but also toward the provocation of different physical experiences and understanding of sense and significance of the built environment.

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[7] Non-classical fiction is not the opposite of classical fiction, but an "other" of classical fiction. Also, non-representational is not the opposite of representational, but an "other" of representational. For example, the element of the presence of the absent grid of Le Corbusier's unrealized project for the Venice Hospital does not indicate the lack of representation, but non-representational here refers to pointing out the reference that has not been actualized in reality but could be. The concepts of non-linear and non-true can be understood in a similar way.

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THE 'SOCIALIST APARTMENT' IN YUGOSLAVIA: PARADIGM OR TENDENCY?

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The development of residential architecture in Yugoslavia during the period of socialism had its peak in the 1960s and 1970s. Significant progress in construction was accompanied by housing research directed towards finding the optimal urbanistic solutions for the newly formed lifestyle of the socialist society. The tendency was to "pack" as many residential units as possible into each building, almost up to the limits of the functional minimum, at the same time with the aim of setting a more humane pattern of living. Innovative theoretical ideas were developed at leading housing research centers and then spread at conferences, consultations, expositions and architectural contests. Top quality design concepts were mostly obtained through architectural contests, which, among other things, also served the purpose of testing theoretical principles and new concepts of residential patterns on actual examples. Although the term "socialist apartment" seems to be accepted in practice, in the scientific sense, it has not been sufficiently explored or examined. The aim of this paper is to explore whether there was a certain architectural pattern as a form of response to the specific socio-economic conditions in Yugoslavia, in terms of a functional scheme that architects followed and which could be defined by the term "socialist apartment".

***Key words*: Yugoslavia, residential buildings, socialism, housing research, design concepts.**

INTRODUCTION

Post-war housing architecture in Yugoslavia was the product of the socialist self-management, non-alignment policy in foreign affairs and decentralization in internal affairs, as well as the economic strength of the state and society as a consequence of these factors. Numerous problems, such as wide-spread poverty, the lack of construction materials on the free market, and the attitude expressed by the communist authorities that "a wish for private house or apartment reflected the expression of the petty bourgeois mentality" (Dobrivojević, 2012) all contributed to the fact that in the first post-war decade the state itself was the only constructor of new apartments (Dragutinović *et al.*, 2017). The tendency to reduce the surface area of apartments, along with short construction deadlines and inexperienced designers resulted in apartments, even those built in Belgrade, being mostly uncomfortable and cramped (Dobrivojević, 2012). On the other hand, uncomfortable and cramped living quarters found compensation in communal public space, which was the reflection of the ideological concept (Milašinović Marić, 2017). Taking into consideration that the concept of "communal apartments" did not accomplish the desired results (Prosen, 2007), and by the end of 1955 the "Law on apartment construction contributions" was passed, introducing a contribution of 10% towards the construction of the apartments paid by state companies, marking the beginning of a new stage in the development of the Yugoslav society.

Post-war reconstruction of the existing and the construction of a new residential fund in Yugoslavia was at its peak during the sixties and seventies of the twentieth century, when several hundred thousand apartments were built across the country.[2] The period of so-called "directed apartment construction", with an imperative of establishing the limits to the existential minimum in communal apartments, maximal space "packing" and optimal functionality of the apartments is the most significant period in the development of residential architecture in Yugoslavia. After an ideological break with the Soviet Union (1948) and the Consultation of Yugoslav Architects in Dubrovnik (1950), architects focused their interests with regard to residential buildings primarily on three points: (a) the concept and application of new systems of prefabrication, (b) the innovative use of modernistic patterns in the aestheticization of architecture

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[2] According to an estimate by the authorities in 1955, at least 200,000 apartments were expected to be built in towns and 800,000 apartments in villages, in order to achieve a tolerable standard of housing (Dobrivojević, 2012). In the period between 1961 and 1971, an average of 120,000 apartments were built annually (Vujnović, 1972).

and (c) experimenting with spatial organization (Alfirević and Simonović Alfirević, 2015). Successful design concepts were obtained mostly through architectural contests, which among other things served the purpose of testing theoretical principles and new concepts of residential patterns on actual examples (Aleksić, 1975). In practice, this was hard to achieve due to stringent residential regulations which limited both the surface area and the structure of the apartments in multiple-family housing units. Experimenting with new ideas was not always the guarantee of success in competitions, but it did enable the public presentation of these ideas, which is why architectural contests were the main scene for promoting innovative practices (Mecanov, 2009; Šišović, 2016).

Housing architecture emerging during socialism in Yugoslavia did not necessarily have socialist intentions, confirmed by examples designed to include more comfort and more space for individuals at the top of the ruling class and for high ranking officials in the Yugoslav Army, which by all means was not in accordance with the ideology promoting social equality (Dobrivojević, 2012; Nikolić, 2015). On the other hand, it seems that architectural practice had already embraced, the term "socialist apartment" (Perkec, 2016; Jansen, 2014; Turcu, 2017; Boumová, Zdráhalová, 2016), which in the scientific sense has not yet been explored or examined. A step forward in the exploration of this topic is an essay entitled "Influence of the socialist ideology on the conception of multi-family housing: new Urban landscape and typological models of housing units", which analyzes this term from the viewpoint of the emerging socialist culture of housing (Ristić Trajković *et al.*, 2015). Unlike much current research that focuses on housing architecture and apartments from the socialist period in Yugoslavia (Aleksić, 1975; Alfirević and Simonović Alfirević, 2015; Bajlon, 1975; Blagojević, 2004; Ćirović, 2012; Dobrivojević, 2012, 2016; Domljan, 1969; Ifko, 2013; Jovanović Nenadović, 2011; Korov, 2011; Kulić, 2009, 2012; Marojević, 1987; Mecanov, 2008, 2009, 2015a; Milašinović Marić, 2011, 2017; Mokranjac, 2016; Petelin, 2017; Prosen, 2007; Teržan, 2011; Šišović, 2016; etc.), this paper goes a step further in the research direction, trying to answer the question of whether specific socio-economic conditions in Yugoslavia resulted in a specific design pattern, in terms of specific functional scheme that the architects followed and which could be described by the term "socialist apartment".

HOUSING ARCHITECTURE AND RESEARCH IN YUGOSLAVIA

After the Second World War, housing architecture in Yugoslavia developed rapidly, achieving significant results during the 1970s, both in scientific and practical fields.

Numerous constructions and newly built city areas were accompanied by parallel theoretical and other housing research, which questioned the limits of the existential minimum in collective housing, the possibility of maximal space "packing" and the aspects of optimal functionality, all required by the state as the biggest investor (Group of authors, 1978; Group of authors, 1979). The leading housing research centers in Yugoslavia were the Faculties of Architecture in Belgrade, Zagreb, Ljubljana, Sarajevo and Skoplje as talent pools of new ideas and new architecture representatives. The same is true of design and research organizations such as: the Yugoslav Institute of Urban Planning and Housing, Institute of Architecture and Urban Planning of Serbia, IMS Center for Housing, Slovenian Construction Center, etc. (Bajlon, 1975). One of the most important roles of these centers was that, by organizing and participating in different conferences, consultations and congresses, their representatives spread new ideas and influenced the development of housing architecture and research in Yugoslavia.

The activities of the "Zagreb" and "Belgrade School of Housing" were of particular importance, as it was within these schools that the systematic development of the functional approach to organizing living spaces occurred. Although these schools supported modernistic principles, each school also found its inspiration in the local tradition of urban culture and its forms, and had certain role models abroad (Korov, 2012). Generally speaking, the Zagreb School was characterized by its consistent application of the modernist idea of dominant function in architecture, whereby shaping occurs as a consequence of function, without any unnecessary or excessive details or emphasis on anything other than the main architectural expression (Marojević, 1992). As opposed to the functional line, which is unofficially referred to as the Zagreb School as it continues the tradition of carefully nurtured architectural form characteristic for pre-war Zagreb architecture (Domljan, 1969), the period between 1960 and 1970 saw a powerful breakthrough in expressionism in Croatian architecture, and emphasis was put on certain authors' approaches, which in itself was a complete negation of the basic functionalistic norms that the Zagreb School traditionally stood for (Marojević, 1987).

Unlike the Zagreb School, which had functional organization as its starting point, i.e. the obvious principle, striving at the same time to reach high aesthetic role models of world modernism (Domljan, 1969), the Belgrade School was dedicated to researching different functional aspects and worked permanently on improving and searching for new concepts of how to organize an apartment, aiming to achieve more humane living conditions. According to Dijana Milašinović Marić, the Belgrade School did not have stylistic unity, neither did it accept original functionalism and international style, as the architects aspired to express their personal interpretations (Milašinović Marić, 2017). By stating the basic principles forming the concept of the so-called "Belgrade apartment of late modernism", Darko Marušić, among other things, mentions that the concept of the apartment was the consequence of socialist "equality" in society, which indicates that the ideology of socialism, in a certain sense, existed as the starting point of apartment design (Marušić, 2010).

The relationship between architecture and ideology was evident on many levels within the architectural discourse in socialist Yugoslavia: from the debate on an "official" architectural style that matches the development of the new society, to attempts to connect traditional architectural heritage and modern architecture. Over a short period, modernism was widely accepted in architectural circles, so

modernism and socialism turned into colloquial synonyms. However, the point is that this is a very complex phenomenon, showing the overlapping of the internal connection between architecture and ideology and the international domination of modernism. Owing to the creativity of the architects, unique experiments were created in this field (Kulić, 2012).

In Slovenia, during the first two post-war decades, a large number of new apartments were built, as was the case in other parts of Yugoslavia. Completely new parts of towns were formed, like Nova Gorica, Velenje and Kidričevo. During the 1960s and 1970s, Slovenian architecture was mainly oriented towards the articulation of the so-called "Slovenian regionalism", which was in a way the search for identity, formed between radical modernism and traditional Slovenian architecture (Ifko, 2013). The introduction of post-modernism marked the end of the progressive period, characterized by experimenting with modern construction techniques and innovation within the frames of given design standards (Petelin, 2017; Teržan, 2011).

In terms of the heterogeneous character of Yugoslav architecture, Kulić, Mrduljaš and Taler emphasize that one of the main reasons for the wide typological differences in collective housing in Yugoslavia was the uncertain and changeable standards (Kulić *et al.*, 2012).[3] By adopting housing regulations on a state level, initiated by the Yugoslav People's Army, the conditions for housing military personnel and their families were raised to a higher level. However, it is particularly important that military regulations found their application in the civilian sector, too, after which they were widely accepted as public good (Damjanović Conley and Jovanović, 2012).

Taking into consideration the whole territory of Yugoslavia, in an architectural sense, the focus was on the maximal "packing" of housing units within objects, even up to the limits of acceptable living minimum for the users, but the aspiration was also to establish a more humane housing pattern (Čanak, 2014; Mecanov, 2015a). As a consequence of these aspirations, the following concepts emerged, making the core of housing research aims related to architecture in the 1960s and 1970s in Yugoslavia: (a) apartments with an extended circulation area, (b) apartments with a central sanitary core, (c) apartments with a circular connection and (d) apartments with extended perspectives ("an enfilade") (Alfirević and Simonović Alfirević, 2013; Lojanica *et al.*, 2011).

APARTMENTS WITH AN EXTENDED CIRCULATION AREA

An extended circulation area was a very important element of the Belgrade Housing School and the functional organization of the so-called "Belgrade Apartment" after the Second World War (Nestorović, 1955; Alfirević and Simonović Alfirević, 2013). A similar concept had, in some way, existed before, between the two world wars in Serbia, in the form of a central multi-purpose room in so-called "salon" apartments and it served the purpose of dining, receiving guests and family celebrations. According to Mirko Todorović, the idea of the common zone of the apartment, where the family could gather and receive guests, represented a further evolution of the concept of the Belgrade salon apartment from the period of early modernism, and similar examples of implementing the extended circulation area with the common table characteristic for that period (even from the period between the two world wars) existed both abroad and on the territory of Yugoslavia (Todorović, 2016). After the Second World War, extended circulation areas appeared as a consequence of the intention to form two centers within the apartment structure: (a) primary – the living room and (b) secondary – the space where a family could gather around the dining room table, outside the kitchen space (Bajlon, 1979). The main supporters of this idea in Yugoslavia were professors Mate Bajlon, Branislav Milenković and Branko Aleksić, all from the Faculty of Architecture, University of Belgrade. It is considered that the term "extended circulation area" was officially used for the first time by Bajlon at the Seminar FAO, organized in Belgrade in 1957 (Bajlon, 1975; Dragutinović *et al.,* 2017). According to Bajlon, extended circulation areas were the result of an attempt to "find the form of family gathering at the table, in cases when the crammed apartment did not allow it, so it was added as an extention of the living room" (Bajlon, 1972). However, the introduction of a bed as part of the living room, according to Bajlon, was not only opposed to the concept of living space, but also to the concept of having an extended circulation area (Bajlon, 1975).

The use of an extended circulation area in scarce socio-economic conditions enabled different options, such as: (a) turning the entrance area into space where guests were received, (b) forming an everyday area where children could learn and play, (c) separating children's activities from their parents' and friends' activities, (d) the feeling of a wider space in the apartment, etc. Although in relation to the time and circumstances in which it emerged, the idea in the theoretical sense was advanced, its application in practice led to various bad interpretations, whereby the living room was replaced by an extended circulation area, which was even supported by the regulations of that time (Bajlon, 1975; Ćirović, 2012). All this, in practice, resulted in the living room being turned into space for the accommodation and sleeping arrangements of one more family members, thus worsening the general comfort of the apartment. The concept of an extended circulation area was applied to a large number of completed examples during the 1970s, as it underwent the testing phase, first in student projects carried out in the studios of professor Mate Bajlon and Branko Aleksić, followed by general public competitions in Yugoslavia. In theoretical research conducted by Bajlon and his associates, it turned out that "the common table concept in the extended circulation area could be solved in two possible ways: by placing the extended circulation area in the outer part of the apartment – with direct lighting through the balcony or loggia, if they existed, or by placing the extended circulation area in the apartment interior and its illumination through the glass surface of the kitchen or artificially" (Milošević, 2007).

[3] "The instructions for construction of residential buildings to be used by Yugoslav People's Army", State Secretariat for National Defence, 1955: "The conditions and technical normatives for design and construction of residential buildings and apartments", Construction Direction for the city of Belgrade, 1973; "Temporary standard of apartments of directed construction", Construction Center of Slovenia (Ljubljana), Center for Housing IMS (Belgrade), 1973, etc.

Most significant constructed examples with an applied extended circulation area concept are the following: residential buildings in apartment blocks 70 and 45 in New Belgrade (Risto Šekerinski, 1970), residential buildings in apartment block 22 in New Belgrade (Božidar Janković, Branislav Karadžić, Aleksandar Stjepanović, 1974), residential buildings in the Banjica area of Belgrade (Aleksandar Stjepanović, Branislav Karadžić, Slobodan Drinjaković, 1972-1976), the competition solution for residential buildings in the Julino Brdo area of Belgrade (Branko Aleksić, 1966), the residential complex in Bulevar Vojvode Stepe in Belgrade (Branko Aleksić, Nikola Saičić, 1973), etc. (Aleksić, 1975). The use value and the quality of the apartment change depending on where the extended circulation area was formed. Most often, it was formed as an extension of the entrance, which allows for a larger hall space (apartment blocks 45 and 70 in New Belgrade, apartment block III in Novi Sad, etc.), or as a visual extension of the living room (apartment blocks 22, 23 and 29 in New Belgrade). All of this adds to the particular quality of the apartment, including the open-plan concept (Alfirević and Simonović Alfirević, 2016a; Čanak, 2013) (Figure 1).

APARTMENTS WITH A CENTRAL SANITARY UNIT

Unlike the previously analyzed concept of an extended circulation area, which is related to a group of professor from the Faculty of Architecture, Belgrade, the concept of the apartment with a central sanitary unit was used for the first time by architects Ilija Arnautović and Milan Mihelič in 1955 in Slovenia (Teržan, 2011). This concept had already been used elsewhere in the world (Alfirević and Simonović Alfirević, 2016b), but in Yugoslavia, it was at the Yugoslav exhibition "Housing for our conditions" in Ljubljana, 1956, where representatives of all republics showed their prototypes as a response to the exhibition topic (Bajlon, 1975), that Arnautović and Mihelič first showed their drawing of an apartment with a central sanitary unit in public ("tloris stanovanja s središčnim sanitarnim vozlom") (Petelin, 2017; Ćirović, 2012). This concept emerged as an answer to the need to unite sanitary space as much as possible for economic reasons, thus achieving cheaper construction. The second reason, as mentioned by Vladimir Kubet, was the positioning of fixed elements (installation block and dividing walls) within the technical core, which in the open space of an apartment enables a greater degree of flexibility in organizing functional processes around its edges, since a free-standing core in the central apartment zone allows access from all sides and emphasizes the circular connection in the apartment (Kubet, 2015).

Apartments with a central sanitary unit, from 1955, envisioned grouping the bathroom, lavatory and kitchen in the same block, while the first examples constructed in Slovenia showed the tendency to place together only the kitchen and the bathroom (residential buildings in the Sava area in Ljubljana (Ilija Arnautović, Milan Mihelič, 1958-1962); Residential-office building in Siska – not completed; residential buildings in the area Šišenski soseski, Ljubljana (Ilija Arnautović, 1967), etc.) (Potočnik, 2013). When the project included the lavatory, it was still treated as a separate unit. According to Vladimir Kubet, the technical core can include: "only cupboards; the bathroom and cupboards, the bathroom, cupboards and the kitchen; the bathroom, lavatory, kitchen and cupboards or; the bathroom, lavatory, kitchen, cupboards and vertical circulation. From the point of geometry, organization of the technical core and looking at the total base of a single multi-family residential object, we can differentiate the linear, dotty and grouped types" (Kubet, 2015). The concept of the apartment with a technical core enabled the option of forming different typologies, however, the majority of examples completed in Yugoslavia did not venture further than the central core, only grouping the sanitary areas. Less frequently, the cupboards were integrated on the edges of the core.

One of the first examples which included this concept was the Sava settlement in Ljubljana (Ilija Arnautović, Milan Mihelič, 1958-1962), whose construction started at the end of the 1950s according to an urban planning project by Edward Ravnikar. The settlement included multi-storey buildings, a revolutionary housing model for that time,

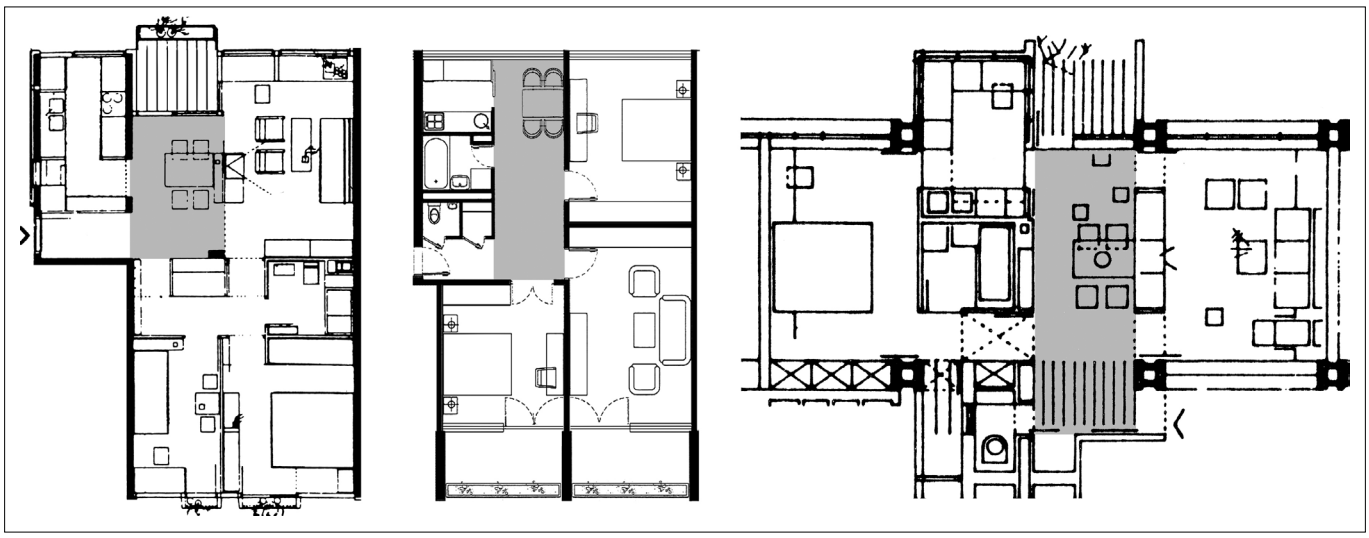

Figure 1. Apartments with an extended circulation area: a) Senjak area, Osijek (Vladimir Tvrtković, 1968-1975) (left), b) apartment blocks 45 and 70, New Belgrade (Risto Šekerinski, 1970) (middle) and c) apartment block III, Novi Sad (Milan Lojanica, Predrag Cagić, Borivoje Jovanović, 1970-1971) (right) (Source: author's private collection)

with a circular connection based around the sanitary unit (Petelin, 2017). Although the original idea of the apartment with a central sanitary core originated from Slovenia, most of its examples were built in Serbia, among which the most significant ones are: residential buildings in apartment block 28 (Ilija Arnautović, 1970-1974), residential buildings in apartment blocks 22 and 23 (Božidar Janković, Branislav Karadžić, Aleksandar Stjepanović, 1969-1974), residential buildings in apartment block 19a (Milan Lojanica, Borivoje Jovanović, Predrag Cagić, Radisav Marić, 1975), residential buildings in the south part of apartment blocks 61 and 62 in New Belgrade (Darko and Milenija Marušić, Milan Miodragović, 1971-1978), residential units in apartment blocks III and Liman III in Novi Sad (Milan Lojanica, Predrag Cagić, Borivoje Jovanović, 1970-1974), and the residential area of Đuro Đaković in Sarajevo (Dragan Dragičević, Oliver Stanković, Mirko Savčić, 1975), etc. (Figure 2).

