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SCOPE AND AIMS

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

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EDITORIAL

Dear readers,

In this issue of *Spatium* we continue with publishing a range of miscellaneous papers, mostly those reporting on the findings of the current urban, rural, environmental and architectural research projects in Serbia. Also, a contribution dealing with the issue of participation in urban design (a case from Malta) is published here. Out of 10 articles, the majority are review papers, paralleled by few professional and other papers. The contributions are presented in the alphabetical order of authors, within the respective categories (in total, more than 20 authors).

As from this number, we have a pleasure to work with and enjoy the support of the new Editorial Board and Publishing Council of the journal *Spatium.*

Further minor corrections of technical nature have also been introduced in this issue of *Spatium.*

Miodrag Vujošević
Editor-in-Chief

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Review paper
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FUEL POVERTY AND PERCEPTION ON HOUSING AND ENVIRONMENTAL QUALITY IN BELGRADE'S INFORMAL SETTLEMENT KALUĐERICA

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Informal development is a specific form of urban sprawl and one of the main challenges for the sustainable development of major cities in Serbia. In this paper we examine this phenomenon with regard to the influence of spatial and urban vulnerabilities of the informal settlements on the housing and environmental deprivation, especially in the context of inhabitants' vulnerability to fuel poverty. The empirical research was carried out on the example of Belgrade's suburban settlement Kaluđerica. The statistical analysis of the results has shown that the observed energy characteristics of housing have no relevant influence on households' financial burden of energy expenditure, but that they considerably influence households' perception on thermal comfort. The relation between a limited access to public services and the lack of amenities in the settlement and noted high household expenditure on transport has proved to be a particularly important indicator. Based on the perception on overall life commodities, a poor quality of the environment has been recognized as a key factor of deprivation related to housing.

***Key words*: urban sprawl, informal development, deprivation, fuel poverty, Kaluđerica.**

INTRODUCTION

The incidence of informal or illegal development is present in different forms in the majority of South East European (SEE) countries, while in Serbia it represents one of the main features of the process of urbanization from the second half of the 20th century onwards. In Serbia, residential settlements of low or medium density, which emerged owing to the uncontrolled construction of single-family housing on mostly private agricultural land in suburban areas of major cities, represent the dominant form of informal development.

Numerous problems these informal settlements face – legal, administrative, financial, socio-economic, environmental and spatial and urban – represent an obstacle to sustainable urban development, while at the same time they have an adverse effect on the quality of life of its residents. These challenges are recognized in a global context in different international documents (e.g. *Global Strategy for Shelter to the Year 2000* (1988); *United Nations Millenium Declaration* (2000); *Ministerial Declaration on Social and Economic Challenges in Distressed Urban Areas in the UNECE Region* (2006)), and in the region of SEE in the Vienna Declaration on Informal Settlements in South Eastern Europe (Stability Pact for South Eastern Europe, 2004). According to the provisions of this Declaration, with Serbia being one of the undersigned, the urban, social and economical integration of informal settlements within the overall city structure is a key factor in preparing for accession to the EU, including undertaking necessary actions for their regularisation (legalisation), sustainable improvements and prevention of future informal development (ibid.:1).

Informal development is recognized as one of the most important topics in scientific and professional research in the field of urbanism and housing in Serbia (Mojović, 2011; Ferenčak, 2006; Milić *et al*., 2004; Petovar, 2003). However, the number of empirical research on current housing problems and life conditions in informal settlements is insufficient, barring the studies dedicated to the analysis of the so-called "unhygienic" or "Roma" settlements (Petrović *et al*., 2012; Vuksanović Macura and Macura, 2007; Jakšić and Bašić, 2005).

This paper is based on the assumption that spatial and urban deficiencies of informal suburban settlements, such as

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lower construction standards, poorly planned environment of dwellings and limited access to various urban resources, contribute to the deprivation of the population, with the risk of fuel poverty being one of the main indicators. In the analysis of this assumption we used the example of Kaluđerica settlement on the outskirts of Belgrade, and the results of two survey questionnaires conducted in 2014 and 2015 by the authors. A general goal of the research is to contribute to a greater understanding of negative social, energy and environmental influences of informal development in Serbia and to show the need for them to be recognized and resolved in the future through planned activities of sustainable improvement.

BACKGROUND

Urban sprawl through the lenses of informal development in Serbia

The model of urban sprawl in post-socialist European countries, including Serbia, differs significantly from the one in developed West European countries (e.g. Hirt, 2007; Slaev and Nikiforov, 2013; Petrić, 2013). According to Hirt (2007:757), these two models differ in at least three key characteristics: (1) *demographic* (i.e., who moves to the urban fringe?); (2) *functional* (i.e., how are the center and the fringe economically linked – where do the peri-urban residents work?); and perhaps most notably, (3) *locational and motivational* (i.e., where did the peri-urban residents come from and why did they move?). Residential preferences point to obvious differences in the process of urban sprawl of capitalist and former socialist cities (Petrić and Bajić, 2015). In the first case, migration of middle and higher social classes towards suburban areas is primarily motivated by their desire for high quality housing in natural environment. In the case of former socialist countries, main factors of urban sprawl in the socialist era were late urbanization and prioritization of industrial development, which contributed to a mass influx of rural populations in search for jobs and more affordable housing on the outskirts of major cities. With the beginning of transition, economical motives remained dominant, so in some cases it was more of a question of induced residential choice than a preferred one (ibid.).

Informal development is one of the main characteristics of the incidence of urban sprawl in Serbia, as well as in the region of SEE. This notion actually represents a form of individual residential development without obtaining the required legal documents (building permits), and on unassigned land (Saveljić, 1989). According to Ferenčak (2006), individual residence buildings erected on mostly agricultural or development land (illegally divided) in suburban areas, which Milić *et al*. (2004) refer to as "compact illegal settlements of newer date", are a dominant form of informal development in Serbia. The settlements in question mostly belong to the so-called "upgraded squatter settlements" (Tsenkova, 2012), which, in time, managed to acquire a certain degree of legality and security of tenure by connecting themselves to the basic infrastructure, obtaining formal land titles, gradual legalization of buildings, inclusion in the new master plans of cities, but also owing to the fact that illegally developed buildings were not demolished.

Large demographic influxes, in the first place owing to mechanical migrations from villages to towns during the socialist urbanization in the second half of the 20th century, and forced migrations from the war-torn areas of the former Yugoslavia in the 1990s, served as the impetus for urban sprawl through illegal development in Serbia. Different factors contributed to this process, such as the inadequate residential and land politics during socialism, outdated and inflexible system of planning in the period of economic and social transition, the advancement of economic crisis and poverty, politically motivated tolerance of illegal development as an informal measure of social politics, insufficient administrative capacities and models of legalization, etc. (Milić *et al*., 2004).

