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ADDRESS
Institute of Architecture and Urban & Spatial Planning of Serbia, IAUS
Spatium
Serbia, 11000 Belgrade, Bulevar kralja Aleksandra 73/II
tel: (381 11) 3207-300, fax: (381 11) 3370-203
e-mail: journal.spatium@gmail.com, web address: www.iaus.ac.rs

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EDITORIAL

Dear readers,

This issue of *Spatium* contains contributions mostly resulting from current research, on various topics, viz.: living spaces with two centres; masonry restoration; assessment in the field of agro-waste management planning; usage of some models in architectural design and education; the role of PPP in municipal waste management; and the problem of understanding reality in architectural design. It also reflects activities of the IAUS as presented in the journal *Savremene urbanističke teme* in the period 1961-1981. The latter is also illustrated on the cover page, where photocopies of three early issues of the journal *Savremene urbanističke teme* are presented. The majority of authors are from Serbia, and other contributors are from Russia and Bosnia and Herzegovina, respectively.

This is the last issue of *Spatium* edited by the current Editor, either in the capacity of a Guest Editor at the beginning of my engagement almost 15 years ago, or subsequently as Editor-in-Chief. I am here expressing many thanks to authors and reviewers, as well as to other colleagues (including those serving at the Editorial Board and Publishing Council of *Spatium*), who all contributed to establish its high academic level and relevance, and to maintain it over this many years.

Miodrag Vujošević
Editor-in-Chief

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SPATIAL ORGANIZATION CONCEPTS FOR LIVING SPACES WITH TWO CENTRES

Đorđe Alfirević[1], Studio Alfirević, Belgrade, Serbia
Sanja Simonović Alfirević, Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia

In a functional sense, the centre of the living space is a gathering area for its users and for visitors. In most cases, the living area has at least one space towards which its users gravitate daily or occasionally. In situations where there are two or more centres in the living area, their position, size and connection determine the character of the functional organization, and they result from the social needs of the users. This paper analyzes characteristic examples of how dwellings are organized with several gathering centres, drawing out three basic concepts: a) living space with centres grouped in a social zone, b) living space with a flexible centre on the boundary between zones and c) living space with a secondary centre in a private area. On the other hand, attention is drawn to the existence of different boundaries of territoriality (boundaries of ownership, hospitality and intimacy), which determine the domains of social, private and intimate zones in housing. Depending on whether the gathering centres are located on one side, on the other, or along the border of territoriality, the degree of intimacy of the living space also changes.

***Key words*: achitecture, housing, living space, territoriality, centre.**

INTRODUCTION

When considering the spatial organization of an apartment or house, the term "centre" usually refers to the central position of a room or element which occupies a notable place in the structure of the whole unit. In a functional sense and in the context of this research, the term "centre" stands for the space where its users gather, in order to satisfy different social needs (socializing, talking, etc.). In modern living space, the role of the centre can be taken by the living room, family room, media room, salon (room for receiving guests), dining room, etc. Emphasizing the gathering centre in the living space, can, but does not necessarily have to, be the main constitutive motif of spatial and functional concept of the living space, which primarily depends on the attitude of the architect and the users' needs (Alfirević, Simonović Alfirević, 2018a).

Depending on the spatial structure and geometry, the users' needs, etc., there can be at least one more gathering centre, a secondary one, with the main role of dividing parallel activities for different users within the same space. The need to form a secondary centre in the living space is common in multi-member households, where the users' needs are different, most often due to generational differences (parents/children, older/younger users). The existence of just one centre can lead to conflicts, as is the case when the social activities of younger family members coincide with those of older members, such as when they are entertaining guests (Montgomery, 1972:41).

By referring back to research in the field of housing space, it can be concluded that a certain number of studies relate to the historiographic analysis of the importance and role of the salon, as the secondary centre in the spatial organization in different time and spatial contexts (Kale, 2005; Seda Dazkır, 2013; Nasır, Öğüt, Gürel, 2015; Alfirević, Simonović Alfirević, 2017; etc.). The second group is made of papers dedicated to dimensional, functional or perceptive analysis of the gathering space (Gür, 2013; Cromley, 2004; Čanak, 1976; etc.). Significant research on this topic was carried out by Yugoslav architect Mate Bajlon, who emphasized the importance and the role of forming the secondary centre through the so-called *Extended Circulation Area* (Bajlon, 1972, 1975, 1979).

The aim of this paper is to explore and systematize the characteristic concepts of living spaces with at least two gathering centres and to re-examine the viewpoint which claims that there are three basic concepts in relation to the distribution of centres, in which the level of intimacy when using the living space depends on the territorial border between the social and private zones.

[1] Pariske Komune 8/22, 11070 New Belgrade, Serbia
djordje.alfirevic@gmail.com

TERRITORIAL BORDERS IN LIVING SPACES

The concept of organizing living space with two centres has not been scientifically researched too widely. Generally speaking, each living space can be divided into at least two zones - day and night zones, which is a consequence of grouping housing functions according to the biological rhythm of their users (Marušić, 1999:7). They can also be divided into three functional units, with the division made into intimate rooms, common rooms and the household (Bajlon, 1979:40). Rooms can also be differentiated according to the level of intimacy of the space: private (intimate and common) space and the social zone of the apartment2, i.e. space for receiving guests (Knežević, 1989:41). The ways a family uses the space for receiving guests or to gather, among other things, make up the identity of that family and are also part of subtle connections creating the feeling of togetherness and family ties (Fiese, 2006:1).

A specific characteristic of the configuration of every living space is the "territorial boundary".3 It stands for the ephemeral separation of the "private" zone (family and intimate) from the "public" zone of the apartment (social), i.e. the extent to which someone is allowed or expected to enter the living space before users have the feeling that their intimacy has been violated. When the boundary is clearly physically defined, it is, in most cases (in smaller structures), identical to the division into the day and night zone, or (in larger structures) the private and social zone, however, it can be changeable and adaptable to the different needs of users, for example with flexible usage of the living space.

The existence of a territorial boundary in the living space in the form of a "social filter" comes from the fact that any space can provoke the feeling of territoriality, which a person can feel towards others and on different levels, in the form of intimate space, personal space or social space4 (Fig. 1.1). These zones represent different feelings of comfort or anxiety in relation to other people occupying the same space. Their values are relative as they depend on cultural characteristics and personality traits (Sorokowska, Sorokowski, Hilpert, 2017; Strube, Werner, 1982; Gifford, 1983). It is important to point out that along with individual territoriality, there is also group territoriality, which in living spaces refers to a family as the main space user. Bearing in mind the viewpoint of theoretician Douglas Porteous, who claimed that "The house reflects how the individual sees himself, how he wishes to see himself, or how he wishes others to see him" (Porteous, 1976:384), it can be concluded that the configuration of living space, the boundaries of territoriality, the surface area of the social zone, and the number and position of gathering centres, all reflect the level of social needs of a particular user and his or her material status (Ristić, 2009).

For the further purposes of this paper it is important to emphasize that the living space includes different levels of territoriality, on the one hand limited by boundaries, while on the other hand limited by relations between the users and the space. The first level is determined by the physical boundary of the living space toward the surrounding public space and shows "the boundary of ownership". The second level is present when there is a clear distinction between social and private spaces, and it presents a supposed "boundary of hospitality" for visitors. The third level is determined by the physical boundaries between the intimate and family spaces and determines the "boundary of privacy" between family members or the household (Fig. 1.2).

GATHERING CENTRES IN LIVING SPACE

In order to analyze the potential influence of gathering spaces on the configuration and character of the living space, it is necessary to perceive their positions on the whole and the relations resulting from them. The most frequently used centres in living spaces are: the living room, family room, media room, salon, dining room, etc.

In living spaces of medium or lower standard, in most cases it is usual that the users' gathering centre is the living room, or if necessary a dining room closely connected to the living room could also serve this purpose (Čanak, 1976:305). By raising the standard, enlarging the structure and the surface area of the living space, the living room is most often representatively furnished, reserved primarily for receiving visitors and for special occasions. According to the latest research, the living room is very often used as a safe haven from family hassle going on in the family room (Rechavi, 2009:133). The term "living room" was not adopted until the end of the 19th and the start of the 20th century, and a previously used term for the space where guests were received was the salon.5 The primary role of the living room is to offer comfort to visitors and to reflect the form in which individuals or a families "want to be seen" (Goffman, 1956:14). It is understood that it should be bright enough, spacious enough and closely connected to the main entrance, as the visitors will enter the space reserved for them through the shortest possible route, avoiding viewing or passing through family or intimate space (Cromley, 2004:167). In many cultures, the living room is the one most frequently used, which is why it is considered "the façade" of the living space (Nasır, Öğüt, Gürel, 2015:16).

As opposed to the living room, in larger living spaces, the family room is the secondary centre, which is less formal

2 In the bibliography, the term "social zone of the apartment" has not been clearly defined despite its use. In the context of this paper, the term will describe the zone of the living space which is available to the guest so that the user (host) does not feel any form of reduced or violated privacy.

3 The main meaning of the term "territoriality" is the pattern of behavior of a person or group, based on the need to control their physical space (sometimes an object or an idea) (Edney, 1974:959).

4 *Intimate distance* defines the distance of 45cm, reserved for extremely close people, family members, partners, i.e. those we trust. Approaching a person we are not close with at this distance can be quite disturbing. *Personal distance* defines the distance from 45-120cm, which is usually the distance we keep when speaking with friends, shake hands or have an opportunity to follow their body language or eye movement. *Social distance* defines the distance from 120-360cm which is present in communication with people we are less close to or with complete strangers. On such occasions we usually speak louder and eye contact is necessary (Hall, 1966:13; Efran, Cheyne, 1973:203).

5 In western culture, mostly in Anglo-Saxon areas, the living room is also described by terms such as: *parlor, drawing room, sitting room, lounge room, lounge, front room, reception room*, etc.

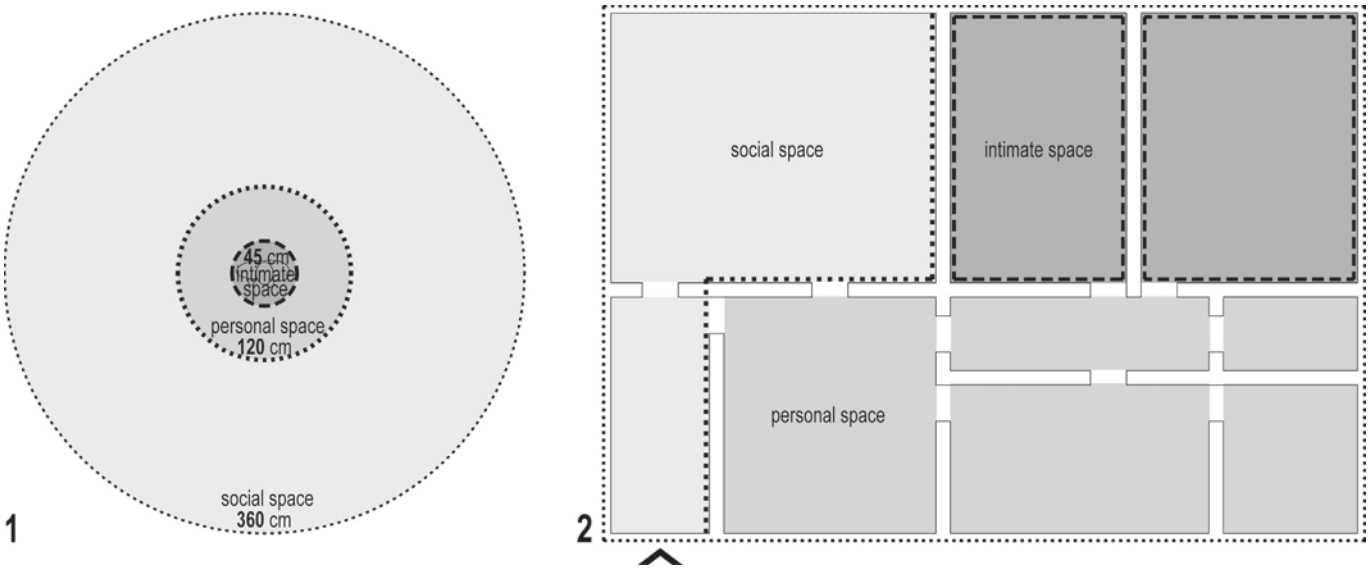

Figure 1. Territorial experience: 1) in personalities 2) in living spaces (Source: author's archive)

than the living room, both in the way it is organized and in the way it is furnished. Most often it is located at a distance from the main entrance, next to the kitchen (sometimes the dining room). It is used for daily gatherings of the family, recreation, relaxation and as a place for children to play, the emphasis being on its comfort and cosiness (Cromley, 2004:168). In smaller living spaces, a family room takes the role of the living room, which means putting together daily activities within the same polyvalent space and in some cases this can create functional problems. As the family room is one of the most intensively used spaces, it is very important that it has adequate dimensions to accommodate all family members. In very large spaces (500-1000m2), activities from the family room are most often divided into several smaller centres (media room, children's playroom, etc.), so that adequate comfort can be provided for all users.

Depending on the size of the living space, the dining room can have a double role – the role of "the family table" and the space for reception of guests and occasional family celebrations. In larger spaces, a festively decorated dining room is most often positioned next to the living room, while the family room includes a smaller dining room for everyday use. Although the role of the dining room is secondary in relation to other centres of gathering, in some concepts, as in the case of the so called "salon" apartments built in Serbia between the two world wars, it can by virtue of its size and position have a primary role in the spatial organization (Alfirević, Simonović Alfirević, 2017).

CHARACTERISTIC EXAMPLES OF LIVING SPACES WITH MULTIPLE CENTRES

Living space with centres grouped in the social zone

Grouping the gathering centres is characteristic primarily for polyvalent living spaces, where the concept of open plan has been applied. The internal openness of the plan depends on: a) the lifestyle and the habits of the tenants, b) their health status and age, c) the concept and distribution of primary supporting structures, d) the structure of the family and organization of life within the living space, etc. (Čanak, 2013:67). It can be said that grouping the centres in a social zone is directly conditioned by the parameters mentioned above, primarily by the lifestyle parameters and the users' habits. The primary motives for use of this concept are the need for space for frequent social contact with friends or members of extended family and the need for presentation and emphasis of status (Fig. 2.1). By grouping the centres in the same space, some of the housing functions related to family activities (such as the family room and dining room) can be transformed into the domain of the social zone, which changes "the boundary of hospitality" in order to achieve larger spatiality and representativeness. In certain extreme cases the scope of the social zone can have a decisive role in generating the spatial concept, whereby the space for receiving guests can occupy almost half of the living space (Fig. 2.2).

These tendencies indicate the users' extrovert nature, as their need for socializing or presenting their living space to others constitutes a significant aspect of their everyday activities.

In living spaces with smaller surface areas, the grouping of different centres has a very significant role, since due to the lack of space, the closeness of the dining room and its positioning in the zone of the so-called "extended communication area" contributes to the feeling of larger spatiality and the formation of two centres: a) primary – living room and b) secondary – the space where the family gathers around the dining room table, which is outside the kitchen space. According to Bajlon, the extended communication area emerged from the need to "find the form of family gathering at the table, in cases when the apartment was so crammed that it did not allow family gatherings, so it was more and more becoming an addition to the living room" (Bajlon, 1972). The use of the extended communication area in scarce socio-economic conditions offered different options, such as: a) turning the entry space into the space for receiving guests, b) making the space

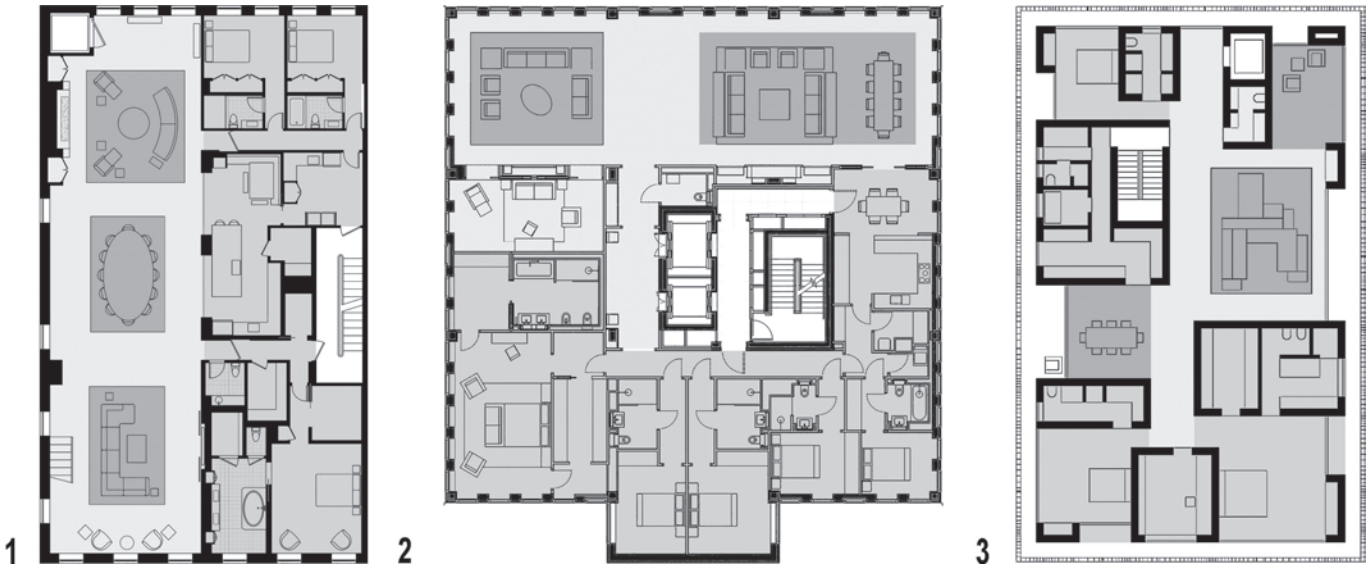

Figure 2. Characteristic examples of living spaces with centres grouped in the social zone: 1) 87 Mercer Street penthouse, New York (Tony Ingrao); 2) Holland Green, London (OMA & Allies & Morrison, 2016); 3) Ninetree Village, Hangzhou (David Chipperfield Architects, 2008) (Source: author's archive)

Figure 3. Characteristic examples of living spaces with flexible centres bordering with different zones: 1) City life Residential Complex, Milano (Zaha Hadid Architects, 2016); 2) Karlatornet, Gothenburg (Skidmore, Owings & Merrill, 2019); 3) 900 North Avenue, Chicago (Kohn Pedersen Fox Associates, 1989) (Source: author's archive)

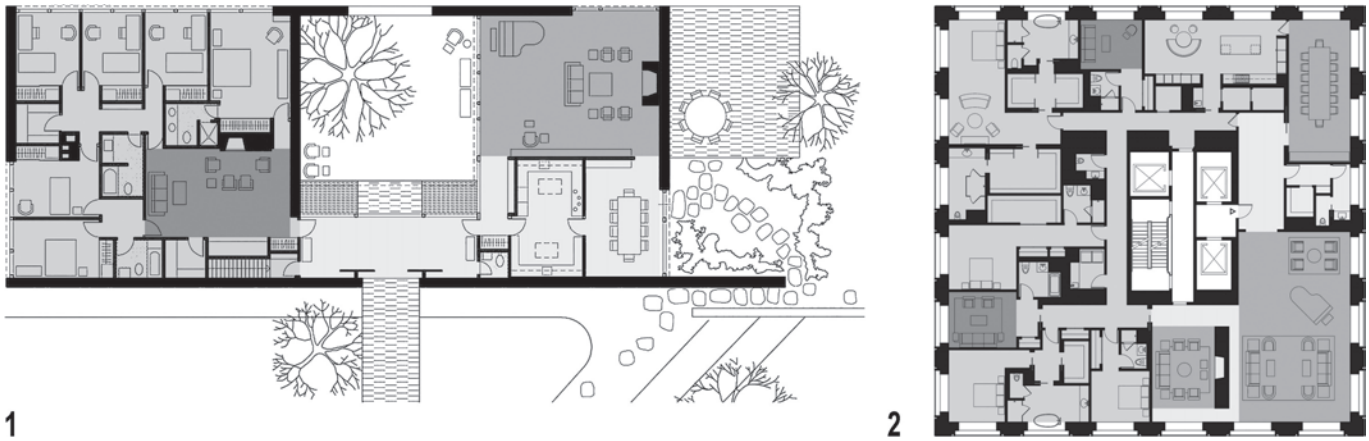

Figure 4. Characteristic examples of living spaces with the secondary centre in the private zone: 1) Hooper House I, Baltimore (Marcel Breuer, 1960); 2) 432 Park Avenue, New York (Rafael Viñoly, 2015) (Source: author's archive)

for everyday use an area for children to play or study, c) separating the activities of children and their friends from parents' activities with their friends, d) giving users the experience of larger apartment spatiality, etc. (Alfirević, Simonović Alfirević, 2018b:10) (Fig. 2.3).

Living space with a flexible centre bordering with different zones

Positioning the centre on the border between the social and private zone of the living space enables flexible use, achieved by separating or connecting the centres. By removing the flexible partition, the social zone is extended to include the space for gathering in the private zone, which temporarily disturbs functional relations and prevents the option of part of the family gathering in a more intimate space (Fig. 3.1). On the other hand, by building a partition and separating the centres one can achieve the necessary conditions for usage of different intensity or regimes. Positioning the centre in this way makes it possible to satisfy the diverse social needs of the users, particularly if it is combined with the concept of organizing the living space to have two entrances, which can contribute to achieving the autonomy of social and private zones for longer periods of time. Depending on whether the family rooms are grouped into one unit or separated into blocks (parents and children), as well as whether the social zone has a corner entrance or a middle entrance, the number of centres in the living space can differ (Fig. 3.2). The users get the largest spatial comfort when the living room and dining room are part of the social zone, while the kitchen and the family room make up an autonomous unit with the intimate zone (Fig. 3.3). Including the kitchen in the social zone is a characteristic of the extroverted concept of functional organization, where part of the private zone space is exposed to being seen by visitors.

Living space with the secondary centre in the private zone

Clear functional separation of the centres into different zones is characteristic primarily for living spaces with large surface areas and a larger number of rooms, but it is also present in the specific (introverted) needs of users who expect the social and private zone to be strictly separated (Fig. 4.1) This concept of spatial organization is most convenient for multi-member, two-generation or three-generation households, as they have a more visible need for separation due to different lifestyle rhythms. The advantages of this concept become more pronounced when the living space can be accessed through two or more entrances, allowing each zone to achieve autonomy, and at the same time to be part of a larger unit (Fig. 4.2). When the secondary centres are situated far into the private zone, bordered by intimate rooms, they are meant to be used for the intimate conversation of users. The main problem that can arise with this concept is the potential segregation of users. In conditions when every member can have a private space and with gathering centres physically separated, there is a higher likelihood of weaker intimate relations among the users, which can lead to alienation.