APARTMENTS WITH A CIRCULAR CONNECTION

The concept of a circular connection was used in numerous examples even before the Second World War in Yugoslavia, as was the case in single-family houses and bourgeois apartments with a salon, where the rooms were connected in simple, cyclical rows (Alfirević and Simonović Alfirević, 2017). After the Second World War, the use of a circular connection in the organization of the housing space emerged primarily as a consequence of strictly defined housing regulations, which, during the period of directed housing construction, minimized the areas of housing space. Aiming to achieve the maximum living comfort in limited conditions, the architects resorted to innovative concepts of functional organization of the living space by using the circular connection. It is important to stress that the circular connection, among other things, contributes to: (a) raising the general quality of the apartment, (b) reducing useless communication, (c) better usability of the surface area, (d) better social integration of family members, etc. (Alfirević and Simonović Alfirević, 2018), all of which led to the frequent application of this concept in architecture throughout Yugoslavia.

At the beginning of the 1960s, under the influence of Scandinavian architecture, projects by Yugoslav architects included for the first time the so-called "Aalto's kitchen", which, according to Dragana Mecanov, was an example of the direct influence of modernism coming from European countries (Mecanov, 2015). The model of a kitchen, situated at the back of the apartment, behind the dining room, as the source of light, was used for the first time by the Finnish architect Alvar Aalto when designing the Hansaviertel residential building in Berlin (1955-1957) (Fleig, 1994). Until the appearance of Aalto's kitchen, the dining room had, in most cases, direct light and was designed as a separate room next to the kitchen or was grouped with the kitchen and living room (Čanak, 2013). Aalto's concept gave the possibility of withdrawing the kitchen from the façade zone to the back of the apartment using indirect light from the dining room, which enabled a significant reduction in the object's length, in accordance with the generally accepted trend of that time, apartment "packing" (Todorović, 2016). Aalto's kitchen examples in most cases achieved an elementary flow of the apartment, established by connecting the entrance, the kitchen, the dining room and the living room in a cyclical line. Some of the most significant examples with simple circular connection include: the residential building in Primorska Street in Zagreb (Zlatko Neumann, 1955), the residential tower on the bank of the river Vardar in Skopje (Aleksandar Serafimovski, 1958-1959), the residential building in Laginjina Street in Zagreb (Ivan Vitić, 1958-1962), apartment block 1 in New Belgrade (Tihomir Ivanović, 1959-1963), the residential building in apartment block 21 New Belgrade (Mihailo Čanak, Milosav Mitić, Leonid Lenarčić, Ivan Petrović, 1960-1965), the residential building in Save Kovačevića Street in Belgrade (Nikola Saičić, 1960-1965), etc.

In comparison with the first post-war examples, in which circular connection is present in its reduced from, subsequent examples from the 1970s indicate the designer's skill in the functional structuring of the space allowing complex circular schemes, which in some examples border with the concept of "flowing" space (Alfirević and Simonović Alfirević, 2016a). The most important examples from this period are the following apartments: the residential building in Kralja Petra Street in Belgrade (Milorad Macura, 1954), the residential building in "Housing Department GNO Zagreb" in Zagreb (Zlatko Neumann, 1955), apartment block 21 in New Belgrade (Mihailo Čanak, Leonid Lenarčić, Milosav Mitić, Ivan Petrović, 1965), the residential object in the Senjak area of Osijek (Andrija Mutnjaković, Stanka Polić, Ivan Tomičić, 1968), Murgle residential settlement in Ljubljana (France Ivanšek, Marta Ivanšek, 1969), Senjak residential area in Osijek (Vladimir Tvrtković, 1968-1970), apartment blocks 22 and 23 in New Belgrade (Aleksandar Stjepanović, Božidar Janković, Branislav Karadžić, 1974),

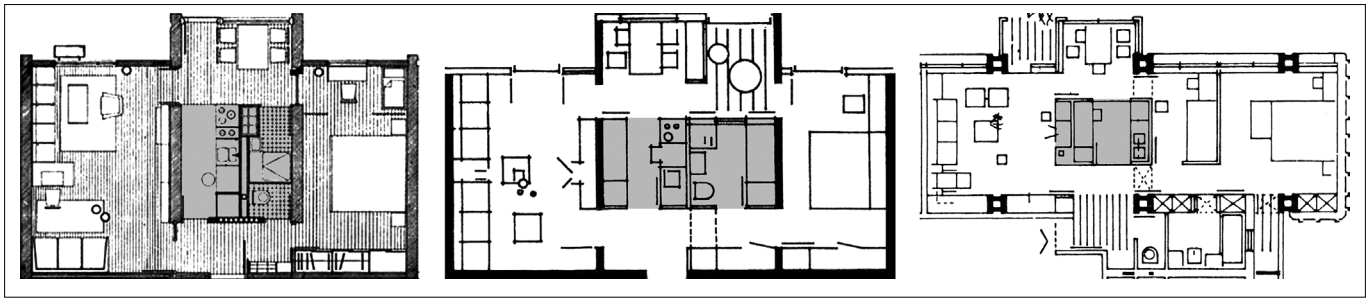

Figure 2. Apartments with a central sanitary core: a) 'Stanovanje s središčnim sanitarnim vozlom' (Ilija Arnautović, Milan Mihelič, 1955) (left), b) South part of apartment blocks 61 and 62, Belgrade (Darko Marušić, Milenija Marušić, Milan Miodragović, 1978) (middle) and c) Liman III, Novi Sad (Milan Lojanica, Predrag Cagić, Borivoje Jovanović, 1970-1974) (right)
(Source: author's private collection)

apartment block 29 in New Belgrade (Mihailo Čanak, Milosav Mitić, 1974), the southern part of apartment blocks 61 and 62 in New Belgrade (Darko Marušić, Milenija Marušić, Milan Miodragović, 1978), Split III housing settlement in Split (Vladimir Mušič, Marjan Bežan, Nives Starc, 1968-1979), etc. (Figure 3).

APARTMENTS WITH "ENFILADES"

The concept of an apartment with extended vistas ("enfilades")[4] and its opening towards the exterior has a similar starting point as the circular connection concept, i.e. it is most often the consequence of the aspiration to create the feeling of a bigger space comfort in restricted space conditions. Unlike the circular connection concept widely present in projects made by Yugoslav architects, the concept of an apartment with an "enfilade" was much less used in practice, as it included the direction of views from the apartment towards the surroundings, along clearly stressed directions of communication. The experience of a wider apartment surface was created by forming long vistas in the apartment and extending them through the façade opening. Although the contour of the apartment remained physically unchanged, this concept changes the user's perception of its size.

In practice, this was most often avoided, even though adequate communication in the apartment in the period of directed housing construction was regarded as being excessive in terms of its usable surface (Čanak, 2011). The communication area was limited by regulations and amounted to a maximum of 14% of the total apartment surface area, which as a consequence had less differentiation of the communications as separate rooms (hall, degagement, entrance, etc.) and their integration into the functional organization of space, whenever possible. As façade openings could not be too large, since their surface area was designed to take up about 10% of the room surface area (which was also defined by regulations), the intention was to allow the views from the interior of the apartment to the surrounding area as well as the passage of light, and this is why the façade openings were often positioned at the far end of extended views. This concept achieved not only better illumination of the interior, but also the experience of greater openness of the space. To support this statement we can quote architect Milenija Marušić, one of the doyens of Yugoslav architecture, who, when stating what a good apartment meant for her, said: "a good apartment is one that you can enter at noon without turning on the lights, so that you can enjoy the daylight beaming through double glass doors, which you can enter straight on, without looking for an entrance left or right in the hall" (Marušić, 2014). All this indicates the fact that although certain housing research principles in the theoretical sense were not defined, they were strictly followed in practice, as they were the result of several decades of architects' experience.

The most significant examples of this concept's application in Yugoslavia were apartments in: Julino Brdo residential area (Milan Lojanica, Predrag Cagić, Borivoje Jovanović, 1967-1971, II prize), Đuro Đaković residential area in Sarajevo (Dragana Dragičević, Oliver Stanković, Mirko Savčić, 1975, II prize), Banjica residential area in Belgrade (Ratko Karolić, Milan Pavković, Mirjana Stojanović, 1971, III prize), Cerak Vinogradi residential area in Belgrade (Darko Marušić, Milenija Marušić, Nedeljko Borovnica, 1981), Senjak residential area in Osijek (Mihailo Živadinović, Zoran Žunković, 1968), Kijevo-Kneževac residential area in Belgrade (Aleksandar Đokić, Mihailo Čanak, 1971-1972), tower blocks in Vojvode Stepe Street in Belgrade (Stana and Branko Aleksić, 1973), the residential object in Radićeva Street in Osijek (Božidar Janković, Branislav Karadžić, Aleksandar Stjepanović, 1969-1974), etc. (Figure 4).

CONCLUSION

Post-war architecture in socialist Yugoslavia was the product of broad policies and practices which included the creation of particular technological, administrative, financial and organizational capacities. Defining the limits

[4] "Enfilade" is a term which in archiecture stands for continuous suite of rooms aligned linearly with each other, which in the Baroque period achieved a more attractive visual impression of the spatial depth (Harris, 2006).

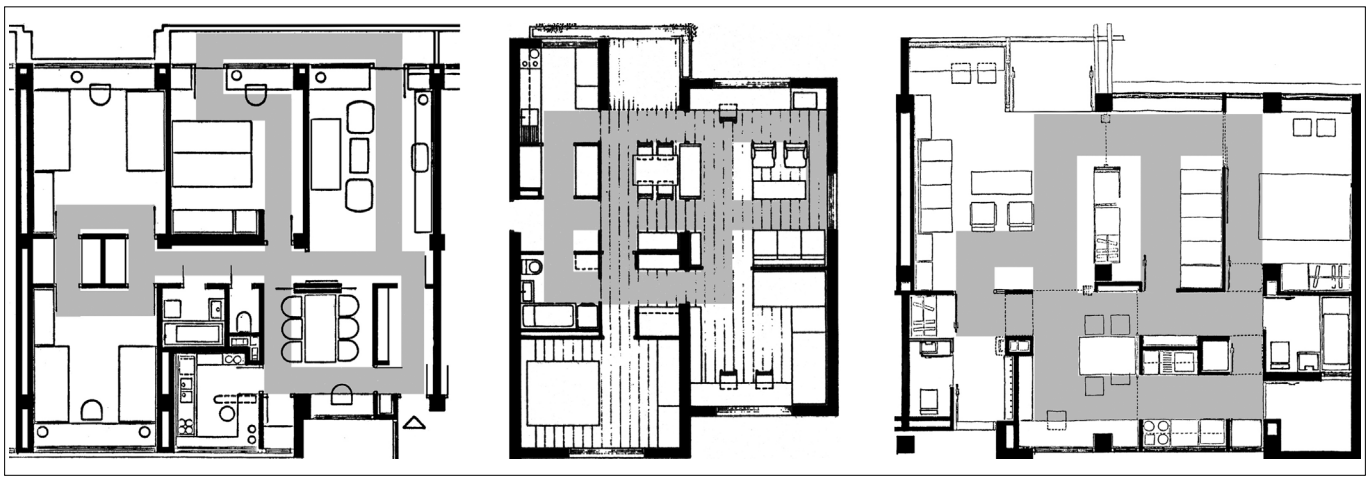

Figure 3. Apartments with circular connections: a) Apartment block 29, Belgrade (Mihailo Čanak, Milosav Mitić, 1967-1974) (left), b) Residential settlement Senjak, Osijek (Mihailo Živadinović, Zoran Žunković, 1968) (middle) and c) Apartment block 23, New Belgrade (Božidar Janković, Branislav Karadžić, Aleksandar Stjepanović, 1974) (right)
(Source: author's private collection)

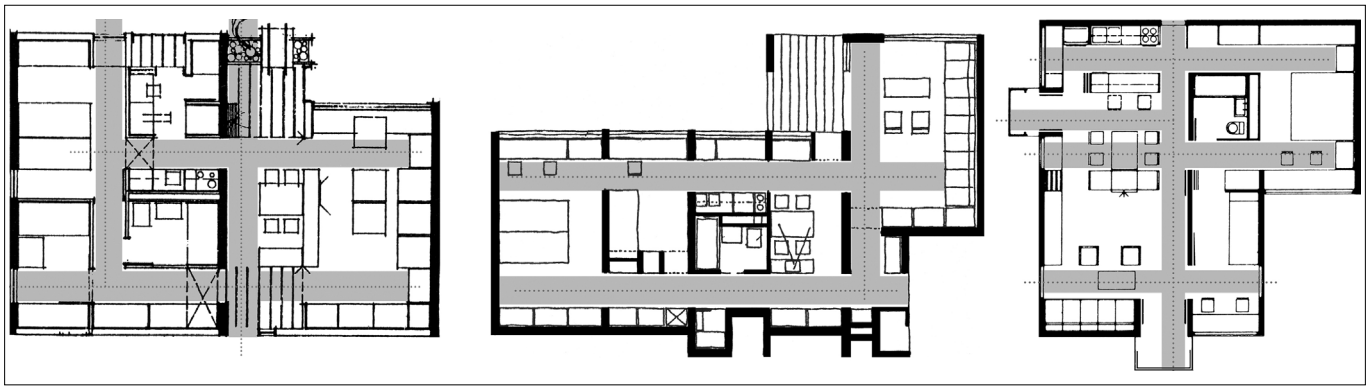

Figure 4. Apartments with extended vistas ("enfilades"): a) Đuro Đaković residential area, Sarajevo (Dragana Dragičević, Oliver Stanković, Mirko Savčić, 1975, II prize) (left), b) Julino Brdo residential area, Belgrade (Božidar Janković, Aleksandar Stjepanović, 1966, II prize) (middle) and c) Banjica residential area, Belgrade (Ratko Karolić, Milan Pavković, Mirjana Stojanović, 1971, III prize) (right)
(Source: author's private collection)

of the existential minimum in collective housing, maximal space "packing" and optimal functionality of apartments were the basic imperatives within which, in time, emerged the aspiration towards experimenting with new housing patterns, aiming to find more pragmatic and humane solutions for mass housing construction of great density. The process of humanizing housing was not characteristic only in the Yugoslav context, similar ideas also appeared in other socialist countries of that period, as in the example of pre-fabricated housing construction in the Soviet Union *(Khrushchyovka*), Czechoslovakia (*Panelák*), Hungary (*Panelház*) and East Germany (*Plattenbau*). Specific features of housing construction in Yugoslavia were the result of the socialist self-management, the policy of the Non-Alignment Movement in foreign politics and decentralization in internal politics, as well as the economic capacity of the country and the society. In the period from 1948 to 1970, housing architecture in Yugoslavia had a clearly experimental character, due to the intensive aspiration towards the research and foundation of new architectural patterns and values to mark the period of economic growth of the country.

By analyzing the above mentioned and other characteristic examples of apartment organization from the socialist period in Yugoslavia, the following can be concluded:

- That during the period of almost five decades of socialist Yugoslavia, **the architects did not have a uniform attitude** concerning the issue of what an adequate functional paradigm was as a solution for apartments in newly formed socialist system, which is why during this period there were **no specific designers' patterns** that the majority of architects could follow.
- That certain **innovative tendencies and designers' principles** existed (the concept of an extended circulation area, the circular connection concept, an apartment with a central sanitary core, an "enfilade" apartment, etc.) and **were based on socialist motives** of achieving as much usable value and spatial comfort in apartments with the minimum standard. Such tendencies were present in leading housing research centers and used in practice by numerous architects and teams.
- That these "socialist" ideas for the organization of living space had **a firm base in theoretical research** and underwent the phase of testing in architectural competitions, housing seminars and congresses, which made them spread over the whole territory of the country; and
- That experiments in the field of residential architecture and their use in practice were **supported by the communist authorities,** as long as they took into consideration the state budget and "equality" of all citizens, which is confirmed by the fact that one of the main financiers of these concepts was the Yugoslav People's Army.

Taking into consideration all of the above, it is safe to conclude that in socialist Yugoslavia there was no specific designer pattern that could be defined by the term "socialist apartment" and that this term could be used just provisionally, i.e. to describe a large number of different examples of apartment organization originating in the period between 1945 and 1991 in Yugoslavia, all of which had at least one of the housing concepts presented as their starting point – an extended circulation area, circular connection, a central sanitary core or extended vistas in the form of an enfilade. For apartments originating in the mentioned period which did not rely on any "socialist motives" as their starting point, it can merely be said that they were "apartments from the period of socialism" and not that they were "socialist apartments".

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A POSSIBILITY OF INTRODUCING THE CONCEPT OF FORM INTO URBAN PLANNING IN SERBIA

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This paper analyses the methodology of drawing up urban plans in Serbia and identifies the effects of their implementation on the quality of built environment. It points out that certain negative effects and problems in spatial development could be related to the absence of the concept of form in planning, or to the lack of direction in the process of developing physical structure through planning guidelines. The analysis of the planning documentation shows that the approach to planning is either too general, disregarding the specificities of the location, or too deterministic, manifested in the rigidly defined building rules that do not allow for diversity in architectural design. It can be concluded that this situation is facilitated by the fact that neither the Law nor the current context of planning support research in planning which would include a systematic existing situation analysis, spatial verification of planning solutions and introduction of parameters of quality in construction, in addition to the current predominantly quantitative ones. On the other hand, this paper points to up-to-date research in the area of urban morphology and contributions to the education of researchers and professionals which could improve planning methodology, and consequently the existing urban practice in Serbia.

Key words: **urban form, architectural and urban design, urban planning.**

INTRODUCTION

The question of introducing the aspects of urban form into design and planning procedures has been present on the international scene from the 1960's until today. It has emerged as a reaction to the issues observed in the built environment created on the basis of architectural and urban conceptions of modernism. In the architectural and urban theory these problems are defined as the absence of context (Nezbit, 1996), separation of architecture and urbanism through the disintegration of traditional spatial configurations such as urban blocks (Castex *et al.*, 1980), the lack of human scale relative to exaggerated dimensions of buildings, distance between them, poor accessibility and safety in movement through urban space.

Contrary to stances saying that form is a visual and aesthetic phenomenon, in the theory of urban morphology form is seen as a complex phenomenon and physical result influenced by different factors of development: socio-economic, functional, sociological, psychological, visual and perceptual. As such, it represents a source of knowledge about developmental processes and the starting point for future development. The introduction of the concept of form into planning suggests a necessity to systematically connect different scales of professional interventions – planning, designing and construction, and to raise awareness of all actors included in the development of built environment about the fact that all these interconnected activities end with an urban form as a physical result of the process which is, in the majority of cases, irreversible.

Tony Hall has observed that physical form has not always had the same position and value in urban planning. Especially in the 1970's, when socio-economic issues took precedent, form was considered a mere result of social and economic goals. After that, the return of the concept of form into planning represents a reaction to that previous period. The position of form was additionally strengthened during the 1990's, when it stood in the heart of research and activities, inspiring requests for its integration with the issues of sustainability and quality of living environment (Hall, 2013).

Certain problems in the development of built environment in Serbia can also be traced to the absence of the concept of form in planning, or to the lack of direction in the process of developing physical structure through planning guidelines. The analysis of the existing planning and design practice in Serbian cities has identified the problems of one-sided

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approach to planning originating in architectural and urban conceptions of modernism (favouring technical and functional aspects), overly general approach to planning, indiscriminate application of imported models, and partial interventions on the level of the city block (Niković *et al.,* 2016).

This issue has been recognised in scientific and professional communities in Serbia for a long time now, but nevertheless, there are no mechanisms which could connect different levels of expert interventions in order to achieve a desired quality of built environment (Niković *et al.,* 2015).