Indicators such as almost triple decrease in urban density and the same increase in urban land consumption, as well as inefficient land use, illustrate the intensity of the process of urban sprawl in the Belgrade metropolitan area in the period spanning over last three censuses (1991-2011) (Zeković *et al*., 2015:71). It is estimated that the area of illegal development occupies more than 40% of the area assigned to residential use within the limits of the Master plan of Belgrade. According to the most recent data published in 2015 by the Ministry of Construction, Transport and Infrastructure, there are 1,476,433 illegal buildings in Serbia, making up around one third of the total number of buildings in the country, and there have been around 771,000 submitted requests for legalisation, that is, around half of the total number of illegal buildings. It is estimated that in Belgrade alone there are around 400,000 illegal buildings, or, around 27% of the total in the whole Serbia, for which around 237,600 request for legalization have been submitted (BETA, 2016).

Spatial and urban factors of deprivation and the problem of fuel poverty in informal settlements

The negative effects of urban sprawl on the environment mainly include the influence of car transport on the air pollution, higher energy expenditure, land and water use (Wilson and Chakraborty, 2013). The model of "informal" suburbanization in Serbia and SEE is characterized by additional spatial and urban vulnerabilities, such as inadequate transportation, utilities and social infrastructure and lower construction standards (Mojović, 2011:127), which, besides negatively affecting the environment and sustainable urban development, contribute to the deprivation of local populations. A high risk of fuel poverty can be deemed as an important indicator of deprivation in informal settlements in Serbia, arising under the influence of both socio-economic and spatial and urban factors. Nowadays this social and energy problem is globally recognized, but still insufficiently discussed in Serbia, even though its presence and adverse effects on our environment had been recognized more than a decade ago (UNDP, 2004).

In this context, deprivation is defined according to Townsend's (1979) broader definition of this notion, as the absence or inadequacy of certain living conditions (diet, amenities, standards, services and activities) which are common or customary in society. Contrary to poverty, which occurs due to the lack of income and other resources,

Townsend (1979:249–251, 1173-1176) proposes a much more complex concept to define deprivation (material and social), the one which includes several different spheres of life. The concepts of housing and environmental deprivation are of great importance for this research as different aspects of material deprivation (MD).[2] The first concept analyses the adequacy of housing conditions and the financial burden of living expenditures per household, while the second measures the quality of housing and the environment. When measuring both aspects of the MD, regional differences and the degree of urbanization are taken as important factors of influence.

The results of the Survey on Income and Living Conditions in Serbia conducted in 2013 in accordance with this methodology showed that compared to cities, the risk of poverty was two times higher in other settlements (34.6% versus 17.8%), and that it increased with the increase in urban density (SORS, 2015:23-24). However, measuring of the MD showed that the standard of living in densely populated Belgrade region was not much higher in comparison with other regions, despite higher monetary earnings, which can be explained by lower non-monetary earnings and "higher living expenses" and greater aspirations.

Spatial and urban deficiencies of informal settlements are directly related to the elements of housing vulnerability, both from the aspect of the quality of housing and environment of the dwelling, and from the aspect of living expenditures. Due to the lack of public services (schools, hospitals, libraries, recreational spaces, green/open spaces, etc.), the residents of these settlements are forced to use these services in nearby urban areas, which, besides overburdening the social infrastructure of the cities, contributes to the increased need for travelling among peri-urban populations (Mojović, 2011). Apart from polluting the air, a frequent use of private cars contributes to higher household expenditures on transport. The lack of remote heating systems and a common use of traditional solid fuels whose burning contributes to both outdoor and indoor air pollution, are specific housing problems of informal settlements. Lower construction standards and uncompleted residential buildings additionally affect the comfort of living and the health of the residents, and contribute to higher household energy expenditure, which is recognized as the key indicator of fuel poverty.

The most commonly used definition of fuel poverty, given by B. Boardman, states that "fuel poor households are unable to obtain an adequate level of energy services, particularly warmth, for 10 percent of their income" (Boardman, 1991:207). However, the definition relevant for this research is a broader one, the one that includes household energy and transport expenditures (e.g. the term "energy precarity" in France), due to its additional connections to the problem of urban sprawl. The main factors affecting the incidence of fuel poverty are low household income, high energy prices and poor energy performance of housing stock. The factor of location is likewise very important, albeit it is mostly related to rural areas. Among numerous adverse effects of fuel poverty on the quality of life and health of the population (EU Fuel Poverty Network, 2011), there are several indicators that showcase material and especially housing deprivation, such as: poor thermal comfort, arrears on utility bills and the reduction of other basic life necessities in households.

The data collected in the Survey on Income and Living Conditions show that in Serbia 18.3% of respondents cannot afford adequate heating, and as many as 37% of the households are in arrears on their utility bills, which is far more than the EU average (SORS, 2015). According to the results of the 2013 Household Budget Survey (RZS, 2014), and the West European definition of fuel poverty, the whole population of our country is fuel poor because an average Serbian household spends more than 10% of its income on household energy expenditures. The share of the total household income spent on home energy bills and transport in urban areas amounts to approximately 16%, while in other areas it makes up almost 18%. This difference, caused primarily by transport expenditures, clearly indicates that the factor of location significantly contributes to the vulnerability of rural and suburban populations to fuel poverty. According to the household income levels and total household expenditure on energy, the Belgrade region is in the lead, particularly with regard to expenditure on electricity, central heating and public transport.

A CASE STUDY OF KALUĐERICA SETTLEMENT

Belgrade suburban settlement Kaluđerica (Figure 1) is considered to be the largest informal settlement of this kind in the Balkans (Saveljić, 1989). According to the 2011 Census, nowadays the settlement has 27,000 inhabitants (although it is estimated that the actual number surpasses 45,000), and around 8,800 households. In a comparative review of the number of inhabitants in Serbia from 1948 to 2011 per settlement, the largest relative increase in the number of inhabitants was recorded in Kaluđerica, which saw the 20 times increase in its size in this period (from 934 inhabitants in 1948 to 26,904 inhabitants in 2011) (Figure 2). If we consider only the last two decades, the number of permanently occupied residences has doubled – from 5,557 in 1991 to 10,775 as recorded in 2011. Family residential buildings mostly built by the residents own hands, or with the help of their friends and family, are prevalent in the existing housing stock, while the construction of multi-family houses is still rare. The average size of residences is approximately 75 m^2, which is around 9 m^2 more than the average size of apartments in the Belgrade region.

Intensive urban and demographic development of Kaluđerica started after 1966, with the key reasons being: 1 – shortage of available apartments in the city under the pressure of mechanical influx of residents; 2 – proximity of Kaluđerica to Belgrade (it is located around 10 km from the city); 3 – good traffic connections; and 4 – lack of adequate planning policies (at the time of the adoption of the Master plan of Belgrade in 1969 and 1970, the demarcation line precluding the construction of individual residential buildings was drafted right in front of Kaluđerica (Žerjav, 2014).