CONCLUSION

From the examples shown it can be noticed that the boundary of territoriality does not necessarily coincide with the boundary of the daily or nightly zone in the housing space, that it is not always clearly defined and that to a great extent it depends on the users' cultural patterns of living, their habits and needs. The paper analyzed three main concepts of centre distribution in the configuration of the living space and their influence on the level of intimacy resulting from that (Fig. 5). The results of the analysis indicate that the widest scope of needs can be satisfied through a flexible concept with a secondary centre on the border between the zones, as it combines the advantages of the remaining two concepts which are "more extreme" (Tab. 1).

Along with the above mentioned concept there are also others, such as those that do not include receiving guests in the living space, which leads to the disappearance of the social zone, or guests being received in the family zone, since there is no social zone. In most living spaces which have a clearly defined social or private zone (family and intimate zone), there are three different boundaries of territoriality ("boundaries of ownership", "boundaries of hospitality" and "boundaries of intimacy"). In smaller apartments, where the social zone is not clearly defined, the boundary of hospitality comes closer and sometimes even coincides with the intimacy boundary. An extreme situation emerges when visitors are not received inside the living space, which makes the boundary of hospitality coincide with the boundary of ownership. The need of users to have separate centres, as well as their design, can often lead to excessive dimensions of the gathering space, or reduction of dimensions of other private spaces within the apartment,

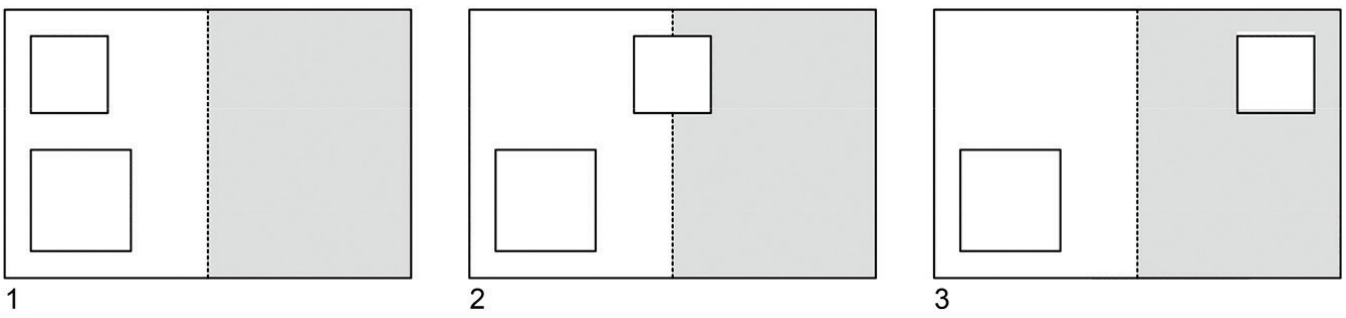

Figure 5. Characteristic positions of gathering centres in a living space with relation to the boundaries of social and private zone (Source: author's archive)

Table 1. Presentation of the concepts analyzed

	Centres grouped in the social zone	**Flexible centre on the zone borders**	**Secondary centre in the private zone**
Functional concept	"extroverted"	combined	"introverted"
Users' motives	Space for frequent social contacts	Space for occasional social contacts	Space for frequent or occasional social contacts
	Representative space that shows status	Space for informal family gatherings	Space for informal family gatherings
Character of space	Polyvalent (open plan)	flexible	segmented
User profile	One-generation households, two-generation households	Two-generation households, three-generation households	Two-generation households, three-generation households
Advantages	Existence of a permanent and clearly defined zone for guests and socializing	An option for forming a larger zone for guests and socializing	Existence of permanent and clearly defined zone for guests and socializing
	--	Possibility of segregating simultaneous activities in social and family zone	Segregation of simultaneous activities in social and private zone
Shortcomings	Activities in social zone disturb simultaneous activities in the private zone	Activities in social zone can disturb simultaneous activities in the private zone	Users' segregation and possible alienation

which can result in disproportionate private and social zones. Having in mind all we have said, it can be concluded that the level of extroversion of the living space is directly related to the character and the needs of its users, i.e. their presentation of the living space to their visitors, but also to the culturological context.

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OPTIMIZATION OF REPAIR MORTAR USED IN MASONRY RESTORATION

Aleksey Kharitonov, Department of Technology of Building Materials and Metrology,
St. Petersburg State University of Architecture and Civil Engineering,
Saint-Petersburg, Russia

***Olga Smirnova*[1]**, Department of Constructing Mining Enterprises and Underground Structures,
Saint-Petersburg Mining University, Saint-Petersburg, Russia

Deterioration of ancient masonry is a contemporary problem. The initial properties of the masonry material that determine its durability, deterioration and degree of preservation have led to the appearance of different approaches towards choosing the technology for restoring masonry. The success of any restoration is largely determined by its compatibility with the original materials used, which requires, as a rule, a complex and long process of selecting their composition. One of the main technological approaches in the science of restoration materials is to search for the optimal composition of the material within a given time limit. This paper presents an approach which uses a large number of variables within strict boundary conditions. The solution to this problem can be found in the field of mathematical modelling using experiment planning methods. The paper presents a method developed for mortar optimization which makes it possible to obtain the desired result within a relatively short period of time.

***Key words*: stone restoration, composition optimization, multicomponent restoration mortar, vapour permeability, lime mortar.**

INTRODUCTION

Deterioration of masonry in architectural monuments is a common problem. Different types of masonry damage accumulate over the years: destruction of the surface layers and facing, the formation of cracks and voids, local deformations leading to solidity of the masonry and weakening of the cross section. All this results in the appearance of emergency conditions (Belentsov *et al*., 2017; Kharitonov *et al*., 2019; Formisano and Marzo, 2017; Giordano *et al*., 2018), which can be corrected by replacing all the masonry elements, strengthening the masonry surface or restoring the stone (Forster *et al*., 2011; Pauletta *et al*., 2018; Ribilotta *et al*., 2019). The initial properties of the masonry material and the degree of its deterioration mean that there are a lot of possible combinations with regard to the technological methods and materials required for its restoration (Heravi *et al*., 2018; Myasnikova and Pervunina, 2019; Šoukal *et al*., 2016; Kalina *et al*., 2018; Kazanskaya *et al*., 2019; Gailitis *et al*., 2019). The type of intervention required for a monument therefore depends on its actual state, as well as on the exact type of material in question.

Use of repair mortars is currently a readily available and common method for restoring various construction products and structures (Plugin *et al*., 2017; Upadhyaya *et al*., 2019; Torney *et al*., 2014).

Restoration of masonry on the basis of brick or natural stone results in large volume of existing masonry being replaced. This is complicated and requires expensive technology (Kazanskaya and Belentsov, 2019; Ochkurov and Vilenskii, 2019); hence, the application of repair mortars has become very popular and widespread worldwide since the 1960s (Forster *et al*., 2011; Ashurst *et al*., 1988; Zarzuela *et al*., 2018; Hosseini and Karapanagiotis, 2018; Sakiyama *et al*., 2018).

Restoration issues concerning architectural heritage require individual methods for calculating the structure that take into account an extremely wide range of influencing factors (Micelli and Cascardi, 2019; Clementi et al., 2016; Lourenço and Roque, 2006; Lourenço *et al*., 2012). The methods used to develop different restoration materials also require an individual approach. For example, the properties of the cement matrix and reinforcing material (e.g., mesh or fiber) should also be considered when selecting the mortar composition (Cascardi *et al*., 2018; Castellano *et al*., 2019; Tilocca *et al*., 2019), which complicates the process of selecting the composition of the mortar.

[1] 21-st Line V.O., 2, 190031 Saint-Petersburg, Russia
smirnovaolgam@rambler.ru

Today, many factors are known to have a negative impact on the state of masonry, the majority of which result from the wrong choice of materials used in restoration. This can be seen in the lack of external similarity between the selected material and the masonry, as well as in the lack of the necessary physical and mechanical properties. The incorrect choice of material can lead to defects that disfigure the visual appearance of architectural monuments. For example, changes in the color of the restoration material in the cracks of natural stone masonry are shown in Figure 1. This is caused by aging of the polymer composition under the influence of ultraviolet light, temperature change and other atmospheric influences.

Figure 1. Color changes in the restoration material used in natural stone cracks on a facade (photo by Olga Smirnova in Malaga city center in 2019)

Masonry damage can be caused by the use of restoration materials with low vapour permeability, namely, mortar based on Portland cement. Low vapour permeability helps to retain moisture inside the stone (Vicente et al., 2018; Hendrickx and De Clercq, 2019). This leads to the accelerated deterioration of the masonry due to frost destruction and salt formation. High-strength lime mortars based on hydraulic lime also have low vapour permeability. Hence, it is necessary to ensure sufficient vapour permeability when designing new restoration materials.

The principles of "scientific restoration" were laid down in the Venetian Charter on the conservation and restoration of architectural monuments (1964) as well as in the Recommendations of Icomos/Iscarsah (2003). These principles must be used in restoration projects for architectural monuments of any status:

- The main objective of the restoration work is to strengthen the genuine parts of the monument;
- The minimum amount of invasive works on the monument should be done to achieve this objective;
- It is possible to use modern technology and physical methods in the restoration to strengthen the monument;
- It is possible to use different materials. Externally and physically they must correspond to the monument's original materials. However, faking the original materials is not allowed;
- Disassembling the original parts of the monument is not allowed. Modern restoration techniques should strengthen the damaged walls without violation; and
- It is necessary to conduct a thorough and comprehensive study of the monument before the restoration operations.

Negative consequences of applying cement-based mortars in combination with brittle porous materials, for example with ceramic bricks, can be seen when monitoring restored cultural heritage (Odgers and Henry, 2012; Gibbons, 2003; Williams, 2001; Smirnova, 2016). On the other hand, there are no signs of deterioration in dense stone materials when Portland cement compositions are used.

The requirement of compatibility between the artificial or natural stones and the restoration materials is paramount when choosing the restoration material (Schueremans *et al*., 2011; Sabri *et al*., 2018; Groot, 2016; Vavričuk *et al*., 2018; Kosenkova *et al*., 2019). The definition of compatibility is considered as "the use of materials that do not bear negative consequences for historical materials" by many scientists (Vavričuk *et al*., 2018; Righetti *et al*., 2016; Lindqvist and Johansson, 2019; Kayan *et al*., 2016; Apostolopoulou *et al*., 2018). Accordingly, the key parameters of compatibility that the restoration materials should have must be stated.

The aim of the paper is to present a method for finding the optimal composition of the restorative materials taking into account a large number of variables within strict boundary conditions within a short time period.

PROBLEM STATEMENT

Compliance with the principle of historicism involves using the results of historical research and archival materials, as well as the study of technologies and techniques in the restoration of monuments in accordance with the concept of scientific restoration, which originated in the middle of the 19th century. The knowledge of historical materials and technologies is a key factor in the development of a restoration project (Forster *et al*., 2011; Ashurst and Ashurst, 1988).

A schematic representation of approaches to the restoration technology used in stone and brick masonry is shown in Figure 2.

Work on creating materials for each item of cultural heritage begins with the study of historical samples using modern analytical methods. A decision on the composition of the restoration material used should be made only on the basis of the data obtained. X-ray analysis is the most reliable method for studying the composition of material samples taken from cultural heritage. The results are refined by other methods of analysis such as electron microscopy or petrography if necessary. The first stage in developing the compositions used in restoration is to study the composition of the historical material, based on the x-ray and other data. Development of a method for optimizing the quantity of the components which make up restoration materials is the main subject of this paper.

A better understanding of the negative consequences of using Portland cement-based mortars in combination with brittle porous materials comes from monitoring restored structures based on these porous materials (Odgers and Henry, 2012; Gibbons, 2003; Williams, 2001). The study of technological approaches to the restoration of porous and dense stone materials using different binder compositions is required since there are not enough published data on this problem.

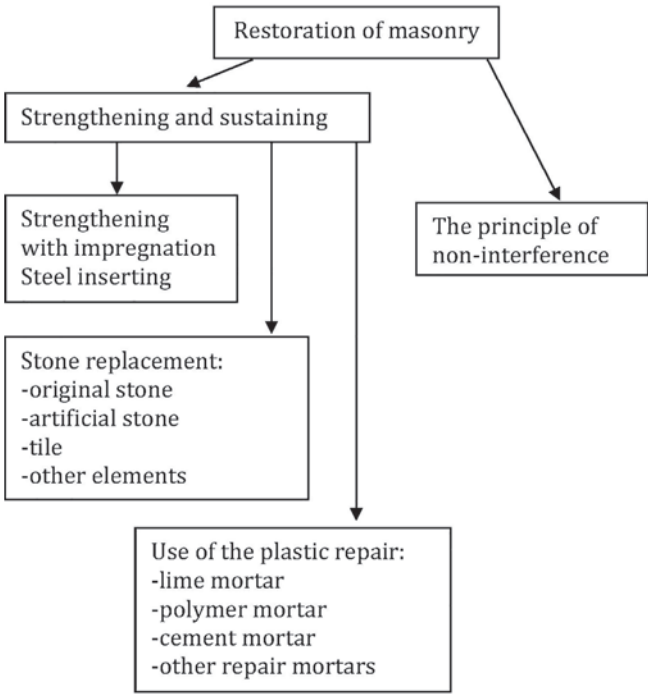

Figure 2. Schematic representation of approaches to restoration technology

In the past, mortar based on air lime was used in the construction of historic buildings for brick walls and for their decoration. Unfortunately, lime was gradually replaced by cement when the technology for binders was developed. The reasons for this are clear – cement mortars make it possible to work faster. The workability of cement mortar is a positive property, but the use of cement mortars has led to poor results. Brick walls that have been repaired with cement mortars have been irreversibly destroyed. This error was recognized by the restoration schools. The decision not to use Portland cement for the restoration of external plaster was made at the world congress for the preservation of monuments of architecture in Paris in 1957.

First of all, the mortar for masonry restoration should not change the mass transfer of moisture through the structure, i.e. it should not differ from the masonry vapour permeability. In addition, the composition of the material must correspond to the historical masonry mortar according to restoration principles. The use of cement and polymeric substances as a binder is unacceptable.

First of all we should consider the requirement of compatibility between the restoration materials and the stone base. It is necessary to set the key compatibility parameters that the restoration materials must have. The following parameters can be selected as the key parameters of compatibility: compressive strength, tensile strength, adhesive strength, density, vapor permeability, capillary water absorption, hygroscopicity, thermal capacity etc. This list is incomplete and can be supplemented or changed depending on the specific conditions and purposes of the masonry, as well as the architectural and construction activities for cultural heritage (Chmielewski and Muzolf, 2018; Fusade *et al*., 2019a; Bencardino *et al*., 2017; Carmona-Quiroga *et al*., 2018). It is also necessary to select the material in accordance with the colour and texture of the surface. All these conditions make the task of selecting the material used to restore masonry and choosing the technological works extremely complicated and expensive activities (Stefanidou *et al*., 2017; Govaerts *et al*., 2018; Fusade *et al*., 2019b). Another important condition is the time limit given for work on a site, which may not be long enough for selecting material with the required parameters. This often leads to disregard for the principles of scientific restoration.

RESEARCH METHOD

The main problem of choosing the restoration material can be formulated on the basis of the above-stated information. Namely, it is finding the optimal composition of the material with a large number of variables in the presence of strict boundary conditions within a given time limit.

Solution to this problem can be presented using mathematical modelling and experiment planning methods to find the optimal value of the response function. This makes it possible to obtain an approximating polynomial that describes the surface of the response function.

Mathematical optimization methods have long historical roots. Their foundations were laid in the 18th century. These methods include variational calculus, numerical methods, etc. A large number of methods aimed at solving optimization problems have been developed to date (Ashurst and Ashurst, 1988; Odgers *et al*., 2012; Gibbons, 2003).

Mathematical model for the process studied here or for an object can be used for optimization. In the latter case the optimization is done empirically. Experimental and statistical methods are used for objects of probabilistic nature that can include many construction and restoration materials. These methods make it possible to determine the values of factors (arguments) corresponding to the extreme values of the target function. Some of the most commonly used methods in experimental optimization are: the simplex method, coordinate optimization method, gradient methods and the deformable polyhedron method.

A review of the optimization methods related to various technologies and objects shows that a step-by-step process using a gradual approach to finding the optimum value is a characteristic of all methods (Blokhin and Gludkich, 1997; Adler *et al*., 1975). The use of these methods in order to find the optimal values of multi-component mixtures for the restoration of masonry is very difficult due to the long duration of the experimental studies. For example, it is necessary to wait 28 days for mortar to harden and reach

the required strength. In this case, one month is required to determine the value of one parameter and in the case of an unsatisfactory value for this parameter, several months will be required to find the optimal value.

The main idea that underlies the proposed method is the use of an experimentally derived mathematical model to find the optimal values of the properties in the form of an objective function. This objective function describes the dependence of the parameters of the physical and mechanical properties of restoration materials (including other criteria in the optimization process) on the quantitative ratios among the mortar components. The authors have developed software that implements the mathematical model and makes it possible to carry out numerical experiments during the process of optimization.

Mathematical models that provide the interpolation function and describe the considered response surface within the factor space were obtained on the basis of processing the results of experimental work using regression analysis methods.

The proposed approach includes the following steps:

- It is necessary to select the optimality criterion and prepare the objective function that represents its dependence on the factors determining the objective function value. The parameters of the physical and mechanical properties of the materials as well as the economic, technological and other parameters can be selected as the criteria. Key requirements are: the criteria should be quantitative, measurable and easily computable;
- It is also necessary to: plan and carry out experiments in order to obtain regression equations approximating the surface of the required factor space; process experimental results with statistical methods; calculate and correct the coefficients of the regression equations; assess the adequacy of the equations, and; determine the statistical significance of the coefficients. The planning of experiments should be carried out using second-order polynomials in the case of available a priori information about the presence of nonlinear dependencies in the processes;
- After that, it is necessary to select the optimization method to find the extreme values of the objective function. Any numerical method can be used at this stage. The steep ascent method, as shown in Figure 3, is proposed in connection with applying the results of numerical experiments using a computer. Figure 3 shows the execution of the working motion along the vector gradient defined in the area of the starting point until the partial extremum of the response function in the direction of the gradient is reached, without its correction at each working step.
  The closed lines in Figure 3 are the isolines of a function where the values of this function are the same. The straight line is the gradient direction. The gradient is the shortest path to the top, i.e. to the optimum area. The optimum area is indicated as N.
  The points in Figure 3 indicate experiments with the coordinates of the factors lying on the gradient. M_0 is the initial arbitrary point for determining the first direction of the gradient. Points 1, 2, 3, 4, ..., 14 are the numbers of the experiments for determining the gradient. M_1 is the point for determining the new direction to the optimum area N.
  The optimum (maximum or minimum of the target function) can be found by performing experiments with the values of the factors lying on the gradient. The gradient is the line perpendicular to the isolines of the target function. At first, four experiments are performed in order to determine the gradient and then the values of the factors lying on the gradient are calculated. The experiments are carried out step by step until the position in which the subsequent value of the function begins to decrease. Next, four new experiments are performed to determine the new direction of the gradient. Finding the optimum continues until the maximum or minimum value of the function is found;
- The chosen optimization method should use the results of numerical experiments and the stated mathematical model. Then, the values of the factors (in our case the determination of mixture composition of restoration material) that correspond to the optimal values of the objective function are determined; and
- Experimental verification of the physical and mechanical properties of the given composition of the restoration material is performed by making laboratory samples. The duration of the experimental studies is reduced by using numerical modelling and obtaining the objective function during the optimization process. The great volume of experimental works and studies can relate to obtaining mathematical models for approaching polynomials (namely regression equations) and can be performed in quite a short period of time.

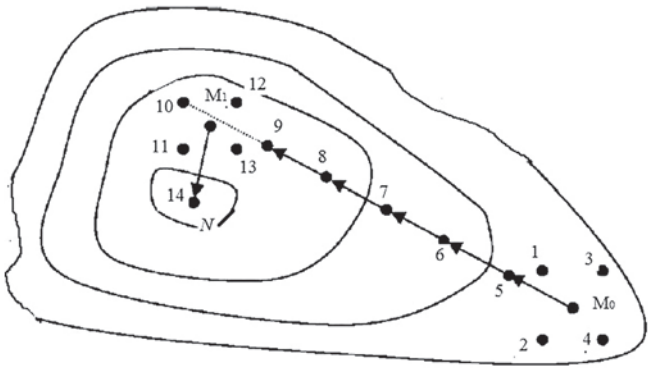

Figure 3. Optimization process with the steep ascent method

The software can be useful for carrying out the numerical experiments using mathematical models. The automation of the whole optimization procedure is complicated by the presence of informal actions related to decision making in the process of searching for an extremum. This methodology abandons the automation procedure in favour of freely choosing an optimization method. The program is flexible and enables different variations of mathematical models to be implemented in the form of polynomials.

RESULTS AND DISCUSSION

An evaluation of the effectiveness of the proposed methodology was carried out as follows.

Mathematical model was chosen in the form of a regression equation that can usually be obtained for studying the properties of building materials. An admixture was added into this equation as a random variable distributed according to the normal law, and simulating the various errors that occur in real experiments. This model was implemented on a computer using a specially developed program that makes it possible to perform numerical experiments using this model.

It was further accepted that the above-mentioned model was unknown. Hence, the task to determine the maximum value of a specific target function within the given limits of the factor space was set using a step-by-step optimization method, i.e. the steep ascent method. All this is necessary for determining the required number of experiments that could be sufficient for solving the problem.

Then, the type of objective function was also stated in order to determine the required number of experiments. The mathematical model obtained was used to determine the maximum of the objective function using the simplex method.

Ensuring the visibility of the results, both intermediate and final, is an important point when using the chosen method. A mathematical model of the process is presented here using the two-factor polynomial of the second degree. It has the following form:

$$y = 30 - 2.2 \cdot x_1 + 3 \cdot x_2 - 2 \cdot x_1^2 + 1.5 \cdot x_2^2 + \varepsilon \quad (1)$$

where

y - the response function (the objective function in the optimization),

x_1 and x_2 - the factors affecting it,

ε - the error distributed according to the normal law.