This paper analyses the methodology of drawing up urban plans which have regulatory dimension, and which also contain elements that regulate future construction. Apart from that, it calls to attention urban plans that are strategic in their character, but which also contain regulatory elements, and underlines consequences of implementing these kind of plans in practice. Through the monitoring of the methodology of drawing up a plan, which in general has three basic phases, the existing situation analysis, the phase of defining planning solutions, and the phase of controlling planning solutions, we have established the structure of the paper in three chapters discussing each of the abovementioned phases from the aspect of the possibility of introducing the concept of form into planning.

The context of planning in Serbia is characterised by challenges brought about by the process of transitioning from the previous rational planning model to collaborative model initiated by the change of socio-economic system in the 2000 (Lazarević Bajec, 2009). In addition to all other elements of market-oriented and democratic society Serbia strives for, which are essential for the introduction of a modern planning model, it is necessary to re-examine the form of the plans which should reflect key requirements instead of professional practice strictly relying on formal planning system.

EXISTING SITUATION ANALYSIS

In order to start drawing up a planning document it is necessary to have as clear a picture of the existing situation as possible. That is why existing situation analysis represents the initial phase in the process of planning. It includes obtaining land registry and topographical under-lays and requirements set by all relevant public enterprises and institutions in charge of spatial values protection and equipping the given location with utilities. Besides that, it should include site analysis and additional expert reports. Dedicating enough time to gathering and systematisation of input data is of great importance. A good existing situation analysis could affect the long-term fulfilment of the planning goals to a great extent, since it represents the best way to asses possibilities, limitations, weak spots and potentials of the given location relative to the set goals.

However, while the content of a planning document is defined by law, the methodology of its drawing up is not, depending instead on the planner's approach. Taking into account general changes in the approach to planning, which has stopped being research-oriented, focusing instead on a quick and efficient adoption of plans as regulatory basis for issuing building permits (Gligorijević and Graovac, 2018), the existing situation analysis phase is routinely reduced to elementary analyses and outlines, lacking a detailed expertise of the space encompassed within the plan boundary. In conformity with the laid down content of the planning document, the result of the existing situation analysis phase consists of a textual and graphic part. The textual part describes the existing situation – built-up area, landscaping, infrastructure, etc. As a rule, the graphic part illustrates the distribution of use in the existing surroundings. The plans are drawn up over land registry or topographic under-lays which are often fragmentary or out-of-date. At best, they contain delineated dimensions of the buildings and the number of floors.

Consequently, in the majority of existing regulation plans the planning process usually begins with this kind of information about physical structure as its basis, since neither the law nor the practice require additional analyses of the existing state. The third dimension and spatial effects of planning are disregarded from the very beginning. This situation is exacerbated by the fact that these parameters remain unverified during the control phase of the plan, which will be further discussed in the chapter about the control of planning documents. Graphic parts of the plan illustrating the distribution of the planned use, roadways and utility infrastructure are the end result of regulation plans. In the textual part of the plan, the building rules are laid down for each planned use – parameters for maximum allowed built-up area – usually not based on the analysis of the existing built area. This "grey area" represents a wide window of opportunity for use, but also for the misuse of the space.

The problem of inadequate recognition of and distinction between the characteristics of urban structure in planning procedures, design, and construction affects the quality of the environment and the potential for sustainable development. Indiscriminate interventions in space, especially in the case of partial construction, disturb the balance of obligatory elements present in the conception of architectural and urban solutions, such as green surfaces, open spaces, relations with the street and neighbouring facilities and lots.

Based on the analysis of the existing state of urban and physical structures in Serbian settlements, conducted within the contextual analysis for the Sustainable and Integrated Urban Development Strategy of the Republic of Serbia until 2030[2] (Trkulja *et al.*, 2018), a large number of valuable architectural and urban types has been noticed – urban settlements with specific typological characteristics and recognisable architectural typology. On the other hand, it has also been noticed that the typology of physical structure is not sufficiently recognized in the planning documents, and that urban settlements, facilities and wholes which represent important Serbian cultural and historic reference points (especially the smaller ones, located in the economically poorer parts of the country) are decaying. Planning procedures and procedures for

[2] Sustainable and Integrated Urban Development Strategy of the Republic of Serbia until 2030 (developed by a wider team of experts, currently in the procedure of adoption).

the management of urban development do not properly recognise and distinguish between important features of physical structures which represent elements of their identity and potential for their growth.

The buildings of vernacular architecture, which make up the majority of urban tissue in urban settlements, are not sufficiently recognised as valuable building heritage, and the same goes for industrial heritage. The protection practise disregards the building heritage of the 20th century, especially facilities built after the World War 2 in modernist architectural and urban style of significant historic, cultural and civilizational value.

The problem of heritage and its position in the planning process has become a separate issue within the context of planning methodology. The most recently adopted declarations (HUL) expand the concept of cultural heritage so that it includes buildings that are not under protection of official institutions, but which have important role in the creation of a wholesome urban and rural environment. In this context the existing situation analysis has become increasingly significant.[3]

On the other hand, the stance that reconstruction and protection of the existing urban forms, the same as the production of new ones, should be founded on the knowledge and understanding of the existing built environment, its distinctive traits and past development, is one of the basic premises in the theory of urban morphology. In this context, typo-morphological and comparative analysis are suggested as useful means for the existing situation analysis. It is used to define and recognise different types of tissues and to conduct a consistent categorization. For example, the urban plan of Porto makes use of the typo-morphological approach which identifies different tissues based on the analysis of morphological characteristics (Oliveira, 2006).

In Serbia, there is a significant number of valuable studies (eg. Kurtović Folić *et al.,* 1997, Perović, 2008, Đokić, 2009) and informal planning documents (eg. strategies of urban development, visual and urban identity, cultural heritage protection with accent on the ambiences, etc.) that study the characteristics of physical urban structure and the effects of construction, and show potential to integrate morphological approach with practice. However, these contributions are not legally binding, and thus not obligatory.

SPATIAL VERIFICATION OR VISUALISATIONS OF PLANNING SOLUTIONS

The second phase, following the existing situation analysis, is the process of defining planning solutions. This phase also results in graphic illustrations of the distribution of use and textual definition of the building rules. Taking into consideration that the planning system in Serbia is based on vertical hierarchy of plans, which means reconciliation of regulation plans with the plans of higher order, it often happens that recommendations laid down in the plans of higher order, in cases when they have regulatory dimension[4], are taken over ("rewritten") by regulation plans. On the one hand, this enables the plans to be reconciled, and speeds up the planning procedure, thus satisfying the criterion of fast procedure. On the other hand, however, the building rules that supposedly regulate the future construction, more often than not do not conform with the character of the space enabling different interpretations in space.

The problem of non-comprehending the character of a location is especially prominent in areas that contain registered cultural assets, facilities and urban compositions of architectural value that do not fall under institutional protection. There are no practical guides and methodologies pertaining to research and evaluation of wider areas that contain valuable cultural and historic assets which could be implemented during the planning process, especially in cases of regeneration (Niković and Roter Blagojević, 2018). In addition to that, since they are not legally binding, regulation plans do not make use of the possibility to examine the location in more detail using the instrument of urban design which could encourage a wider understanding of planning solutions by the local community, and consequently, contribute to a more active participation of the public in the planning procedure. It is important for professional preservationists who re-examine preservation approaches to the context of planning, to recognise this issue. They have observed that a detailed analysis of the location could help define clear principles on which to found planning solutions, whose recognition and implementation might improve and preserve the existing context (Dimitrijević Marković, S., 2012).

Additionally, the introduction of the concept of form in the phase of defining the planning solutions primarily represents an instrument which a planner can use to examine the potential of the location. This should be differentiated from the concept of image – which is a visualisation of a planning solution often created in order to convince someone (by planner to convince investor, or investor to convince user) that the solution is valuable. This concept of image is usually used in environments such as Serbia, where the pressure of foreign models, often adopted indiscriminately, is particularly strong. In such cases, typo-morphological studies and conforming with the context have a key role in the preservation of the location's character and identity (He, J. W. and Henwood, M., 2012).

The inclusion of the urban-architectural competition phase in the planning procedure can be a useful way to define guidelines for the regulation plans. It would be especially important for the zones of urban renewal where competition could provide the most suitable proposals suggested by the current Law on Planning and Construction (Art.27): compositional and massing plan, and the landscape design project.

[3] Milenković points out that in the future, the majority of interventions in the area of design and planning will entail reconstruction and renewal of the existing physical and urban structure, and that designer's role will be predominantly that of a preservationist obligated to conduct a more detailed research of the existing situation, and to consider to a much greater extent its typological, topological and morphological characteristics (Milenković, 1993).

[4] This is the case with the previous Master Plan of Belgrade 2021, which prescribed urban indicators for determining the construction capacity and based on which the urban conditions for construction were issued for locations that were not covered by the regulatory plans for further elaboration. In addition, the same construction rules were prescribed for parts of the city with different morphological characteristics (Niković *et al.*, 2014).

Malfroy (2001) points to the example of the Pariser platz's competition in Berlin (1996) where, according to him, the successful reconstruction of this public space subsumed the critical approach and extensive preparation, especially morphogenetic studies having the proximity of the important structures such as the Branderburg's Gate. The interaction between the informatics on space and the idea of the square as a representative public space resulted in the Master Plan with precise conditions in terms of urban rules (mixed use, the spatial hierarchy which supports the Gate as the dominant, directing traffic and introducing the landscape elements) and building typology (the continuity of the fronts, facades with maximum of 50% of openings, gradually decreasing heights of buildings as they get closer to the Gate; respecting the proportion and scale of classical order; restrictive use of materials and colours – the neutral ones). Đokić (2009) gives the guidelines for the city square development in Serbia on the basis of the evaluation of existing conditions. He points to the criteria which could be used in evaluating the existing ones, as well as in planning the future squares, where these places have to be: expressive, protected, meaningful and accepted by users. Moreover, he relates these criteria to the physical characteristics – position, size and shape, and gives valuable guidelines for planning: concerning the architectural frame of the square which in Serbian examples usually misses continuity and unity; raising the level of urbanity (through higher occupancy and construction indices and mixed uses); making distinction between squares and parks and decreasing square's dimensions. The value of these recommendations is demonstrated through several examples of competitions. However, in Serbia, even when the competitions are held with the aim of examining location and integrating the best results in plan in the final outcome, the investors' interests prevail which affects the resulting physical form (Marić *et al.,* 2010)

Even though the visualisation of planning solutions, primarily through images, is the expected result of the introduction of the concept of form into planning, in its essence it serves to make connections between the model of space and the model of life (Milenković, 1993), that is to say, between performances of urban form and users' needs. Corresponding to the users' requests, performances of urban form do not belong only to the visual and aesthetic domain, but also to the domain of technical functionality and spatial experience. They constitute a set of criteria that can be used to evaluate the suggested model of urban form; which is a flexible and dynamic system of dialectically linked elements, and which enables us to change and redefine the system configuration, i.e. the final, resulting physical forms (Figure 1).

This approach enables us to re-examine both foreign models and past models that are sometimes also used indiscriminately in the attempt to introduce a human dimension and the qualities of traditional town into architectural and urban conceptions of Modernism. Instead of that, entities that have already established themselves in traditional urban and physical structure undergo comparative and morphological analysis based on the established set of criteria. The results of the research are used as the starting point for new conceptions and modalities in the operationalisation and the process of designing and planning.

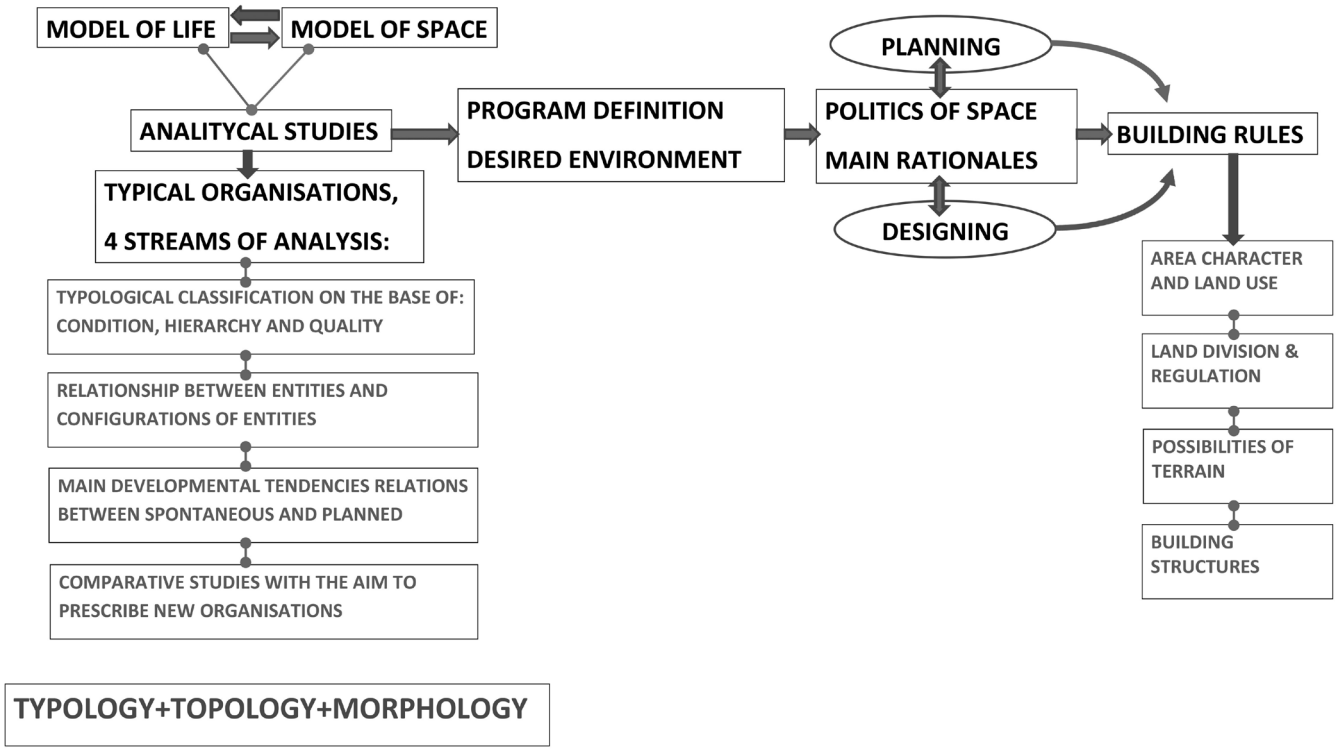

Figure 1. The process of urban planning in function of interconnecting the model of life (needs) and model of space (urban form) (Source: authors)

PLANNING REGULATIONS AND CONTROL OF PLANNING SOLUTIONS

Basic elements of planning solutions which regulate future construction represent the building rules usually expressed through quantitative indicators – construction index (CI, equivalent of floor area ratio – FAR) and occupancy index (OI, equivalent of built up area ratio – BAR) .

In contrast with the excessively general approach, we can find a too deterministic approach, or insufficient recognition of diversity. This problem manifests itself, for example, in the application of the building rules in Belgrade, where the analysis of the current practice shows certain trends which in time tend to become (unwritten) rules of construction, in other words, "easy to do". They are the consequence of an unclear definition of a wide range of shaping possibilities through planning indicators on the one hand, while, on the other hand, they have emerged as a consequence of the interpretation of plans by the authorised body which issues building permits, and which additionally narrows the repertoire of forms. Planning solutions, first of all regulation, levelling, occupancy index and construction index, significantly affect the designers' solutions, favouring, directly or indirectly, the usage of certain shapes. Insisting on the utilization of permitted urban parameters to the maximum degree (by the investor) leads to typified solutions in newer residential architecture.

Beside the issue of the lack of inventiveness and freedom of form, planning, design and building procedures are plagued by another problem – inadequate identification of and differentiation between the characteristics of urban structure, which affects the quality of the environment and potential for sustainable development. Indiscriminate interventions in space, especially due to partial building, disturb the balance between the elements that must be present in the conception of architectural and urban solutions – green areas, open spaces, relation with the street and neighbouring facilities and lots.

The analysis of detailed regulation plans adopted for the Belgrade municipality of Stari grad[5] shows that several planning guidelines are not consolidated, which makes it impossible to conform with all the elements essential for the proper functioning of urban structures. If the investor's primary request, the implementation, to a maximum degree, of permitted urban parameters pertaining to construction was realised, it is clear that it would be impossible, within the defined urban and physical frame, to deliver on the required capacity of parking space and green surfaces. An additional problem arises from the fact that in the process of the implementation of planning documents, the authorised body issuing building permits does not inspect whether the requirements for green areas are fulfilled; they only check quantitative urban indicators – construction index, occupancy index, and the number of floors. The percentage of green surfaces on the lot does not affect the process of issuing either the building or the usage permit, despite the fact that in the majority of cases the required minimum is not fulfilled.

[5] The analysis conducted within the expert study for the requirements of the Strategy of sustainable development Stari grad (2012).

Practice has shown that plans are usually verified to the degree necessary for their implementation. However, the most commonly present issue is the fact that the rules are either insufficiently clear, or overly restrictive. The authorised bodies controlling the plans are forced to follow the rules of construction laid down in the plans, instead of being guided by the location itself and its requirements. Additionally, practical experience suggests that instead of relying on quantitative indicators of construction index and occupancy index (which often collide), the rules should be defined based on the factual situation on the field, and that construction lines which would define borders of the buildable area on the lot should be set, which would in turn define occupancy. The height of the facility should be added to this – in accordance with the height of the cornice or the number of floors. This serves to define the building volume, all of which amounts to the introduction of the third dimension into planning and links the planning with designing and construction (Niković, 2015).[6]

According to Habraken, a basic question for architects and planners is the meaning of a well-built environment, i.e., "What are the criteria according to which we assess the quality of the environment?". To accomplish that, namely, to connect different influences and qualities, control has proved to be a true operational force bringing change on the one side, whereas that very change reveals control. Participants in the designing and planning process configure the form, and the review of this process helps us find mutual priorities and values. Habraken has noticed that physical environment is structured hierarchically and that different surroundings reveal different types of hierarchy. In order to introduce control, we should apply the procedure of comparison which will reveal how hierarchies influence one another. They do not have to be congruent, but they can certainly be positioned reciprocally and relatively to one another. Where the control is centralised and belongs to a small group of people, the change is limited to large and sparse operations, and uniformity occurs. That is why in today's change of direction toward decentralised management of space it is necessary to study relations between patterns of control and sustainability. Habraken has developed a concept of territorial depth which corresponds to the levels of hierarchy in the landscaping of physical environment (Habraken, 2009).

Even though the answer to the question "What is the goal of planning?" is, a good quality of built and living environment, there are ever more studies showing that modern planning process has neglected greater good, giving primacy to private interests and short-term planning goals.

Ferenčak points out the fact that by its definition planning represents a conscious and permanent management of city space with the aim to achieve and keep good city for its people. With that in mind, he defines 15 characteristics or criteria by which to measure the concept of good city or the form of good city (or its fragments). He notices that the modern process of planning is based on official

[6] Mrs Ljiljana Novaković, at the time Secretary at the Secretariat of Urban Planning and Construction gave speech at the panel Modern architectural practice: institutional framework and rules of construction, on 25 June 2014 in Belgrade, about her experience with plan control.

procedures with strong bureaucratic potential, while planning regulations lack elements based on which these procedures are to be implemented, and which would have a direct, practical and positive effect on achieving the status of good city. That is why he suggests that these characteristics/ criteria should be incorporated into the law on planning and construction, seeing that it would be the only way to realise them in practice (Ferenčak, 2018).

Such comprehensive studies with resulting guidelines are rarely the base for regulation plans and especially for implementation. Even if they are incorporated in plans, the current practice of development does not take a holistic approach but can rather be described as a partial approach. It is necessary to develop a methodology of planning and implementation of plans where tighter collaboration between professionals involved in various phases would be provided.

CONCLUSION

The problem of the absence of the concept of form in the planning practice in Serbia affects different aspects of space. This problem is obvious both to the professionals who analyse the effects of planning, and to the users of space – through its diminished value in use. In addition to that, the value of space emerges from satisfying human needs functioning not only on technical and functional level, but also on socio-psychological and visual and aesthetic one. There are numerous examples of failed modernist creations of space as a consequence of two-dimensional planning and the absence of human scale. To that we can add the newest examples of building in Serbia which represent a consequence of urbanism dictated by investment. They are not based on the complex existing situation analysis, nor on consideration of variety planning solutions through visualisations, and they lead to the erosion of urban identity and character, often disregarding basic human need for privacy and the right to view.