[2] According to the *EU-SICL* methodology, the basic dimensions of the MD include economic limitations, accessibility of consumer durables, housing deprivation and, in addition, the aspect of the environment of the dwelling. The last aspect is related to the problem of social exclusion, which, as a rule, does not affect only the poor, but sometimes entire cities (Guio and Maquet, 2007).

Figure 1. Belgrade municipalities and the position of Kaluđerica settlement (Source: https://commons.wikimedia.org/wiki/File:Belgrade_municipalities02.png, processed by authors)

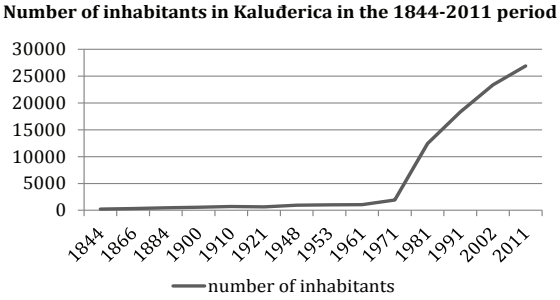

Figure 2. Number of inhabitants in Kaluđerica in the 1844-2011 period. (Source: authors, according to: Saveljić, 1989 and RZS, 2011)

The last empirical research on the roots of development of Kaluđerica settlement and its spatial and social characteristics was conducted in the late 1980s using a survey questionnaire on the local population (Saveljić, 1989). According to Saveljić, urbanistic plans of the settlement were designed with great delay and their primary purpose was recovery, instead of planning and guidance, and since there were no corresponding preliminary researches, they were based on unrealistic assumptions (ibid.:133). According to the data from this study, in that time in Kaluđerica there was no water supply nor sewage network. Households had septic tanks and the water was supplied from an old public drinking-fountain connected to the city water supply system, or from private wells with chemically and bacteriologically polluted water. The social infrastructure was also insufficiently developed, especially with regard to the capacity of the elementary school (classes were organized in three shifts) and the community health care center, and owing to the lack of amenities for the young, and for sports and recreation. Apart from substandard streets (narrow, without sidewalks, usually unpaved), the transportation network was characterized by an inadequate public transport with timetable and vehicle capacity which did not fulfil the needs of daily migrations. Even though in the course of last several decades there have been some improvements with regard to utilities and public infrastructure in the settlement, numerous problems dating back to the 1980s can be recognized today by the local population, as witnessed by the results of a more recent survey (Petrić *et al.*, 2014). Among other things, this survey showed that the main motives for settling in Kaluđerica were: 1 – property in ownership, 2 – size and quality of the house, and 3 – property values/re-sale values (ibid.).

METHODOLOGY

In this paper we used the data obtained from two questionnaire surveys conducted in Kaluđerica settlement (Petrić and Bajić, 2015; Bajić and Petrić, 2015). Based on the first survey conducted in February/March 2014 on a representative sample of 90 households (making up 1% of the total number of households according to the 2011 Census), we analysed residential preferences of the population living in Kaluđerica, as an important factor of urban sprawl in the post-socialist Belgrade. The main tasks of this research were to establish motives for settling in Kaluđerica, the satisfaction with different neighborhood amenities, and variability of suburban residential preferences. The second survey was carried out in February 2015 on a sample of 50 households, with the aim to examine the problem of fuel poverty in this suburban area. We examined the following key indicators: household energy expenditure (in % of monthly income), electricity and transport expenditure, energy services arrears, general energy characteristics of residential buildings and indicators of thermal comfort, whereby the last two indicators were defined according to the national methodology used in the TABULA project (Jovanović Popović *et al*., 2012).

In both surveys the sample was formed by the random sampling method, taking into account only the criterion for balanced distribution of households in the settlement according to the previously designated spatial zones (Figure 3). For the most part the research was conducted as door to door survey questionnaire, while a smaller part of respondents were surveyed by email. Both surveys were anonymous, and the answers to the questions were given only by one member of the household, i.e. its representative.

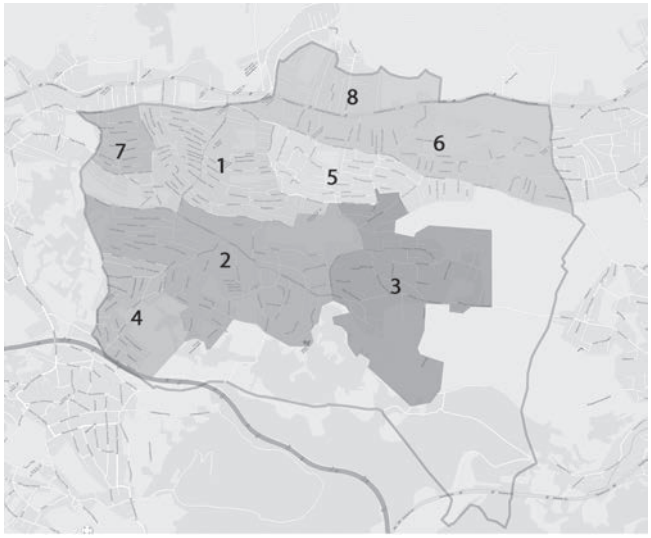

Figure 3. Division of the settlement into zones (Source: authors)

This paper is primarily focused on the analysis of relations between recognized spatial and urban problems in the areas of informal development and indicators of deprivation with regard to fuel poverty, as well as inhabitants' perception of the quality of life in Kaluđerica. Statistical analyses of the results included parametric tests (Pearson's Correlation) and non-parametric tests (Chi-Square) within the SPSS (Statistical Package for Social Sciences), Version 21.0.

RESULTS

Fuel poverty factors

Factors of household energy expenditure and achieving thermal comfort

The results of the Survey on Fuel Poverty in Kaluđerica show that 66% of the respondent households spend over 20% of their total monthly income on household energy and transportation. Applying Pearson's Correlation in examining the relations between the household size and energy consumption, a small positive correlation is noted between the variables, which shows that larger households, i.e. households with more than four members, mostly set aside a greater share of their income for energy expenditure (Figure 4). The same method has been used to establish that these households also have a smaller share of persons who earn a regular monthly income compared to three-person households, which generally proves their greater vulnerability to fuel poverty (Figure 5). According to the respondents' answers, only 12% of the surveyed households have electricity bill arrears. Comparing arrears with the size of households, it has been established that households with more than four persons on average have less arrears for the electricity consumption than households with up to three persons (Figure 6).

In approximately two thirds of the households surveyed, the use of solid fuels (wood and coal) is a dominant source of household heating, where firewood is the most represented fuel, used by 66% of the households. Even though over one half of the households have individual central heating, as much as 36% of the homes are still heated by solid fuel stoves. On average, households spend RSD 5,800 (cca. EUR 48) monthly on electricity, with one third of them spending between RSD 5,000 and RSD 15,000 on electricity (cca. EUR 41 to 123).