The y function is smooth and continuous. It is defined in the region of positive values. The last condition is fulfilled by the choice of constraints of the factors (factor space).

The study of function (1) shows that it has no extremum. This means that in this case the optimization problem should be reduced to determining the maximum values of this function within a given factor space. The highest value of the selected function has a minimum value of x_1=2.3 and a maximum value of x_2=3.84. All this should be confirmed by the study of this function using the method of planning experiments.

Finding the extremum of the function in question by means of the steep ascent method shows that the maximum values of the target function really correspond to the following values of the factors x_1=2.3 and x_2=3.84. The initial region used to determine the gradient is located in the middle of the factor space.

The dependence as noted earlier is unknown. This was taken into account when determining the type of target function (regression equation) by experiment planning methods. In view of this it was initially assumed that the mathematical model is a linear polynomial. Statistical analysis of this model shows that it is inadequate and therefore a second-order polynomial should be chosen.

The adequate regression equation obtained in coded values of factors with statistically significant coefficients has the following form:

$$Y = 30.78 - 10.81 \cdot X_1 + 11.57 \cdot X_2 - 1.08 \cdot X_1^2 + 1.28 \cdot X_2^2 \quad (2)$$

The equation is in the form of real variables:

$$Y = 31.44 - 2.7 \cdot x_1 + 2.49 \cdot x_2 - 1.92 \cdot x_1^2 + 1.58 \cdot x_2^2 \quad (3)$$

Comparison of the regression equation (3) with the original one (1) shows that the equations are very close and a small discrepancy can be explained by the imposition of "noise".

Starting point from which the search for the maximum begins is in the middle of the factor space, as with the steep ascent method. This was assumed when finding the maximum of the target function in question using regression equation (2) and the simplex method. The implementation of the simplex method using the results of numerical modelling by equation (2) shows that the maximum values of the function Y correspond to the values of the factors x_1 = 2.3 and x_2 = 3.84.

The following results were obtained by finding the maximum of the two-factor response function by various methods. The desired maximum was found using the results of 22 experiments taking into account the verification of the presence of a maximum in the vicinity of the point of the expected maximum using the method of steep ascent. The desired maximum was found using the results of 13 experiments without taking into account verification of the presence of a maximum in the vicinity of the point of the expected maximum. The required maximum was found in 16 experiments using the simplex method. The number of real experiments for obtaining the regression equation in the form of the polynomial of the second degree was 7. Thus, the use of the proposed technique for a two-factor experiment makes it possible to halve the number of real experiments. It is obvious that this result will persist even with an increase in the number of factors.

The effect is even greater when considering the effectiveness of the proposed technique in terms of the duration of the tests. For example, if we assume that 28 days are required to estimate the strength of a cement composition, then 1 year is required to find the maximum of the response function for the strength of the samples using the gradient step-by-step method. This period can be reduced up to two or three months taking into account the experimental confirmation of the maximum, found using the proposed technique.

CONCLUSION

The masonry restoration of architectural monuments is a contemporary task. The initial properties of the masonry material that determine its durability, deterioration and degree of preservation have led to the appearance of different approaches towards choosing the technology used to restore

masonry. One of the main technological approaches in the science of restoration materials is therefore the search for the optimal composition of the material with a large number of variables, in the presence of strict boundary conditions and within a given time limit. The proposed approach for the optimization of multicomponent restoration mortars makes it possible to develop a material with properties that meet the key parameters of compatibility between the mortars and natural or artificial stone within a limited period of time. The basic idea of the proposed approach is the use of an experimentally obtained mathematical model for optimization of the material composition in the form of the objective function. The objective function describes the dependence of the parameters of the physical and mechanical properties of the restorative materials or the other optimization criteria upon the quantity of the components. Special software has been designed that can carry out the mathematical model and hold numerical experiments in the optimization process. The solution to the problem can be found in the field of mathematical modelling using the experiment planning method. The desired results can be obtained within a relatively short period of time using the method for mortar optimization presented here.

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TERRITORIAL ANALYSIS AS SUPPORT TO THE STRATEGIC ENVIRONMENTAL ASSESSMENT PROCESS FOR AGRO-WASTE MANAGEMENT PLANNING

Nikola Krunić[1], Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
Boško Josimović, Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
Aleksandra Gajić, Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
Marina Nenković-Riznić, Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia

Strategic Environmental Assessment (SEA) for waste management planning (WMP) has been applied around the world for fifteen years now. In addition to identifying potential trends in space and the environment by means of WMP, the SEA process contributes to involving the general public in issues relevant to the environment. In turn, the endpoint of the SEA process is a set of results that enable appropriate decisions to be made related to WMP. Bearing this in mind, it is necessary for all the segments of the SEA process to be supported by specific spatial analyses and presentations enabling visual monitoring of the results. In this context, an important role is played by GIS tools, since they offer support to the SEA process and give it a new quality, which, in addition to visualizing the results, also increases objectivity in the evaluation of the planned solutions. This paper presents the deployment of GIS tools in spatial analysis and the support they provide for the SEA process during the development of the Agro-Waste Management Plan for Oplenac Vineyard in Serbia (AWMP). The results indicate the possibility of applying GIS tools to increase objectivity in the Multi-Criteria Evaluation (MCE) of the planned solutions in the SEA process.

***Key words*: territorial analysis, GIS, Strategic Environmental Assessment, waste management plan.**

INTRODUCTION

Strategic Environmental Assessment (SEA) is one of the most important instruments for directing the planning process towards achieving environmental protection goals and decision making in alignment with the principles of sustainability. Its main application lies in strategic planning, which also includes waste management planning. Applying SEA makes it possible to identify the benefits and effects of the proposed spatial changes, taking into account the capacity of the space in which the planned activities are carried out, and, based on that, it is possible to make decisions on the suitability of the proposed spatial changes (Josimović *et al*., 2015). The role and importance of SEA in policy-making in different domains of social action, as well as the role of this instrument in the decision-making process, have been discussed by a number of authors (Therivel, 1992; Therivel and Partidario, 1996; Nilsson and Dalkmann, 2001; Nilsson *et al*., 2005; Maričić and Josimović, 2005; White and Noble 2012; Josimović and Crnčević, 2012; Josimović *et al*., 2016, and others). In this context, the exceptional importance of the topic at hand from a scientific and professional standpoint can be seen in developmental policy making, affirmed by the fact that an increasing number of international institutions, e.g. the European Commission, UNDP and UNEP are introducing the instruments and requirements for the application of SEA, with a view to increasing the number of developmental initiatives in line with environmental protection and the principles of sustainable development (more details in Dalal-Clayton and Sadler, 2005; Chaker *et al*., 2006; Biehl *et al*., 2019).

SEA contributes to integrating the impacts at the strategic level of planning. For the purposes of making good decisions regarding the sustainability of the solutions defined in the plans, it is necessary to consider different aspects of the potential impacts. Multi-criteria analysis has been strongly recommended by various authors (Partidário and Coutinho, 2011) for this purpose.

[1] Bulevar kralja Aleksandra 73/II, 11000 Belgrade, Serbia
nikola@iaus.ac.rs

On the other hand, with the development of GIS tools as a decision support system, many researchers (Kontos and Halvadakis, 2002; Parisakis, 1991; Kontos *et al*., 2005; Geneletti, 2010; Gorsevski *et al*., 2012; Eskandari *et al*., 2012; 2015) are using GIS instruments as a major impact assessment tool in landfill site selection and waste management. The implementation of GIS technologies in waste management analysis involves the creation of geospatial databases used for spatial analysis, visualization and monitoring. The GIS combines spatial data (maps, ortho/satellite images, etc.) with qualitative and quantitative data (Kontos *et al*., 2005) in order to support Multiple-Criteria Decision Analysis (MCDA), which is necessary in the elaboration and implementation of waste management plans. GIS can be used as the most important instrument in landfill site selection, recycling plant site selection, and the spatial distribution, quantities and flows of waste, as well as the detection of waste sources in the field. GIS databases store all relevant data about waste sources, quantities and types of waste, and they include location criteria, which are then evaluated using predefined evaluation criteria. The results are presented in the form of maps based on all predefined parameters, and this data can be used in the relevant decision analysis for different types of waste management.

The NoAW project is based on the principles of a circular economy in the context of agro-waste removal. The initial phase in removing agro-waste is the creation of an AWMP, with the support of the SEA process as a key instrument for directing the planning process towards the goals and principles of a circular economy. As it has the highest production of wine and produces the largest quantities of waste in Oplenac Vineyard, Aleksandrović Winery was selected as the case study. As such, it constitutes a representative sample for research and data extrapolation at the regional level. It is for the reasons stated above that the Aleksandrović Winery is a partner in the NoAW project.

The main aim of this paper is to raise awareness of the NoAW concept in wine production in Serbia. The operational goals include searching for, identifying and visualizing geographic data, as well as its spatial selection, in order to facilitate the organization of the agro-waste flow in Oplenac Vineyard. For these purposes, GIS tools were used in spatial/territorial analysis as support to the WMP and SEA in wine production in Serbia. Geospatial data and locations were combined with information gathered in the field about the generation of biowaste in wine production. This geoinformation was used to calculate the amounts of biowaste (from pruning and from grape petioles, seeds and grape skin) in the past, and to predict these amounts in the future. The spatial data collected was then incorporated in the spatial geodatabase used for monitoring the generation and spatial distribution of agricultural waste, as well as for the implementation of the NoAW concepts in wine production in Serbia.

THE CASE STUDY AREA

Aleksandrović Winery belongs to the Šumadija Region, which is considered as a functional-wine region. This region has around 10 active bigger and a few smaller wineries in 9 municipalities. It is divided into several winery subregions (vineyards), with Oplenac Vineyard (where Aleksandrović Winery is located) as a special research interest (Figure 1).

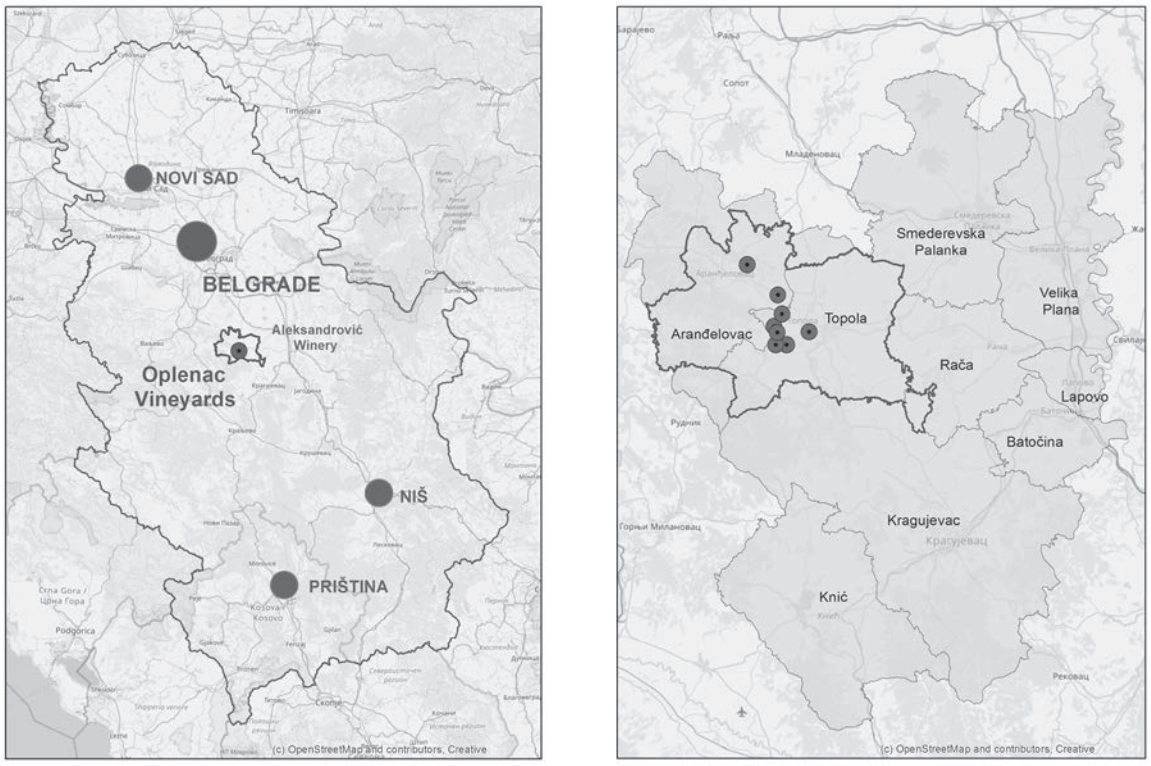


Figure 1. Position of Oplenac Vineyard and Aleksandrović Winery on the territory of Serbia (left)
Šumadija wine Region with Oplenac Vineyard (subregion) (right)
(Source: authors)

Aleksandrović Winery was selected as a representative case study because it is a leading winery according to the total area of its vineyards (75ha) and its wine production. Research was carried out and methodological concepts for the assessment of the territorial impacts of Aleksandrović Winery were applied to the wider territory of Oplenac Vineyard (8 wineries and 137 ha covered by vineyards) (Figure 2). By applying the principle 'Think regionally, act locally', the data collected from Aleksandrović Winery was extrapolated to the Oplenac Region, meeting thus, on the one hand, the prerequirement for regional waste management, and justifying the role of SEA as an instrument applied at the level of strategic planning (national, regional, subregional) in the initial phase of implementing the concept of sustainable waste management, on the other.

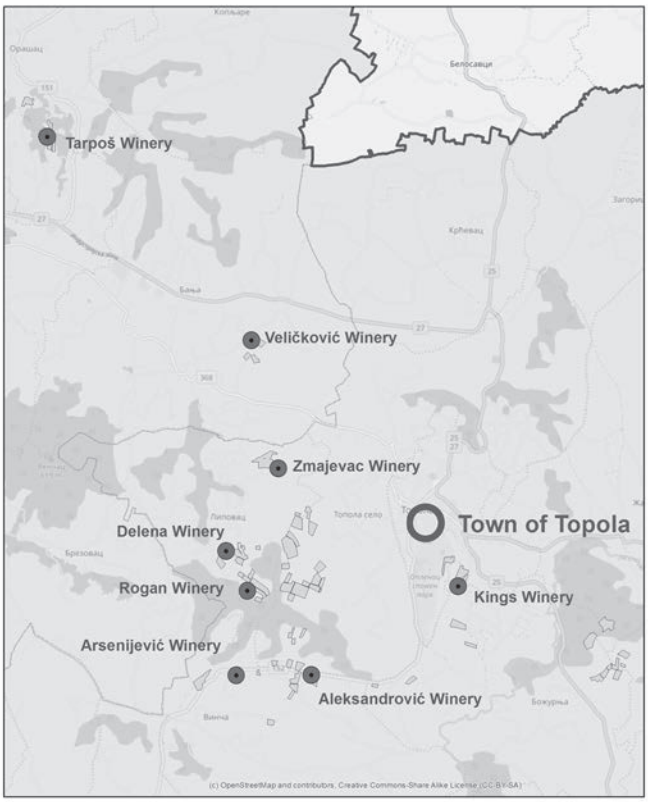


Figure 2. Oplenac Vineyard wineries (Source: authors)

METHODOLOGY AND DATA

In order to monitor agro-waste production in the wine industry, spatial data was collected on different territorial levels. Further, spatial analyses were conducted on the data provided from Aleksandrović Winery.

All spatial data necessary for the spatial analysis was included in the geodatabase on two hierarchical territorial levels – local and regional. At the regional level, data on 'Oplenac Vineyard', 'Regional Vineyards' and 'Wineries' was collected. Oplenac Vineyard was delineated by merging all the cadastral units which belong to that region: in administrative terms, the area belongs to the municipalities of Topola and Aranđelovac in Central Serbia. The Regional Vineyards layer contains polygon features associated with the position of wineries within Oplenac Vineyard. This layer contains the estimated amount of agro-waste (per ha, per year) for eight major wineries in the region. The Vineyards layer contains the features of winery production facilities. Data was collected in the field and provided by Aleksandrović Winery, and then combined with locations determined from satellite images.

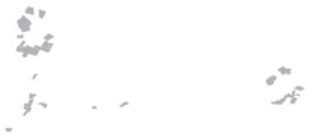
Locally significant data relate to the vineyards belonging to Aleksandrović Winery. This layer consists of polygon features associated with the position of production facilities, vineyard distribution, the sort and number of vines in each vineyard, the planting date, etc. Aleksandrović Winery vineyards cover a total of around 75 ha (55% of all the vineyards in the region) and consist of more than 30 spatial units (parcels) and one production facility. All the data was provided by Aleksandrović Winery and used as a basis for calculating the amounts of agro-waste produced after pruning for the Oplenac Region.

In addition to this specific data, more general data was also used which is directly linked to agriculture, and specifically to wine production. This data includes 'Aspect', 'Slope', and 'Height' generated from the European Digital Elevation Model (EU-DEM, https://land.copernicus.eu/imagery-in-situ/eu-dem/eu-dem-v1.1?tab=metadata). Aspect identifies the compass direction that the downhill slope faces for each location. It is used for choosing the optimal location for planting vineyards. Aspect is represented at two levels – the first with 8 major geographic directions (N, NE, E, SE, S, SW, W and NE) and the second, generalized to "cold" (NW, N and NE), "hot" (SW, S and SE) and neutral directions (W and E). Slope identifies the steepness of the terrain at a certain location. If the slope value is low, the terrain is flatter, while a higher slope value means that the terrain is steeper. This is important for agricultural production since erosion processes are more prominent as terrain steepness rises. The slope values are in degrees and generalized into 4 classes. Classes refer to their suitability for wine production. The values are in the ranges 0–5, 5–20, 20–45 and over 45 degrees. Terrain elevations are grouped into height zones, and range in terms of the suitability for agricultural production in Serbia; they are defined as: up to 250m, from 250m to 500m, 500m to 750m, 750m to 1000m, 1000m to 1500m, 1500m to 2000m, and above 2000m. The optimum height of the terrain for vineyards should not exceed 500m. An overview of the datasets is given in Table 1 below.

The first part of the analysis included calculating and modeling waste production from pruning (per year) in Aleksandrović Winery, together with the total agro-waste produced from pruning (since the establishment of the winery). Accordingly, two assumptions were made:

- The total amount of agro-waste per vine/plant after pruning is 1.5kg. This value is used as an average, and it was measured in the field during the winter of 2017/2018. For further modelling and calculation, the observed values of agro-waste amounts are used for each vineyard and specific variety; and
- The above mentioned amounts can be achieved when the full plant vegetation potential is reached, which takes place in the third year after planting, on average. Accordingly, the agro-waste production for each vineyard is calculated with a three-year "delay" instead of immediately after planting.

Table 1. Basic metadata

Data	Data description	Reference scale	Attributes	Usage	Example
The Aleksandrović Winery vineyards	Locations/Parcels of *Aleksandrović Winery* vineyards *Topola, Serbia*	1:1000	Vineyard distribution, the sort and number of vines in each vineyard, the planting date	Calculating the amount of agro-waste production after pruning, Analysis of the spatial location, Accessibility	
Oplenac Vineyard	*Vineyard area, Central Serbia*	1:1000	Shape of the area		
Regional vineyards	Locations/Parcels of vineyards in Oplenac Vineyard	1:1000		Calculating the amount of agro-waste production after pruning, Analysis of the spatial location, Accessibility	
Wineries	Location/Position of wineries in Oplenac Vineyard	1:1000	Locations	Analysis of the spatial location, Accessibility	
Aspect	Aspect for each cell of a raster surface	1:25000	Aspect: N, NE, E, SE, S, SW, W and NE	Choosing the optimal location for planting the vineyards	
Aspect generalized	Aspect for each cell of a raster surface	1:25000	Aspect generalized to "cold" (NW, N and NE), "hot" (SW, S and SE) and neutral directions (W and E).	Choosing the optimal location for planting the vineyards	
Slope	Slope values for each cell of a raster surface	1:25000	Slopes in degrees generalized into 4 classes.	Estimation of agricultural production	
Height	Height values of each cell of a raster surface	1:25000	Height range in 6 classes: < 250m; 250–500; 500–750; 750–1000; 1000–1500; 1500–2000; > 2000m above sea level	Choosing the optimal location for agricultural production in Serbia	

The second part of the analysis included the estimation of waste from grape petioles, seeds and grape skin in the year 2018. This step included calculation of the total amount of grapes, performed by multiplying the number of plants by 1.2, which represents the projected yield per plant expressed in kg. The next step was to calculate the amount of waste from grape petioles. The amount of petioles counted as waste was fixed at 5% of the total amount of grapes, which was then subtracted from the total amount of grapes. In the next step, waste from seeds (fixed at 3%) and grape skin (fixed at 10%) was calculated for the remaining amount of grapes.

The third part included the extrapolation of the data obtained at the regional level. Therefore, the same methodology was applied for modelling the total agro-waste, agro-waste per year and agro-waste per hectare in Oplenac Vineyard for the year 2018. An overview of the results is given in Table 2 below.

According to the calculations made for Aleksandrović Winery, the same methodology was applied to estimating the amount of pruning waste for 7 additional wineries located in Oplenac Vineyard. These calculations were used for mapping and detecting the average agro-waste production per ha per year. These results served as input for identifying the current state of agro-waste management at the regional level, as well as being the basis for developing the AWMP.

The data collected in the field and the waste generation and treatment model developed here can be used in further research of the wine regions in Serbia and in the implementation of the NoAW concepts within them. Given their importance for wine production, the experiences gained in this research can be applied in the wine growing regions of the Danube Basin in Serbia, such as Fruška Gora and Negotin Vineyards.

Table 2. The average and total amount of agro-waste (AW) per vineyard for the year 2018

No.	Winery	Agro-waste (kg/ha				Total
		Pruning	Petioles	Grape seeds	Grape skin	Agro-waste (kg)
1	Aleksandrović	8 214	329	187	624	701 566
2	Rogan	7 554	302	172	574	120 428
3	Delena	6 810	290	166	552	39 088
4	Kings Winery	7 977	319	182	606	99 930
5	Zmajevac	7 313	293	167	556	66 620
6	Arsenijević	7 500	300	171	570	93 951
7	Tarpoš	7 650	306	174	581	87 118
8	Veličković	7 500	300	171	570	25 623
The Oplenac Vineyard (137 ha)		**7 910**	**317**	**181**	**602**	**1 234 325**

RESULTS AND DISCUSSION

Initial results show that the average amount of waste from pruning stands at around 1 083 608 kg, i.e. 7 910 kg/ha, which makes app. 88% of the total amount of agro-waste in Oplenac Vineyard. The waste from grape petioles, seeds and grape skin contributes significantly less to the total amount of agro-waste (around 12% altogether).