This problem has been recognised internationally and the solutions are emerging with a more developed approach adopted by urban design both in theory and in practice. However, in the case of Serbia, general theory of urban design and urban morphology together with specificities of Serbian environment (e.g. urbanism dictated by investment) have to be significantly re-examined and adjusted to the context of planning. Planning and construction in Serbia exist in the institutional and legal framework which does not adequately recognize categories of urban identity, typology and character of space. These deficiencies are reflected in the planning methodology applied in the drawing up of regulation plans which define elements that regulate future construction. It has emerged that the phases of the existing situation analysis are condensed and incomplete, that they do not include detailed information about space and, above all, about physical structure. Spatial inspections of planning solutions which give visual form to suggested urban parameters in specific context and put them in relation with actual needs of future users of the space, both private and public, are lacking. In the end, the mechanism for the control of planning solutions which prevents negative effects of the implementation of planning parameters is also lacking.

As special recommendations for the three phases in the planning process, it is important to develop a strategic approach to planning and to find ways to introduce informal (non-obligatory) elements and steps in the planning practice. Besides mentioned strategies of urban and sustainable development, the following is also important:

- In the first phase of the existing situation analysis it is necessary to analyse specific characteristics, typological classification and characterisation of space. In this sense, the introduction of special (preliminary, conceptual) studies and analyses of urban context are recommended (studies of existing conditions of physical structure as a part of strategies of urban development, visual and urban identity, cultural heritage protection with accent on the ambiences, etc.);
- In the second phase, i.e. in the course of defining planning solutions, it is necessary to visualise urban parameters through graphic illustrations (3D animations, visualisations). The instruments of urban design and urban-architectural competitions could be a useful step for improving methodology of planning; and
- In the third phase it is necessary to establish criteria for the control of urban form, i.e., of those aspects of space that cannot be quantified. In that sense, it is important to improve regulations and integrate theory with practice. Introducing the criteria of good city into the the legal framework is of great importance, and so is developing procedural steps to bridge the gap between plans and built forms.

In all three phases/steps, qualitative indicators of good urban form are useful – in order to inspect the existing situation, to create new proposals and to control development. The basic problem is how to achieve consensus regarding indicators/ parameters, and implement them consistently. In that sense, proposals to incorporate these criteria and indicators into the law are reasonable. Form is more than just an aesthetic phenomenon, it also represents a manifestation of integrative approach to protection and planning of space. In that sense, urban morphology offers a wide range of theoretical and practical contributions.

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A METHODOLOGICAL FRAMEWORK FOR INTEGRATED PLANNING IN THE PROTECTION AND DEVELOPMENT OF NATURAL RESOURCE AREAS IN SERBIA – A CASE STUDY OF SPATIAL PLANS FOR SPECIAL PURPOSE AREAS FOR PROTECTED NATURAL AREAS

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Spatial plans for special purpose areas for natural resources are one of the main instruments for their protection and development, and significant results have been achieved in spatial planning practice in Serbia in recent years. The main purpose of this research is to consider a methodological framework for drawing up integrated plans enabling protection and development in areas of natural resources. The results of a comparative analysis are presented through a case study of four spatial plans: for the Kopaonik and Đerdap national parks and for the Stara Planina Mountain and Radan Mountain nature parks. The representation of the elements and models of implementation in the plans was considered. The main conclusion of this paper is that the integrated planning for the protection and development of natural resource areas in spatial plans is satisfactory, primarily in terms of the relativization of conflicts, though monitoring the implementation of the plans can be further improved.

***Key words*: Spatial planning, spatial plan, special purposes, natural resources, development, implementation.**

INTRODUCTION

The role of spatial planning is the key to the protection and development of protected natural resources, and spatial plans for special purpose areas (SPASP) are a significant instrument for this purpose. Many spatial plans for the special purpose areas of national parks, nature parks and other larger natural resource areas have been adopted and implemented in Serbia over the last fifteen years.

In addition to the Law on Planning and Construction (2009), the planning of protected natural resources and the character of the special purposes are mostly determined by the Law on Nature, in which the concept of protection is based on the following basic elements: protected natural areas – as protected areas; protected wild species and protected objects of natural tangible heritage; protected areas – as areas that have a pronounced geological, biological, ecosystem and/or landscape diversity because of which they are declared protected areas by a legal document on protection; protected zones – as areas outside the boundaries of a protected area, ecologically important areas and/or ecological corridors, which can be determined while establishing areas for the purpose of preventing or mitigating any internal impacts; protection regimes – as a set of measures and requirements by which the method and degree of protection, use, planning and improvement of the protected natural area are determined; etc.

Protected areas for which spatial plans for special purpose areas are, as a rule, drawn up include: strict nature reserves; special nature reserves; national parks; landscapes of exceptional quality; and nature parks. Due to their larger coverage and the need to align different functions and activities in the protected area, spatial plans for national and nature parks particularly stand out (Eagles and McCool, 2002).

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A national park is an area with a larger number of diverse natural ecosystems of national importance, pronounced landscape quality and cultural heritage (González, 2013) in which man lives in harmony with nature.

A nature park is an area of well-preserved natural values with preserved natural ecosystems and picturesque landscapes, designated for the preservation of the overall geological, biological and landscape diversity, as well as for satisfying scientific, educational, aesthetic, cultural, tourism, cultural, health and recreational needs.

Spatial plans for protected areas have boundaries, inside of which is the area where adequate regimes of protection are necessary. In addition, the boundaries of the spatial plans may also encompass an even wider area in which there are mutual impacts between the special purposes and other functions and activities in the area, or in which other activities with the character of the special-purpose activities are recognized, or which are under the cultural heritage protection regime (Zan *et al.*, 2016). In this case, the boundaries of the spatial plan are, as a rule, determined by the boundaries of the cadastral municipalities, and only exceptionally by the analytically determined boundaries or boundaries of cadastral parcels when there is the need for large-scale planning and when the area is covered by a large number of planning documents.

In drawing up spatial plans for protected natural areas, the character of the special purposes and the main subject of planning are not the only aspects of planning. Spatial planning for the protection of natural areas also needs to consider sustainable development in a wider context, whereby the development of tourism is planned as a complementary activity (Dabić, 2002). Most spatial plans for special purpose areas in Serbia have used an integrated approach to planning the sustainable development of mountain areas, particularly in relation to tourism development. (Krunić *et al.,* 2010). In this context, the main issues that influences all aspects of the sustainable development of mountain areas include a balance between the development and protection of natural resources and values (Milijić, 2015). For this reason, a major challenge for the further development of spatial planning methodology for protected natural areas lies in analyzing previous good practice in Serbia and further improving it in order to achieve a satisfactory level of alignment between the protection and development of natural resources.

The research in this paper was conducted using a case study of four spatial plans for special purpose areas of the newer generation, prepared at the Institute of Architecture and Urban & Spatial Planning of Serbia. These are: the Spatial Plan for Stara Planina Nature Park and Tourism Region (from 2008); the Spatial Plan for Kopaonik National Park (versions of the plan from 1989, 2009, 2016); the Spatial Plan for Đerdap National Park (from 2013), and the Spatial Plan for Radan Nature Park (from 2014). The basic criteria for selecting these spatial plans were their natural diversity and the fact they were produced in the last decade for different areas in central Serbia.

MAIN ELEMENTS OF THE CONCEPT OF PROTECTION AS A FRAMEWORK FOR PLANNING IN PROTECTED NATURAL AREAS

The protection of nature and natural resources and the potential development of tourism were determined to be the special purposes of the Spatial Plan for Stara Planina Nature Park and Tourism Region. The framework for such purposes was determined by the major goal of ensuring the lasting protection of the natural phenomenon in the nature park area, as well as by the goal of determining the capacity of the area for its presentation to the public, recreation and complementary activities, education and scientific research.

The protected area of the National Park, established as an IBA, IPA, PBA and EMERALD site, was designated as a special purpose area by the Spatial Plan for Kopaonik National Park, while there is also a plan to establish its biosphere reserve status under UNESCO's Man and the Biosphere Programme (MAB). However, tourism in the most important part of Kopaonik's primary tourism destination is designated as another special purpose of the area. Other special purposes in the Spatial Plan also include: water resources management; protection of cultural heritage; and a land security zone with a special-purpose complex.

The protected area of Đerdap National Park, which is of key importance for determining the planning solution, is established as a special purpose area in the Spatial Plan for Đerdap National Park. Đerdap National Park is an IBA, IPA and PBA site and is part of the EMERALD network. The National Park is included in the tentative list of UNESCO World Heritage Sites and is a candidate for being a Biosphere Reserve (MaB). Other special purposes in the Spatial Plan, determined by planning and strategic documents at the national level, are: its diverse cultural values; its position as a section of the Pan-European Transport Corridor VII – the Danube; the water infrastructure – the hydropower potential of the Danube, with the two existing hydropower plants, Đerdap I and Đerdap II; as a tourism destination Donje Podunavlje (Lower Danube Basin); as a zone of exploitation and significant reserves of minerals – part of the Majdanpek-Bor basin; and as the border area between the Republic of Serbia and the Republic of Romania.

The protected areas of the Đavolja Varoš Monument of Nature and the Radan Mountain protected area, with their great biological and landscape diversity, geoheritage objects and phenomena worthy of being geoheritage and with their cultural and historical heritage, as well as sustainable tourism development and agriculture, are designated as special purpose areas in the Spatial Plan for Radan Nature Park (Maksin *et al.*, 2011).

In the past, the concept of protecting natural resources has been based on a three-degree protection regime which needs to be spatially determined and considered in terms of planning:

- First degree protection regime – implemented in the protected area or part thereof with the original or a slightly changed ecosystem of exceptional scientific and practical importance, which enables processes of natural succession and conservation of habitats and communities of living things in conditions of wilderness;

- Second degree protection regime, active protection – implemented in the protected area or part thereof with a partly changed ecosystem of high scientific and practical importance and with especially valuable landscapes and geoheritage objects; and
- Third degree protection regime, proactive protection – implemented in the protected area or part thereof with partially changed and/or changed ecosystem, landscape and geoheritage objects of scientific and practical importance.

The act on the declaration of protected natural resources/areas refers to the protection study, by which a protection regime with the cartographic presentation of boundaries is determined. However, such a legal solution raises many questions and problems in practice. There is no methodology given for creating a cartographic map for the protection regimes, and the scale, type and updating of the physical layouts are not prescribed, which raises the question of the usability and further implementation of the prescribed protection regimes. At the same time, practice has shown that the protection regimes have been determined only in the context of protection, without considering any aspects of development in the protected area or its surroundings (Stefanović *et al.*, 2017). This causes further conflicts with other activities in the area, as well as with the planning documents at the republic and local levels. Therefore, it is necessary to draw up the spatial plans for special purpose areas with a detailed graphic determination of the protection regimes and their alignment with aspects of development, and also obtain synthesis solutions to many other issues.

The conservation and improvement of the environmental quality in protected areas of natural resources is primarily determined by the relationship between the natural and anthropogenic factors, actually by the regimes of the preservation and use of natural resources and values (Margules and Pressey, 2000). In the area of the spatial plan outside the protected natural resources, the environment is significantly affected by anthropogenic factors associated with construction areas in rural and urban settlements, as well as by the infrastructure and arable land. For this reason, the integrated protection of the natural environment in the area of the spatial plan may be based on the following requirements and solutions:

- Treating the natural environmental protection in accordance with the provisions of the planning documents, as well as on the basis of the forest, hunting, agricultural and other plans, programmes and other documents drawn up on the basis of and in accordance with the planning documents;
- Determining a moderate concentration of stationary tourism and development of a tourism infrastructure in the planned area (according to the spatial capacity), and, if possible, to the benefit of settlements and localities on the edge of these areas and in sub-mountain areas;
- Building a circular road ring around the protected natural resource area and wider tourism region, with radial connections, as well as the possibility of organizing the public transportation system to reduce the number of individual passenger vehicles, i.e. to ensure that the daily visitors from the surroundings (particularly skiers from ski resorts) can enter the protected natural resource area without traffic overload (example of the Spatial Plan for Kopaonik);
- Creating a single water resources management system;
- Building sewerage systems in the settlements situated in the area covered by the spatial plan with a complete sewerage network and sewerage treatment equipment (example of the Spatial Plan for Stara Planina);
- Building a district heating system for all concentrated complexes in new sites in the mountain areas; implementing clean energy, primarily gas, as well as geothermal, solar, electric and biogas energy;
- Introducing an integrated waste management system, recycling and the use of energy from waste in adequate devices;
- Establishing a system of permanent monitoring of all environmental quality parameters in the area covered by the spatial plan (quality of soil, water, air and vegetation); and
- Reconsidering the level of compensation for the use of commercial space and nature in the protected area to ensure higher income for their protection, as well as compensation to the local population for restrictions in production.

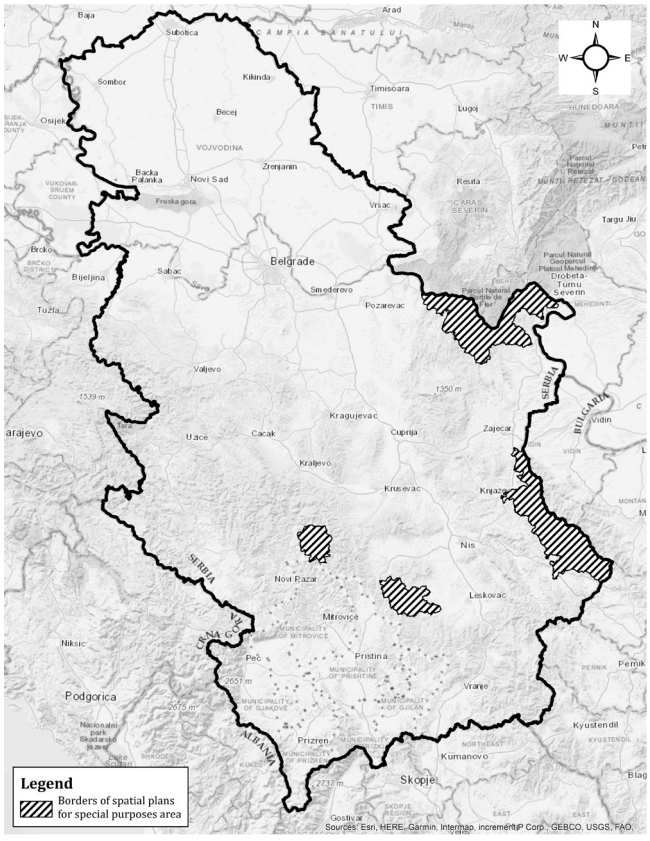

Figure 1. Location of the case study spatial plans for special purposes in the Republic of Serbia

PLANNING THE PROTECTION AND DEVELOPMENT OF THE PROTECTED NATURAL AREAS IN THE SPATIAL PLANS FOR SPECIAL PURPOSE AREAS – CASE STUDY

The case studies of the spatial plans presented here for Stara Planina, Kopaonik (2009), Đerdap and Radan Mountain show that, relative to the plan's coverage, 37% to 74% of the area is under protection (Table 1). Out of this, 2.7% to 4.53% of the area is under the 1st degree protection regime, 8.7% to 15.12% of the area is under the 2nd degree protection regime and 21.56% to 58.68% of the area in under the 3rd degree protection regime. In relation to the total surface under protection, the 1st degree of regime is on average 7%, the 2nd degree is on average 24.5%, and the 3rd degree is about 68.45%.

The 1st degree protection regime – in the natural resource area under the 1st degree protection regime, the use of natural resources and all other uses and activities are prohibited, except for scientific research, organized education and limited presentations.

The 2nd degree protection regime – in the protected natural resource area under the 2nd degree protection regime, the use of natural resources is restricted and controlled. Construction and the use of space are also restricted and concentrated. Activities in the area can be performed to the extent that they enable improvement of its conditions and the presentation of natural resources without consequences for their primary value. No construction is allowed other than planned and controlled construction and development of the area for the following needs:

- Tourism and recreation – construction of Alpine and Nordic ski trails (with accompanying systems and facilities) and snowboard trails and parks, building golf courses and other sports and recreation grounds;
- Presentation of the protected natural resources – excursions, fishing, hiking, horseback riding, biking and other trails, along with tourist information points, trail marking, the construction of smaller facilities for resting, watching natural beauty and educational functions, which are to be built as rustic facilities;
- Construction and reconstruction of the transport and technical infrastructure to connect, equip and revitalize rural settlements, tourism resorts and tourism centres and settlements situated in 3rd degree protected areas, as well as to connect Alpine and Nordic ski resorts; and
- Reconstruction of the existing suprastructure facilities for electrical power, water resources management and forestry, and the construction and reconstruction of the residential buildings and agricultural facilities of rural households within the existing buildings plots along with mandatory controlled municipal solid waste disposal and sanitary, safe waste water collection and disposal.

The 3rd degree protection regime – in the protected natural resource areas under the 3rd degree protection regime there is selective and controlled natural resource management, construction and the use of space and other activities, along with the condition of maintaining high environmental quality and biological and landscape diversity. This includes agricultural and forest zones and zones of settlements which, in addition to the planned utility infrastructure of the existing settlements, also implies: the planned development of tourism centres and settlements and tourism and recreational infrastructure; restricted use of minerals; forestry development; livestock development and development of other branches of agriculture; hunting and sport fishing; as well as other forms of sustainable development.

These plans fully confirm that the protection of natural areas should be seen in a wider context of sustainable development, with a special accent on the development of tourism (Dabić, 2002; Milijić, 2015). Because the majority of these resources are in mountainous areas (Stara Planina and Kopaonik), stationary and excursion tourism with winter sports and recreation, Alpine skiing and other winter sports are the dominant forms of tourism. As the rationality of business in mountain tourism implies the use of a year-round tourism offer, for which there is enough potential in the protected natural resource areas in mountains, numerous other forms of tourism are envisaged for in the summer season, such as sports and recreational, cultural, hunting, rural, health and urban tourism (business, congress, event tourism, etc.), as well as transit tourism.

As for the mountain areas, the contents of tourism, recreation and sports are zoned and organized into two main altitude zones: the mountain zone and the sub-mountain zone.

Table 1: Balance of areas/coverage of the special purpose area spatial plan and zone of protection

SPASP	Zone under the 1st degree protection regime		Zone under the 2nd degree protection regime		Zone under the 3rd degree protection regime		Total area under protection		Outside the protection regime		Total plan	
	1		2		3		1+2+3		4		1+2+3+4	
	км²	%	км²	%	км²	%	км²	%	км²	%	км²	%
Stara Planina	41.60	2.70	196.79	12.76	904.93	58.68	1143.32	74.14	398.58	25.86	1541.90	100
Kopaonik	14.71	4.53	36.00	11.08	70.08	21.56	120.79	37.17	204.05	62.83	324.84	100
Đerdap	56.33	3.65	134.15	8.70	447.51	29.02	637.99	41.37	904.09	58.63	1542.08	100
Radan mountain	9.51	2.03	70.93	15.12	156.55	33.38	236.99	50.53	232.21	49.47	469.20	100

The mountain zone consists of a belt of the higher-altitude mountains with a dominant mountain offer in the area and new tourist accommodation directly related to this offer. The sub-mountain zone consists of the lower-altitude foothills of the mountains and wider surroundings, with a tourism offer related to the hilly and lowland areas and accommodation in the existing rural and mixed settlements and urban centres (examples of Kopaonik and Stara Planina).

The planning criteria for commercial tourism are the following:

- Achieving a high standard of the tourism offer in the area, at the same time as presenting the protected natural resources;
- Organizing the activities and development of the area for specific forms of eco, ethno and monumental tourism in the area;
- Achieving a dispersed distribution of tourist accommodation, depending on the available area for construction, as well as on the protection regime, possibilities of a rational water supply and channelling of wastewater, the possibilities of rational traffic access, etc.;
- Elevating the standard of the existing tourist accommodation facilities, and building new high-standard tourist accommodation;
- The construction of new high-standard facilities for sport and recreation, and public services, within the year-round tourism offers of the resorts, tourism centres and settlements, which is important both for tourism in the protected natural areas and for mountain villages; and
- Transport and functional connections for the tourism offer for the sub-mountain and wider tourism zones.

The approaches to the spatial plans are different regarding the details and number of rules prescribing the level of development and construction. This depends on the total plan coverage area and the area under the protection regime, the level of development, the number of settlements and inhabitants, the percentage share of building land in the overall plan coverage area, the existing and planned locations for tourism, etc., which has also consequences any further implementation.

The different ways of presenting the planned proposals have been used in the plans, i.e. rules, standards and capacity for future land development and use. For example, the spatial plans for Kopaonik and Stara Planina have used parameters in specifying the future tourism centers which relate to the type and standard of tourist accommodation capacities, number of beds, number of skiers, number of visitors, number employees, occupancy level of the accommodation capacities in season and out of season, etc. The population density is higher in settlements, i.e. the number of people per unit area (ha, km^2). The determinants regarding the vertical regulation of hotels and residential buildings (e.g. the maximum number of floors GF+3 or maximum height of 20m) are also given for the Stara Planina Mountain, as well as that the architectural design should be in accordance with the traditional architecture in the region (ethno model).