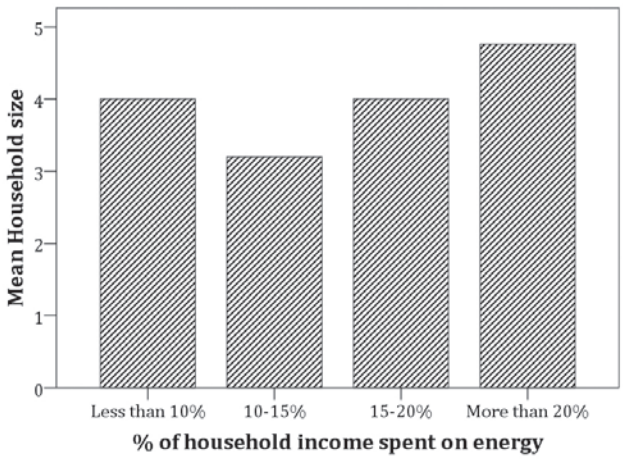

Figure 4. % household expenditure on energy compared to the household size (Source: authors)

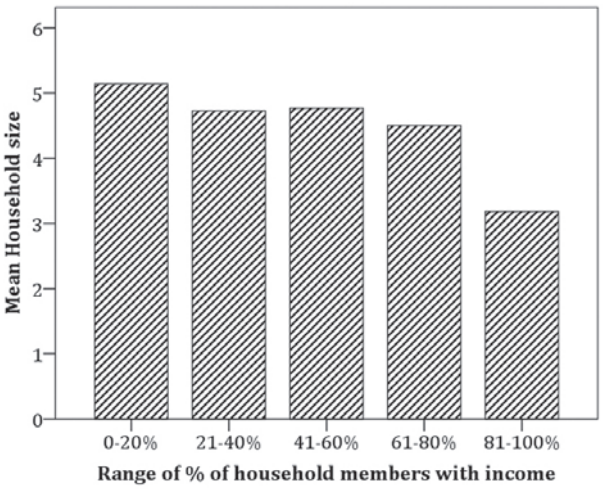

Figure 5. % persons who earn income compared to the household size (Source: authors)

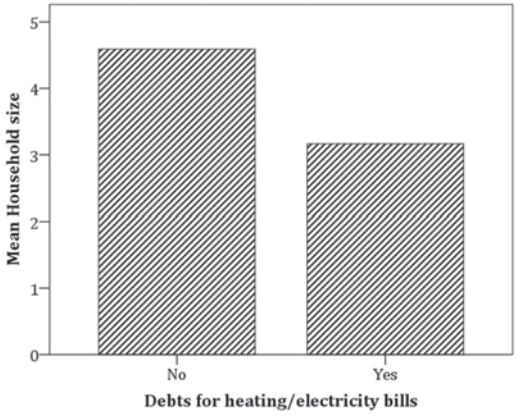

Figure 6. Electricity bills arrears compared to the household size (Source: authors)

The applied Chi-Square test has shown that there is no significant relation between heating systems and energy sources on one hand, and the cost of household electricity on the other. However, in the category of higher electricity costs (RSD 5,000-15,000) there are significantly less households using solid fuel and electricity stoves for heating than the houses with individual central heating or apartment-contained central heating. The data prove that the usage of cheaper firewood and traditional heating systems, as well as electric thermal storage heaters, at favorable night rates still represents the most available and economical type of heating in Kaluđerica.

The analysis of the general energy characteristics of housing stock indicates a relatively low level of energy efficiency of residential buildings, mainly due to the lack of financial resources of the residents for completing the construction of their houses (Bajić and Petrić, 2015). Approximately two thirds of the houses are detached and almost square-shaped at the base, while the majority of the houses have sloping roofs and attics that are in 28% of the cases used for dwelling. Unfinished roof, i.e. temporary roof structures are recorded in 12% of the houses. The finished facade is present at 56% of the houses, while the share of openings on the facade and unfinished facades of all the houses is 22% each. Customary thermal insulation of the finished facades is 5 cm thick

polystyrene. Additional measures of thermal insulation of the houses are applied in smaller portion, therefore thermal insulation of floors on the ground exists in only 40% of the houses, while only 26% of the houses have roof heat insulation.

The Chi-Square test applied to measure the extent of the influence of thermal insulation used for the facade on household electricity expenditure, as well as on the share of energy consumption in relation to income earned, has proved that there are no significant relations between these category variables. However, it is interesting to note that households living in the residences with partially finished thermal insulation or in non-insulated homes, generally incur lower electricity costs (up to RSD 5,000), while the households in thermally insulated houses incur higher costs (RSD 5,000 – 15,000). This can be explained by the obtained results that the households which live in houses with partial thermal insulation or without insulation of the facade, use in vast majority wood as a primary source of heating (86%) alongside with coal (9%). Moreover, out of all the households which spend over 20% of their income on energy, as much as 66.7% live in thermally insulated houses, whilst in the category of households which spend less than 20% of their income on energy, the houses with unfinished thermal insulation are predominant. At the same time, around one half of the households living in thermally non-insulated houses spend more than 20% of their income on energy.

The data on thermal comfort also indicate that less than one third of the surveyed households heat the entire living area during the heating season, whereby more than 70% of them live in a house with average net usable space of 100m^2. Approximately 28% of the households living in the house with average net usable space of 100m^2 heat up to 50% of this area. Around 50% of the respondents expressed that they were satisfied with the thermal comfort in their homes during winter months, 44% of the respondents were only partially satisfied, while 6% of the respondents were not satisfied. They cited unfinished facade and roof, as well as decrepit windows as the main reasons for their dissatisfaction.

The applied Chi-Square test has found a significant relation between the existence of thermal insulation and satisfaction with thermal comfort in homes (either flats or houses), i.e. that there is a significantly higher percentage of those who are satisfied with the indoor air temperature whilst having thermal insulation of facade (64.3%), compared to the