The vineyards of Aleksandrović Winery and other wineries in Oplenac Vineyard were located using GIS and spatial data. Each vineyard location is associated with many attributes important for its maintenance: parcel size, number of plants and planting age, variety, amount of pruning waste, etc. Waste quantities were estimated based on field measurements. This data is significant for the wineries, the region, and viticulture in Serbia, in a number of ways: a) attention is drawn to the annual production of waste that is constantly being generated but not properly treated; and b) estimates and calculations are provided, as well as specific locations where waste is generated, which is important for the rationalization of production in this winery, and also for the future development of the industry/service of wine production waste treatment.

The semi-quantitative approach usually applied in the SEA process is expert-knowledge-based and subjective. The subjectivity refers, among other things, to the group of criteria for determining the spatial dispersion of potential impacts of the planned solutions developed in the AWMP. The application of GIS tools and territorial analyses, as well as their visual presentation in the form of maps, makes it possible to determine with a high level of certainty the spatial dispersion of potential environmental impacts, making the process of evaluating the planned solutions more objective.

CONCLUSIONS

Generally speaking, the advantages of establishing a geodatabase are numerous: firstly, this approach allows the estimation, spatial modelling and monitoring of the amounts and flows of agro-waste; furthermore, it makes it possible to easily update and use different spatial data at various territorial levels.

GIS was used in full as a supporting tool in the multi-criteria evaluation method (MCE) in the SEA process, for the purpose of devising Agro-Waste Management Plans (AWMP). In addition, GIS was used as an analytical tool when the spatial

data and data on waste production in the Aleksandrović Winery were collected.

The vineyards of Aleksandrović Winery and other wineries in Oplenac Vineyard were located using GIS and spatial data. Each vineyard location is associated with many attributes important for its maintenance: parcel size, number of plants and planting age, variety, amount of pruning waste, etc. Waste quantities were estimated based on field measurements. This data is significant for the winery, region, and for viticulture (wine growing) in Serbia, in a number of ways: a) attention is drawn to the annual production of waste that is constantly being generated but not properly treated; b) estimates and budgets are provided for quantities and specific locations where waste is generated, which is important for the rationalization of production in this winery, but also for the prospective development of the industry/service of wine production waste treatment; and c) the tourism potential of the wineries in the region is improved by GIS spatial analysis.

Although the starting point of this research was the analysis of data collected exclusively in Aleksandrović Winery, the concept 'Think regionally, act locally' was implemented by means of extrapolating the data collected in Aleksandrović Winery to Oplenac Vineyard, meeting thus the prerequirement for implementing regionalism in waste management. A similar, but more generalized, methodology was applied at the national level. However, for this level, the specific data that Aleksandrović Winery provided for Oplenac Vineyard was unavailable. This is why data available from the Agricultural Census was used in order to capture the main flows of agro-waste in Serbia.

In addition to the stated role of GIS in this research, the database created could have a significant role in creating an integral information waste management system, which would include all the data on waste streams and would offer support for the operation of the waste management system. The system would enable fast and high-quality waste management, monitoring, and updating data on waste, and would serve as a basis for planning the waste management strategy at the regional level.

The main contribution of this approach is the integration of spatial data and the data provided by Aleksandrović Winery (collected in the field), which can be an example of 'good practice' for implementation of the no-agro-waste concept in other wineries and wine regions in Serbia.

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Data availability

The data that support the findings of this study are freely available in 'Spatial/territorial analysis as support to WMP and SEA for the selected case study area', accessible at https://doi.org/10.15454/HOTPJB.

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PUBLISHING AND SPATIAL PLANNING – THE DRIVING ROLE OF THE INSTITUTE THROUGH THE PRISM OF THE JOURNAL SAVREMENE URBANISTIČKE TEME (1961-1981)

Milena Milinković[1], Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
Jasna Petrić, Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
Ana Niković, Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia

This paper emphasises the role of people who have been employed at the Institute of Architecture and Urban & Spatial Planning of Serbia as well as a number of its external associates in the development of spatial planning in Serbia. It highlights the significance of the publishing role of the Institute, which goes hand in hand with its work on scientific research and professional projects, with a special focus on the journal *Savremene urbanističke teme* (Engl. *Contemporary Urban Themes*), one of its five serial publications. This journal is significant because it published analytical and study articles, translations, critical reviews, and reviews of important achievements in urban and spatial planning at a time when spatial planning in Serbia was still in its pioneering phase, which resulted in the launch of ambitious projects with a wider social impact. The important contribution of this paper is the bibliography of the journal *Savremene urbanističke teme*, as well as four accompanying registers that present all of the authors of its texts and all of the published titles.

***Key words*: journal *Savremene urbanističke teme* (Engl. *Contemporary Urban Themes*), bibliography, publishing activity, spatial planning, Institute of Architecture and Urban & Spatial Planning of Serbia.**

THE INSTITUTE OF ARCHITECTURE AND URBAN & SPATIAL PLANNING OF SERBIA AND THE BEGINNINGS OF PUBLISHING

The Institute of Architecture and Urban & Spatial Planning of Serbia celebrates its 65th anniversary in 2019. It has been established and began operating continuously since 1954. First, it was founded as the Institute of Architecture and Urban & Spatial Planning at the Faculty of Architecture, University of Belgrade, and it was only seven years later, in 1961, that it became an independent institution. Although founded (according to official decision number 3696 from December 7, 1954) to study and address particular problems in the field of architecture and urban planning, to give scientific and expert opinions in the field of planning, to design and construct architectural structures and urban solutions, to organize public lectures aimed at scientific reference and discussion, and to organize consultations and conferences on architecture and urban planning, from the mid-1960s the Institute was already "increasingly oriented towards research and professional work in the field of spatial planning and organization" (Petrović, 1978).

Along with the first scientific research papers (Milinković, 2016b) and professional projects, publicity activities also developed throughout these years, and these have become an important backbone of the Institute's work. The journals that were the forerunners of those published today at the Institute are: *Zbornik radova* (Proceedings), in which presentations of projects from the field of architecture and urban planning were published (Milinković, Niković, Petrić, 2019), *Savremene urbanističke teme* (Contemporary Urban Themes), with papers in the field of spatial planning, and *Saopštenja* (Press Releases).

Unlike the current series of publications, *Arhitektura i urbanizam* (the top national journal in the field of transport,

[1] Bulevar kralja Aleksandra 73/II, 11000 Belgrade, Serbia, milenam@iaus.ac.rs

urban planning and construction – M51, and recently, i.e. as from 2019 this journal is categorised as a national journal of international importance – M24) and *Spatium* (a national journal of international importance – M24), which strictly apply the recommendations given in the *Act on Editing Scholarly Journals*, of July 9, 2009 that relate to both the journal as a whole and its constituent parts (Milinković, 2016a, 2018), this was not taken into account in the 1960s, '70s and '80s.

In addition to journals, the first three of which have ceased to be published over time, numerous Special Editions have been published, with 86 monographs published to date. Also, a significant place within the publishing oeuvre of the Institute is occupied by collections from the scientific and professional conferences it has organized.

THE FLAGSHIP AND DRIVING ROLE OF THE INSTITUTE IN THE PRACTICE OF SPATIAL PLANNING

The 1960s were fruitful for the Institute of Architecture and Urban & Spatial Planning of Serbia not only in terms of launching journals, i.e., publications in the fields of architecture, and urban and spatial planning, but they were also years in which the pioneering role of the Institute took off and the staff and long-term asociates of the Institute were able to lay the foundations of spatial planning in Serbia.

The beginnings of spatial planning at the Institute rested on architectural and urban traditions as well as on the courage of individuals to step out from their profession as architects and urbanists and express the enthusiasm inherent to the period of post-war reconstruction and construction of the country. Above all, Milorad Macura should be mentioned, who became director of the Institute in 1962, a few years before the *Savremene urbanističke teme* journal was launched, and remained as such until 1968. The organizational system that Macura introduced at the Institute when he became director shaped its scientific and research character. He conceptualized the method of working at the Institute as a kind of synthesis of individual and collective engagement, in order to secure the acceptance and implementation of every progressive idea (Janakova Grujić, 2010:237). Milorad Macura's role was paradigmatic – he instigated large-scale initiatives following great role-models, and at the same time overcame the obstacles he encountered "in the way it was usually done in that heroic era: either the obstacle was broken down, or a new job that was always within reach was accepted" (Manević, 1996:68). He approached each theme at the Institute in a systematic and meticulous way, based on scientific research work and many years of experience gained through practice. Milorad Macura was also profiled as a person who was able to think beyond established norms and frameworks, introducing and theoretically elaborating the term "spacium", defined as "the space of human life formed, organized and equipped by the work of society" (Macura, 1964:49). The term "spacium" includes "all categories of spaces in which human life takes place, including the region and the city and the building and the room" (Ibid.). From this kind of thinking, the postulate continues to develop that "the space of modern man is organized – it is looking for a plan and an organizer" (Janakova Grujić, 2010:244). It is therefore not surprising that Macura's emancipatory role resulted in regional (spatial) planning being mentioned in the studies and development programmes at the Institute in the given period for the first time. Despite the fact that the focus of the Institute's work was on architecture, in the 1960s, through scientific research work, it endeavoured to affirm regional planning, that is, to influence the formation of theoretical, normative, methodological and other assumptions for initiating the development of the Spatial Plan of the Republic of Serbia (Marić (ed.), 2014:151).

This ambitious project – the Spatial Plan of the Republic of Serbia – was initiated at the end of the 1960s by the Institute of Architecture and Urban & Spatial Planning of Serbia and the Bureau for urban planning and communal activities of Serbia, which worked together on the so-called "first element" (inventory, analysis and assessment of the current state). The Institute of Economics worked on the so-called "second element" (economic development), and Center for the Analysis and Design of Spatial Systems (CADSS) worked on and coordinated the "third element" (spatial organisation). Development of the Spatial Plan of the Republic of Serbia at the time was coordinated by eminent experts and associates from the Institute – Dimitrije Perišić, Dušan Radmanović and Borko Novaković. Unfortunately, the pre-draft of this spatial plan, formulated in the early 1970s, was not referred as far as the review procedure and was never adopted. In the next version, the Spatial Plan of the Republic of Serbia was prepared in the late 1970s (working version "Basis of the spatial plan"), and experts from the Institute, Branislav Kojić and Đorđe Simonović, had limited involvement consisting of preparing expertise in the development of villages. Following this, work on the spatial plan was stopped, i.e. there was a pause until the beginning of the 1990s, when the Institute took the leading role in developing the first adopted Spatial Plan of the Republic of Serbia (1996), the adoption and implementation of which were meant to initiate reforms in the field of planning, while also respecting current trends in European planning systems and practices. Dimitrije Perišić led the drafting of the plan, and the team for the coordination and synthesis of the plan was made up of him, Ksenija Petovar, Miodrag Vujošević, Dragiša Dabić, Branislav Đorđević and Branislav Derić, as associates or employees of the Institute. The Institute was one of 8 scientific and professional institutions that, in 2010, were involved in developing the current Spatial Plan of the Republic of Serbia for 2010-2020. Drafting of the plan was coordinated by the Republic Agency for Spatial Planning, and the Institute participated to a considerable extent in preparing the study basis and synthesis of the plan, and developing a programme for its implementation. Those from the Institute responsible for drafting this plan were: Miodrag Vujošević, Slavka Zeković, Ksenija Petovar, Marija Nikolić, Marija Maksin, Dragiša Dabić, Saša Milijić, Mila Pucar, Marina Nenković-Riznić and Omiljena Dželebdžić (Marić (ed.), 2014). Most recently (as from September 2019) Institute was commissioned (in a consortium with five other institutions) to develop the Spatial Plan of the Republic of Serbia from 2021 till 2035. The management team of this Plan is consisted of the experts from the Institute: Saša Milijić, Marija Maksin and Nebojša Stefanović.

In addition to the important place and role that the Institute of Architecture and Urban & Spatial Planning of Serbia has had since the 1960s in its continuous work on the umbrella planning document for the state – the Spatial Plan of the Republic of Serbia – it has also developed spatial planning practice at lower planning levels, as well as further strengthening the links between spatial planning and scientific research.

Another highlight is the Institute's role in drafting the first regional plan in Serbia for the Kolubara District, which was affected by an earthquake; the Plan was adopted in 2002. The management team working on the plan was made up of: Dimitrije Perišić, Slobodan Mitrović and Saša Milijić. Subsequently, the Institute participated, usually with a leading role or as part of a partnership, in the drafting of another 5 of the 9 regional spatial plans in Serbia adopted by 2015, and in the programmes for their implementation adopted by 2016.

The role achieved by the Institute in the 1980s and 1990s was also important in its development of a methodology for spatial plans for special purpose areas, with an emphasis on applying an integrated problem-solving approach in the relativization of conflict, the protection and remediation of space, sustainable development, etc. Spatial plans for special purpose areas are based on these factors (for large mining basins, protected areas of natural values and immovable cultural assets, mountain and other tourist areas, areas of water storage reservoirs, infrastructural corridors, etc.), and a significant number of these plans have been developed by the Institute of Architecture and Urban & Spatial Planning of Serbia to its own high standards. Preparation of these planning documents has been and is managed by some of the Institute's leading experts: Nenad Spasić, Dimitrije Perišić, Saša Milijić, Radomir Malobabić, Vesna Jokić, Zoran Mirjanić, Marija Maksin, Miodrag Vujošević, Slavka Zeković, Nikola Krunić, Omiljena Dželebdžić, Olgica Bakić, Dragiša Dabić, Igor Marić, Slobodan Mitrović, Gordana Džunić, Marina Nenković-Riznić, Jasna Petrić and others (see: Marić (ed.), 2014).

Finally, in the field of spatial planning practice at the Institute, the role of its experts in preparing a large number of spatial plans for cities and municipalities stands out (over 16). This activity began in the 1970s and continued through many years of cooperation with local self-government units in Serbia and Montenegro (Valjevo, Požarevac, Bor, Knjaževac, Topola, Aranđelovac, Užice, Čajetina, Priboj, Aleksandrovac, Lazarevac, Budva, Bar and others). From the ranks of the employees and associates at the Institute, those responsible for preparing spatial plans for municipalities and cities were: Borko Novaković, Nikola Manojlović, Nedeljko Borovnica, Milan Bursać, Aleksandar Penušliski, Dobrivoje Tošković, Nenad Spasić, Miroslav Antanasijević, Marija Maksin, Vesna Jokić, Dragiša Dabić, Igor Marić, Saša Milijić, Nikola Krunić and others (Marić (ed.), 2014:156).

It is important to note that the development of spatial plans at the Institute is accompanied by appropriate IT support, that is, the use of modern information systems in planning has been successfully developing and advancing its methodology at the Institute since 1990. Preparing spatial planning documents in GIS (leader: Nikola Krunić) became standard practice at the Institute, beginning in the period 2005-2008 when the Spatial Plan for the Stara Planina Nature Park and tourist region was produced. This was the first spatial plan to be completely developed in a modern GIS environment. By introducing this practice, the Institute proves that the development and implementation of GIS, first in spatial, but also in urban planning, enables "integration, precision, simpler data exchange, the visualization of planning solutions and the formation of a database and information system for the planning area, as well as the monitoring of conditions and processes in space and more effective control of the implementation of planning documents" (Marić (ed.), 2014:161).

THE *SAVREMENE URBANISTIČKE TEME* JOURNAL

This paper gives special attention to the journal *Savremene urbanističke teme* – a periodic publication that first came out in 1965 and included analytical and study articles, translations, critical reviews, and any significant achievements in urban and spatial planning. The last issue, number 8, was printed in 1981.

The first issue of *Savremene urbanističke teme* focused on the relationship between social and spatial planning in Yugoslavia and the mutual influence that the community and space have on one another. Since the relations between social and spatial planning are not sufficiently understood, nor clearly defined, the Commission for Regional Studies, Planning and Design entrusted Dr. Branislav Piha, permanent expert associate of the Institute, to study these issues and, through a comparative analysis of legal documents and practices, define unresolved questions and particular attitudes. The results of this research were presented in the only appendix in this issue of the journal.

The second issue contains contributions from the 3rd Congress of Yugoslav urbanists. Papers by authors Branislav Kojić, Branko Maksimović, Milorad Macura, Branislav Mirković and Ranko Radović were printed. Branislav Kojić pointed out the unevenness of the network of settlements in the territory of Serbia as a consequence of the different political, social and economic conditions in which the settlement system was formed and developed in certain parts of the Republic (central Serbia gained complete independence in 1878; Vojvodina was part of the Austro-Hungarian Empire until 1918, and Kosovo and Metohija and part of the Sandžak (Ottoman administrative district) of Novi Pazar belonged to the Turkish Empire until 1912). Branko Maksimović gave an overview of the concepts formed abroad in relation to cities and suburban zones as regulators of the overall development of cities and a means of limiting the growth of "large" cities. Milorad Macura wrote about spacium, introducing in his work, a term that reflects the original and avant-garde way of thinking of the time. On the sixtieth anniversary of the Institute's foundation, the editorial board of the *Spatium* journal published a translation of this text into English and a transcript of the original text from *Savremene urbanističke teme*, no. 2, highlighting the importance of the numerous aspects of spatial planning considered and dealt with by the author, and with that the pioneering role of the Institute in the development of spatial planning in the state as it was then (Vujošević, 2014). In his paper, Branislav Mirković gave an overview of the natural and man-made factors that

influence the formation and development of cities and which greatly influence urban practice. Ranko Radović addressed the issue of the relationship dynamics between the cities within a particular region.

The third issue included five papers. Some of them looked at the problem of regional spatial planning in the socio-economic conditions of the time in Serbia and in the world, bearing in mind that regional spatial planning in the modern world was created between the two wars, but it was not until 1960 that regional spatial plans were mentioned in Serbia, i.e. with the introduction of urban laws in the Republic. Other papers in the issue highlighted the influence of human factors and natural factors on spatial planning. The authors of these papers were Branislav Kojić, Ranko Radović, Branislav Mirković, Vladimir Bjelikov and Branislav Piha.

Two papers from the fourth issue by Milorad Macura and Borko Novaković were contributions to a congress on the problems of determining the urbanization policy in FR Serbia, which expressed the meaning and role of spatial planning and spatial plans and listed some of the elements of spaciological issues.

Savremene urbanističke teme number 5 contained translations of professional papers published under the joint title of *Villes moyennes* (Engl. *Medium-sized cities*) from themed issues of the French journal Urbanisme (ISSN 0042-1014) from 1973, numbered 136 and 137. The translations were done for the research project "Methodical Model of Planning in the Case of Small Cities", financed by The Republic Association for Science of Serbia and from the Institute's scientific fund. The idea was to compensate for the lack of texts dealing with this theme and to provide the expert public with an insight into the position of medium-sized cities in the French national network of settlements at the time. As stated in the preface by Nenad Spasić (1978), editor of this issue of *Savremene urbanističke teme*, "there are significant differences between the network of cities in France and here in Serbia as well as in the conditions in which cities develop, (but it is) possible to draw some parallels, especially concerning the spatial and environmental aspects of development planning and physical planning for medium and small cities". A total of 19 papers were translated, 12 from number 136 and 7 from number 137 of the journal *Urbanisme.*

The sixth issue was devoted to research, planning, monitoring and management in the field of the environment through the presentation of four scientific and research projects: Spatial organization of the territory and environmental protection; the urban environment; the rural environment; and housing, integrated into the macro-project "Socio-political problems in human and environmental relations".

Issue 7 of *Savremene urbanističke teme* focused on a study entitled "Babin zub – a future sports and recreation complex on Stara Planina Mountain", which was produced at the Institute of Architecture and Urban & Spatial Planning of Serbia from July 1974 to August 1975 for its client, the Municipal Association of physical culture, Knjaževac.

The eighth issue presented two translated texts: *Research on the Quality of Life in Urban Settlements*, a paper by Swedish and Danish authors from Third Urban and Regional Research Conference held in Warsaw in 1975, and *Urban Environmental Indicators* by the Organization for Economic Cooperation and Development - OECD.

Although the Institute was established as a center that would enable the development of scientific work in the field of architecture and urban planning, the contributions in the eight volumes of *Savremene urbanističke teme* indicate the visionary aspirations of the Institute's employees who, through their scientific and professional work, have greatly contributed to the development of spatial planning.

Despite the great importance that this journal had, both from expert and scientific aspects, the final issue of *Savremene urbanističke teme* was published in 1981.

It was not until a request was made that Serbia's National ISSN Center assigned an International Standard Serial Number 2406-1115 (ISSN - International Standard Serial Number) to the journal *Savremene urbanističke teme* in October 2014. Once an ISSN number has been assigned by the National Center, the established procedure is that this number is sent to the International ISSN Center in Paris. It is then included in the International ISSN Register (Komnenić, 2004). Thanks to the ISSN number, analytical analysis of the journal *Savremene urbanističke teme* was made possible in the COBISS system, followed by the development of a bibliography with accompanying registers.

The periodicity of publication and number of papers per volume

From 1965 to 1981, 8 issues of the journal *Savremene* urbanističke teme (Table 1) were published, with a total of 61 contributions (Table 2). The first four issues of the

Table 1. The periodicity of Savremene urbanističke teme

Year	Number
1965	1
1965	2
1965	3
1965	4
1978	5
1978	6
1979	7
1981	8

Table 2. Number of papers per issue

Year	Issue number	Number of papers
1965	1	3
	2	6
	3	5
	4	2
1978	5	22
	6	6
1979	7	13
1981	8	4
Total		**61**

Table 3. Editors of the journal Savremene urbanističke teme

Editors-in-chief	Year	no.
	1965	1
Petar Grujić, technical editor	1965	2
	1965	3
	1965	4
Nenad Spasić, editor	1978	5
	1978	6
Dragiša Dabić, editor	1979	7
Sonja Prodanović, editor	1981	8

journal came out in 1965, and the next issue, number 5, came out thirteen years later. Despite the irregularity of its publication and the unequal number of papers in the journal, these texts present significant scientific projects, and urban and spatial plans, as well as translations of texts written by experts from France, Sweden and Belgium in the field of planning and spatial planning, and they highlight the important contribution of this journal in the development of spatial planning and urban practices in Serbia**.**

Editors

The specificity of the first issue of this publication is that it did not have an editor. Petar Grujić took on the responsibility for the technical editing of the next three issues of the journal in 1965 (No. 2, 3 and 4). Nenad Spasić was editor of the 5th and 6th issues published in 1978. Dragiša Dabić was the editor of issue number 7 in 1979, and the final issue, from 1981, was edited by Sonja Prodanović (Table 3).