Considering that further development and elaboration of urban plans for areas intended for development is expected, it is not necessary to give all urban planning parameters, but only those giving general directions. Furthermore, the availability of physical outlays, based on which the plans and scale drawings are produced, does not allow more details to be included. On the other hand, it is necessary to give as many specific rules as possible for the entities that have the possibility of direct implementation. In this context, there are examples of plans (Spatial Plan for Kopaonik, version 2016) which, in some segments, such as the construction rules for a business-residential complex, include precise detail to the level of the building plot for a complex and specify all urban planning parameters (minimum plot area, floor area ratio, plot coverage, maximum number of floors, and occasionally the gross building area, horizontal regulation – position of the building, distance from the plot boundaries, etc.). This form of determination is not necessary, and not always possible, but may be useful and an excellent example of combining the planning and urban planning methods in prescribing the requirements for planning, use and construction.

Further elaboration of plans involves the drawing up of urban plans, primarily detailed regulation plans, which are, as a rule, prescribed for the zones and complexes intended for tourism in the areas under the 3rd degree protection regime, as well as for some other types of land use (skiing infrastructure, communal and traffic infrastructure, etc., in or outside the protected area).

A COMPARATIVE ANALYSIS OF THE APPLICATION OF THE ELEMENTS AND MODELS OF IMPLEMENTATION IN SPATIAL PLANS FOR SPECIAL PURPOSE AREAS FOR PROTECTED NATURAL AREAS

In addition to the mentioned elements of spatial plans, which indicate a simultaneous elaboration of aspects of protection and aspects of development for areas of protected natural resources, a comparative analysis of the application of the elements and models of implementation in the special purpose spatial plans was also carried out (Stefanović *et al.*, 2015). The analysis was based on the attitude that the "model of the implementation of spatial plans is a simplified presentation of a set of the related planning decisions on future actions, thus reflecting the logical, functional and time coherence of the planning actions depending on the type and method of planning" (Stefanović *et. al.*, 2017). It was also based on the main types of models of implementation recognized in the practice of drawing up plans and their elements, as well as on the criteria for assessing the application of the model (Stefanović *et. al.,* 2017a). In accordance with this, two models of implementation were analyzed: the model of implementation for the protection of an area, which refers to all aspects of protected natural resource areas, and the model of implementation for planning solutions of a technical nature, which refers to the planning solutions aiming at further development, primarily the development of tourism capacities and accompanying infrastructure (Table 2).

Table 2: The representation of the elements and models of implementation in spatial plans for special purpose areas

	Spatial Plans for Special Purpose Areas	I Planning elements				II Post-planning elements							III Monitoring elements			Representation of elements in model (%)
						Dynamic framework		Measures and instruments								
		Strategic framework	General goals	Specific goals	Planning solutions	Priority planning solutions (4 years)	Medium-term and long-term stages	Planning-programming	Organizational	Normative-legal	Financial	Participants (subjects)	Monitoring system	Evaluation (indicators)	Institutional and organizational aspects	
Model of implementation for spatial protection	Stara planina	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	93
	Kopaonik	✓	✓	✓	✓	✓		✓	✓			✓				57
	Đerdap	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓	79
	Radan planina	✓	✓	✓	✓	✓		✓	✓			✓	✓		✓	71
Model of implementation for planning solutions of a technical nature	Stara planina	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	79
	Kopaonik			✓	✓	✓	✓	✓	✓			✓				50
	Đerdap	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	79
	Radan planina	✓	✓	✓	✓	✓		✓	✓			✓				57

The implementation model for protected areas was applied, and is dominant, in the Spatial Plan for Stara Planina Nature Park and Tourism Region, which has the highest percentage of the model's elements out of the spatial plans analyzed here and all models of implementation. In addition, the implementation model for the planning solutions of a technical nature, the elements of which mostly relate to the tourist accommodation capacities, tourism infrastructure like ski lifts and ski trails, utility infrastructure, etc., was also applied to a high level. These contents are supported by a number of rules for their use, development and construction, which are rather detailed regardless of the fact that they are implemented indirectly through urban plans. A characteristic of this Spatial Plan is that it is the only one in which the two mentioned models of implementation also contain precisely specified financial measures and implementation instruments which, in addition to the sources of financing, also comprise the costs by planning solution.

The implementation model for the protection of space is dominant in the Spatial Plan for Kopaonik National Park. It refers to a series of goals, planning solutions and other elements of the plan to protect natural values, and it also prescribes the use of space in the areas under the 1st, 2nd and 3rd degree protection regimes. Like in other spatial plans, the implementation model for planning solutions of a technical nature also refers to the tourist accommodation capacities, tourism infrastructure and utility infrastructure, along with a number of rules for the use, design and construction of the tourism facilities and accompanying infrastructure.

The results of the analysis are similar to those for the Spatial Plan for Đerdap National Park and the Spatial Plan for Radan Nature Park. The specificity of these spatial plans, also including the Spatial plan for Stara Planina, lies in the fact that they are the only ones containing the elements of implementation which consider and tentatively specify the monitoring system, as well as the institutional and organizational aspects of implementation, through the dominant implementation model for the protection of areas.

The Spatial Plan for Đerdap National Park stands out as a specific case regarding the application of its model of implementation. The implementation model for the protection of areas and the implementation model for the planning solutions of a technical nature are equally represented in this Spatial Plan, which is a consequence of the fact that the special purposes in this plan are, along with the protection of the natural resource area, both the aspect of water resources management and the energy aspect of the Đerdap system. In addition, only this spatial plan is characterized by a tentatively specified monitoring system and by the institutional and organizational aspect of implementation through the implementation model for planning solutions of a technical nature.

CONCLUSIONS

The main aim of the research and its results presented in this paper is to consider a methodological framework that enables integrated planning for protection and development in protected natural resource areas. Starting from the attitude that it is not desirable to detemine the

protection regimes for natural resources by means of an act on protection exclusively in the context of protection, without a synthesized approach and without considering the aspects of development in the protected areas, as well as without precise graphic drawings, the authors have directed the research to the practice of drawing up spatial plans for special purpose areas.

The legal framework in Serbia provides the main elements of the concept of protection based on the type and values of the natural resource and area, as well as on the determination of the three-degree protection regime for these areas. However, until 2000, the normative protection and reservation of areas, also including the protection of natural resources, was relatively close to the practice of the developed European countries, but at the same time the real intensity and efficiency were far behind, along with a pronouncedly large gap between the normative and real protection (Maksin-Mićić, 2000). The total process of natural resource protection has been, for the most part, completed through drawing up and adopting spatial plans for special purpose areas for almost all protected natural areas, in normative, profesional, but also scientific terms, thus reducing the gap between normative and real protection.

The analysis of the new generation of spatial plans for special purpose areas for the protected natural areas of Kopaonik and Đerdap national parks and Stara Planina and Radan nature parks clearly indicates that lately special attention in Serbia has been directed to the planned protection and sustainable development of the protected areas. In this sense, it is obvious that the concept of protecting natural resources is planned integrally with the development of other activities in the area, primarily tourism facilities and infrastructure. By also taking into account the strict protection regimes of the 1st, 2nd, and 3rd degree, as well as their optimal application, it seems possible to specify the spatial distribution and principles for developing other facilities in the area.

This is also indicated by the results of the comparative analysis of the elements and models (protection and planning solutions with techical details) and their application in the mentioned plans, which have the purpose of developing tourism capacities and other systems in the area.

When planning for the protection and development of natural areas it is necessary to balance the contrasting interests of protecting natural values, the development of tourism, and the socio-economic development of local communities, and apply the new methods identified in the plans analyzed here. Planning and managing the development and regulation of tourist centres and resorts inside the protected area are based on improving the infrastructure and communal equipment, and the timely regulation of building land on the sites and in zones planned for construction. In order to reduce conflicts that occur between the local needs and protection, the basic principle is the realization of the benefits for the local community through its involvement in the protection of natural assets, the promotion of local products, and the development of skills and knowledge, as well as establishing a balance between tourism and other economic activities.

The conclusion of the authors is that the methodology for integrated planning in relation to the protection and development of protected natural areas in spatial plans is satisfactory, though it can be further improved, particularly from the aspect of monitoring its implementation. Along with the need for further scientific research on the protection and development of protected natural areas, it seems that the topic of balanced development has moved to the field of implementing the existing normative and planning systems. Spatial plans for special purpose areas for protected natural resources are undoubtedly the main instrument for the protection and development of such areas, and significant results have been achieved in the spatial planning practice in Serbia over recent years.

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AN ARCHITECT'S RELATION TO STRUCTURE: ANALYSIS OF PINKI CULTURAL SPORTS CENTER BY IVAN ANTIĆ

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Architecture represents the synthesis of form, function and construction. In the works of the architect Ivan Antić this can be read at the first view of the building. A master in designing movement through an object, Antić constantly developed the relationship between function and form, as well as between function and construction. A detailed analysis of his work, projects and drawings, gives insight to these relations, making them clear. The observer can see the architect's logic and simplicity in designing even the most complex buildings. The relationship between the design concept and the way the structure manifests itself in his projects will be presented in this paper. The logic behind the design of Pinki Cultural Sports Center, with emphasis on structure, as well as the relationship between the architect and the engineer can be seen throughout this paper.

***Key words*: sports hall, catenary, spatial structures, cable systems.**

INTRODUCTION

The construction of large scale and large span objects has always demanded the collaboration of experts from different fields. The realization of an architectural design depends largely on the relationship between the architect and the engineer and their team efforts. The interdependence of form and structure, the juxtaposition of spatial relations, and the function and construction speak about the complexity of design and the impossibility of separating these two professions. This paper shows the attitude that architect Ivan Antić had towards the structure. Understanding these two professions contributes to the successful realization of projects that over time become monuments of time, culture and people. The main purpose of this paper is to present the relationship between architecture and structure and their joint action in the design process, through chosen works of Ivan Antić. The reason behind it is that his projects clearly manifest the above mentioned relations that can be read on his buildings. His relationship with the engineers that worked with him can be seen on large span buildings, especially in an analysis of Pinki. This paper is an addition to previous analysis of Antić's projects, but it can also be the basis for further research. It confirms the importance of great engineering achievements in architecture and leaves a written trail that records notable engineers from the Balkans.

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ABOUT THE AUTHOR

The architect Ivan Antić, a full professor at the Faculty of Architecture, at the University of Belgrade, and a member of the Serbian Academy of Sciences and Arts, was one of the most significant architects of the 20th century. He worked on a variety of different projects, but those that stand out are his cultural and sports buildings. During his studies, Antić worked as a steel bridge engineer in the Ministry of Transport, where he upgraded his skill and precision in drawing (Milašinović Marić, 2005). It can also be concluded that this is why he developed an affinity towards large span structures, which can be clearly read on his buildings. Shortly after completing his studies, due to circumstances in the architectural practice of the time, at the invitation of construction engineer Milan Krstić, young architect Ivan Antić began working in the Belgrade-based studio Rad in the company of great names in engineering (Mitrović, 2012). He worked in this studio for three years, during which he improved his knowledge of structural analysis and created a network of contacts for future team work. His acquaintance with architect Ivanka Raspopović led to successful cooperation on the project for the Museum of Contemporary Art in Belgrade and the Memorial Museum Kragujevački oktobar in Kragujevac. With the engineers Milan Krstić, Petar Damjanović and many others he worked on sports buildings. Along with the experience gained in practice, he worked at the Faculty of Architecture as an assistant, teaching architectural design at the invitation of Stanko Kliska, an architect from Zagreb. The two of them had

previously worked together on projects for health facilities, whose functions were extremely complex (Mitrović, 2012). These circumstances in the life of Ivan Antić, at the very beginning of his career, had an impact on his architectural style. His architecture shows the careful attention he gave to the functional and structural design of buildings, not leaving out any aspect of architecture. Ivan Antić used all his knowledge when designing an object to unite form, function and construction, thus creating a specific architectural expression.

IVAN ANTIĆ'S ARCHITECTURE

"The only thing I have ever wanted was to have a geometric form, clean. Some rational form. Whether it be a square, a triangle, a circle or an ellipse. This can be seen in my projects." These were the words of Ivan Antić (Milašinović Marić, 2005). It is possible to perceive his wide architectural opus just by following these words. The logic behind his designs emerged from his desire for highly functional buildings, first and foremost designed for their users. At the same time, following the requirements of the project task, he developed a form that created a specific expression in space. This logic is clearly visible in his sports objects with the strict urban, functional and structural demands that the architect fulfilled with ease. His most fruitful period, when he designed sports and recreational centers in collaboration with eminent engineers, produced some of the most significant projects in Yugoslavia built between 1965 and 1980 (Milašinović Marić, 2017). By observing the buildings belonging to the Sports and Recreational Center "25. maj" on the right bank of the Danube in Belgrade it is impossible not to notice the exceptional artistic value of the composition with the existing scenery. The position of the objects on the site had its roots in the combination of different functions, while the expressiveness of the form was achieved by using complex structural systems. The restaurant, which was later privatized and turned into a gym, is situated on large cantilevers which seem to rise above the water. The floor plan of the object shows the simple geometry behind this design. It is an equilateral triangle divided into subareas based on its geometric center, which has a concrete core that gives it structural stability. When you can read the architect's logic in the design, especially when it is based on geometry, it is much easier for the engineers to find a solution for complex structures and large spans. Through communication between the architect and the engineer it is possible to build objects that become the symbol of a particular area. In order to fit the pool roof into the aesthetics of the restaurant, a concrete shell forms a hyperbolic paraboloid that perfectly complements the appearance of the entire site. Edmund Balgač, an engineer, worked with him on this project. It was a few years later that the two of them developed the idea of the cultural and sports center Pinki (Balgač, 1975) which will be analyzed in detail in this paper. Another significant building by Antić is the Olympic pool at Poljud in Split, built for the Mediterranean games, which he was invited to work on as an accomplished architect. He did not want to compromise on its strong form of a wave pointing towards the sea by adding any additional elements to this building. The structure's two main girders were made from reinforced concrete to form the wave, interconnected with beams in an orthogonal direction, which were used as the support for the stands. The structure was designed in this way because the architect wanted each element to have a specific function and for nothing to disturb the simplicity of the form. This design made it possible to have an unobstructed view of both the pools and the scenery, since it enabled the opening of large glazed surfaces, thus connecting the building with the surroundings. Antić's structural logic stemmed from his long collaborations with various engineers at the very beginning of his career. He liked to point out that there is nothing more beautiful than a large span construction, undisturbed by small elements, because in itself it has a high aesthetic value (Milašinović Marić and Marić, 2018).

CASE STUDY: STRUCTURAL ANALYSIS OF PINKI

For the design of the youth and sports center at Zemun, later renamed Pinki Cultural Sports Center (Pinki Zemun), strict demands were set before Antić by the Town Planning Institute of Belgrade, such as strict observance of the regulation lines and height. He skillfully overcame the demands and designed the object to fit perfectly into the urban tissue. Rectangular in plan, the building is 68 m wide and 54 m long. The design of the building was also conditioned by its complex function, which required the design of the object from within. All of the structural elements, as well as the design, were subordinate to the smooth functioning of the building. Since the dimensions of the object were fixed, and the program was required, the interdependence between the close functions was established first. Thus, the sports hall was close to the other sports facilities, and the pool was located below the hall, relying heavily on its foundations (The Main Project). Nowadays things have changed, and they are subletting smaller spaces for different functions.

The roof structure gives this building its character. In agreement with the engineer Edmund Blagač there were three possibilities for the form of the roof: a convex, horizontal or concave roof silhouette (Conić, 1975). Knowing that a cubic form needed some kind of an accent, to fit the demands, as well as the personal affinities of the designer, a concave roof structure was chosen to be solved as a cable suspended roof. This chosen structure, which is at the same time the roof of the sports hall, follows the slope of the stands and forms the least possible volume of space it encloses, thus contributing to the cost-effectiveness of the building in terms of its use (heating-cooling systems, ventilation).

The main facade of the building is very interesting because it clearly presents its function, as well as its structural behavior (Figure 1, Figure 2). It is possible to notice that the architect had a sincere approach to displaying the function and structure of the building, so it appears like a clear and precise mechanical system that serves sport. The flow of forces is also displayed on the facade, from the roof to the strains and from the strains to the foundation. The chosen material for the facade perfectly places the object in its site, the old core of the municipality of Zemun, and at the same time shows the beauty of the modern buildings of that time. At first glance, simple in its form, this building evinces elegance, especially because it is easy to read. Cubic form is eased with the shape of the concave roof manifested on the

facade as a thin parabola above a large curtain wall, through which is possible to see what is going on inside the building. The slope of the roof follows the slope of the stands which follow the slopes of the main staircases, thus making it easy to see the movement throughout the building. Side annexes complement the building, contributing to its monumentality.

Figure 1. The main facade
(Source: author)

The structure of the object was designed by engineer Edmund Balgač, who worked with engineer Miroslav Conić on the final design (Conić, 1975). The first proposal was to make a wooden roof construction with cables pulled through, but this was put aside. In the final design, wood was replaced with concrete and steel sheets. The structural elements of the object were made from reinforced concrete and poured on site, like in other buildings from that period, but there are a few specific solutions applied in this project.

The first specific solution of this building is its foundations. Because of the high levels of groundwater caused by the proximity of the river Danube, in addition to the load transfer, it was necessary to secure the underground facilities from penetration by groundwater. The contractor used new machines and special hydro insulation to make this possible. A foundation slab with ribs was chosen for the construction because of the great loads it had to transfer.

The structure of the pool is indented from the rest of the object and it is connected through the neoprene bed to the

Figure 2. Detail of the main facade
(Source: author)

foundations. The pool is deeper on the side under the diving board, so this difference in height was used for placing equipment necessary for the pool but which does not need full floor height. On this little segment of the building, it is possible to see the skill of an architect who thinks simultaneously about function and structure.

The solution for anchoring the tie rods is also very interesting. These foundations are at the same time the columns for the side annexes. They are shaped as troughs and are exposed to both stress and strain loads. They oppose the strain loads with their weight, and transfer stress directly to the ground with all their width. Their depth is equal to the foundation depth of the building.

Reinforced concrete frames are the main structure for the roof, the stands and the arena and they were placed every 14.4 m. Roof strains were placed every 7.2 m, which required new structural elements to accept vertical and horizontal loads from the roof and to transfer them to the frames. These elements make up a single horizontal lattice in plane with the slab, and a vertical lattice in plane with the columns. Every roof tie rod is pretensioned with different forces, which can be seen in the main project calculations. Pretensioning different forces into structural elements was solved by calculating the number of cables in each element, so it varies from two cables in the ground floor area to eleven in roof strains which carry the loads of the roof. The bottom lattice belt is also pretensioned (The Main Project).

This type of structure is special because its horizontal forces comprise a closed system. The horizontal forces from the roof are transferred through the horizontal and vertical

lattices, which transfer the vertical forces to the foundation (Figure 3, Figure 4). At the bottom of the annex column, the forces change from strain to stress because they are used as the support for the slabs. In the structural analysis of the building presented with the main project, it is possible to see the relation between the reinforcement and the pretensioned cables in these columns. The pretensioned cables are used to transfer the strain, while the reinforcement was calculated for stress.

The most demanding structural component in this building, and certainly the most aesthetic, is the roof. The design and structural analysis were completed by Edmund Balgač. The structural solution does not include cables in both orthogonal directions, which makes it different from other common solutions. Cable suspended systems are usually used for large span roof structures. They are attractive and can be formed above differently shaped floor plans: circular, elliptical or rectangular. Besides being cost-effective, their advantage is that they produce only the tension forces, while the stress, bending and torsion are minimal or nonexistent. The ideal forms for these structures are catenary and parabola, while keeping in mind the forces in the cable. If the arch rise of the cable is lessened, its length is too, but the forces would be greater. The optimal shape is found when there is a balance between all of these demands to accomplish the cost-effectiveness of structure (Whal, 2007). Compared to classic structures, the advantage of suspended systems is that they can be built quickly with prefabricated elements, thus saving on material and scaffolding, as well as time. The suspended systems are made of steel rods or cables. Because they are thin, they do not have enough self-weight to oppose the external loads, which is why they have to be pretensioned. Other than by snow and seismic loads, they can also be affected by sound or other mechanical vibrations, as well as temperature. They need reinforcement in the opposite orthogonal direction for stability. Because they are usually used for roofs, their geometry is solved as a hyperbolic paraboloid to avoid water retention. These structures can be held by different types of supports: columns, wall, elliptical or circular concrete girders (Dančević, 1978).