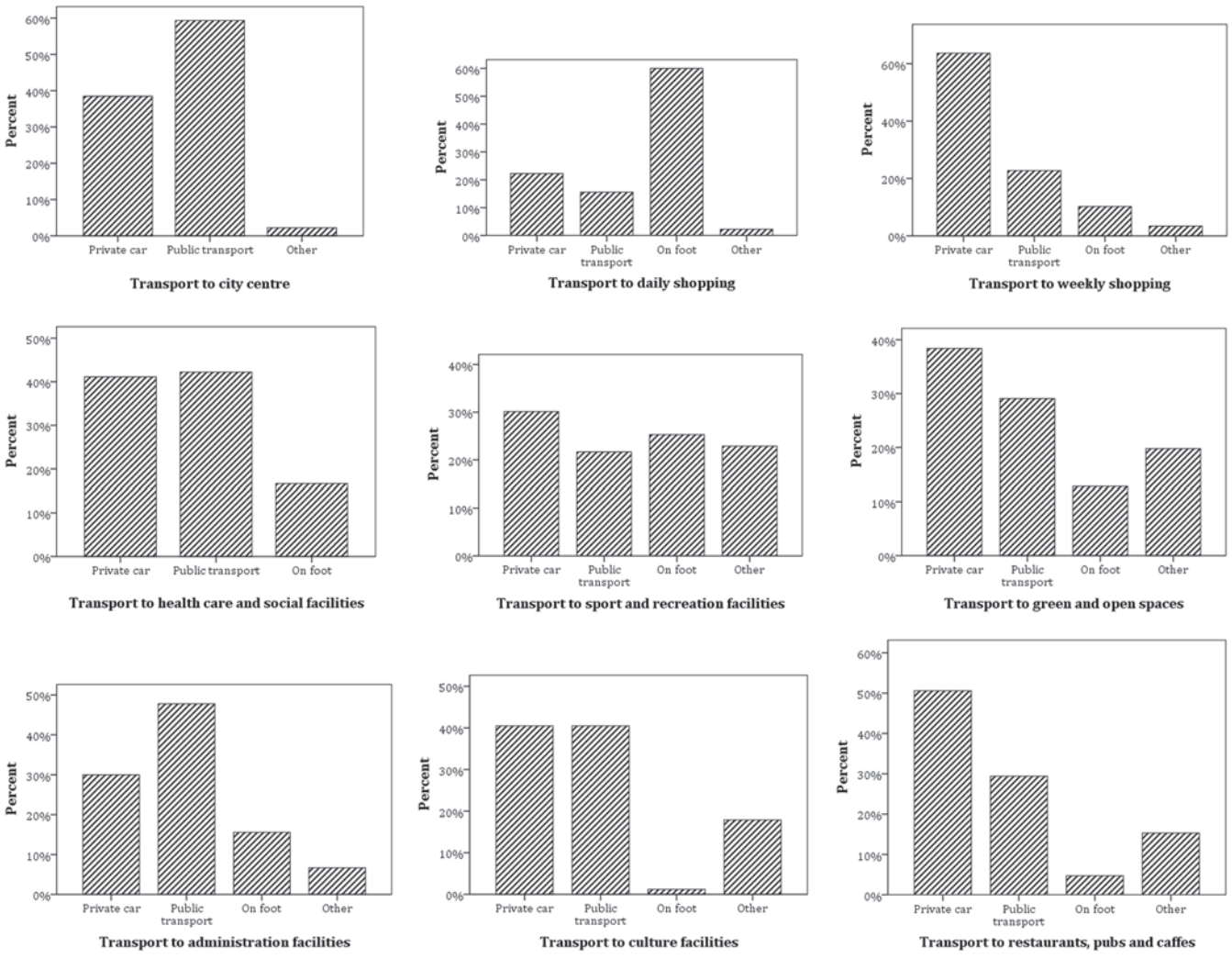

Figure 7. Means of transportation of the inhabitants of Kaluđerica as per the type of activity (Source: authors)

percentage of the respondents without thermal insulation or with partial facade thermal insulation (31.8%). It has also been established that the satisfaction with thermal comfort is increasingly higher in the households which heat from 50% to 100% of the living space than in the ones heating less than one half of the living space (80% versus 20%), as well as that the satisfaction is higher in the households heated by the central heating or apartment contained heating systems than in the households using solid fuel and electricity for heating (64% versus 36%).

Factors of transportation fuel expenditure

The survey results show that, even though the residents of Kaluđerica mostly travel by public transport, as many as 70% of the surveyed households regularly use cars, thus incurring monthly fuel costs of around RSD 10,000 (cca. 82 EUR), which is four times the city average.

The lack of public infrastructure and amenities along with poor traffic connections of the settlement with the local public transport network highly influence the significant expenditure on the use of private cars as means of transportation in dealing with residents' everyday activities (Figure 7). The average distance 34% of the respondents cover while performing their daily activities ranges from 6 to 10 km, while 9% of the respondents daily cover the distance greater than 21 km (Figure 8).

Public transport is primarily used for travelling to the city center (around 60%), visiting Community Health Center and other social (42%) and administrative facilities (4%).

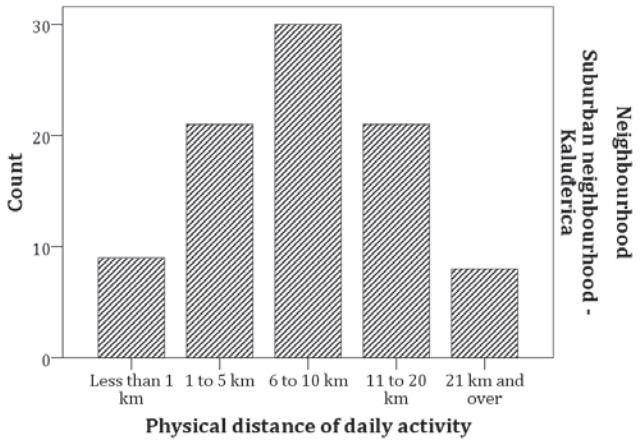

Figure 8. Average distance covered while performing daily activities in Kaluđerica (Source: authors)

On the other hand, the usage of individual car transport is predominant in large scale weekly shopping for supplies (64%), use of sports and recreational facilities (30%), green areas and open spaces (38%), and restaurants, pubs and cafes (51%). Both means of transportation are used in equal share when visiting cultural facilities (around 40%). Walking is predominant for everyday shopping, although in this case around 22% of the respondents also use car as means of transportation, which shows inadequate accessibility and spatial distribution of large supermarkets in the settlement.

Perception on housing and environmental quality

The survey of the inhabitants' perceptions on the overall housing commodities of Kaluđerica suburban settlement showed that most of the respondents expressed relative and absolute satisfaction (42%), mainly due to the following: favorable position of Kaluđerica, which is secluded from the city and noise; good transport; ownership of the land and arable land for cultivation. As many as 30% of the respondents expressed neutral stand and indifference with regard to this topic, noting that in today's Kaluđerica "it is, nevertheless, better than it was" and that despite deficiencies in infrastructure, there was a certain degree of satisfaction due to relatively close position of institutions and facilities. On the other hand, 28% of the respondents were not satisfied with the overall amenities of living in the settlement, stating as key reasons the lack of activities for the youth, few cultural and sporting events, narrow streets and other infrastructure issues. Out of the seven advantages offered in the survey, the respondents marked the highest satisfaction with well-organized public transportation (74%), good neighbors (68%) and favorable location of Kaluđerica (60%), while by far the largest dissatisfaction was with the environmental quality and the level of hygiene (76%) (Figure 9).