INTRODUCTORY NOTE TO THE BIBLIOGRAPHY

The bibliography in this paper is primarily retrospective because it represents a certain number of papers published in several issues of a serial publication within a certain number of years. Although the number of papers, the number of volumes, and the number of years during which the journal *Savremene urbanističke teme* was published is not large, this bibliography, as the result of a research project, is a testimony, made up of collected knowledge and information about the journal and its role at the very beginning of the development of spatial planning in Serbia.

The bibliography includes all the contributions distributed over 8 issues of the journal *Savremene urbanističke teme*. It was developed by creating records in the electronic catalog at the library of the Institute of Architecture and Urban & Spatial Planning of Serbia within the COBIS.SR shared database. The records were created and gathered in one place, with the aim of providing the professional reading audience with an insight into research activities, urban practice and the beginnings of spatial planning in the Institute.

The bibliography was prepared *de visu* (with the publication in hand), which secured the authenticity of the information provided. When developing the bibliography, the International Standard Bibliographic Description for Component Parts ISBD(CP)[2] was used to describe the bibliographic items. Due to the extensive bibliography in the printed form, a shortened version of this standard was applied (the journal title and ISSN number were omitted). In addition to the title, responsibility and any notes, the description includes the year of publication, the volume number and the pages on which the text of the given article is located.

All bibliographic items are numbered in Arabic numerals, in continuous order from 1 to 61. In addition to the bibliographic material, a title registry, a name register, a subject register and a chronological register were made. Due to the considerable number of foreign authors given in etymological form, the bibliographic units and registers (except the chronological one) are given in alphabetical order.

Accompanying registers

The registers play an important role in the use of the bibliography. The registers are lists of systematic metadata from bibliographic units according to predefined principles. In this case, they are lists of titles, names, subject definitions and numerical codes, and like any other metadata they "describe, explain, locate or otherwise make it easier to search and use" (Petrić, Milinković, 2017: 156) the bibliography and find the required information.The first of the four registers is the *Register of titles*, which contains the titles of all the contributions to the journal. It contains all of the titles of the papers in Serbian, their translations in English, and the titles in French for all translated texts from the journal *Urbanisme*, as well as two original titles in English, the first by the Organization for Economic Cooperation and Development - OECD and the second, by Swedish and Danish authors. The bibliographic units that refer to the French titles and their translations include information on the issue numbers of the journal *Urbanisme* in which the original texts are located, as well as the exact pages on which they can be found. The bibliographic description of the text by the Danish and Swedish authors includes, among other things, the name of the city, the year of the conference and the name of the conference during which the original material was presented. For the second translated article from English, there is no other data apart from the titles in English and Serbian, as well as the name of the collective body that authored the article, since these are the only data that can be found in the bibliographic unit on the original text. In response to the listing of all variants of the titles, including the originals and translations, one can conclude what potential role-models they were at the time, given the lack of domestic texts on similar themes. The second register is the *Register of names* which is a list of the surnames and names of all of the authors, co-authors and translators. All of the names in this register, and in the previous register of titles, are arranged alphabetically according to the surname of the author. If there is a dual surname, individual determinants are applied to both, with a reference to the variant adopted. The *Register of names* is significant because it also contains the names of those co-authors whose names are not listed within the bibliographic

2 ISBD(CP) International Standard Bibliographic Description (component parts)

unit. This happens when the bibliographic unit describes texts produced by more than three collaborating authors. In addition to these determinants, the register also contains collective determinants, that is, the names of collective bodies (names of organizations and institutions) that appear as the author of the work. The collective determinants include all forms of the names, both in Serbian and in foreign languages, as well as acronyms that refer to variants of the full name. The next register in this bibliography is the *Subject Register*. It focuses on the basic research subjects covered in the texts. This register gives readers an insight into the topic presented by highlighting the most important terms mentioned in the title, abstract or conclusion, or any other keywords taken from the actual paper. The determinants are also listed alphabetically within this register. The numeric codes adjacent to the heading and subheading in all three of these registers represent the link between the registers and the bibliographic unit of the description to which they refer. The fourth and final register is the *Chronological Register*. It gives an overview of the published works in chronological order, indicating the ordinal number of the bibliographic unit, the year of publication and the number of the volume in which the article was published.

The bibliography of the periodical publication *Savremene urbanističke teme* is registrational in terms of its bibliographic description, providing only elementary information on the papers. If viewed from the standpoint of processing, this bibliography is subject-based because it provides relevant data on urban practice, scientific research and the first steps in the development of spatial planning at the Institute in the first decades of its existence. Its primary character is seen in the fact that it was made *de visu*, that is, according to seen material. According to the type of material covered, it is a bibliography of the constituent parts of the publication. It is also, as already noted, retrospective because it covers and processes papers from a journal published from 1965 to 1981 (Vranes, 2010: 32).

Creating a bibliography is only the first step in trying to prevent the efforts made by the editors, authors, co-authors and translators of this journal from being forgotten, indicating the importance of spatial planning. Its task is to present all of the published titles from *Savremene urbanističke teme* in a single place for potential readers, by means of pre-structured metadata within the COBISS.RS (Cooperative Online Bibliographic System and Services) system. The bibliography in this form is an apparatus that refers us to a physical or printed copy of a journal. The next step would be to present the content, i.e. to digitize it and make it available in full text format by uploading the digitized material to the Institute's website or institutional repository, thus facilitating access to the texts and saving time spent going to the library. This would be followed by integrating the texts from the *Savremene urbanističke teme* journal with the already formed annotated electronic domain corpus in the field of spatial planning for the purposes of searching, extracting information, statistical processing and forming an electronic dictionary of terms specific to that domain.

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Chronological register

CONCLUSION

From this brief overview it is transparent the long-standing role of the Institute's leadership, both from professional and scientific aspects, as well as in the launch of a serial publication by means of which its gained experience is documented. Although the journal *Savremene urbanističke teme* did not meet today's criteria for publishing scientific and professional publications, its contribution to the development of awareness of the importance of spatial planning is certainly indisputable, since at that time such a journal did not exist in Serbia. It was therefore important to launch a serial publication that would provide information on the first steps in the development of spatial planning in Serbia, as well as professional practice in this field overseas.

Just as, more than half a century ago, the main task of the journal *Savremene urbanističke teme* was to inform staff at the Institute, as well as external associates and the professional and wider public about current themes in the field of spatial planning (Spasić, 1978), it is also the task of this paper and accompanying bibliographies to show today's researchers and professional public the enthusiasm of those working at the Institute for laying down the foundations of spatial planning in Serbia, indicating the significance of the authors' names and the themes they developed.

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GEOMETRIC MODELING AND COMPLEXITY - A CONCEPTUAL APPROACH IN ARCHITECTURAL DESIGN AND EDUCATION

Rada Čahtarević [1], Faculty of Architecture University of Sarajevo, Sarajevo, Bosnia and Herzegovina
Adna Proho, Drei Architekten, Stuttgart, Germany

By encompassing abstraction and patterned information, the new fields of geometry and mathematical models of complex dynamic spatial systems provide a new method for spatial modeling. Different approaches to the application of spatial modeling in architectural design are possible, taking into consideration on the one hand the theoretical background and knowledge of geometry, and on the other, advanced computational techniques. The generative principles of complex dynamic spatial formation allow parallels between the differentiated representations and directions of approach to spatial organization. The integration of conceptual, theoretical and practical methods into complex dynamic geometric models in the preliminary phase of design could support the development of cognitive capabilities, internal representations and understanding of complex dynamic formative processes. The development of nonlinear, dynamic, complex spatial imaginative thinking corresponds with trends in contemporary computational design. The application of complex geometric modeling, including sophisticated mechanisms of human perception, intelligence and creativity, provides a synthesis of artificial and human potential.

***Key words*: architectural design, complexity theory, geometry, modeling.**

INTRODUCTION

Architectural design process deals with spatial determination and creation, in the context of a complex natural and artificial environment, and thus goes beyond the principles of rational linear logic that are not capable of encompassing the extremely complex intertwining of multiple parameters that shape the design space. The complex character of design means that adequate representation is difficult, and that it is not possible to apply a simple analytical approach, or to find optimal solutions by logical operations (Simon, 1962).

Through the process of graphical representation and modeling, it is possible to analyze a design, anticipate solutions and evaluate different variants, synthesizing multi-leveled abstract and concrete spatial information in proper representations. Graphical representation of an architectural design relies on geometric spatial modeling, from classical Euclidean and projective geometry to contemporary dynamic geometric structures and computational models. The expansion of new fields of geometry that are supported by computing technology, as mathematical models of complex dynamic systems, could provide a new approach to spatial modeling that should be investigated and applied in architectural design. Different approaches are possible, considering on one hand the theoretical background and knowledge of geometry, and the other advanced computational modeling techniques. The role of geometry in architecture and architectural education will be analyzed and explored in this research through consideration of the application of complex dynamic geometric modeling in the conceptual phase of architectural design.

DESIGN COMPLEXITY AND GEOMETRIC MODELING

The development of architectural spatial concepts and the structural framework of spatial plans are determined by spatial geometry. Based on the abstraction of spatial elements and their relationships, geometry deals with the universal properties of spatial structures, as the union of empirical experience and logical deduction, which can be applied in physical science and engineering. Geometric modeling is a rational and intuitive process that involves the perceptual, cognitive and logical structures of the

[1] Patriotske lige 30, Sarajevo, Bosnia and Herzegovina, radac@af.unsa.ba

human mind in a single stream of incessant activity. Classic geometry fixed by conventional means of representation is now changing, expanding towards greater complexity and a more dynamic form. Information technology opens new constructive possibilities in a new medium, raising some fundamental questions related to the modeling of space, enveloping non-linearity, self-organization and complexity.

Complex nonlinear dynamic systems

The theory of complex systems has been developing since the second half of the 20th century, generating new concepts in science and technology. Complex systems are composed of numerous different components, connected in a nonlinear way, forming a whole dynamic spatiotemporal pattern that cannot be described as the sum of its parts. The science of complexity envelops the diversity and heterogeneity of many natural and physical systems. Numerous design and engineering problems could be better approached with a basic understanding of the dynamics and properties of complex systems. By transcending linear ways of thinking, new spatial concepts are established, based on complex systems theory and its models. Various kinds of complex systems at the abstract level exhibit common properties (Mitchell, 2009). Different natural, physical and artificial human-designed systems can be studied based on similar principles of their complex dynamics and organization.

The elements of complex systems are characterized by diversity, differentiation, a leveled hierarchical structure and complex dynamics (Simon, 1962). The stability within those complex systems results from a dynamic balance, with more equilibrium states, which maintain the system to be stable but not static. The structural hierarchy of complex systems is neither homogeneous nor linear. The identity of complex systems emerges from their dynamic organization, in which their boundaries and hierarchies are simultaneously maintained and transformed (Cilliers, 2001).

The geometric model of a complex dynamic space envelops a continuity of varying degrees of complexity, forming a hierarchical multiplication of scale sizes and dimensions. The generator for the development of a complex system could be a geometric structure with different degrees of complexity. Forms of complexity have a changeable shape that is only a phase state at a certain level of development dynamics. One form includes a variety of spatial and temporal levels, and passes through various stages and degrees of formation. The principle rule of the spatial order is transmitted through different levels and directions, different scale sizes and dimensions. The visual representation of complex dynamic forms expresses multiple-scale order and often visually "irregular" shapes as a result of iterated transformation processes on different scales (Figure 1).

Modeling and geometry of complex design space

From the ancient systems of proportions, Renaissance projective space and modernist geometric modularity, to the digital morphogenesis and computational design of the late 20th century, architects have been trying to determine rules and patterns for the suitable spatial modeling of architectural forms. The rules of geometry have often been intertwined with rules of composition, aiming to achieve unity for all parts of a designed object, recursively applying rules at different levels of details, mostly in a top-down structure: from abstract definitions to specific instances (Mitchell, 1990).

The development of CAD/CAM technologies, dealing at first mainly with the application of computer graphics in the representation of an architectural design, highlighted the need to further explore the possibilities for geometric modeling based on more complex geometry. Both geometry, understood as a decontextualized system imposed from above, and geometric form, seen as a perfect solution to spatial problems, are in conflict with architectural endeavors emerging in the real space of an extremely complex context.

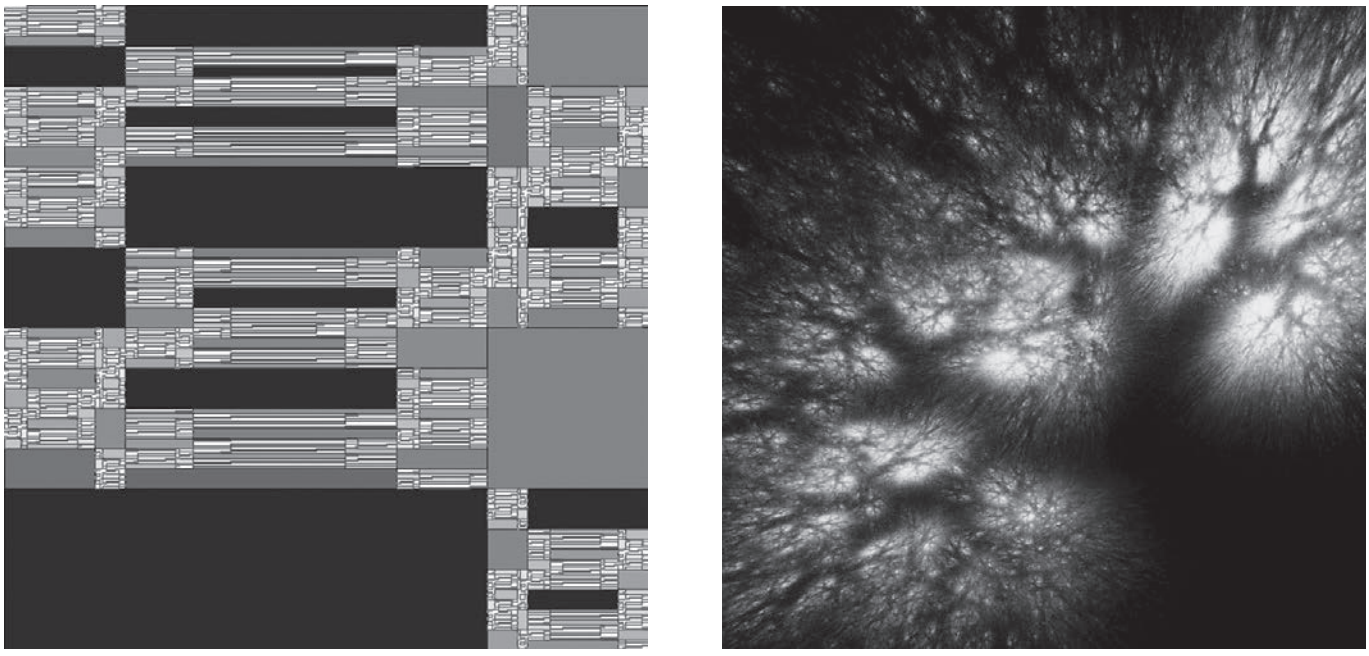

Figure 1. Representation of complex geometric structures: Examples of fractal geometric patterns as iterated multiple-scale ordered systems. (Source: authors using Fractal Subdivision applet and Apophysis software)

The geometrization of space in modernism based on universal abstract shapes is superseded by the universality of complexity and transformability of an evolutionary form (Čahtarević, 2008).

Studies of the properties of complex dynamic processes and their morphogenetic manifestations and patterns, with the help of theoretical models of complex systems on one hand, and enhanced with computing technology on the other, contribute to a better understanding and application of equivalent principles in the design of architectural form. The design process includes indeterminate, unstable and complex situational contexts. In the conceptual stage of design, a specific kind of thinking is required that has a complex character. It includes the multiplicity of different parameters, which may be conflicting, complementary, or have an ambiguously defined structure. The design process involves an unstable area of exploration as uncharted territory. Conceptual design thinking requires an open design space, where the resolute solution is often not the most optimal choice, but rather emerges from the synthesis of a multitude of different insights throughout the design process (Cross, 2008).

Digital and post-digital tendencies in architectural design

Architecture of the "digital age" relied on digital information technology and spatial modeling in virtual space, by rationalizing the form through computational geometric determination, which prompted computational geometric formalism. On the other hand, biomimicry and the exploration of natural generative processes have led to a new approach by means of the digital materialization of the architectural form. It integrates biology, physics and geometry with engineering, towards design based on the interconnection of form, structure and material (Menges, 2007). New insights into the notion of material, shape and form, can be gained through a new approach to geometric reasoning and modeling based on more complex and dynamic conceptions of geometry. By entering a new domain of information technology and computation, algorithmic processing of information and pattern-oriented design, geometric modeling introduces non-linearity, self-organization and complex relationships into architectural design, as well as parametric design and digital fabrications (Legendre, 2011).

The "digital turn" brings into focus the integration of modeling, graphic imagery, and geometry (Ammon, 2017). The application of 3D modeling software in architectural design rarely demands a deeper knowledge of computational logic and the utilization of computing techniques in architecture is often reduced to mastering the commercial software and its graphic user interface. In fact, digital tools reveal that full spatial control is not possible and is limited by the user interface properties, demanding that the designer enters the depths of programming and computational logic. "Computational design" is mainly focused on the logic of the design process, the formal quality of the design methodology based on computational power and information processes, structural design and performance. The language of the formal logic of the computer and the algorithmic design rules aim to define the model of the object being designed as a computational process (Aish and Bradella, 2017).

What characterizes the "post-digital" approach in architecture, on the one hand, is how to get behind the limits of the user interface, and on the other hand how to get out of the standard representation models that computer graphics relied on in the early "digital age". The restriction of user interfaces could now be overcome by programming and coding, but at the expense of the simplicity of design description, making it mostly unreadable and incomprehensible, and lacking coherent correlation with natural linguistic, visual or cognitive human capacities, or with intuitive processes of human creative performance.

After the breakthrough of the digital and computational paradigm into the engineering and design domains, a new approach is arising in reaction to the overall impact of digital technology on human society. Human-computer interaction has become a new paradigm, focusing on the human role in contemporary technology. Computational systems established in formal languages cannot capture the intentionality, judgment, and insight necessary for a creative approach to design problems. Computational systems, as symbolic systems that are enclosed in structural rules, limit open interpretations that lead to an understanding of new, unrepeatable situations, in the context of existing representations and their necessary modifications (Winograd, 1991).

INTEGRATING INTERNAL IMAGINATION WITH GEOMETRIC MODELING AND REPRESENTATION

Following architectural thought, from modern and postmodern "form follows ..." to the architectural "digital age", the classical education of architects and the application of geometric modeling of space was focused mainly on functional design and technical external visualizations of architectural design solutions. Eastman (2001) emphasizes the importance of the designer's internal mental imagination and representation of the current design context as the main concerns in design education. Mental imagery, used for cognitive processing and reasoning, could be internalized from the learned external representations. Thus, the ability to learn new representations has become crucial in forming mental constructs and the contextual definition of complex designs (Eastman, 2001).

The emphasis in the first digital phase was on the externalization of mental processes through computational tools, treating computers as an extension of the mind (Picon, 2004). The digital became hybridized with the physical; the material world became enhanced and even produced digitally. But the reverse process is possible: to internalize computational principles as enhanced mental imagination. It is necessary to put internal and external representations in a proper balance, avoiding too much emphasis on external representations powered by computer technology.

Computer-aided design brings almost infinite possibilities of variations and generation of forms. Picon warns that "While form can vary endlessly, choices have to be made; decisions have to be enforced in order to break with the theoretically reversible nature of digital manipulation"

(Picon, 2004). Stolterman emphasizes the importance of design judgment, which must be equally valued as rational decision-making within "design as an informed process of intention" (Stolterman, 2003). Design judgment is based on accumulated experience and designer choices in complex and unique situations based on "knowledge inseparable from the knower" (Stolterman, 2003). The qualitative and quantitative aspects of a particular situation are too complex to be oversimplified and analyzed by simple, or single, rational models, so the analytic approach often dissolves in an endless chain of data and divergent information structures. Too much emphasis on computational generalization and rationalization causes a loss of particular and real insight into the specific situation, making some aspects invisible by rational framing, potentially causing unforeseen consequences by reducing the real-world complexity. It is necessary to enhance capabilities for design judgment as a convergent process that provides focus and "brings form and meaning" into complex, real-world situations (Stolterman, 2003).

Thus, the educational goal dealing with complexity in the architectural design should not be just to learn an advanced technique of digital and parametric modeling or force a theory as a direction to follow by executing rational algorithmic rules, but rather to enhance human cognitive capabilities and insight into the multi-leveled and interactive aspects of complex real situations. No computational model can fully subsume environmental complexity, so the recognition of behavioral tendencies and patterns is considered as the main objective of computational morphogenesis, according to Menges (2007).

Modeling process becomes the most important aspect in design, which takes place on multiple levels and in parallel. According to Ammon "design models play an important role as instruments of cognition" (Ammon, 2017). It is necessary to instigate a basic knowledge of new spatial models into architectural education, based on a more complex and dynamic approach, introducing architectural students to the geometry of complex systems and their modeling. Internal mental imagination and reasoning can be enhanced, not just by imposing formal computational determination and digital expression by computer-generated external representations, but based on the integration of complex dynamic geometric modeling and representation with intuitive insight in the preliminary conceptual phase of design. The results of such an approach used at the Faculty of Architecture at the University of Sarajevo are presented here as an example of possible teaching methodology.

Conceptual approach to complex form and geometry in architectural education - case study at the Faculty of Architecture, University of Sarajevo

At the Faculty of Architecture, University of Sarajevo, within the framework of elected subjects and modules, students were introduced to the theoretical background of the theory of complex systems, as well as new fields of geometry such as fractal geometry, dynamic computational models such as cellular automata, and examples of various software applications that allow visualization of complex geometric structures. However, specific software was not immediately used in the further process (reasoning, planning and design). The aim of the study was for students to apply the theoretical research and project design in their master's theses, supported by an understanding of dynamic formative geometric concepts and complex spatial patterns, with the aim of achieving the complex dynamic morphological genesis of spatial organization in preliminary architectural design. The geometry in this approach should not be considered just as a frame of descriptive external representation, allowing graphic visualization of the shapes conformed into the geometric figures and bodies, but as a generator of internalized mental structuring of information, allowing different interpretations coordinated within material, physical and environmental constraints. By structuring spatial information, geometric spatial modeling becomes a generator of the creative formative process, supporting intuition, and directing it into intelligent, qualitative, innovative thinking.