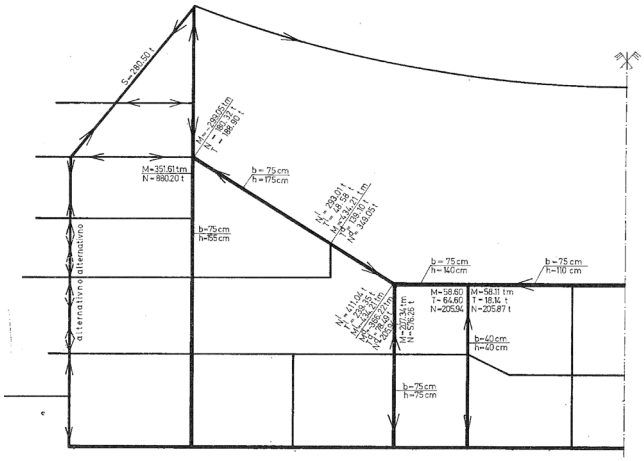


Figure 4. Closed system of forces
(Source: Balgač, 1971)

This suspended roof is specific because it has no cables in the opposite orthogonal direction. The whole structure is carried by the tension cables placed on the longitudinal axes every 80 cm. The span of the roof is 51.2 m, measured in between the side girders. The engineer needed to find a solution to avoid water retention that would fit the aesthetic and structural demands of this concave roof. The solution was to change the arch rise of the parabolically shaped cables from 4.2 m to 4.85 m, thus forming a roof slope towards the longitudinal facades. In this way, the engineer made a double curvature roof structure without the use of cables in the other orthogonal direction. The structural analysis and the calculations of the cable rise are a part of the main project. The special quality of this structural design is its simplicity. Even though the roof has a double curvature, by eliminating the cables in the orthogonal direction, the engineer accomplished having no columns on the main facade, thus contributing to the overall design and aesthetics of the building. (Figure 5)

> "This system without cables in two orthogonal directions has proven its existence, easiness of construction and speed of construction" (Conić, 1975), said engineer Miroslav Conić.

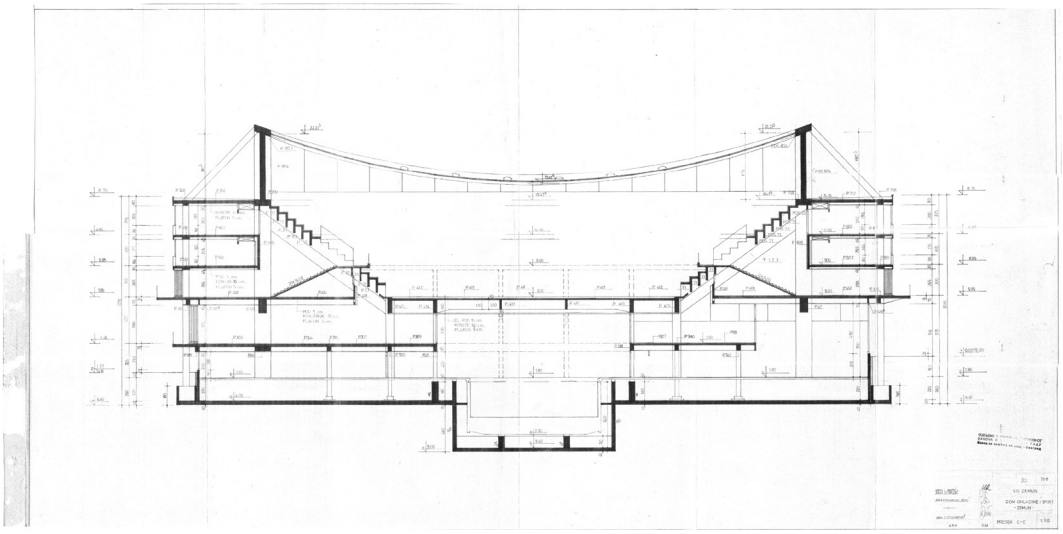


Figure 3. Section
(Source: The Main Project)

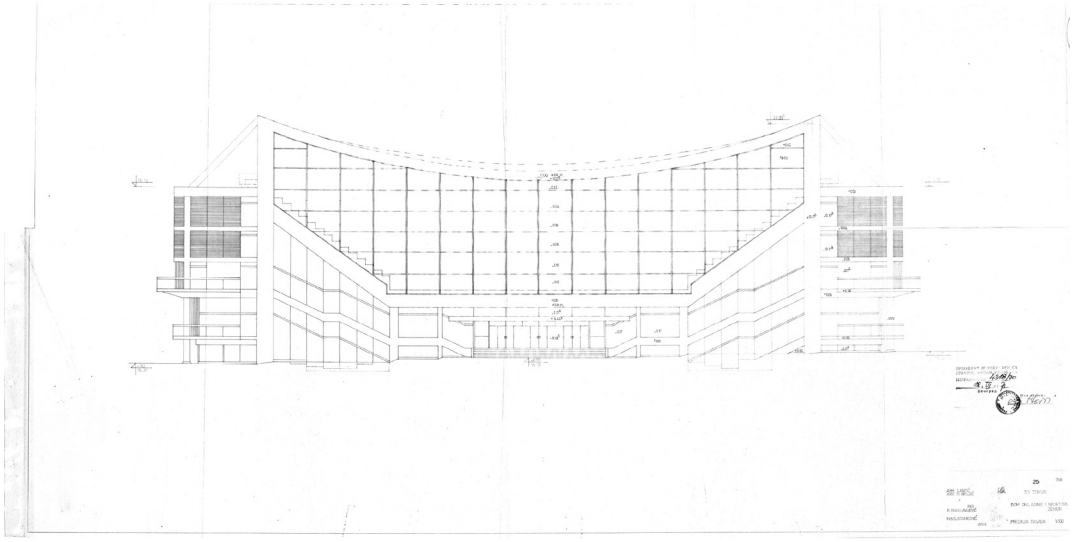


Figure 5. Elevation
(Source: The Main Project)

Suspended roofs in Yugoslavia were rarely built before the roof structure of Pinki was made (Balgač, 1971). The first suspended roof in Yugoslavia was the German pavilion for Zagreb Fair in 1957 (Figure 6.1). The main engineer on the project was Kruno Tonković (Podhorsky, 2005). Balgač worked as an engineer on two sports halls with suspended roofs shaped as a hyperbolic paraboloid, one in Leskovac in 1961 (Figure 6.2), and the other one in Subotica in 1968 (Figure 6.3) before the construction of Pinki. These roofs were inspired by the first one of this kind, the Dorton Arena in North Carolina (Figure 6.4), designed by the architect Matthew Nowicki and the engineer Fred Severud in 1950 (NCSU Libraries). The design proposal for Pinki was put forward in 1971, and it was built in 1974 (Pinki Zemun).

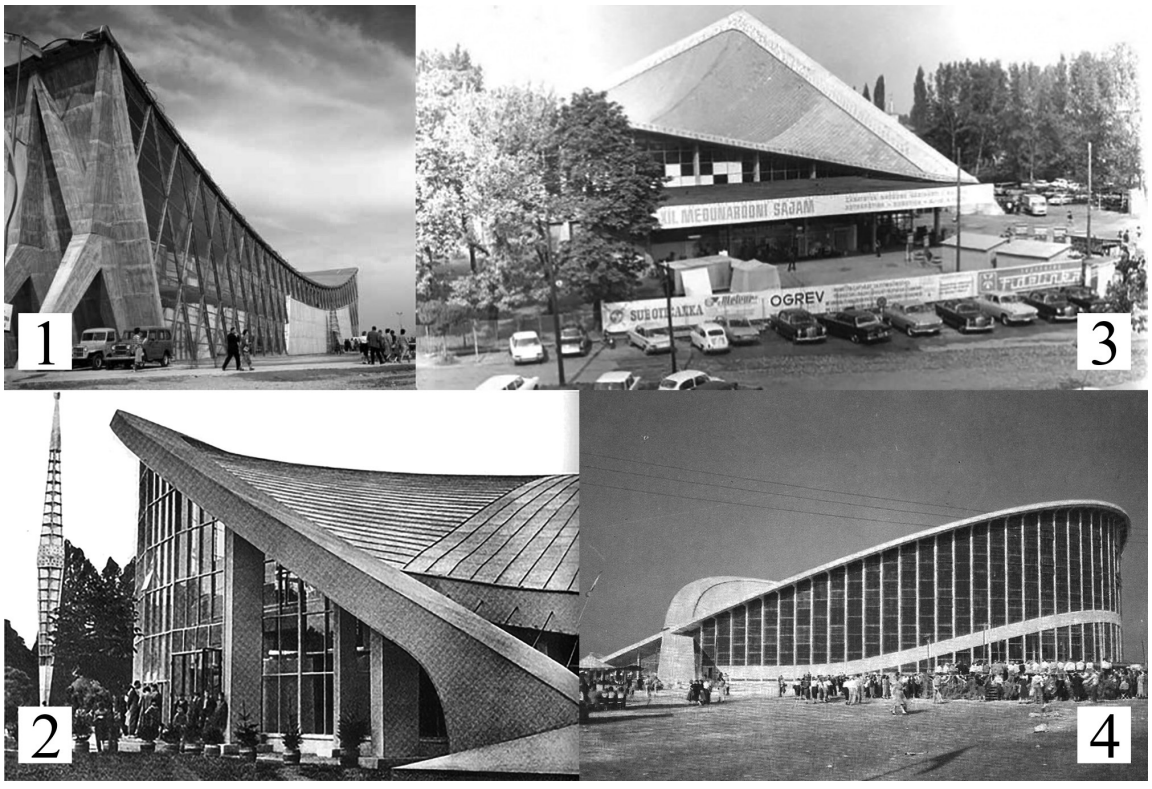


Figure 6. Examples of suspended roofs
Figure 6.1 German pavilion at Zagreb Fair
(Source: http://www.d-a-z.hr/hr/aktualna-tema/100-%25-vitic---zidne-novine-i-izlozba-uz-stogodisnjicu-rodenja,4746.html)
Figure 6.2 Sports hall at Leskovac
(Source: https://mojgradleskovac.wordpress.com/2014/12/19/)
Figure 6.3 Sports hall at Subotica
(Source: http://www.gradsubotica.co.rs/gradi-se-hala-sportova/)
Figure 6.4 Dorton arena
(Source: https://www.flickr.com/photos/north-carolina-state-archives/22112868996)

Balgač emphasized the advantages of building suspended cable roofs. He used to say that they were rare because not many engineers were familiar with the calculations necessary for building them. He gave a thorough explanation of their structural analysis in two articles in Izgradnja magazine for roofs shaped as a hyperbolic paraboloid. By giving examples built throughout the world, he showed how cost-effective suspended roofs were because of their speed of construction on movable scaffolding. Additionally, he pointed out that this type of structure gives freedom to the architect to design different shapes (Balgač, 1969). The first structural design for Pinki was a suspended cable roof with wooden ribs. The advantage of this design, as Balgač said, was the relationship between the volume mass and the stresses allowed in the material that mostly carries only its self-weight. From these calculations he saw that wood was the most adequate material for these types of structures. The advantage of forming wooden space frames, due to their small self-weight, is presented in papers by Nenad Šekularac (Šekularac and Adžić, 2006; Šekularac *et al.*, 2011). These papers also mention that there is almost no need for the use of scaffolding, which makes these structures highly cost-effective. The suspended roof's main structural elements are cables, on their own or inside a prefabricated element, while the elements made of reinforced concrete are usually used as side girders, columns or frames. As an advantage of wooden prefabricated elements, Balgač pointed out that the construction would take up less time if all elements were prefabricated, thereby having almost no need for scaffolding. This would lessen the cost of construction in comparison to sports halls made entirely of reinforced concrete (Balgač, 1975).

Roof structure with wooden ribs

The structural design of the roof for Pinki is a cable suspended system. Its primary structural elements are pretensioned cables which are pulled through the ribs placed on every 80 cm with a span of 51.2 m. Over the ribs is the roof membrane, which carries insulation and the other necessary layers. In the first structural design, with the wooden ribs, the engineer considered using wooden beams with a cross section of 16/22 cm with 6 Ø7 cables pulled through them. The reinforcement in the opposite direction was planned to be made from wooden boards 5 cm thick attached to the wooden ribs. Since the wood would be under all the insulation it was necessary to find the right coatings to protect it. Their wish was to leave the wood as natural as possible, but the right coatings could not be found in Yugoslavia at the time. Wood seemed to the architect to be the ideal solution because it gave a certain character to the interior (Balgač, 1971). The aesthetics of wooden spatial structures are always a good choice for large spaces because of their warmth and color (Šekularac *et al.*, 2012). Wood also has good acoustics, which is another of its advantages, especially for this building, because the sports hall was planned to be beneath the roof. However, the structure's main problem was that there had not been enough research on the behavior of wood in long span structures, which is why they needed to conduct several experiments. The high cost of these experiments and the long waiting time for the results resulted in the decision to change the design to concrete ribs (Figure 7).

Roof structure with concrete ribs

The concept of the structural design remained the same, even though the material was changed for the main project. The suspended roof had ribs every 80 cm, with 6 Ø7 pretensioned cables pulled through them. Over them a roof membrane with insulation was placed. The total load for the roof construction remained almost the same. It was 4 kg/m^2 more than for the design with wood, which is around 3% of the total load. The span also remained unchanged. In this design, which is the one that was built, prefabricated elements were made of concrete with the dimensions 18x16x80cm, and were called "pearls". In their middle there is a pipe which is 1.5 cm longer than the element, through which the cables were pulled and then pretensioned. The reinforcement in the other direction was steel sheets 1.5 mm thick and 3 cm in total height, filled with concrete. Its connection with the ribs was made with concrete anchors. The spaces between the "pearls" were filled with epoxy mortar after the pretensioning to get a monolithic roof that would work as a membrane. The cables were protected by injection of suitable mortar through the pipes. (Figure 8)

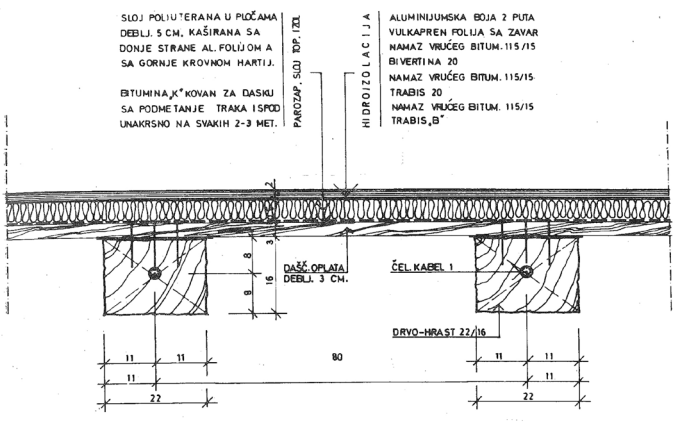


Figure 7. Detail of wooden ribs (Source: Balgač, 1971)

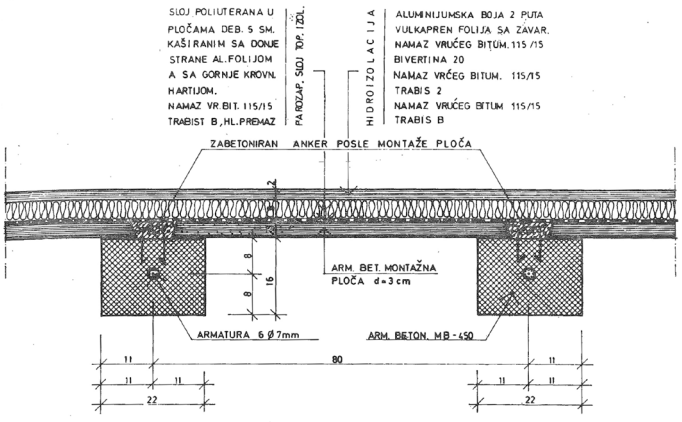


Figure 8. Detail of concrete ribs (Source: Balgač, 1971)

Structural forces in the suspended roof

Independent of the material used for the construction of the suspended roof of Pinki, its structural system remains the same. It must be mentioned that engineer Balgač tried to keep the load in the same frame, whether the roof was made of wood or concrete. The cable is shaped as a catenary under the influence of self-weight (Engel, 2001). Starting from this fact, the forces in the cable can be calculated as an evenly distributed load in the vertical axis of the cable, following the load flow. When the ends of the cable are fixed at the same height, the force inside the cable depends on the total load q, its span l and rise f which it forms (Figure 9). The greatest forces appear inside the cable with the smallest rise (4.2 m), so it had to be calculated first (The Main Project).

Pretensioning the cables inside the concrete ribs was carried out while they were still placed on the movable scaffolding. The cables passed through both side girders and the center of the concrete "pearls", after which a tension force was applied. Forces which appear inside structural elements are called rebound forces and they pulled the "pearls" up, at the same time pressing them against each other, and against the last ones onto the side girders (Balgač, 1971). This is the pretensioning process that was applied to this structural system. The rebound forces were used to unload the ribs and to transfer the forces to the side girders. They had to be greater that the total load for the rib to be constantly in a state of stress.

The value for the snow loads is another one in the line of specific solutions in this project. Contemporary regulations say that the snow loads for Belgrade are 75 kg/m^2, but for this project a value of 180 kg/m^2 was used. The engineer explained that this was done as insurance in case of a lot of water retention. If it rained heavily, or snow melted, the relatively low roof slope would not allow the water to flow immediately, and for this reason he used greater loads for his calculations (Balgač, 1971).

Special characteristics of the Pinki structural system

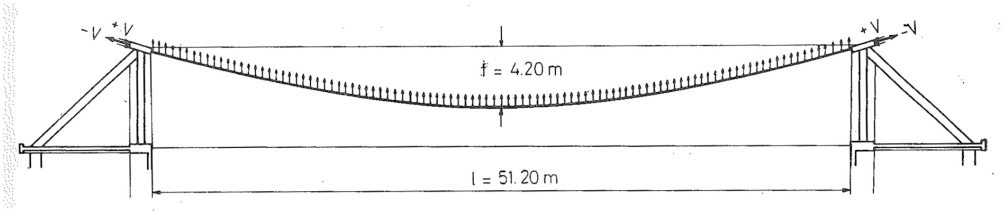
In comparison with the examples of buildings with suspended roof systems built before Pinki, the first difference is their position in the urban tissue. Unlike the Dorton arena or German pavilion which seem like a sculpture in a park or on a plateau, this building in Zemun is larger in size and situated inside an urban area. Because of the project demands and the position of the site, Ivan Antić, together with the engineers, did not have the necessary space to design special forms for structural elements. The main difference between these objects is the flow of forces inside the closed or open system. At Pinki, they strived to make a simple and economic design, so they formed a closed system of forces in which the whole weight of the building was a reaction to the roof forces. If they had made an open system, the roof strains would have had to be anchored straight into the foundations, which required extra space around the building.

By comparing Pinkis suspended roof to previous suspended roofs, it can be seen that Balgač had come up with a more simple and economic solution than the previous complex ones. The most significant difference was the absence of cables in an orthogonal direction that are usually used as reinforcement for the whole system. Instead of the cables, the roof membrane was made out of steel sheets filled with concrete that acted as necessary reinforcement. This solution contributed to the simple construction of the roof, and because of saving time, construction costs were reduced. Looking at the structural system, it can be seen that by eliminating the cables in the opposite direction, the columns on the main facade were not needed (Table 1). This also affected the appearance of the building, leaving the main facade open, which the architect then designed to be a tall glass curtain wall to observe the events inside the sports hall. It has to be emphasized that this is the only example of a sports hall with a suspended roof in which the main hall is situated on the first floor of the building, thus resulting in the need for a higher roof as well. This was one of the challenges in the structural design because it required a special solution for the foundations (Table 1), as shown previously in this paper.

CONCLUSION

The sports hall Pinki, designed by architect Ivan Antić, is one of the most important examples of architecture in the 20th century, and from its detailed analysis it is possible to conclude that for this type of building the relationship between the architect and the engineer is very important. The architect, together with the engineer, came up with a simple and cost-effective solution that responded to all the demands placed in front of them, thus creating a new recognizable symbol of Zemun. The cubic form of the object was refined with the parabolic shape of its roof, creating a game of geometry and transfer of loads visible on the building's facades.