The most common sources of pollution include: incomplete and inadequately developed draining and sewage networks in the settlement; Kaluđerica stream flowing through the settlement, which represents a burning issue because it is contaminated by the inflow of faecal matter making it a source of disease spread; unsuitable waste disposal – irregular transport of waste, insufficient number of garbage bins and containers and their inadequate arrangement, burning of waste; air pollution, especially during the winter due to private boiler rooms; the vicinity of the solid waste landfill site at Vinča; and the like.

The results of a conducted survey on the inhabitants' attachment to this settlement additionally attests to the

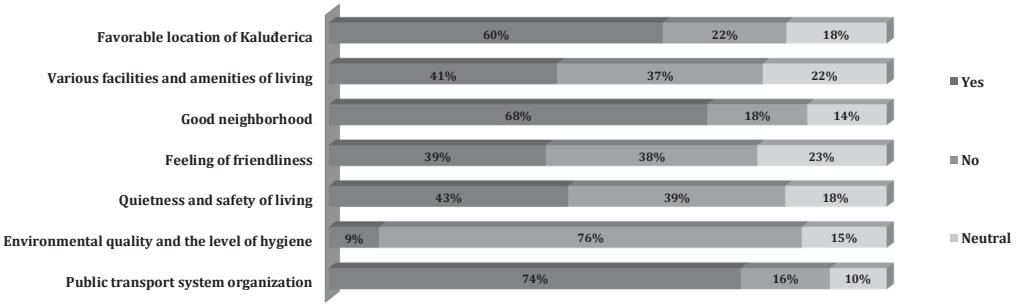

Figure 9. Satisfaction with the amenities in Kaluđerica (Source: Petrić and Bajić, 2015)

perception of the quality of housing in Kaluđerica, whereby around 60% of the respondents said they would move to a more urban part of the city, provided they had the means to do it.

CONCLUSIONS

This paper analyses the influence of spatial and urban issues of the informal suburban development in Serbia on certain aspects of the inhabitants' deprivation in these areas. As a specific indicator of housing and material deprivation in informal settlements, the risk of fuel poverty has been examined, taking into consideration a low level of energy efficiency of the housing facilities, the lack of efficient heating systems, higher transportation costs, as well as a significant share of the households with lower income. The Survey on Fuel Poverty directly addressed the indicators of this phenomenon, while the Survey on Residential Preferences included the indicators of the population's perceptions on housing amenities of the settlement, especially the ones relevant for the aspect of deprivation in relation to the housing environment. The assumption of households' vulnerability to fuel poverty has been confirmed in Kaluđerica, since 66% of its households spend over 20% of their monthly income on energy and transportation (Bajić and Petrić, 2015).

The research results show that spatial and urban factors have a significant influence on the transport expenditure, while on the other hand they have a limited influence on energy expenditure of the household. The lack of public and commercial amenities in Kaluđerica increases the need for inhabitants to use private cars, especially for weekly shopping, sports and recreation, use of green and open spaces, and to reach restaurants, pubs and cafes and cultural facilities. This need is certainly emphasized by an inadequate coverage of the public transportation network, i.e. by a considerable distance of the newly built parts of the settlement from the nearest bus stops. Applied statistical analyses established that heating systems and energy efficiency characteristics of the buildings, primarily in terms of the applied thermal insulation, had no relevant influence on the household electricity expenditure, nor on the share of electricity costs compared to household income. However, it has been noted that the households living in unfinished homes and using solid fuel stoves, often combined with electric thermal storage heaters, have significantly lower expenditures and set aside a smaller share of their income for energy than the households living in thermally insulated houses heated by the central heating systems. On the other hand, it has been proved that these two variables influence thermal comfort to a significant degree, i.e. that satisfaction with the air temperature in flats or houses is much higher with the respondents living in houses with thermal insulation or with the central heating system, which is directly linked to the possibility of heating larger living spaces during the heating season. These findings imply that for many households in Kaluđerica facing the issue of fuel poverty means recoursing to risky methods of energy saving, i.e. the reduction of living space to be heated and the usage of cheaper and lower quality fuel for heating, which besides inadequate thermal comfort, also involves a high risk on the health of the inhabitants (UNDP, 2004). Electricity bills in arrears have not been recorded, but there is a possibility that the respondents have not been completely honest in presenting possible financial issues. In this, as well as in other indicators of fuel poverty, we should bear in mind a limited sample of the surveyed households as a potential restriction in determining the relevance of the obtained results.

Based on the respondents' perceptions on the overall living and housing amenities, low hygiene levels and environment protection recognized as important factors of the housing deprivation have been singled out as key factors of dissatisfaction with the housing neighborhood. This is another crucial indicator of the current state of urban sprawl in Serbia, where living on the outskirts does not imply achieving a "higher" quality of life in a natural, unpolluted environment.

Acknowledgments

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CONTEMPORARY SERBIAN ORTHODOX CHURCH ARCHITECTURE: ARCHITECTURAL COMPETITIONS SINCE 1990

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This paper focuses on the architectural competitions for Orthodox Christian churches in Serbia since 1990, both on the analysis of the designs submitted and the competition requirements. The first competition for an Orthodox church in Serbia after World War II was announced for Priština in 1991. After that, competitions for the temple in Čukarica, Novi Beograd, Niš, Aleksinac and Kruševac were conducted. Thanks to the fact that architectural competitions allow a greater degree of creative freedom to the architects than regular practice, various solutions were offered, from replicas of models from architectural history and tradition to fully non-traditional proposals. Depending on the relationship to tradition, architectural design approaches can be classified into three main groups: radically modernizing, conservatively traditionalist, and compromising. Of the six competitions conducted, four churches were built, which are among the most architecturally successful newer churches in Serbia. This points to the importance of the implementation of the architectural competition in this field of architecture. The diversity of the award-winning projects shows that there is awareness of the possibility for the further development of church architecture, favouring a moderate approach.

***Key words*: Christian Orthodox church architecture, architectural competitions, tradition, Serbia.**

INTRODUCTION

Contemporary Orthodox Christian church architecture in Serbia is in a crisis, marked by the profound misbalance between the number of churches built since 1990 and their architectural quality, which is similar to the situation throughout Orthodox Christianity today (Manić *et al.*, 2015b). Of the hundreds of churches designed and built during this period of time in Serbia, only a few of them have achieved a positive reception among the professional audience[2]. This state of affairs is the consequence of several factors, of which two stand out. The first one is the marginalization of this architectural programme during socialist Yugoslavia, on account of the ideological hostility of state socialism toward religion, which was present to a greater extent in the Soviet Union, Romania and Bulgaria – predominantly Orthodox Christian countries – during their socialist period. The second factor is the widespread skepticism in general towards the possibility and the appropriateness of using modern, non-historicist architectural language in Christian sacral architecture[3]. This attitude is present not only in Eastern, but also in Western Christianity as well, even though there is a strong tradition of modern religious Western Christian architecture – both Roman Catholic and Protestant, including some masterpieces of the most important twentieth century authors, and some of the pioneers of modern architecture – Le Corbusier, Mies van der Rohe and Frank Lloyd Wright.