Students were introduced to a new kind of abstraction, based on compressed information instead of generalizations, and which can uncover unique principles that govern the dynamics of complex systems, revealing their generative structure hidden in mostly disordered visual shapes. Students worked at different levels of abstractions, allowing parallels between the top-down and bottom-up approaches. The form of the architectural object is viewed as a whole, but also as part of a larger entity, in a spatial, temporal, material and immaterial sense, interacting with a complex environment as a multi-layered integrative system of subsystems. In complex geometric modeling, the form cannot be reduced to the sum of its elemental parts. Form emerges from a multi-layered network of reciprocal relationships that overlap across different levels and scales of magnitude. The students were instructed to recognize and abstract the patterns of different architectural spatial forms (from natural to artificial, from urban to structural or material). The importance of the particular situation and context was emphasized, returning geometry to concrete patterns that contain historical, temporal and material layers (Figure 2).

The students first detected all the elements of impact and significance to the project (characteristics of the specific location, sociological conditions, architectural program and others), then they made an abstraction of them (from concrete to abstract), establishing a scheme of interrelationships and interdependencies between the elements. This resulted in the pattern of their function that would define the form of the project. The form thus defined represented the synthesis of all spatiotemporal levels of the object, which are treated separately in the classical design approach. In the classical approach, the design process was not focused on the form of the object, but rather on the shape and function to which other components of the solution were subordinated. In the process of setting up the concept of a future object, instead of a linear process, a multi-leveled network is created. This network becomes the frame of reference for formulating the concept. In this way, the conceptual form of the object arises from the elements significant to it.

The final solution is the concretization of the abstract, making it possible to reconcile the conceptualization

and operationalization: the abstract form as a constant, and the particular materialization becoming a variable determined by specific constraints. By means of a geometric conceptual model that integrates mental images and geometric structures, space is hierarchically constructed, not only describing objects like shapes, but the process of generating, mapping, transforming, combining, and forming. Its topological form, which is the general framework, is differentiated into increasingly detailed levels, introducing specific limits. Form is created as a conceptual and structural expression of modeling that can integrate discreteness and continuity, 2D and 3D representations (Figure 3).

Results and discussion

The students recognized spatial conceptualization and its geometric modeling based on complexity theory and its application as being more comprehensive than the usual design approach (including modern and postmodern design methods, which are more focused on spatial visualization). Considering the multi-leveled interdependence of individual elements as factors of importance in the project, through the complex intertwining of the analytical and synthetic procedures in the process of defining the form, students were more confident and creative in their search for final solutions.

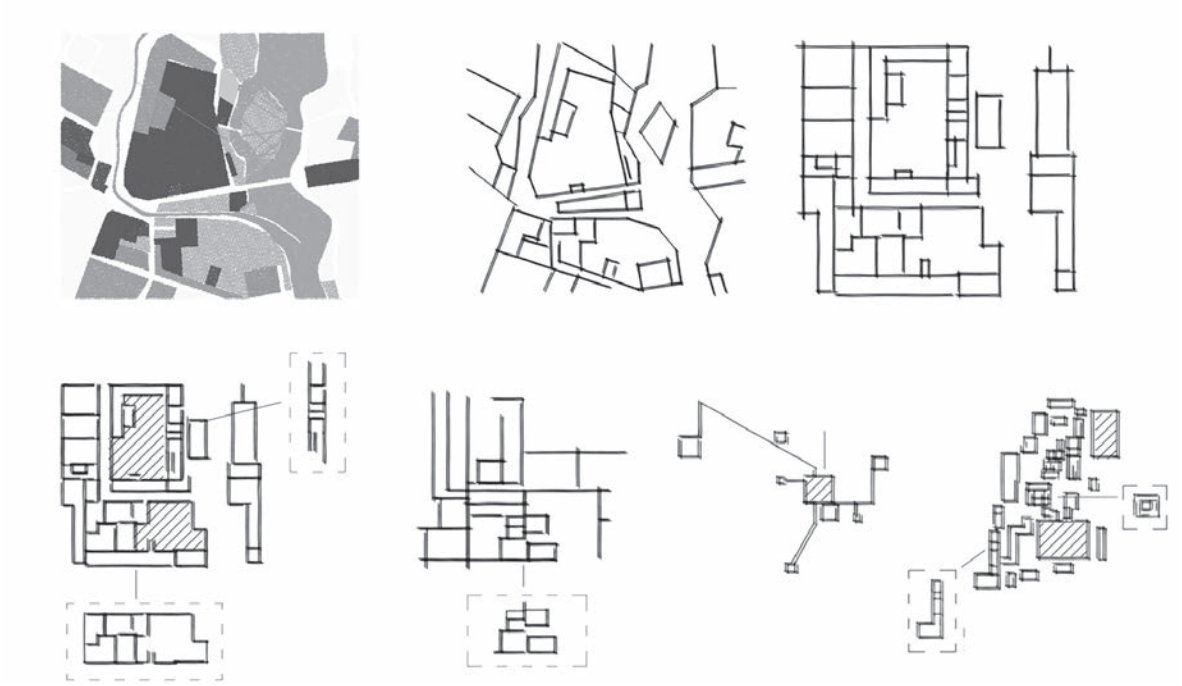

Figure 2. Abstracted patterns of urban structures, as the principles of organizing complex systems and subsystems - analytical research in student design work. (Source: MA student A. Alibegović, Master's thesis: "The complex geometry of the city as a generator of ideas for the design of the administrative facility", Faculty of Architecture Sarajevo, 2015)

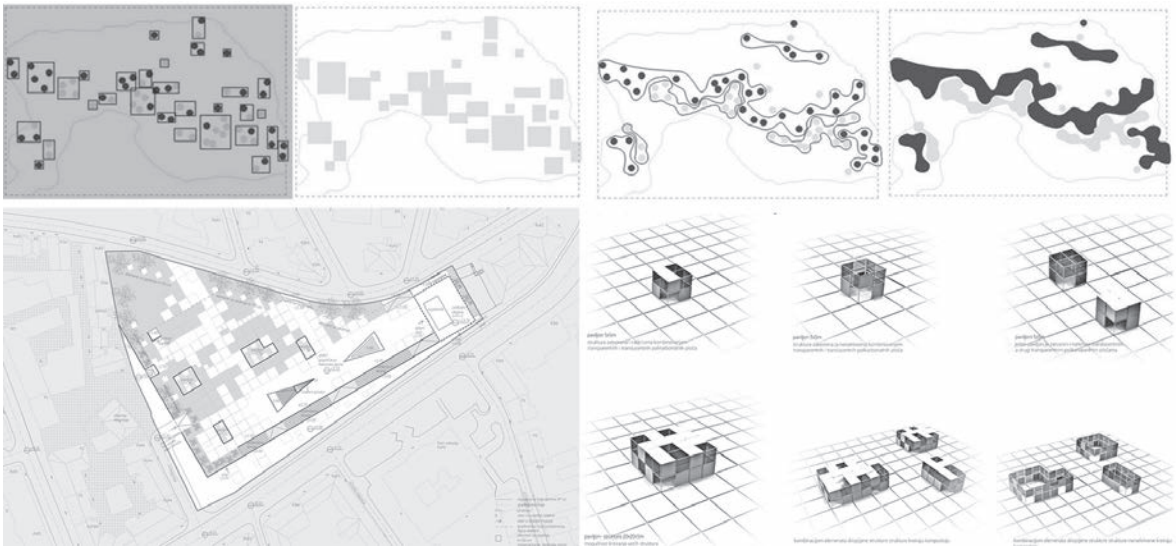

Figure 3. Conceptualization of spatial organization based on analyses of complex patterns of order and disorder of the city in war. (Source: MA Student Adna Šarac, Master's thesis: "Museum of the Sarajevo Siege 1992-96", Faculty of Architecture Sarajevo, 2015)

In the development of the design concept, the principles of functioning are defined, and empirical facts are established. A multi-leveled abstraction of facts and their connection as abstract laws and explanations are followed by concretization and a return to material practice. By abstraction, depending on the nature of the information or data being processed, different structural patterns of spatial design can be explored. In the next step, the patterns are joined: by overlapping, connecting, networking on different levels, thus forming a hierarchical structure of complex character. A multitude of different variations can be explored, through many levels and scales. The complex solution emerges from the non-linear development of the design process realized through a reciprocal use of bottom-up and top-down approaches, also integrating different intermediate levels. It is important to emphasize the importance of a complex nonlinear approach to design modeling in all phases, from ambivalent preliminary sketches to more concrete and contextual interpretations. The models must be visually and structurally legible, but open for a wider and more complex internal insight, allowing multiple variations and flexible representations.

CONCLUSION

Integrating the geometric abstraction and rational determinism of formal design methods with an intuitive, subjective experience of space can be achieved, turning away from a narrow understanding of "digitally" determined design and computational geometric formalism, towards a more complex spatial conceptualization and modeling. Modeling conceptual design space combines mental processes and geometric structures, simultaneously building and describing a space of mental and physical informational matrices. Established by dynamic relational patterns formed as a hierarchy of different connections at different levels and spatiotemporal scales, more complex design models are based on geometric abstractions integrated with the intuitive and creative processes of the human imagination and cognition. Represented through different media and different levels of complexity, geometric form becomes the generator of creative processes and new qualitative expressions. The complex character of architectural design requires on the one hand the externalization and visualization of conceptual thinking through abstract modeling, enabling the parallel setting, description and evaluation of problems and solutions, and on the other hand the internalization of representation and mental imagination, creating a design space as a complex system with more interdependent levels of abstraction and comprehension.

The focus of architectural education should be directed towards the development of more dynamic and complex spatial imaginative thinking corresponding with developing computational trends in contemporary design and more complex concepts of geometry. The application of complex geometric modeling, as the integration of the abstract and physical realms, including the sophisticated mechanisms of human perception, intelligence and creativity, provides a synthesis of artificial and human potential.

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PUBLIC-PRIVATE PARTNERSHIP AS A POSSIBILITY FOR IMPROVING MUNICIPAL WASTE MANAGEMENT

Đorđe Jovanović[1], School of Engineering Management, Union Nikola Tesla University, Belgrade, Serbia
Tatjana Živković, Belgrade City Administration, Belgrade, Serbia

A consequence of the high concentrations of the population in big cities is the growth in the amount of municipal waste generated. This has resulted in an accelerating need for developing as efficient a municipal waste management system as possible on a local level, based on legal requirements and the rules of good conduct within this field. The city of Belgrade is used as a case study for analyzing the existing problem of waste management (based on the Waste Management Plan), system elements and operational performances (special waste disposal), and the possibilities for improving the system by contemporary technical and managerial solutions. This is especially analyzed on the basis of provisions and obligations stipulated in the recently signed PPP contract on public-private partnership (PPP). In this paper, the author discusses possible comprehensive improvements of the municipal waste management system based on the obligations of the signatories of the said contract.

Key words: **municipal waste, management, PPP, Belgrade.**

INTRODUCTION

The issue of generating an increasing amount of waste, along with its management and disposal is becoming a growing and alarming problem of the contemporary world, especially in developing countries (Ferronato and Torretta, 2019). Managing solid waste, in particular municipal solid waste (MSW) and food waste results in serious pressure on the environment and society as a whole, especially in cities (Dasgupta and Gondane, 2019). In order to manage and solve the issue of MSW, modern integrated facilities in accordance with the highest standards are used. Through their work, energy is acquired through waste combustion, as well as organic substratum (compost), and inorganic inert matter is placed in landfills. In addition, recycling is conducted wherever possible.

Reduction of the amount of waste deposited is a desirable option for waste management, since in this way, numerous risks associated with landfilling can be avoided (self-combustion, waste landslides, etc.), as well as the impact of the landfill itself, since they can have a significant negative impact on the environment and human health. Air, groundwater, surface water and the soil are directly affected, and noise pollution is another result (Ohajinwa *et al*., 2019).

Air pollutants emitted from landfills are nitrogen and sulfur oxides, dioxins, furans, dust and heavy metals (Hussain and Bordoloi, 2019). Municipal landfills emit landfill gas (a by-product of the waste biodegradation process), of which about 50% is methane (potentially explosive gas), and unpleasant odors have a significant impact on the quality of life in the vicinity of the landfill. It can be said that (generally) there is no direct and instant impact of the work of landfills to human health. However, indirect threats to health can, over time, result from: uncontrolled waste distribution into the immediate environment by the wind (and by animals feeding on site) (Pornpilai Thanomsangad *et al*., 2019), separating gaseous pollutants, the (self-) combustion of waste and resulting emission of (hazardous) products of combustion, the penetration of processed water from the landfill into subterranean waters, the endangerment of the water supply and watercourses in the wider area, as well as the spread of unpleasant odors. Inadequate management of (potentially hazardous) medical waste, as well as its treatment (World Health organization, 2018) and finally disposal, might lead towards an increased risk to the health of people located in the vicinity of landfills (Manzoor and Sharma, 2019). Thus, it is very important to clearly understand both the ecological impact of landfills and their impact on human health (Manjula *et al*., 2019).

The contemporary concept of infrastructure planning for "green and smart cities" (Crnčević, *et al*., 2017), as well as

[1] Bulevar vojvode Mišića 43, Belgrade, Serbia
jovdjor@gmail.com

implementation of the "circular economy" concept (Ghisellini *et al*., 2016) are nowadays widely accepted (Lieder and Rashid, 2016). In addition, the concept of public-private partnership (PPP) is increasingly being implemented in the field of public utilities and waste management (Brdarević and Jovanović, 2012), with the goal of improving the existing praxis and reducing risks to both people and the environment. The development of cities in the context of demographic changes (Pantić, 2019), the smart planning (Bijelić and Filipović, 2016) of previously used space (urban plans), and the effects of the created infrastructure all impact the quality of the environment, thus changing the existing urban praxis. This is because certain negative elements associated with spatial development are often linked to a lack of structure in planning or a lack of direction in the development of physical structures using planning guidelines (Niković and Manić, 2018).

Environmental issues and the democratization of society have placed such topics high on the priority list (Jovanović *et al*., 2013) of contemporary society (Jovanović and Jovanović, 2014), with individuals (Jovanović *et al*., 2015), and other interested parties (Petrović, 2012), gaining a high public and media presence (Jovanović and Aćimović, 2014; Jovanović and Aćimović, 2014a).

WASTE MANAGEMENT IN THE REPUBLIC OF SERBIA

The field of waste management in the Republic of Serbia (RS) is covered by legal and strategic planning regulations (Živković, 2019). Waste management within the RS is defined by the Law on Waste Management (2018), the Law on Packaging and Packaging Waste (2019) and numerous other by-laws (regulations and decrees). Waste disposal within the RS is defined by the Decree on Waste Disposal in Landfills (2010) and the Rulebook on Methodology for the development of Rehabilitation and Remediation projects (2015), which defined the methodology for developing rehabilitation and remediation projects related to the existing unsanitary municipal waste landfills/dumps. Besides the aforementioned legal regulations, within the RS, practically the sole manner of waste management is still the disposal of waste in local landfills that (with very few exceptions) do not fulfill even the basic hygienic, technical and technological conditions.

Data on waste management within the Republic of Serbia is collected in accordance with the Law on Waste Management, and the report includes all types of waste (except Article 4 - Exemptions from application). The following entities are obliged to provide a report on the amount of waste generated (Article 75): the producer, owner and/or other waste holder, except households; legal entities participating in waste transport; producers and importers of products that, after being used, become special types of waste; operators at the facilities for recycling or reuse of waste; and landfill operators. All entities obliged to provide an annual report are also obliged to keep a protected daily record of the quantity of waste generated, collected, used, disposed of, imported and exported, and to submit it to the Agency for environmental protection (SEPA). These data are collected in accordance with applicable legislation in the RS, including rulebooks and decrees.

Chapter 4 of the Law on Packaging and Packaging Waste (2009), entitled "Reporting on Packaging and Packaging Waste" stipulates that reports should be written. The average daily quantity of waste generated per capita (kg) usually amounts to 1 kg (average annual value per capita amounts to 0.37 t), and the amount is higher in cities. The Ministry of environmental protection and SEPA have, based on the legal demands of the entities obliged to provide reports, created a unique report entitled "Waste Management in the Republic of Serbia in the Period 2011-2018" (2019). Based on the analysis in the report (2019), the number of facilities generating waste, as well as facilities participating in waste management constantly increased from 2011 (783) to 2018 (4571). Since the establishment of the reporting system (2013), the number of annual reports submitted from 2013 to 2018 ranged from 7,105 to 16,026. This trend of increase (from 2011 to 2018) is also expressed by the total amount of waste produced per capita annually (1.2-1.7 kg/inhabitant/per day), as well as the total amount of waste in comparison to the GDP (149-230.2 t/mil $).

During 2018, the amount of municipal waste generated and collected continued to increase, with a slight increase in the scope of its collection, from 77% in 2011 to 87% in 2018. This expresses the success of the collection of certain fractions of municipal waste in local communities (waste paper, cardboard, packaging waste), as well as other types of waste that usually ended up in dumpsters, and an additional reduction in purchasing power as a consequence of the economic crisis (Managing waste in the Republic of Serbia in the period from 2011 to 2018, 2019).

Reports on the amounts of waste disposed of in 2018 were submitted by 32 operators. The amount of non-dangerous waste being disposed of is constantly increasing, from 347,367 t in 2011 to 1,716,092 t in 2018 (which is about five times more). Significant amounts of non-dangerous waste are made up of mixed municipal waste, street cleaning debris and bulky waste, to the amount of 822,000 t, followed by, based on reports, waste from slag processing from thermal processes, solidified waste from waste treatment plants, mixed waste from construction and demolition, waste land and rock, as well as mixtures or fractions of concrete, bricks, tiles and ceramics (Managing waste in the Republic of Serbia in the period from 2011 to 2018, 2019).

SOLID MUNICIPAL WASTE MANAGEMENT IN THE CITY OF BELGRADE

If we are to assume that the city of Belgrade has about 2,000,000 inhabitants (plus daily transit and tourists), and that every inhabitant generates (on average) about 1 kg of waste per day, we come to an amount of about 2,000 t of waste to be managed on a daily basis (Local Plan on Municipality Waste Management in Belgrade for the period from 2011 to 2020, 2011). The development concept of the city of Belgrade thus points to the existence of a need for urgent organizational and spatial definition of municipal waste disposal, as well as the remediation of existing locations, the activation of new ones, and the establishment of a recycling system.

According to the Local Plan on Municipality Waste Management in Belgrade for the period from 2011 to 2020

(LPMWM, 2011), improvement of the waste management system includes the following components:

- Replacement of existent dumpsters with underground dumpsters, which would contribute to building a more efficient organization of the collection process, reducing the waste spreading out of the dumpsters and improving the appearance of the city streets;
- Extending the scope of municipal waste collection;
- Setting up dumpsters for the primary selection of waste, with the goal of developing recycling – green islands;
- Construction of 14 centers for separate collection of recyclable waste – recycling yards in the city of Belgrade;
- Construction of two transfer stations in the city of Belgrade;
- Construction of three lines for separating recyclable waste;
- Construction of facilities for mechanical-biological waste treatment;
- Construction of facilities for combined production of thermal and electric energy (co-generative facility) that use waste fuel to produce electric and thermal energy;
- Construction and expansion of the landfill in Vinča in accordance with existing regulations;
- Remediation of existing landfills in Mladenovac, Sopot and Grocka, as well as provision of disposal sites until the new landfill is built;
- Reconstruction of a facility for treating waste of animal origin;
- Construction of a facility for producing biogas from agricultural waste;
- Construction of a facility for composting "green waste"; and
- Construction of a facility for recycling construction waste.

This Plan (that is, the new organizational structure) suggests that the (existing) public waste management company (PUC "City Sanitation") should be divided into two companies: a company in charge of waste collection and transport and a company in charge of waste treatment and disposal. The PUC City Sanitation (for the collection and transport of waste) would be in charge of the collection and transport of waste to transfer stations and the center for waste management from municipalities with no transfer stations planned for them. The company would also have jurisdiction over setting up dumpsters for the separate collection of recyclable waste and for recycling yards, as well as lines for recyclable waste separation. In this way, waste management would be moved from public municipal companies in other municipalities (Grocka, Mladenovac, Surčin, Sopot) and merged into this company. The PUC City Sanitation (for the treatment and disposal of waste) would have jurisdiction over waste transport from the transfer station to the center for waste management, as well as over the center for waste management. Both PUCs in question would have contracts with the city for the provision of these services.

There are two possible methods of managing the waste collection system and center for waste management. According to the first suggestion, the PUC City Sanitation for the collection and transport of waste should manage the collection of waste, and the PUC City Sanitation for the treatment and disposal of waste should manage the centre for waste management. According to the second suggestion, the PUC City Sanitation for the collection and transport of waste should manage waste collection, and the PUC City Sanitation for the treatment and disposal of waste should operate landfills, but a private partner would operate the facilities for the mechanical and biological treatment of waste and the facilities for the mixed production of thermal and electric energy. The total management rights should not surpass 49% (LPMWM, 2011).