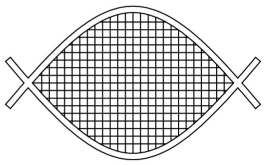
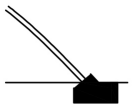
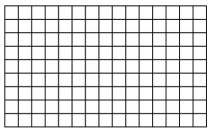
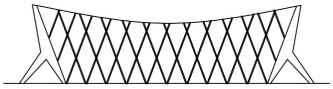
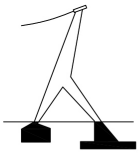
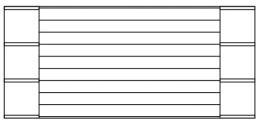
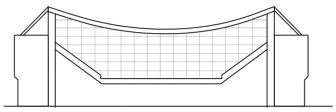
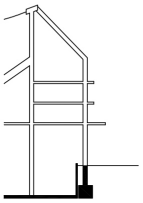
All Antić's sports objects give a sense of easiness accomplished through geometry and slim, simple large span structures. In comparison to the freedom he had while designing Sports Recreational Center 25. maj or the pool at Poljud, where he had a large enough area to design free forms in the space, what makes the project for Pinki special



$$S = q\frac{l^2\sqrt{l+\frac{4f}{l^2}}}{8f}$$

Figure 9. Forces in cables
(Source: Balgač, 1971)

Table 1. Comparative analysis of suspended roofs

	POSITION OF CABLES IN THE SUSPENDED ROOF	MAIN FACADE	FOUNDATIONS
DORTON ARENA, 1950.	cables in orthogonal directions 	strong girders, columns on the facade 	girders are founded directly into foundations (open system of forces) 
GERMAN PAVILION, ZAGREB FAIR, 1957.	cables in orthogonal directions 	visible columns 	combined foundations (ones accept strain, others accept stress) 
PINKI, 1974.	cables in longitudinal direction 	no structural elements on the facade of the sports main hall 	the whole weight of the building accepts the forces from the roof 

(Source: authors)

is the simplicity of the solution in which he had to put all the complex functions under one roof and still create a unique building. This is the exact spot where Andric's skills as an architect are best presented. Through the synthesis of form, function and construction he gave, at first glance very simple solutions, using the logic acquired during his work in practice and with the support of many significant engineers from that period.

> In the words of Ivan Antić: "The duty of us architects is to design a building that won't jut out in the scenery, which will be beautiful, which will, with all of that, have the right measure, the subconscious dose of the inborn norms and the love for the city you were born and raised in" (Milašinović Marić, 2005).

Acknowledgments

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LAND COVER CHANGES OF THE BELGRADE AREA OVER THE PAST THREE CENTURIES

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This paper studies land cover changes of Belgrade over the past three centuries. For this purpose we applied an interdisciplinary approach by integrating historical and landscape ecological perspectives. We have produced four reconstruction maps presenting land cover at the turn of the 18th, 19th, 20th and 21st centuries, based on historical maps and written sources. The conversion of the land cover from historical maps was done based on CORINE Land Cover level 3, while Land Cover level 1 was used for displaying on the reconstruction maps. This allowed us to compare the changes that occurred from the turn of one century to the next. It has been determined that the land cover of Belgrade has transformed from dominantly semi-natural in the 18th century, to agricultural in the 19th century, and artificial in the 20th century. We have determined that the driving forces of the land cover changes were activities that were part of the political agendas of various states that governed Belgrade. The present analysis bridges the gap in the relevant literature on the land cover changes in Belgrade in the long-term, and provides qualitative and quantitative results relevant for research-based management actions, planning processes and restoration ecology.

Key words: **land cover changes, landscape history, driving forces, interdisciplinary approach, Belgrade.**

INTRODUCTION

The landscape is part of the heritage whose patterns were inherited from earlier times, therefore the understanding of the present relies on knowing the past (Marcucci, 2000). Over the past centuries, the anthropogenic impact on the landscape has vastly increased in intensity and range. Observed through the land cover lens, the greatest changes at the global level were caused by the permanent use of land for agriculture and settlements (Ellis *et al*., 2010; Plieninger and Bieling, 2012). The conversion of natural ecosystems to agriculture is considered to be the most significant historical land cover change (Ramankutty and Foley, 1999). Urbanization, which was greatly driven by industrialization, led to the vigorous growth of the artificial land cover (Antrop, 2004; Liu *et al*., 2016). Hence, studying landscape changes invites an interdisciplinary approach, integrating landscape ecology and history, to understand the underlying processes and to address practical problems society is facing (Bürgi and Russell, 2001).

The causes, processes, and consequences of the land cover change in East Europe are attracting growing interest among scholars (Gutman and Radeloff, 2017). However, in the case of Serbia and the Belgrade Area the history of the land cover and drivers of their changes are almost unexplored (Plieninger *et al*., 2016). In this paper we look at the land cover changes in Belgrade, the capital of the Republic of Serbia, over the past three centuries. We have considered the land cover changes caused by a combination of political, cultural and socioeconomic driving forces, particularly focusing on distinct governmental policies. The aim was to quantify the land cover changes in the Belgrade Area and to describe the relationships between different governmental policies and the land cover changes during a period of three centuries, from 1717 to 2017. Using the theoretical and methodological framework of the interdisciplinary approach and multiple-source historical data analysis, we have provided entirely new qualitative and quantitative results on long-term land cover changes in the Belgrade Area.

The purpose of the study that we have conducted lies in the analysis and synthesis of the causes and effects, which leads to the reconstruction of the trends in land cover change, and the answers to the question of why and how the changes occurred and progressed. Also, the purpose of the study was to shed light on the potential perspectives of development

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based on historic reconstruction. The findings and results for the Belgrade Area, presented in this paper, although appearing axiomatic at first glance, are completely new and have so far not been explored, and have therefore not been explicated.

MATERIALS AND METHODS

History and research period of the study area

Belgrade is located in the north-central part of the Republic of Serbia, at the confluence of the Sava River into the Danube (Figure 1). The study territory, the Belgrade Area, is a space within the boundaries of the Belgrade Master Plan, and it covers a surface of 77,600 hectares (776 km^2) with a population of 1,310,000 in 2001 (Macura and Ferenčak, 2003). The Belgrade Area consists of three geographic subregions: Šumadija, Srem and Banat subregions (Marković, 1980). These subregions are separated by the Sava and Danube rivers. According to the ecological classification, the Belgrade Area has the natural resources of three biomes (Figure 1, right). One is a hilly biome, with sub-Mediterranean forests of Hungarian oak and Turkey oak in the Šumadija Subregion (elevation 72 m to 511 m). The second is the biome of Southern European deciduous forests of the lowland and inundated type around the Sava and Danube in all three subregions (Banat, Srem and Šumadija), as well as on the lacustrine terrace in the Srem Subregion (elevation 72 m to 84 m). The third is the steppe and forest-steppe biome on the loess plateau only in the Srem Subregion (elevation 72 m to 93 m) (Matvejev and Puncer, 1989).

We analyzed land cover changes in the Belgrade Area and its subregions between 1717 and 2017. During these three centuries the territory was often in different states (Figure 2). In brief: at the turn of the 18th century and during the 19th century, the Srem and Banat subregions were part of the Habsburg monarchy, while the Šumadija Subregion was part of the Ottoman Empire. For two decades during the 18th century (1717–1739) all three subregions were part of the Habsburg monarchy. Later, the Srem and Banat subregions remained part of the Habsburg monarchy until 1918, while the Šumadija Subregion changed from Ottoman to Serbian rule in 1878. After the end of World War One (WWI), all three subregions were merged into the single territory of the City of Belgrade, which became the capital of the newly-created Kingdom of the Serbs, Croats and Slovenes/Kingdom of Yugoslavia, and as of 1945 socialist Yugoslavia. After the disintegration of Yugoslavia, Belgrade became the capital of Serbia once again. All changes in government and states were accompanied by armed clashes and/or large social changes.

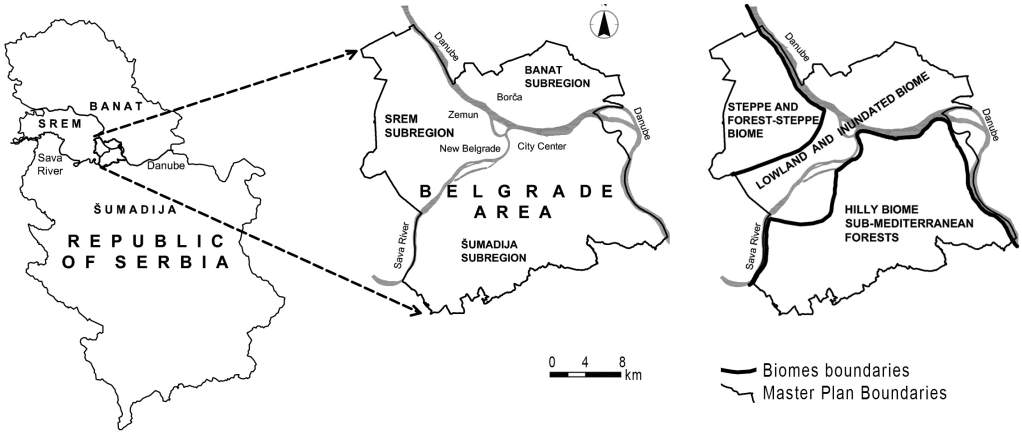

Figure 1. The study territory, the Belgrade Area, a space covered by the Belgrade Master Plan (left). The three geographic subregions of the Belgrade Area, separated by the Sava and Danube rivers (center); the position of three biomes in the Belgrade Area (right).
(Source: authors)

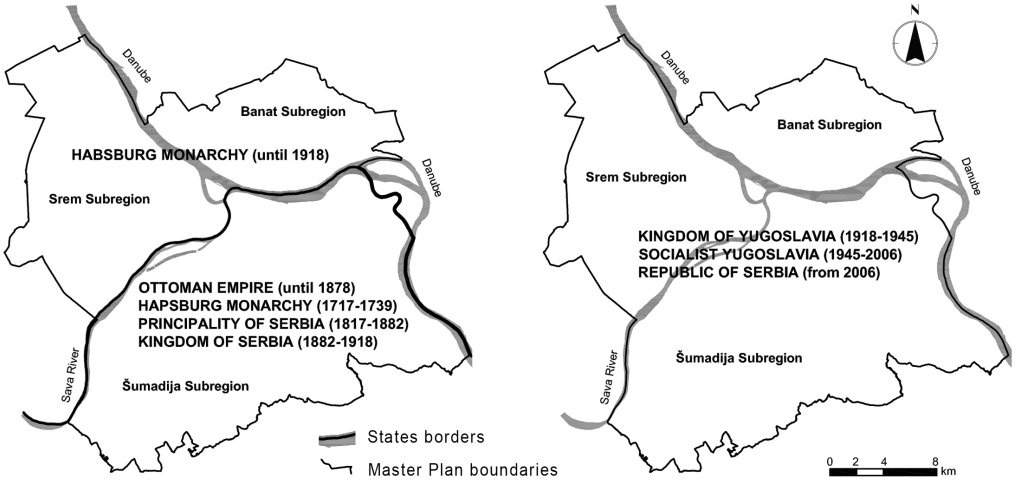

Figure 2. Historic states and geo-political boundaries in the Belgrade Area.
(Source: authors)

Producing reconstruction maps

The method applied to identify processes in the Belgrade Area's land cover changes over the course of three centuries was based on an interdisciplinary approach (Bürgi and Russell, 2001) and multiple-source historical data analysis (Yang *et al*., 2014). Generally, written history speaks about driving forces, and charted history about their effects on land. Using a chronological series of maps it is possible to determine how land cover changed in the past (Haase *et al*., 2007; Skaloš *et al*., 2011), although historical maps need to be aligned, owing to various deficiencies, in order to be compared (San-Antonio-Gómez *et al*., 2014; Fuchs *et al*., 2015). The source maps were acquired from several collections of historical maps, in scales from 1:10,000 to 1:100,000 (Table 1).

The first step in the process of producing reconstruction maps was determining the accuracy of the historical sources (Yang *et al*., 2014), and then establishing unique land cover codes and descriptions. For this purpose we used the CORINE (Coordination of Information on the Environment) hierarchical classification (Bossard *et al*., 2000). CORINE Land Cover (CLC) level 3, was used for defining (description), while CLC level 1 was used for the display on the reconstruction maps (Table 2). This allowed for various data sources to be classified into five land covers, forming a unique and coherent reconstruction map. This also allowed for the comparison of historic maps on various time cross-sections.

ArcGIS 9.0 software, produced by ESRI, was used for map vectorization and data analysis, in the Gauss-Krüger projection. The ArcGIS software package enabled very fast acquisition of spatial data from digitized maps and provides a number of important information that can be explicitly interconnected with different aspects of the functioning of the city area over time. The historical maps were scanned, geo-referenced and superimposed on the vector data of the Existing land use map of Belgrade Master Plan 2003 and the CORINE 2006. The original maps from the 17th, 18th, and even 19th centuries were more or less distorted (Škalamera, 1973), so rubber sheeting had to be used (Haase *et al.*, 2007). The four obtained reconstruction maps provided the data about areas and quantified the surface of areas of each of the five land covers as output. The changes in areas clearly indicate – by decreasing or increasing – what happened to which land cover in the Belgrade Area during each period.

The reconstruction maps were produced for periods around significant historical turning points that initiated social processes that in turn would change the land cover. Consequently, the reconstruction maps are not dated by year, but descriptively. To understand historical land cover changes we used literature from political, social, and other historiography, as well as various written documents. These sources, along with the data from official statistics, were also used for human population dynamics estimates, which are irrevocably linked to understanding changes in land cover.

FINDINGS

Main Land Cover Changes in the Belgrade Area 1717-2017

Drastic land cover changes in the Belgrade Area during the past three centuries are clearly visible from the reconstruction maps (Figure 3) and documented through the land cover structure (Table 3).

Figure 3a and Table 3 show that at the beginning of the 18th century almost the entire Belgrade Area was covered by forest and semi-natural covers. This prevalence existed at the end of the 18th century, but the share of forest and semi-natural coverings had decreased. The agricultural cover increased, as is shown in Figure 3b and Table 3. The true decline of forest and semi-natural covers occurred in the 19th century. By the end of the century these land covers accounted only for about one tenth of the Belgrade Area surface. Parallel to this, the agricultural cover increased, and at the beginning of the 20th century it was seven tenths of the total area (see Figure 3c and Table 3). During the 20th

Table 1. Period covered by the reconstruction maps and main cartographic sources

Period covered by reconstruction map	Year and main subject of the selected historical maps used to produce the reconstruction maps
Turn of 18th century	1688 Map of the Siege of Belgrade (Joan Baptista Gumpp), 1: 17,600, NLS, Kr II-600 1717 Map of the Route and the Siege of Belgrade, 1: 14,400, NLS, Kr II-437 1721 Map of Belgrade and its Surroundings (Hauptmann Amman), 1:12,200, OStA, KA, Gib 25 1763-1787 First Military Survey B IX a 577 [Temeschwarer Banat 1769–1772], map sheets: 137, 138, 150 and 151, 1:28,800; http://mapire.eu/en/
Turn of 19th century	1788 Map of Belgrade and Wider Surroundings of Šumadija and Srem, 1: 28,000; OStA, KA HIIIe 3044 1788 Map of Belgrade and the Immediate Environment, 1:28,800; OStA, KA, BIIIa 239 1789 Map of the Siege of Belgrade, 1:10,000; NLS, Kr I-52 1806-1869 Second Military Survey B IX a 530 [Ungarn], map sheets: 73XXXVIII, 73XXXIX, 74XXXVIII and 74XXXIX, 1:28,000; http://mapire.eu/en/
Turn of 20th century	1869-1887 Third Military Survey, 1: 75,000; http://mapire.eu/en/ 1893 Serbian Military Map of Belgrade, 1: 75,000; NLS, Kr II-1-20, Kr II-1-27, Kr II-1-28 1895-1897 Map of Belgrade and the Northern Part of Šumadija, 1: 25,000; OStA, KA, Gib 57-3 1913-1916 Map of Zemun, Belgrade and Pančevo, NLS, Kr II-15-26XXI
Turn of 21st century	2003 Existing Land Use (Belgrade Master Plan, 2003), 1: 20,000; Urban Planning Institute of Belgrade 2003 Type of Green Areas (Belgrade Master Plan, 2003), 1: 20,000; Urban Planning Institute of Belgrade 2006 CORINE Land Cover Serbia, 1:100,000; Belgrad, EvroGeomatika 2016 Existing Land Use (Belgrade Master Plan, 2016), 1: 20,000; Urban Planning Institute of Belgrade

(Source: prepared by authors; source information: National Library of Serbia (NLS), Austrian State Archives (OStA, KA), http://mapire.eu/en/, Urban Planning Institute of Belgrade)

Table 2. CORINE Land Cover codes and description, level 1 and level 3, relevant to the Belgrade Area, for 18th, 19th, 20th and 21st centuries

CLC Level 3			CLC Level 1
18th century	19th century	20th and 21st century	
1.1.1 Continuous urban fabric	1.1.1 Continuous urban fabric	1.1.1 Continuous urban fabric	1. Artificial areas
1.1.2 Discontinuous urban fabric	1.1.2 Discontinuous urban fabric	1.1.2 Discontinuous urban fabric	
	1.2.1 Industry and commerce	1.2.1 Industry and commerce	
1.2.2 Main road network	1.2.2 Road and railway network.	1.2.2 Road and railway network	
1.2.3 Port areas	1.2.3 Port areas	1.2.3 Port areas	
		1.2.4 Airports	
1.3.1 Mineral extraction sites	1.3.1 Mineral extraction sites	1.3.1 Mineral extraction sites	
	1.3.2 Levee	1.3.2 Levee	
		1.3.3 Construction area	
1.4.1 Green urban areas	1.4.1 Green urban areas	1.4.1 Green urban areas	
		1.4.2 Sport and leisure facilities	
2.1.1 Non-irrigated arable land	2.1.1 Non-irrigated arable land	2.1.1 Non-irrigated arable land	2. Agricultural areas
		2.1.2 Permanent irrigated land	
2.2.1 Vineyards	2.2.1 Vineyards	2.2.1 Vineyards	
2.2.2 Orchards	2.2.2 Orchards	2.2.2 Orchards	
2.3.1 Pastures	2.3.1 Pastures	2.3.1 Pastures	
2.4.2 Complex cultiv. patterns	2.4.2 Complex cult. patterns	2.4.2 Complex cultiv. patterns	
2.4.3 Agriculture, with significant areas of natural vegetation	2.4.3 Agriculture, with significant areas of natural vegetation	2.4.3 Agriculture, with significant areas of natural vegetation	
3.1.1 Broad leaved forest	3.1.1 Broad leaved forest	3.1.1 Broad leaved forest	3. Forest and semi-natural areas
		3.1.3 Mixed forest	
		3.1.2 Coniferous forest	
3.2.1 Natural grassland	3.2.1 Natural grassland		
3.2.4 Transit. woodland scrub	3.2.4 Transit. woodland scrub	3.2.4 Transit. woodland scrub	
4.1.1 Inland marshes	4.1.1 Inland marshes	4.1.1 Inland marshes	4. Wetlands
5.1.1 Water courses	5.1.1 Water courses	5.1.1 Water courses	5. Water bodies
5.1.2 Water bodies	5.1.2 Water bodies	5.1.2 Water bodies	

(Source: authors after Bossard et al., 2000)

Table 3. Land covers structure (CLC level 1) of the Belgrade Area through the centuries

CLC level 1	Turn of 18th century		Turn of 19th century		Turn of 20th century		Turn of 21st century	
	ha	%	ha	%	ha	%	ha	%
1. Artificial areas	936	1.2	1279	1.7	3450	4.5	23550	**30.4**
2. Agricultural areas	8193	10.6	29624	**38.2**	54747	**70.4**	38725	**49.9**
3. Forest and semi-natural areas	58521	**75.3**	36082	**46.3**	9082	11.7	10327	13.3
4. Wetlands	5496	7.1	5702	7.4	5638	7.3	983	1.3
5. Water bodies	4454	5.8	4913	6.4	4682	6.1	4015	5.2
Total study area	77600	100.0	77600	100.0	77600	100.0	77600	100.0

(Source: authors)

century, agricultural areas gradually decreased, and at the beginning of the 21st century this land cover accounted for only a half of the Belgrade Area surface. On the other side, the artificial land cover increased extensively. The wetland cover was small at the beginning of the 18th century, and by the early 21st century it had almost disappeared. The described changes had their own dynamics in different subregions over the course of the three centuries. The following sections will describe changes in the subregions examining them from one century to the next.

Semi-natural Eighteenth Century

The 18th century was a period of the Ottoman Empire's dwindling power (Quataert, 2005). However, during that period both powers, the Ottoman and the Habsburg empires, were preoccupied with military and diplomatic activities, so the region around the Sava and Danube rivers, the area of contact and borders, was primitive and neglected with insignificant land cover changes.

The Šumadija Subregion was part of the Habsburg Monarchy for two decades in the 18th century, while the rest of the time it belonged to the Ottoman Empire. Wars between the empires were the main factor driving the population movements. They forced the rural population to abandon their villages, and this population was reduced from 3,500 to 1,750 by the end of the century (Nikolić, 1903). Nevertheless, during this entire century the land cover remained practically unchanged. Forest and semi-natural covers, which accounted for 75.6% of the subregion's area, had decreased by an insignificant 0.7% by the end of the century (Table 4).