This paper focuses on the analysis of designs submitted in the architectural competitions for Orthodox churches since 1990 in Serbia. This subject was selected due to the fact that such designs are all based on the same competition requirements, and yet the architects are allowed to deploy a certain level of creative freedom, so it is possible to encounter a large number of different approaches,

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[2] see: Jovanović M., 1987 and 2007; Mitrović, 2009; Kadijević 2009, 2010, 2013b, 2015; Kadijević and Pantović, 2011 and 2014; Jovanović Z., 2011; Folić, 2013; Milenković, 2013; Manić, 2009; Manić *et al.*, 2013.

[3] see: Ioan, 2001; Tuleshkov, 2002; Barbas and Tsagallas, 2003; Milovidov, 2012; Fernandez Cobian, 2007; Schloeder, 2014; Manić *et al.*, 2015a and 2015b.

concepts and unique styles compared to the contemporary architectural practice in this field. Only the open public competitions were analyzed. The year 1990 was chosen as a starting point for our research because it marks the start of the transition from socialism, which had started to collapse in the previous year in the whole of Europe. Furthermore, those competitions were the first ones to take place after the period between two world wars.

This research serves as a contribution to the study of sacral architecture from the aspect of architectural and urban design. The objective is to acquire an understanding of different approaches and viewpoints on the possibilities of further developing Serbian Orthodox church architecture. Another important goal is the systematization, critical assessment and classification of the designs submitted to architectural competitions for Orthodox church buildings over the last two and a half decades. The purpose of the research was to provide a better understanding of contemporary Serbian Orthodox Christian church architecture and to investigate the development tendencies and potentials, on one hand, and assess the readiness of the professionals and the Church circles to accept some of the models offered, on the other.

THE COMPETITION DESIGNS AS CONTRIBUTIONS TO CREATIVENESS - ANALYSIS AND CATEGORIZATION

Competition for the Orthodox temple in Priština

The first architectural competition for designing an Orthodox temple in the post-war period in Serbia was called in 1991 for the temple in Priština. Of a total of sixteen concept designs submitted, seven were taken into consideration (Milenković A, 1996: 109); no first prize was granted, and the winners of two second prizes ex aequo were the architect Spasoje Krunić (Figure 1) and the team of architects: Svetolik Tanasijević, Darko Delale and Stevan Mićić[4] (Figure 2).

Both designs represent attempts to modify the traditional model using contemporary architectural engineering, which was achieved by the stylization of the construction elements and a slightly simplified facing. The construction works were commenced based on Krunić's project, which was more refined and pure architecturally than the other award-winning design, which exhibited the strong

[4] At the exhibition *Tradition vs. Contemporary Serbian Church Architecture*, a slightly different list of authors was published: Delale, Mićić and Radmilo Erić.

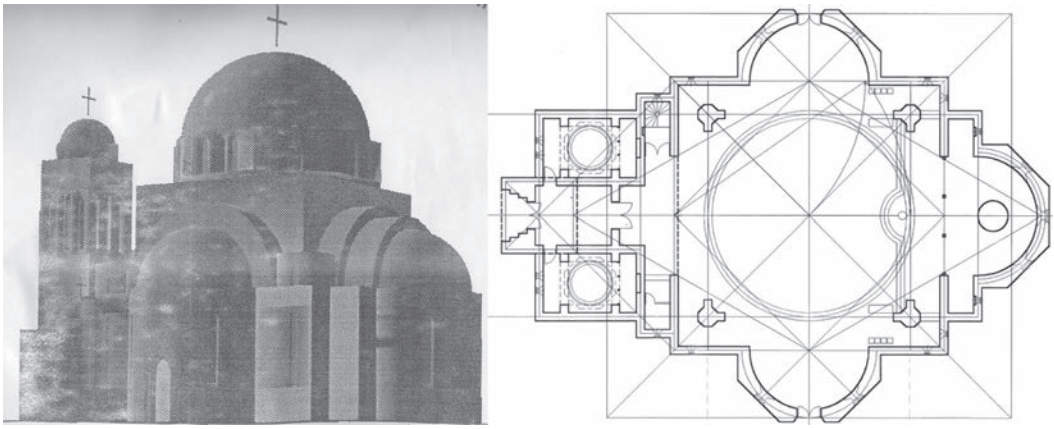

Figure 1. The church in Priština, second prize – Spasoje Krunić
(Source: IAUS archives)

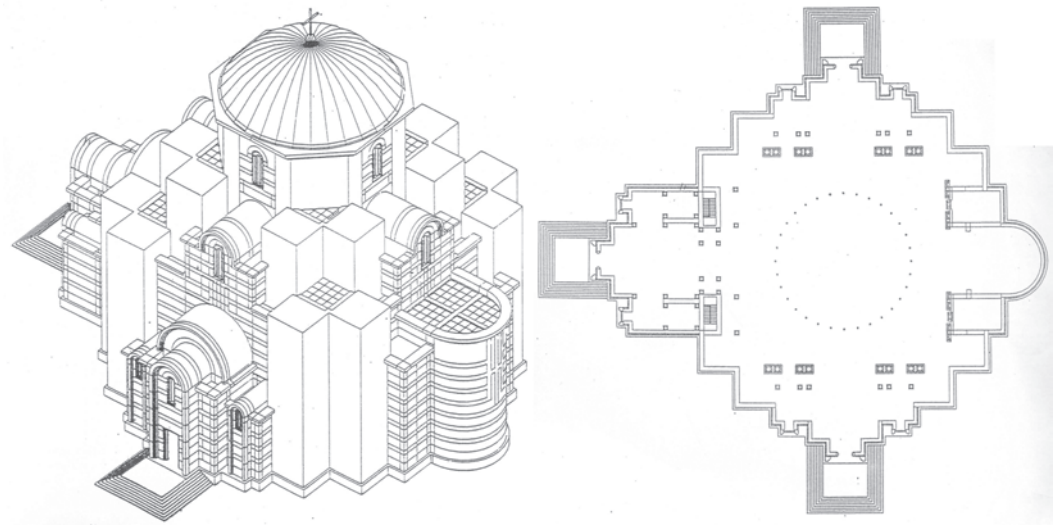

Figure 2. The church in Priština, second prize – Delale, Mićić et al.
(Source: IAUS archives)

effects of postmodernism. The main construction works were completed, however, after the Serbian Autonomous Province of Kosovo and Metohija was placed under UN interim administration in 1999, the construction site was abandoned, and the temple was defiled and became under threat of being demolished by ethnic Albanians.