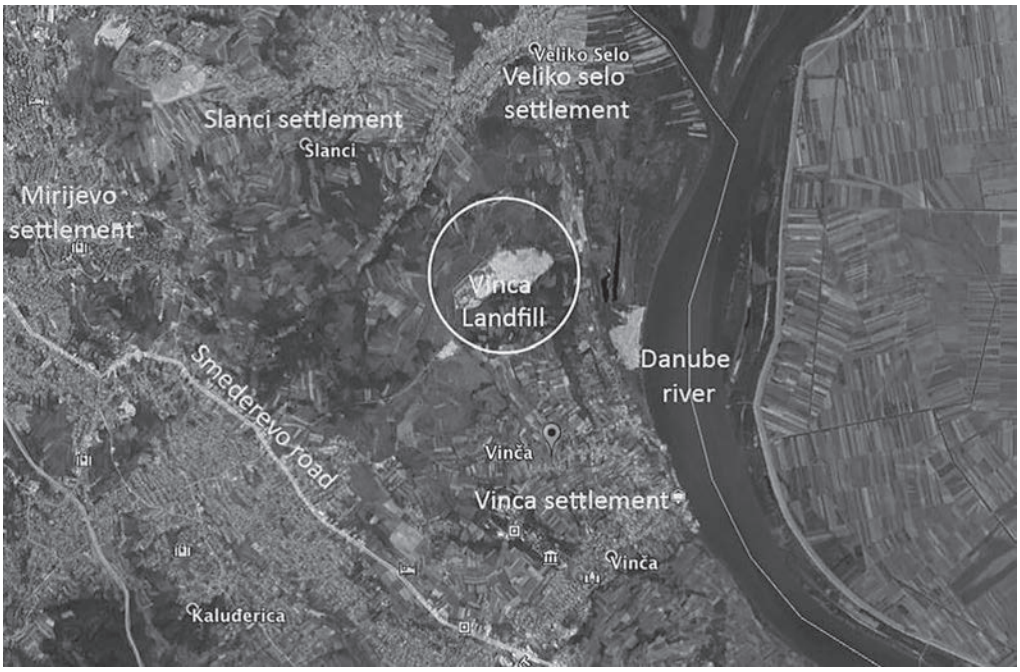

Figure 1. Location of the Project and surrounding settlements (Source: Stakeholder engagement plan, 2018)

ANALYSIS OF THE FULFILLMENT OF THE PROVISIONS OF THE PLAN FOR WASTE MANAGEMENT IN THE CITY OF BELGRADE

Using the method of analysis, activities, the obligations and the level of their fulfillment (activities) were analyzed on the basis of the LPMWM, as were the implementation deadlines (based on the available documentation of the city Secretariat), and the following conclusions shown in Table 1 were reached.

Analysis of the former activities of the SEP and PUC City Sanitation proves that the LPMWM was only partially implemented in relation to the replacement and procurement of above-ground dumpsters and procurement of equipment and mechanization for collecting and transporting municipal waste. Implementation of the requirement regarding the recycling centers (of which there are only three out of 14 planned) began in 2018 and continued in 2019 with procedures relating to obtaining building permits. The construction of two transfer stations is only in the phase of developing the urban project and drafting the DRP and technical documentation. The installation process for underground containers is also in its initial phase, given the fact that plans are being put in place for the installation of underground containers for selection and recycling for the period from 2019 to 2029 individually for each municipality.

Former experience and numerous studies have shown that privatization (PPP) often improves the work of state companies (PUC) in relation to the entire management system and requirements for preserving the environment (Impacts of privatization of the environment – lessons for developing countries, 2003). By concluding and implementing the PPP contract, the possibility of establishing an improved municipal waste management system on the territory of the city of Belgrade in accordance with the national positive regulations, standards and conditions of the EU Directives, has been opened. Certain components of the LPMWM that have not been fulfilled until now, that is, that have not even been set in motion, and that are not included in the PPP contract, clearly cannot be completed until the new plan is passed. This refers to remediation of the existing landfills in Mladenovac, Sopot and Grocka as well as to: the provision of disposal sites until a new landfill is built; reconstruction of the facility for the treatment of waste of animal origin; construction of a facility for the production of biogas from agricultural waste; and construction of a facility for composting green waste.

PPP AND MUNICIPAL WASTE MANAGEMENT IN THE CITY OF BELGRADE – AN ANALYSIS OF THE POSSIBILITIES AND POTENTIAL IMPROVEMENTS

With the goal of improving the municipal waste management system and solving the problem of the landfill in Vinča which has been present for decades, and at the suggestion of the city of Belgrade, in 2015 a competitive dialogue process was launched for selecting a private partner. Following the procedure in accordance with the positive regulations of the RS, and in compliance with the high EU standards on waste management and environmental protection, the Public-Private Partnership Contract (PPP) was signed in 2017 by the city of Belgrade, represented by the Secretariat for the Environmental Protection, and the private partners Suez Groupe S.A.S (France) and I - Environment Investments LTD (England). For the purpose of implementing the contract, a special purpose company entitled Beo Clean Energy was established within the territory of the Republic of Serbia in order to manage the project. The basic purpose of the company is to provide the service of treatment and disposal of municipal solid waste (MSW).

This service includes the private partner fulfilling requirements in the fields of projecting, financing, construction, operation and maintenance of the facility for the treatment and disposal of about 510,000 t of MSW annually and over 200,000 t of construction and demolition waste. The amount of 340,000 t of MSW will be treated (incinerated) within a facility that produces electric and thermal energy from waste, and about 170,000 t of MSW will be treated and disposed of in a new sanitary landfill that will be constructed as a part of the project. Moreover, over 100,000 t of construction waste originating from demolition annually will be treated in the facility for the treatment of construction and demolition waste.

The private partner in the landfill in Vinča is obliged by the contract to provide a building permit for the following facilities and infrastructure: production of energy (electric and thermal) from waste; treatment of construction waste; wastewater treatment; gas production; construction of a new landfill; remediation and re-cultivation of the existent landfill and internal traffic as a part of the supporting infrastructure. The private partner (Beo Clean Energy) should acquire a building permit in accordance with positive national regulations. Upon completion of the facilities, the private partner is obliged to provide the service of the treatment and disposal of municipal waste to the service users, and upon the expiration of the 25-year contract, the private partner is obliged to return the management rights for the sanitary landfill to the city of Belgrade.

Regarding the infrastructure, 5 km of the 110kV power line should also be constructed. Thus, the new substation of the Vinča landfill would be linked to the EMS substation Beograd 20 (Plan for detailed regulation of the construction of lines of 35kV from the TS 35/10kV "Vinča" to the sanitary landfill Vinča, urban municipalities Zvezdara and Grocka, 2019), as well as the supply of electricity for self-consumption provided from the distribution network over the new 35/10kV power line (Plan for detailed regulation of the construction of lines of 35kV from the TS 35/10kV "Vinča" to the sanitary landfill Vinča, urban municipalities Zvezdara and Grocka, 2019) that shall be built within the Vinča landfill. This power line will be linked to the existing power line Vinča 35/10kV via the 5 km-long 35/10 circuit.

The thermal energy produced in the facility from the process of waste combustion (Waste to Energy) will be transported to the PUC Belgrade Power Plants via an 8-km-long mostly underground pipeline for district heating, which will connect the Vinča landfill with the Konjarnik district heating facility (Detailed regulation plan for the construction of a hot water network from the sanitary landfill in Vinča to the Konjarnik and Mirijevo heating plants – Urban municipalities Zvezdara and Grocka, 2019).

Table 1. Analysis of the provisions of the Plan for waste management in the city of Belgrade, and the level of fulfillment of its obligations in comparison to the planned activities

Activity planned by the plan	Obligations based on the Plan	Level of fulfillment of the Plan/Note
Replacement of the existing dumpsters with underground dumpsters and installation of underground dumpsters - contributing to more efficient organization of the collection process, reduction of waste spreading out of the dumpsters and improvement of the look of the city streets in 14 urban municipalities	Obligations – the city: Secretariat for the Environmental Protection (SEP) and Secretariat for Municipal and Housing Affairs (SMHA) Company: PUC City Sanitation	Continuous replacement of worn-out above-ground dumpsters is being carried out at existing locations in 14 urban municipalities on the basis of funds provided by the SEP, and the public procurement procedure is carried out by PUC City Sanitation. Installation of underground dumpsters was carried out until 2016. In total, 2,036 units (raging in size from 5m3, 3m3, 1.8m3 and 1.5m3) were installed on the territory of 10 urban municipalities (Stari grad, Vračar, Savski venac, Palilula, Zemun, Novi Beograd, Rakovica, Zvezdara, Voždovac, Čukarica), where the cleaning, collection, transport and disposal of waste is conducted by PUC City Sanitation. Out of the stated number of underground dumpsters, during the year of 2019, a total of 208 of them have a recycling function for different types of recycling. Other recycling containers include: recycling side containers 3.2m3 – municipal waste disposal jumbo, 114 units; and recycling bells for glass (78 units) and textiles (23 units). Because the requirements in the LPMWM (location, presence of underground infrastructure, construction, traffic, spatial and demographic characteristics) could not be completed within the 10-year period given, the city adopted a plan for installing underground dumpsters for selection and recycling for the period 2019-2029 in the Stari Grad urban municipality in 2019. Plans for other city districts will also be adopted. SMHA did not determine the type of containers used for the disposal of household waste.
Procurement of equipment and mechanization for primary waste selection with the goal of developing recycling–green islands	SEP PUC City Sanitation	SEP provides the means for procuring equipment (containers of different volume, abrollkippers, 240 l bins, recycling bells for glass, etc.) and mechanization (trucks, presses, forklifts and other mechanization needed for waste collection and transport), and the PUC City Sanitation conducts the process of public procurement. Note: for the majority of the equipment and mechanization, provision of the means and the public procurement were conducted in 2018 and 2019.
Construction of 14 centers for separate collection of recyclable waste – recycling yards in the city of Belgrade	SEP	Besides constructing 3 recycling centers, the procedure for obtaining the necessary documentation for issuing building permits for 9 recycling centers has been initiated – different stages of the process are underway under provisions of the law on planning and construction (collection of data on location conditions, drafting a PDR for certain locations, conducting expropriations for certain locations, etc.).
Construction of two transfer stations (TS) within the city of Belgrade	Obligation of the city: SEP 2 TS with recycling separation lines on site: 1TS for urban municipalities Zemun, Surčin, N. Beograd and 1TS for urban municipalities Čukarica Rakovica, Voždovac; For other urban municipalities (Vračar, Stari Grad, Savski Venac, Zvezdara, Palilula, Grocka, Sopot, Mladenovac), PUC collects and transports the waste to the center for waste management in Vinča	Location TS Zemun, Surčin, N. Beograd: urban project for transfer station located in Zemun Polje completed. Location TS 2, Mladenovac: the process of drafting a PDR and technical documentation for the TS is currently underway. Note: the procedures currently underway were launched in 2018 and 2019.
Construction of facilities for mixed production of thermal and electric energy (co-generative facility) powered by fuel acquired from waste	SEP	Related to the fulfillment of obligations under the PPP Contract
Construction and expansion of the landfill in Vinča in accordance with regulations	SEP	Related to the fulfillment of obligations under the PPP Contract
Remediation of the existing landfills in Mladenovac, Sopot and Grocka, and provision of a disposal site until the new landfill is built	SEP	Not fulfilled
Reconstruction of facilities for treating waste of animal origin	SEP	Not fulfilled
Construction of facilities for the production of biogas from agricultural waste	SEP	Not fulfilled
Construction of a facility for composting green waste	SEP	Not fulfilled
Construction of facilities for recycling construction waste	SEP	Related to the fulfillment of obligations under the PPP Contract
Remediation of waste disposal sites – "wild landfills" on the territory of the city of Belgrade	SEP and PUC City Sanitation	During each year, according to a pre-determined plan, remediation and cleaning of wild landfills is carried out in locations that are, as a rule, a permanent place of uncontrolled waste disposal. This problem is not addressed adequately and considerable financial resources are invested in the short-term remediation of sites, which again become waste disposal sites.

The project is financed through loans from international financial institutions (IFI) and in accordance with the regulations of the Republic of Serbia and the environmental and social demands of the IFI financials, especially the International Financial Corporation (IFC) and the European Bank for Reconstruction and Development (EBRD). The city of Belgrade, besides being obliged to finance the remediation of the existing landslide in the body of the landfill, is also obliged to pay a certain amount expressed in RSD annually exclusively for the provision of treatment of municipal waste from the moment the provision of services started.

By analyzing the potential improvements to municipal waste management by implementing the PPP concept (based on the signed contract), the City of Belgrade might expect to achieve the potential system improvements expressed in Table 2.

issue of its realistic fulfillment comes to the fore. Namely, its goals, such as an increase in the scope of the organized waste collection to 100%, developing building capacities for the treatment and disposal of waste and the introduction of a system that would use the waste resources (30% recycled, 35% used for the production of energy 35% of waste disposed of in a sanitary landfill), have not yet been met.

According to the analysis shown in the tables, and based on the available internal documents of the city SEP, it might be stated that the majority of activities required of the city originating from the current LPMWM were only started after the conclusion of the PPP contract in 2017. Activities carried out in accordance with the LPMWM were insignificant before the signing of the contract. In support of this statement, it is sufficient to state that only the procurement of equipment and mechanization for waste collection and transport, as well as the remediation of wild

Table 2. Possibilities for potential improvements to municipal waste management in the city of Belgrade based on the obligations stipulated in the PPP Contract

Activity	Contractual obligations and deadlines	Possibility of improvement / Note
Construction, expansion and remediation of the landfill in Vinča in accordance with the regulations	Signed PPP Contract on September 29, 2017 within the obligations of the private partners (PP); Effective Date: December 31, 2018	Closing the unsanitary landfill, construction of new facilities, remediation and re-cultivation of the landfill, use of the landfill for managing municipal waste from the effective date of the PP services (01.10.2021) for a period of 25 years, that is, until 01.10.2046.
Remediation of landfill landslides and stabilization of a part of the landfill in Vinča	Obligations of the MEP, deadline: 31.12.2019. The obligation was fulfilled in June 2019	Through remediation and construction of the supporting structure and by forming new channels and separators for the collection of wastewaters, stopping of the further landslide of the landfilled waste materials on the pedal part of the landfill in the watershed of the Ošljanski stream that flows into the Danube River.
Construction of a facility for mixed production of thermal and electric energy (co-generative facility) powered by fuel acquired from waste, and the acquisition of a production license	Obligation of the PP in accordance with positive regulations. Deadline: license for production of electrical energy - 05.10.2022. Deadline: license for production of thermal energy – 05.10.2022.	Based on legal requirements (Law on Waste Management, Law on Environmental Protection and Energy Law), the use of waste to produce energy.
Construction of a facility for gas production	Obligation of the PP in accordance with positive regulations. Deadline: linked to acquisition of an integrated license – 18.11.2023.	Based on the legally prescribed obligations (Law on Waste Management, Law on Environmental Protection, and Energy Law), the use of waste to produce energy.
Construction of a facility for treatment of construction waste	Obligation of the PP in accordance with positive regulations. Deadline: linked to acquisition of an integrated license – 18.11.2023.	Based on the legally prescribed obligations (Law on Waste Management), establishment of a municipal waste management system on the territory of the city and fulfillment of obligations under EU directives in the field of waste management.
Construction of a facility for wastewater treatment	Obligation of the PP in accordance with positive regulations. Deadline: linked to acquisition of a integrated license – 18.11.2023.	Based on the legally prescribed obligations (Law on Waste Management, Law on Environmental Protection), fulfillment of conditions for operating a sanitary landfill

Through this project, the city of Belgrade plans to treat the maximum amount of biodegradable MSW generated and limit the use of the landfill for the disposal of treated residue and inert waste, thus contributing to the RS fulfilling the demands of EU Council Directive 1999/31/EC of 26 April, 1999 on the landfill of waste, regarding the reduction of biodegradable MSW disposed of landfills. However, by analyzing the current LPMWM that sets the strategic goals until the year 2020, the

landfills, have been continuously carried out. Certainly, it should be noted that implementation of the PPP contract implies the harmonization of its regulations with existing ones in order to establish a municipal waste management system. In this regard, the City of Belgrade has adopted new regulations, amendments and supplements to the existing documents, as well as planning documents, related to the subject area.

CONCLUSION

If we perceive waste as potential and realistically available raw material, then its disposal represents material, energy and financial loss, which is the least desirable option for waste management. On the other hand, the costs of collection, processing and disposal of waste are significant and require a large quantity of energy (fuel), a work force and an adequate organizational model that can support this. This paper discusses two possible solutions (based on LPMWM) for the treatment of MSW in Belgrade (in order to implement the PPP concept of elimination of MSW, or not) that provide the most environmentally acceptable option in the present situation. The city of Belgrade wishes to develop an economically viable, comprehensive and modern mixed complex for treating (biodegradable) waste that would generate energy from the waste produced on the territory of the city. Moreover, the city wishes to build a facility for treating construction and demolition waste and a new sanitary landfill for waste treatment, as well as to conduct remediation by collecting landfill gas on the location of the existing landfill to use for the production of electric and thermal energy in Vinča. Thus, this project and its implementation are a national and local priority.

The LPMWM analysis shows that the PPP represents a real possibility when speaking of fulfillment of the all provisions stipulated in the Plan for Waste Management in the City of Belgrade. All of the above is analyzed in the paper on the basis of the provisions and obligations stipulated in the recently signed contract on public-private partnership (PPP) and environmetal benefit. Also, some of the possible comprehensive improvements to the municipal waste management system are presented based on the obligations of the signatories of the PPP contract. On a local level, as a form of improvement in this field, new regulations and amendments to the existing and planned documents are planned. A significant fact is that, by signing the Contract on PPP, the treatment and storage of waste over the following 25 years is the responsibility of the private partner, and not of the public waste management company, as planned by the LPMWM for the city of Belgrade. The signed contract, as well as the implementation of its provisions, represents a realistic possibility for making significant improvements in the field of municipal waste management in Belgrade.

Without significant and additional investments in the field of waste management in the city of Belgrade, it is not possible to fulfill the provisions of the plan. That is why the concept of the PPP is imposed as the optimal solution (foreseen by the plan) to fulfill all of its requirements. Based on comprehensive analysis, it can be concluded that the current PPP model is at the time being the most appropriate option for addressing MSW issues in the city of Belgrade in the context of contemporary management, technological trends and environmental requirements.

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BOUNDARIES OF REALITY IN THE PROCESS OF ARCHITECTURAL DESIGN

Jelena Bogosavljević[1], Faculty of Architecture, Belgrade, Serbia

Starting from the fact that the reality of the world of projections is comprehensive only when its architectural reality is created outside that reality, to become a new reality within reality, the paper addresses establishment of the relationship between an architect designer and reality, by his double presence within and outside reality. The existence of reality is questionable, because the actuality of the world of projections, which, though present in reality, often does not have meaning and is therefore created outside reality, only to exist again with meaning. In that relation, as the real world in reality, it is expressed also as an unreal world outside reality, whose imaginary reality is studied with architectural projection in a lifelike scope of reality. That way, the meaning of the projection in the process of architectural design is checked by projecting its meaning outside reality, while in the transition of an architectural design from one reality into another, the architect designer also develops his/her creative role, by reading and connecting individual (personal) and collective (universal) codes of the world of projections, which exists as two-folded and realistic in the reality scope.

Key words: **coding, reality, dream, world of projections, negation.**

INTRODUCTION - DEREALIZATION OF PROJECTIONS

Given that reality is lifelike only when it is manifested as both the common and individual reality of the world of projections, its formulation can be explained by its derealization, i.e. by undesigning the common reality if it is an issue of the meaning of its projection, or by designing an individual reality if it is an issue of projection of the meaning. For an architect, it is a projection of both meaning and its purpose in the form of a unique world of common reality to which he relates and an individual one which he creates with regard to the formalization of a new manifestation by a simultaneous belief in the non-existence of meaning within the common reality and its existence within the individual one. It is about the architect's ability to relativize reality by derealizing the world of projections in order to be able to affect reality to the extent due to which it is changed. In this regard, a projection of meaning exists when it depends on the meaning of a projection (Frankl, 2007: 17). The architect himself must lose the need for meaning solely within the common reality and then search for it in an individual one. Additionally, it is about his losing the illusion of reality in order to present the world of projections as it really is (Figure 1).

In that sense, the formulation of reality in relation to derealization of the world of projections is a negation of the form of the common reality and a confirmation of the architectural content of the individual reality of the architect as a designer. This is a position wherefrom he equally realistically refers to both collective and individual architectural reality whose actor he is, i.e. the reality in which his emptiness results from the absence of meaning or its realization in the conditions of meaninglessness (Ibid., 19). Derealization of the world of projections is his principal role, namely, to actualize it in relation to the real time and space in which he acts. In this regard, his participation does not mean interpretation, but recognition, and even rejection of universal values and, accordingly, a unique projection of their meaning. Thus, the world of projections is perceived as an interaction of overestimated circumstances of the common reality, on the one hand, and of underestimated circumstances of the individual reality, on the other hand. Therefore, if otherwise determined, his desire for meaning is realized in the form of his will, oriented towards the necessity to respond to real circumstances in a way which allows him to deliver the meaning offered to him by reality (Ibid., 24).

Architect must make his conviction of meaning a starting point that is examined in view of a need for meaning, by deceiving himself in the common reality, only to convince himself in an individual reality by his ability to manage it independently by initiating it himself. Once he has achieved this successfully, it becomes his unique need, whose values are not the means but the meaning, i.e. a new value in itself,

[1] Bulevar kralja Aleksandra 73/II 11000 Belgrade
jelena.bogosavljevic@arh.bg.ac.rs

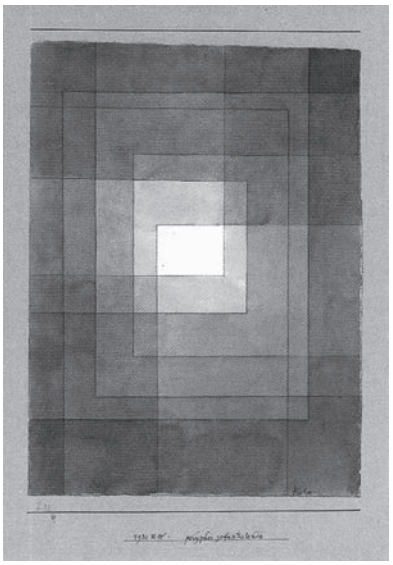

Figure 1. Paul Klee: Polyphonic Setting for White 1930 (Source: https://www.pinterest.com/pin/48061920999386082/)

which observes the sustainability of the simultaneous and current circumstances of the common reality and future circumstances of the individual one (Ibid., 25). Anthropologically, derealization of the world of projections depends on his self-projection directed towards the unique meaning of his realities. In addition, there is an issue of architectural identity for the purpose of creative realization which is not a purpose or an aim in itself, but represents the meaning of both the conscious and unconscious contribution of the architect as a designer, i.e. the one who perceives the derealization of the world of projections as self-oblivion, an unconscious projection of the meaning of an individual reality in order to focus consciously on the meaning of a projection of the common reality. Reality is real if a specific desire for meaning is defined in the form of an equal effort by the collective and individual will of its actors (Ibid., 28).

Simultaneous undesigning and designing the reality of the world of projections represents a unique and transient possibility that is inseparable from reality. Accordingly, a reality of reality represents a perpetual change of meaning regarding its realities. For the architect and even with regard to his status as a designer, this change of meaning of a projection is relevant for the common reality and a projection of meaning is inherent in the individual reality. His intention is to respond to the meaninglessness of values in reality by undesigning the world of projections by the visible meaning of a projection, and the projection of an invisible meaning of his realities. On the one hand, a need for meaning is a prerequisite for undesigning the common reality, and, on the other hand, a search for meaning is a requirement for designing an individual one (Jovanović, 2013: 70). Having confirmed the non-existence of meaning by its existence, the unique possibility of derealizing the world of projections also becomes a unique architectural reality inasmuch as it excludes its own transience. In this regard, if there is a continuous change of meaning, it can never be inadequate, and, therefore, it must not be excluded from the architect's architectural content, and even from the formal manifestation of architecture.