The Srem Subregion was part of the Habsburg Military Frontier toward the Ottoman Empire (Ilić, 2014). The crucial driving force in the mid-18th century was the passing of a number of decrees that confirmed the frontiersman obligations of the rural Serbian population to defend the Habsburg Monarchy, and in return their peacetime benefits

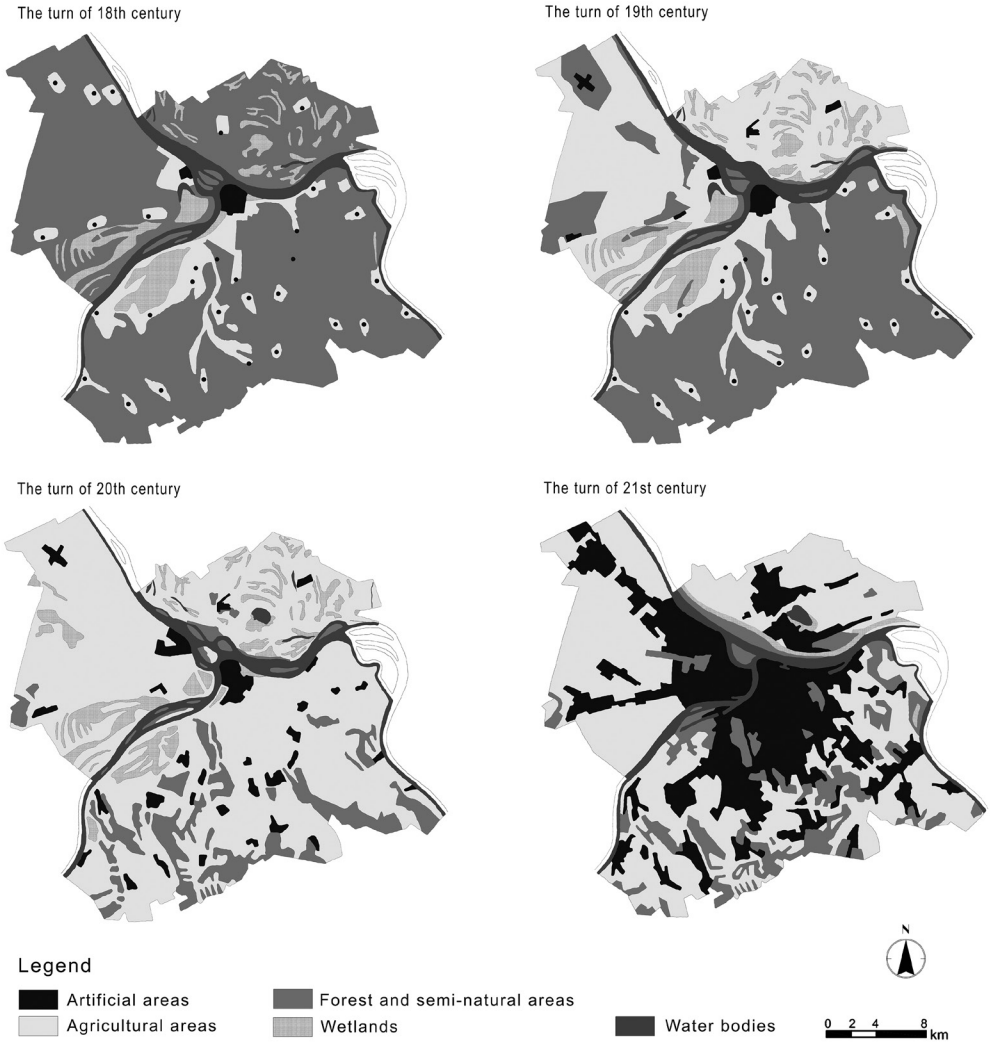

Figure 3. Reconstruction maps of land cover of the Belgrade Area, at the turn of (a) 18th, (b) 19th, (c) 20th and (d) 21st centuries. (Source: drawings by authors)

Table 4. CLC level 1 surfaces (ha) and changes (%) in subregions Šumadija, Srem and Banat in the 18th century

CLC level 1	Šumadija Subregion			Srem Subregion			Banat Subregion		
	Land cover in ha		The change in %	Land cover in ha		The change in %	Land cover in ha		The change in %
	Turn of 18th century	Turn of 19th century		Turn of 18th century	Turn of 19th century		Turn of 18th century	Turn of 19th century	
1. Artificial areas	753	753	0.0	160	353	120.6	23	173	652.2
2. Agricultural areas	6369	6771	6.3	1559	13807	758.6	256	9046	3433.6
3. Forest and semi-natural areas	31132	30908	- 0.7	17384	4855	-72.1	10005	319	-96.8
4. Wetlands	1764	1665	- 5.6	1879	1883	0.2	1853	2154	16.2
5. Water bodies	1424	1574	10.5	1520	1677	10.3	1510	1622	7.4

(Source: authors)

were increased. The rural population increased from 490 to 2,790, while in Zemun, the main town in the subregion, it increased from 1,520 to 3,190. This was accompanied by a 758.6% increase in the agricultural land cover (from 1,559 ha to 13,807 ha), and by a 72.1% decrease in semi-natural covers (from 17,384 ha to 4,855 ha).

The Banat Subregion was also part of the Habsburg Military Frontier (Ilić, 2014). Unlike Srem, it was a wilderness prone to flooding by the Danube. The population of two old villages Borča and Ovča increased from 350 at the beginning of the 18th century to 600 by the end of the century (Đurić, 1953). The bottoms of shallow marches would turn into meadows in the summer, and they were used to graze local livestock and livestock from other parts of Banat. This naturally produced agricultural land accounted for 67.7% of the area of the subregion (9,046 ha), which was an increase of 3,433.6%.

Agricultural Nineteenth Century

During the 19th century the Habsburg authorities gradually brought order to the Srem and Banat subregions steering them towards the European model in the socioeconomic and cultural respect. Unlike this approach, the Ottoman administration in the Šumadija Subregion did not have a modernization capacity, and as the empire declined, the Principality of Serbia gradually gained autonomy (Table 5).

After 1815, gaining the status of a vassal principality within the Ottoman Empire (Ćirković, 2004) was the crucial driving force of the land cover change in the Šumadija Subregion during the 19th century. The principality of Serbia promoted the settlement of newcomers, and the rural population increased 28-fold, from 1,750 at the beginning of the 19th century, to 48,500 at the end (Jagodić, 2004). The population of Belgrade increased from 34,000 to 69,480 (Nikolić, 1903). The response to these processes was deforestation and the creation of arable land and meadows (Jovanović, 1954). At the end of the 19th century the agricultural cover accounted for 69.1% of the subregion. Formerly dominant forest and semi-natural land covers dropped to 19.2%.

In 1867, after the Turkish population and Ottoman military left Belgrade and Serbia, the Habsburg Monarchy abolished the Military Frontier and set up a civil administration in the Srem Subregion. This was the main driver which opened up the process of agricultural modernization. With the establishment of the civil administration, peasant family cooperatives became landowners (Gaćeša, 2007). The rural population grew from 2,790 to 4,300 by the end of the 19th century, and the population of Zemun increased from 3,190 to 15,840. Agricultural land accounted for 77.3% of the area at the end of the century. The authorities raised its productivity through land commassation and road regulation.

The Banat Subregion, also ruled by the Habsburg Monarchy, experienced a peaceful 19th century. The small population, which was 2,590 at the end of the 19th century, was mainly involved in raising livestock (Đurić, 1953). The peaceful situation led to the stabilization of the pasture-based economy of driving livestock from remote areas of Banat. By the end of the 19th century the agricultural land cover accounted for 73.6% of its area.

Artificial Twentieth and Early Twenty First Centuries

The 20th century was full of rough and powerful turning points in the Belgrade Area (Arandelovic *et al*., 2017). After WWI all three subregions – Šumadija, Srem and Banat – merged into the unified Belgrade, which became the capital of the Kingdom Yugoslavia. After WWII, the socialist Yugoslavia modernized the country within a few decades. After the breakup of Yugoslavia, Serbia became an independent state again in 2006.

Following the merger, the Šumadija Subregion was the only one that was intensively inhabited during the period between the two world wars, experiencing intensive immigration mainly by the poor population. Illegal construction flourished in what had previously been agricultural outskirts (Vuksanović-Macura and Macura, 2018). The creation of the socialist Yugoslavia in 1945 launched the industrialization of the country. Planned collective housing estates sprouted in the surrounding agricultural areas, followed by a new wave of illegal construction in the 1970s. In the 20th century population of the Šumadija Subregion increased from

Table 5. CLC level 1 surfaces (ha) and changes (%) in subregions Šumadija, Srem and Banat in the 19th century

CLC level 1	Šumadija Subregion			Srem Subregion			Banat Subregion		
	Land cover in ha		The change in %	Land cover in ha		The change in %	Land cover in ha		The change in %
	Turn of 19th century	Turn of 20th century		Turn of 19th century	Turn of 20th century		Turn of 19th century	Turn of 20th century	
1. Artificial areas	753	2477	228.0	353	800	126.6	173	173	0.0
2. Agricultural areas	6771	28726	324.3	13807	17066	23.6	9046	10159	12.3
3. Forest and semi-natural areas	30908	8410	-72.8	4855	464	-90.44	319	613	92.2
4. Wetlands	1665	1198	28.0	1883	2432	29.2	2154	973	-54.8
5. Water bodies	1574	1458	-7.3	1677	1458	13.1	1622	1709	5.4

(Source: authors)

Table 6. CLC level 1 surfaces (ha) and changes (%) in subregions Šumadija, Srem and Banat in the 20th and early 21st centuries

CLC level 1	Šumadija Subregion			Srem Subregion			Banat Subregion		
	Land cover in ha		The change in %	Land cover in ha		The change in %	Land cover in ha		The change in %
	Turn of 20th century	Turn of 21th century		Turn of 20th century	Turn of 21th century		Turn of 20th century	Turn of 21th century	
1. Artificial areas	2477	14358	479.7	800	6796	749.5	173	2366	1267.6
2. Agricultural areas	28726	17862	-37.8	17066	13109	-23.2	10159	7754	-23.7
3. Forest and semi-natural areas	7987	8410	5.3	464	781	68.3	613	1129	84.2
4. Wetlands	1198	70	-94.2	2432	0	-100.0	973	912	-6.3
5. Water bodies	1458	1324	-9.2	1458	1237	-15.2	1709	1435	-16.0

(Source: authors)

68,480 to 930,000. The artificial land cover increased from 6.0% to 34.6% of the subregion area, which was an increase of 479.7% (from 2,477 ha to 14,358 ha) (Table 6).

The Srem Subregion, especially its part along the left bank of the Sava River, was considered for the expansion of Belgrade after WWI, but the beginning of WWII thwarted this initiative. The socialist Yugoslavia decided to resume the realization of this idea, which was a crucial turning point in the process of developing New Belgrade (Blagojević, 2007). In parallel with the development of New Belgrade, Zemun expanded on the loess plateau. The population of the Srem Subregion increased from 20,130 to 424,600 by the end of the 20th century. With the destruction of the agricultural land and wetlands, the artificial land cover increased from 3.7% to 31.0%, which was a change of 749.5% (800 ha to 6,796 ha).

After WWI, and particularly after 1945, the Banat Subregion became interesting for the complete transformation of the remaining wetlands into arable land. This idea was realized with the construction of levees, a system of drainage canals and pumps (Đurić, 1953). After 1945, an agro-industrial complex was created in this area, with a dozen new villages. Some plots of land remained the property of farmers, who would later sell them for illegal construction. Planned settlement was carried out up until the mid-1980s, and subsequently illegal settlement as well. The population increased from 2,590 to 82,200 by the end of the 20th century. The artificial fabric increased from 1.3% to 17.4% of the total area of the subregion, which was an increase of 1,267.6% (from 173 ha to 2,366 ha).

DISCUSSION AND CONCLUDING REMARKS

The turbulent history of the wider area surrounding the confluence of the Sava and Danube rivers includes three no less tumultuous "small" histories of the subregions, which would merge into Belgrade after WWI and develop into the city that we know today. Up to 1919 the three subregions of the Belgrade Area – Šumadija, Srem and Banat subregions – had their separate courses of development. The Srem Subregion was one of Central Europe's gates to the Orient. It was always slightly privileged within the southeast of the Habsburg Monarchy thanks to its frontier position and a large quarantine which, in addition to a sanitary role, also played an economic role in the 18th and first half of the 19th century. The Banat Subregion, even though part of the Habsburg Monarchy, was an inactive area during the 18th and 19th centuries, which should be attributed to its unattractive geographic position, lack of links to relevant roads, and nearly wild inundated wetlands along the Danube. On the right banks of the Sava and Danube rivers was the Šumadija Subregion, with its special history. Its diversity during the late 18th and significant portion of the 19th century was marked by the liberation from the Ottoman Empire.

The differences in these histories of subregions resulted from the differences in long-term policies, strategies and actions of the authorities that controlled them. In the 18th century the Habsburg Monarchy established the Military Frontier, which entailed colonizing the area around the border with the Ottoman Empire (Ilić, 2014). The preventive defense policy of the Principality of Serbia in the 19th century did not differ significantly from the Habsburg policy, since the Principality of Serbia considered colonization as the basic premise for defense from Ottoman harassment of the population and overt attacks. In the early 20th century, the new Kingdom of Yugoslavia envisaged the expansion of Belgrade urban structures in the direction of the liberated Srem and the transformation of the Banat marshy meadows into arable land, along with the construction of bridges across the Sava and Danube rivers as spatial and symbolic factors in strengthening its sovereignty over the acquired subregions (Vuksanović-Macura, 2015).

Different governments had their characteristic practices for shaping and changing the land cover, as well as quite specific approaches to its regulation and maintenance. For centuries the Ottoman Empire had had an efficient administrative apparatus that collected taxes in the Balkans, but after the 18th century the Empire was weakened and did not have the strength to maintain the landscape as a factor of economic vitality. Therefore, there were no significant changes in the land cover, and the Šumadia Subregion remained under forest and semi-natural covers up to the first half of 19th century. Unlike the Ottoman treatment, the Habsburg government strived to make the traditional agricultural regime more efficient in the Srem Subregion (Radulović, 2016). Having carried out commassation and the regulation of roads, in the 19th century the authorities transformed small agricultural plots into large swathes of land suitable for the intensification of production, without changing arable land as the prevailing land cover. Contrary to the changes in the field size, type of crops, and land cover types, which were undertaken in the entire Pannonian Plain, the Habsburg Monarchy did not carry out this scope of works in the Banat Subregion of the Belgrade Area. Therefore, in the late 18th and early 19th century there was a gradual shift from semi-natural land to low-quality pastures, while the wetland area remained unchanged. In the ecological sense, this caused difficulties in natural forest restoration and kept marshiness. In the 19th century, the Principality of Serbia systematically carried out a colonization policy, while the clearing of forest for creating new villages, towns, and agricultural land was both a cultural and an economic process (Macura and Puača, 1995; Ćorović, 2015). Even after gaining autonomy in the late 19th century, there was a strong tradition of deforestation for the purpose of gaining new arable land and urban cover. The consequences were floods and soil erosion on steep terrain.

In the 20th century, after WWI and the unification of the three subregions into the Belgrade Area, the Kingdom of Yugoslavia, and subsequently socialist Yugoslavia, were interested in expanding the urban fabric as a means of accommodating new inhabitants in the process of gradual and later intensive urbanization. In the Kingdom of Yugoslavia, the expansion of Belgrade was basically left to poor newcomers who built modest houses on the edges of the city, while land speculators provided them with plots created on what had previously been agricultural land. This process, which was a response to population pressure, was tolerated by the authorities, even though was illegal (Vuksanović-Macura and Macura, 2018). During the

Socialist Yugoslavia, Belgrade urban land further expanded at the expense of agricultural land, through the large-scale development of large residential blocks (Hirt, 2009). On the other hand, migration to Belgrade continued spontaneously, affecting the land cover, but neither the state nor the city authorities were able to channel it socially, economically or spatially. Therefore, the process of urbanization and inadequate policy were a combination of underlying drivers causing excessive urban sprawl and drastic changes from agricultural to artificial land cover in the Belgrade Area during the 20th century (Zeković *et al*., 2015). In absolute values, there was a similar increase in the artificial land cover in the Šumadija and Srem subregions, while this process was most pronounced in the Banat Subregion, and two times higher than in the other two. Such a trend of accelerated change of agricultural into artificial land has continued in the first decades of the 21st century, in post-socialist Serbia (Krunić *et al*., 2014).

The decisions that initiated the processes of land cover changes were always passed by the top governing authority. Deforestation in the Šumadija Subregion in the early 19th century was initiated and personally managed by the Prince of Serbia. The decisions related to commassation in the Srem Subregion in the 19th century came from Vienna. The decision to expand Belgrade to the territory of the Srem Subregion after WWI came from the Ministerial Council of the Kingdom. The decision to build New Belgrade, to be a symbol of socialism, came from the Communist Party top leadership and the state president. The decision to continue reclaiming the wetlands in Banat after WWII also came from the top of the new socialist government.

Each of the policies carried out during the 18th, 19th, 20th and 21st centuries was the driving force of the drastic changes in the land cover. We have found that during the 18th century *wartime operations* in the Belgrade Area led to the renaturalization of the land cover by shifting the population; in the 19th century *immigration* and the *colonization* of the Belgrade Area led to deforestation, reclaiming of wetlands and commassation of land, which expanded the agricultural land cover; finally, the *urbanization* of the Belgrade Area in the 20th century, supported by the creation of the first and second Yugoslavia, resulted in the expansion of the prevailing artificial land cover. A consequence of different processes in the subregions that comprise Belgrade today – geopolitical position, natural environment, the ruling policy, and governing authority – is a historical constant that has brought the system, structure, form, and function of the Belgrade Area land cover to its present state.

In the past three centuries the artificial land cover growth has proven to be very stable. Regarding the prospect for the next several decades, one should expect this to continue. In the course of our research we have not noted any trends that would cast doubt onto that. A very small increase in forest and semi-natural covers may also continue. However, further growth of artificial cover, as well as forest and semi-natural covers, will continue at the expense of the agricultural land cover. Considering the fact that the territory of the Master Plan is fixed, it will be necessary to formulate such a developmental policy within its area that will control and direct the growth of developed structures, while at the same time encouraging the development of forest and semi-natural covers, as well as protecting and safeguarding the agricultural cover. Pursuant to such a scenario, it will be necessary to develop new strategies and approaches to planning. In this sense, the Banat Subregion requires special attention from all actors, because it is unquestionable that a new "Danube City" is being created there, but it is insufficiently structured and without clear urbanity.

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ABOUT THE "ATTRACTIVE DANUBE" PROJECT

The Republic of Serbia is included in the project "Improving Capacities for Enhancing Territorial Attractiveness of the Danube Region": ATTRACTIVE DANUBE (DTP1-270-4) through the Institute of Architecture and Urban & Spatial Planning of Serbia (IAUS). The project, within the INTERREG Danube Transnational Programme, was co-financed by European Union funds (ERDF, IPA). For more details, see http://www.interreg-danube.eu/attractive-danube.

This project, set to last from January 2017 to June 2019, strengthens institutional capacities for strategic planning and better territorial development management. All 11 countries in the Danube region are enhancing their attractiveness, and that of the region, with regard to the population's quality of life and business and tourism development, through trans-border cooperation and improvement of management capacities at all levels.

During the project, every participating country strives to establish a set of relevant national indicators for monitoring territorial attractiveness trends, through a public participatory process – a set of workshops with representatives of institutions at all governance levels (from local to national, universities, institutes, corporates, tourism and non-governmental organisations, etc.).

Given that every area has its unique potential for development that should be used to position it in relation to the competitive environment of other regions, the system of territorial attractiveness indicators is a tool for making decisions based on facts, which will improve the attractiveness of the Danube Region as a whole, and of its individual member countries.

The participatory process of selection of relevant national territorial attractiveness indicators resulted in the creation of the online GIS platform called TAMP – Territorial Attractiveness Monitoring Platform, at two spatial levels:

- National TAMP (N-TAMP), which covers every country participating in the project (the Serbian page is http://tamp.gis.si/serbia/), and
- Common TAMP (CO-TAMP), which covers all Danube Region countries participating in the project (11 countries, http://cotamp.gis.si/attractive_danube/).

These platforms allow interested users to access territorial attractiveness indicators with the aim of supporting the decision-making process in strategic planning and territorial development management at all levels of governance in the Danube Region countries. Both platforms will be updated at least until the end of 2022.

During the final year of the project's implementation, a handbook for using TAMP platforms will be prepared, with recommendations for their application in the decision-making process. This will allow for continuous monitoring of the dynamic territorial development of the Danube Region and improve its attractiveness.

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