> "A pre-judgment becomes a prejudice only if there exists an objective possibility for the pre-judgment to be corrected: that is, if we have at our social disposal (or can at least work out) generalizations which can set experience in a more adequate framework, and if the pre-cast judgment runs counter to these more adequate generalizations" (Heler, 1978: 294).

The architect should understand that his need and search for meaning are inherently meaningful. From this point of view, derealization of the world of projections actually lies in the fact that meaning always exists (Jovanović, 2013: 38). Its visible non-existence is derealized by undesigning the common reality, and its invisible existence by designing the individual reality of the world of projections. The formulation of reality by its derealization is possible in this relation only when the architect's intention is the meaning of architectural reality, which is a real change in its reality. This implies that meaning is available to the architect as a designer in any circumstances and conditions of its realities. He does not need to address the issue of meaning of a projection, but he must point out the issue of projection of the meaning of architecture so that it, and even he himself, can maintain their meaning in reality. It is also related to the fact that coding of the reality of the world of projections, by its formulation, is additionally a matter of the architect's architectural potential. His ability to perceive the current issue of meaning of a projection is an inability to meet the requirements of meaning of the common reality, and the issue of meaning of the projection is an opportunity to point out the unconditional meaning of the individual reality of the world of projections. Therefore, reality becomes real if derealization of the world of projections is the deepest meaning of its realities. This means that the formulation of reality by derealization of the world of projections is additionally a confirmation of its oneiric nature. By the projection of an ideal reality, dreams can be realized by losing the illusion of reality.

ABANDONING PROJECTIONS

Reality implies the inevitable presence of an architect taking into account his role as a designer. From this point of view, abandoning reality is a matter of the architect's free choice whether to participate in it or not, as well as an issue of the way in which he addresses it as a designer, especially due to the differentiation between the common and the individual reality by the projection of their unity and, accordingly, the uniqueness of a design. A design whose uniqueness does not correspond to the projection of the unity of its realities is unacceptable and even impermissible and therefore a measure of the authenticity of the world of projections, and his truth if it is the reality of his realities. This means that returning to reality must be preceded by its abandonment, i.e. discovering the truth of the world of projections in the design. If it exists, there is either a false or genuine display of the unity of opposing and seemingly contradictory realities, for the purpose of the uniqueness of the world of projections of their apparent diversity (Frankl, 2007: 35).

Taking into account that the world of projections includes all cross-sections of his realities, it implies a simultaneous horizontal cutting of the common reality and a vertical cutting of the individual one. This relates to the architect's understanding that, due to the impossibility of perceiving

the common reality as the individual one and vice versa, the unity of the horizontal and vertical cross-sections of the world of projections is a unique architectural reality of an abandoned reality that is manifested as a reality beyond reality (Ibid., 36). In this regard, the architect's belief and even his sincere determination to move from it is the meaning of his role as a designer. By abandoning reality, he verifies and validates the authenticity of the world of projections by a unique perception of the differences between his realities (Figure 2).

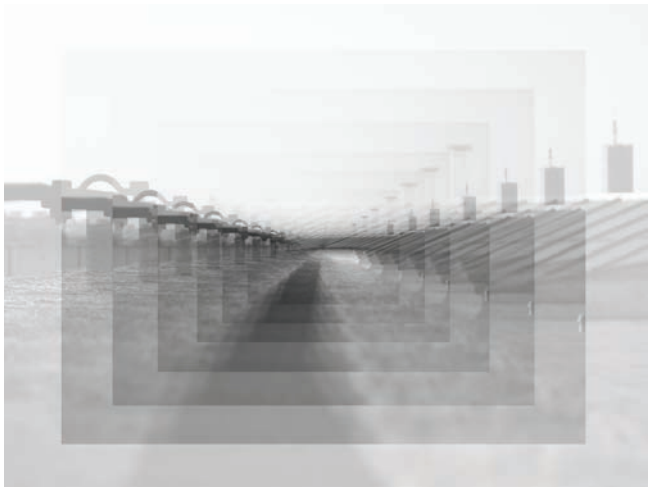

Figure 2. Visual Reverberation (Source: Author, 2019)

In this sense, abandoning reality involves his readiness to make the authenticity of the world of projections conscious so that he responsibly accepts his role as a simultaneous possibility to open the unconscious in relation to the individual reality by closing the conscious in relation to the common one. This is achieved by harmonizing his realities. This means that he perceives the common reality as a projection of conditional or non-conditional reflections of the reality he abandons, while the individual reality is perceived as a self-projection of unconditional reflections of the world of projections. By such a perception, he acquires the ability to observe reality in relation to the realities of the world of projections beyond it. Consequently, the role of a designer is reduced to, and is even based and depends on a qualitative feature, i.e. his self-projection beyond himself, which is a realized quality of architecture with regard to the common reality and a self-realized quality related to the individual reality of the world of projections. If he is excluded from this relation, the authenticity of the world of projections will be manifested in the absence of the unity of the architect as a designer and the uniqueness of architecture as well. On the one hand, his truth is the feature indicating the presence of architectural quality, and on the other hand, the presence of the architect as a designer. Viewed in this way, the credibility of the authenticity of the world of projections is associated with his freedom to determine it as a reality beyond reality, and, accordingly, to decide on his own on the uniqueness of a design by projecting the unity of his different realities (Jovanović, 2011: 9). In this regard, the role of a designer belongs to him if his return to reality confirms the authenticity of the world of projections beyond it. At this point, he is offered the status of a designer who, by opting for the conditional boundaries of the common reality, causes the unconditional boundaries of the individual reality of the world of projections.

> "The way we ourselves are being imagined can also be revealed by nicknaming oneself in the dream: behind - time - I; shopping - I; beauty - parlor - I; pantsless – I" (Hilman, 2013: 106).

Subsequently, the architect can view the authenticity of the world of projections as the perception of the reciprocal integrity of his reality only once he has liberated it by having abandoned reality. This is his ability for self-deception for the purpose of self-detachment and self-projection, transcendence of the common reality within the individual one of the world of projections beyond it. By returning to reality he accepts the abandoned reality as an entirety of the truth of his realities. He examines the authenticity of the common reality by self-detachment, and confirms the authenticity of the individual reality by self-projection. In regard to the authenticity of the world of projections, he defines the designer's predictable role as unpredictable. In order to develop the skills of self-detachment and self-projection as a designer, he must understand that, in relation to the common reality, the cause of self-detachment is verification of its authenticity, and, in relation to the individual reality, the reason for self-projection is its confirmation. This means that, on the one hand, the authenticity of the world of projections is a cause of abandoning reality, and, in that sense, it always exists, while, on the other hand, abandoning reality is a reason for its confirmation. Therefore, the authenticity of the world of projections, in addition to the cause of the meaning of its projection, must also include the reason for the projection of its meaning (Frankl, 2007: 40). The existence thereof indicates the intentional character of his motifs as a designer and abandonment of reality in relation to the authenticity of the world of projections is his intention to point out their unity as well.

The authenticity of the world of projections is unique when it appears as a simultaneous intentionality of its subject and object. The architect in the role of a designer is equally subjective within the individual reality and objective within the common one. Additionally, their values constitute meaning (Jovanović, 2011: 33). Otherwise, the life of the architect, and even architecture, becomes an instrument of manipulation with the real authenticity of their realities in reality. It is therefore important that the architect convince and determine himself in the role of a designer in a way that allows him to be simultaneously a cause of and a reason for the authenticity of the world of projections. In this sense, to abandon reality in relation to the authenticity of the world of projections is his own return to reality, a position which excludes the possibility that anyone else, even including himself, can prevent him from accepting reality, or, furthermore, deprive him of his right to the reality where his role as a designer is a unique, autonomous and authentic characteristic of his inalienable architectural status. In this regard, the authenticity of the world of projections must be a display of the unique truth of his reciprocal reality. Although the common reality cannot be perceived as an individual one and vice versa, they must co-exist together. The individual reality of the world of projections cannot exist without the common reality, however, it can and it should precede it.

Thus, abandoning reality is a sufficient requirement for the authenticity of the world of projections with regard to the common reality, and a necessary requirement in relation to the individual reality.

Coding reality by abandoning it is a matter of the real boundaries of the architect in the role of a designer, when he is beyond it. First of all, his determination to re-establish and confirm his status in relation to the architecture realized in reality, as well as his true credibility and, therefore, his contribution as a designer, are a matter of his architectural awareness. The authenticity of the world of projections is related to his conscious unwavering motifs in relation to any expectations caused in the common reality and unconscious hidden motifs in relation to his own expectations that arise within the individual reality. A design as a measure of his authenticity is a projection of the relationship between its meaning and its purpose. In order to be established, this relationship must be consciously made visible, which is why the unconscious abandonment of reality is inherently meaningful. In the role of a designer, it is an invisible difference between those reasons for the individual reality that are not known to the common one. On the one hand, the authenticity of the world of projections is a limit of its freedom, and, on the other, it is its infinity (Frankl, 2007: 45). Therefore, the abandonment of reality may be explained as a starting point of the authenticity of the world of projections as well as its outcome, bearing in mind that the return to reality is the responsibility of the architect in his role as a designer. It is meaningful if he gives a meaning to it himself by abandoning reality. Thus, the abandonment of reality is inseparable from the authenticity of the world of projections, given that it is caused by its content. This means that the design is another reason for its authenticity, bearing in mind that the architect is both aware and unaware of his limits as a designer. To abandon reality means to eliminate its meaninglessness or its lies with the aim of generating its meaning or truth thereabout, i.e. visibility of the authenticity of the world of projections in reality and its invisibility beyond it.

Coding of reality by abandoning it is the authenticity of the world of projections, provided that the conscious abandonment is simultaneously the unconscious indulgence in its realities. On the one hand, it is separated by self-detachment, and on the other hand, it is duplicated by self-projection. From this point of view, its meta meaning lies in its relationship with the authenticity of the world of projections. Bearing this in mind, a designer's role is in itself a meaning of his architectural undertaking, and even of his contribution.

ENCOMPASSING THE IMAGINATION OF REALITY

The relationship between meaning and its purpose is associated with the experience of a new world where the architect's awareness of his role as a designer becomes available. In this sense, the inclusion of reality is an issue of its transcendence, the reciprocal reality of the world of projections, as well as a problem of the oneiric imagination of the architect as a designer being on the other side of reality. Since a design is a projection of the relationship between meaning and its purpose, it is essential for expressing their relationship, which is an unbreakable bond if expressed in the form of a projection of the architect's unique awareness. As a designer, he is, himself, an oneiric pattern for creating a design that is a unique expression of a new reality (Jovanović, 2017: 74). This means that a feature of the design in the form of a means becomes a procedure for the oneiric imagination of the world of projections. In that sense, the transcendence of reality is his oneiric experience of the reciprocal reality of the world of projections, which is consciously and unconsciously gained experience of his unique reality. He can and must innovate reality by a projection of another, i.e. new, world. In the event of designs whose meaning is not related to their purpose, they represent an expression of parts of the reality of the world of projections, due to which they are also a negation of his oneiric nature, as well as of the architect as a designer who fails to realize his dreams by the projection of an authentic and authorized world.

In this regard, a projection must also involve a creation. Consequently, the inclusion of reality by the oneiric imagination of the world of projections is possible only if he is a creator himself (Ibid., 76). On the one hand, he designs by a conscious projection of the common reality, i.e. by self-detachment, and, on the other hand, he designs and creates by means of an unconscious projection of the individual reality, i.e. by self-projection. In that sense, he can encompass reality by the oneiric imagination of the world of projections if he is able to indulge in the oneiric experience (Jovanović, 2012: 23). As a result, it is the beginning and the end of creation and vice versa. By shaping the world of projections where the objectivity of the designer's role can be defined subjectively, he creates in a way that his creation occurs by an unconscious projection of the individual reality to be experienced by a conscious projection of the common reality. When in the role of a designer, the individual reality is, therefore, an unaware falsification of the architect's awareness of the common reality. A projection of the relationship between meaning and its purpose is also a projection of their connection if the design is the oneiric imagination of the world of projections. Their connection represents a valuable part of reality, i.e. its new meaning, implying that the new reality is a creative projection of the unity of his realities. Bearing this in mind, the oneiric experience of the architect as a designer is his creative principle that allows him to express the unity of the reality of the world of projections by a design which is a conscious and unconscious projection of the architectural content of his unique consciousness. Therefore, a design is a new reality if it is manifested as the creative imagination of the architect as a designer. His awareness of being an architect and being allowed to design is not sufficient or even acceptable unless he unconsciously becomes aware that he is an architect in his role as a designer if he creates by designing, and it belongs to him only if a design is a personal expression of his attitude towards reality. This means that he creates an individual awareness and realizes the collective one of the designer of a new reality by which reality can also be included.

> "If therefore the reflection is not to presume upon what it finds and condemn itself to putting into things what it will then pretend to find in them, it must suspend the faith in the world only so as to *see it,* only so as to read in it the route it has followed in becoming a world for us" (Merlo-Ponti, 2012: 48).

His awareness of the inclusion of reality, preceded by the oneiric imagination of the world of projections, is a new reality in terms of the reality of its scope (Jovanović, 2012: 25). On the one hand, the hither reality is a visible reality of the world of projections, and, on the other hand, the transcendent reality is its invisible reality. In addition, its visibility is associated with a meaning of the projection, and its invisibility is related to a projection of the meaning. Visibility is established within the common reality and affected by collective consciousness, while invisibility is revealed within the individual reality and it is stimulated by individual consciousness. In this sense, the hither reality is a formal nature of the common reality, whereas the transcendent reality is an essential nature of the individual reality, and therefore the primal reality of a new reality, i.e. an integral part of its scope, while the world of projections is a reality of reality where a design represents both an objective and subjective entity of its new reality. Additionally, bearing in mind the transience of the hither reality, its new reality is permanent, since it has an impact on the creation of the architect's future world and the future life of architecture. It indicates the crucial value of his role through the formalization of its meaning by creating architecture. In this regard, the uniqueness of his role as a designer lies in the mediation between the hither reality and the transcendent one by harmonizing the reciprocal realities of the world of projections. The architect as a designer is therefore a creator of a new reality of the unique world of his realities.

> "For, if something comes-to-be, it is clear that there will be substance, not actually but potentially, from which the coming-to-be will proceed and into which that which is passing-away must change" (Aristotle, 2016: 21).

Since the hither reality is determined by time and space, a belief in its actuality is reduced to the meaning of a projection by repeating the content of the collective consciousness (Jovanović, 2017: 77). However, the transcendent reality is not determined by time and space, and accordingly, a belief in its actuality is based on the meaning of a projection by changing the content of collective consciousness within the individual one. In this regard, the relationship between meaning and its purpose must consequently indicate a relationship between the architect and his role as a designer, as well as his architectural abilities and his designing skills. From the architect's position, he now has the status of a designer, which allows him to create a new reality by connecting the hither reality and the transcendent one by maintaining the relationship between his collective and individual consciousness. In this sense, coding reality by its inclusion also encompasses its connection with his oneiric imagination of the world of projections. The oneiric experience of the architect as a designer is a bond uniting them in this relationship. Therefore, a design is a unique expression of a new reality, including the one that is created to be designed, on the one hand, and on the other that is designed to be created. This means that a design exists when it is an expression of a new reality, its re-creation by a deviation from its projection. Thus, the oneiric experience is the architect's ability to transform into a designer who is skilled to implement a project as a procedure for the oneiric imagination of the world of projections by encompassing reality. The hither reality is the world of the architect's projections; the transcendent one is the world of projections of the architect as a designer. Therefore, the new reality must contain the oneiric experience of the individual and common realities, which are its internal and external worlds respectively: his own reality in which a projection of the inner and outer world is his realistic attitude towards the reality it encompasses and the new one he creates. In this regard, it belongs to both the collective and individual reality of the world of projections. It is his virtual world. Encompassing reality by the oneiric imagination of the world of projections is, therefore, the possibility of creating a new oneiric reality by a transition from one to another reality, i.e. by their connection.

ONEIRIC NEGATION

Since the oneiric experience of the reciprocal reality of the world of projections is its oneiric reality, it is also a starting point for its confirmation in reality (Ibid., 82). In this sense, the confirmation of reality is an issue of its designation and a problem of its actualization by the oneiric negation of the world of projections. This means a designation of an undesignated collective reality by designating the individual one, by transcending, and even renouncing the new oneiric reality. It is a subjectivization of the collective experience by an objectification of the individual experience of the world of projections, through a mutual confirmation of their unity in reality. Therefore, the oneiric negation of the world of projections is an ability of articulation and valorization of the gained oneiric experience in the individual designing experience of an architect, also capable of confirming it as collective. Thus, by the oneiric negation of the world of projections the architect confirms reality by collectivizing personal experience (Ibid., 84). Confirming reality by the oneiric negation of the world of projections, therefore, represents an abolition of their boundaries established in his oneiric reality, i.e. boundaries between the objective collective reality and the subjective individual one. In addition, it is also a confirmation of his reality in reality.

In this regard, the collective reality is always binding to the individual one. This means that the architect must confirm his role as a designer in the oneiric reality by his self-deprivation, i.e. by articulating his own oneiric experience in the creative experience of the world of projections by designating a projection of its meaning. From this perspective, the individual reality is a projection of achievement which is a formalization of the meaning of the designer's creative role, his individualization, authentication, and even authorization if it is confirmed as a meaning of the projection in the collective reality. This means that he is himself a confirmation of the relationship between the individual reality and the collective one, whose connection depends on the capacity of his creative affinity to be bound to it. In that sense, self-deprivation is a measure of the mediocrity of his role, its credibility in the design, and accordingly of the projected meaning.

He sets norms to reality by a projection of his creative experience, a unique display of the individual and collective, i.e. newly created, reality. By being bound to it, he does not depend on, but becomes connected to it. In addition, it is

confirmed in the form of a creative projection of the oneiric reality. In this regard, he, together with his design, connects its meaning and purpose and confirms their relationship in reality. Its confirmation by the oneiric negation of the world of projections is a newly created reality whose new value is above average if it is a display of the creative experience of the architect as a designer. The level of mediocrity is therefore an indicator of its lack of meaning and purpose, and even the meaning of its existence and his purpose in his role as a designer. On the contrary, by self-deprivation he confirms his own belief that he is convinced of reality to the extent that allows him to be responsible for it by his participation in its creation. Because of that, self-deprivation is a requirement for changing its meaning. The newly created reality does not exclusively mean its visibility in the form of a formalization of the realized manifestation of architecture (Figure 3).

> "One poet has already noticed this, thanks to his ingenious intuition and expressed in the following words: I, it's someone else" (Žuve, 1997: 53).

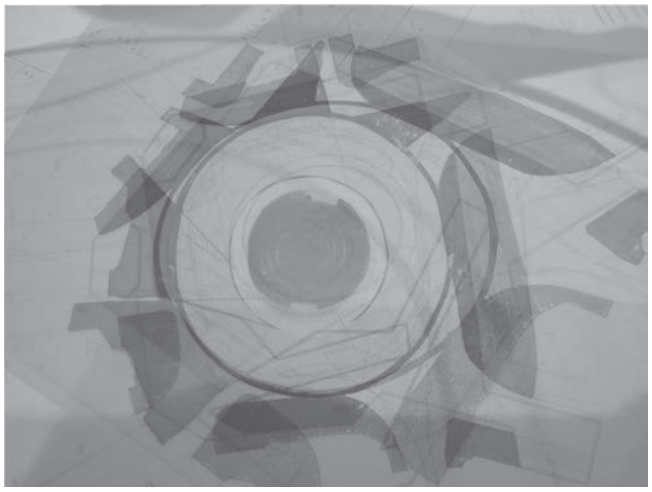

Figure 3. VERTIGO Competition for Slavija Square with Fountain in Belgrade (Source: Author, 2012)

On the one hand, the architect as a designer is exposed even to unrealistic expectations of the collective reality whose requirements are so demanding that they do not allow him space and time for individual creation. This additionally obliges him to define and decide to actualize his role as a designer in the creative one (Jovanović, 2014: 11). In this regard, the confirmation of reality by the oneiric negation of the world of projections is his new opportunity to realize an unconceivable and unpredictable connection between the collective reality and the individual one in the form of their conceivable and predictable connection in the newly created reality. This means that he must understand the oneiric experience of the world of projections as the creative experience of his newly created reality. Additionally, he has to perceive the confirmation of reality by the oneiric negation of the world of projections as the unity of form and meaning of his realities. On the one hand, self-deprivation is a requirement for the unity of individual and collective realities, and, on the other, it is a confirmation of their uniqueness in the newly created reality. In this regard, he must initially decide to develop his role as a designer into a creative one in order to be bound to it in relation to his condition and confirmation. If he has decided so, he further confirms that, in the newly created reality, the uncertainty of the individual reality is a possible certainty of the collective one and vice versa.

CONCLUSION

If an architect wants to create a new and different world, he must assume responsibility for creating it by designing. This means that the designer's value system must be developed in the direction of a creative meaningful view of reality so that he can also change it. On the one hand, his role is visible as being average if a representation of the reality of the world of projections includes the principle of repetition, and, on the other hand, he is above average if his principles include a change. Hence, the reality of the world of projections is related to the existence or lack of meaning of the architect's values. From this point of view, it is a new reality of reality which allows for a constant change of meaning. In addition, it is an opportunity to change essentially the formal nature of the common reality and to change formally the essential nature of the individual reality of the world of projections.

The reality of the world of projections is, therefore, its creation, which establishes it as its new reality. For the architect's life, this is a real change from the sense of his role as a designer into the status of a creator. Additionally, he becomes aware that if a design is a unique representation of the reciprocal reality of the world of projections, he is also the real reason underlying the cause of its change. For the life of architecture, it is a new manifestation with the meaning and purpose to which it relates.

Coding the reality of the architect's world of projections represents an insight into the universal codes of reality in order to recognize the codes of his reality. Bearing in mind the multilayered manifestation of reality and the nature of their relationships, discovering its structure requires coding in relation to the world of projections (Jovanović, 2018: 9). Seemingly, it is about not accepting reality in order to accept the world of projections as the new reality. In this relationship, the coding of reality is a categorization of the world of projections with regard to its realities.

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