Exhibition and science conference Tradition and Contemporary Serbian Church Architecture

At the exhibition and science conference entitled *Tradition and Contemporary Serbian Church Architecture* organized by the Institute of Architecture and Urban & Spatial Planning of Serbia (IAUS) and the Faculty of Theology in Belgrade in 1994, several authors were invited to give their opinions about the contemporary Orthodox temple in Čukaricki Vis in Belgrade. This initiative could be understood as a specific call to an architectural competition for designing an imaginary church. The organization of the science conference and exhibition was an attempt to provide an answer to what a contemporary Serbian Orthodox temple should look like in the early phases of the church building expansion during the 1990s. This significant contribution made by various authors who, in terms of their theory and design solutions, tried to take stock of the challenges of contemporary sacral architecture, has remained an isolated event without a strong impact on the construction practice.

The exhibition and the proceedings (Stojkov and Manević, 1995) showcased the proposals of Aleksandar Đokić, Igor Marić, Mihailo Mitrović and Predrag and Vesna Cagić. Architects Cagić offered a tailored solution with the central plan base in the shape of a free Latin cross with a dome, and one-part altar interconnected with the nave into a single space with a separate bell-tower. The styled and modern form was achieved by facing free from architectural decoration, as well as by polarizing window-free walls and glass surfaces. The solution submitted by Igor Marić was based on the past as a decisive criterion, relying on a traditional composition scheme – the cross-in square base with a dome and pyramidal cascading of forms. The author offered a postmodern solution not using the exact medieval architectural style elements, but transforming them into modern shapes and materials, including an external narthex of steel and glass.

Competition for the Orthodox temple in Čukarica, Belgrade

In Belgrade, the first competition was called in 1995 for the architectural and urban concept solution for an Orthodox temple and its accompanying facilities in Čukarica. The competition was called in January that year by Stankom Corporation and the Archbishopric of Belgrade and Karlovci in cooperation with the Association of Belgrade Architects (DAB). The call was general, public and non-anonymous. One of the jury members, prof. Branislav Milenković, criticized the non-anonymity provision in his text published following the competition (see Milenković B., 1996b). The main objective was to obtain a quality solution for a temple and its accompanying facilities, while other elements of the competition were survey based. The competitors were requested to provide urbanist solutions for a simple composition of the whole complex, while respecting the condition of functional separation of each group in order to enable construction in phases.

The competition's urbanist requirements defined that the temple should be visually and functionally dominant, which corresponded with its position on a hill and guaranteed that the temple would be a part of the cityscape. It was also defined that the temple should be oriented west-east with a possible deviation of up to 30°, featuring a fenced churchyard and a walking path at least 5m wide for the purpose of processions, with the optional design of a drinking fountain. An architectural requirement worth mentioning was placing the altar in the apse and ensuring the altar's visibility from any corner of the nave. The competition program defined that "towards the east side ... the interior of the temple ends ... (with the apse)" (underlined by authors). As for the recommended form, it was suggested "not to copy the existing local churches, but to draw inspiration from their form in order to ensure harmony with the Orthodox temple lines and yet add the air of freshness, liveliness and beauty; so that gradually a new style acceptable to the Orthodox religion is achieved", as said by the then Patriarch Pavle in an interview first published in the *Official Gazette of the Serbian Orthodox Church*, No. 3 from 1986, which he gave while still holding the seat of the Episcope of Raška-Prizren Eparchy. It was also defined that a dome building design should be submitted. The invitation contained a precise functional scheme (Figure 3) with the defined design program of the building. The developed spatial program included: a presbytery with the altar, a proscomidium (prothesis), a diakonikon, and a south and north pastophorion; a soleas with the side choirs (kliros); a nave with seats alongside the walls and two side entrances; a narthex, with two adjacent chapels (the north one for placing candles and the south one for the confessional and baptistery, with a note that the baptistery may stand separate as well); a church shop; and a connection to the choir gallery. The requirements included a three-part interior organization (altar – nave – narthex), with a bell-tower – integrated, or as a separate object. Following the participants' questions, it was clarified that designing a dome was required, with an explanation that the majority of Church circles are in favour of such a solution for the temple, and that the soleas is not the place for believers.

The proposed scheme is not completely traditional, mainly since it requires pastophoria (parabemata), in addition to the prothesis and a diakonikon, which form an elaborate presbytery. Pastophoria, are mentioned in an Old Testament description of the Temple of Jerusalem (1 Chronicles, 28:12; Ezekiel, 40:17), and were present in early Christian architecture (Constitutions, II:LXVII) as the auxiliary side rooms, having different functions and occupying different positions in different eras and places (see Varalis, 2006; Marinis, 2014). They sometimes served just as the prothesis and diakonikon or skevofilakion, so that the terms became intermixed. After the iconoclastic crisis, the function, meaning of the terms, and the position of the prothesis and diakonikon were finally settled and they became part of the sanctuary, which was the arrangement accepted and used in medieval Serbia. Since then, additional, separate pastophoria were not found until recently. In this scheme they serve as auxiliary spaces to the prothesis and diakonikon in which

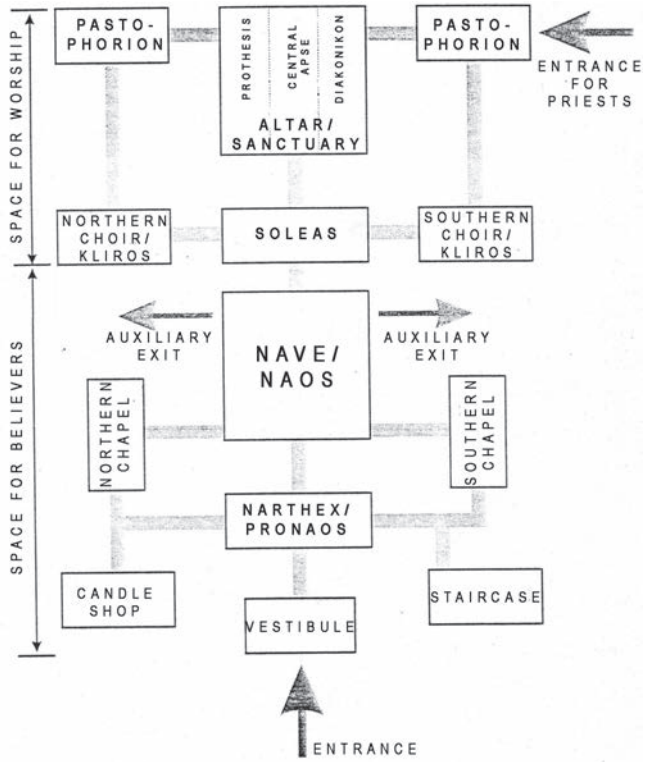

Figure 3. Functional scheme of the church (Source: DAB archives; translated by authors)

liturgical objects, books and vestments are stored and the preparation for the liturgy is done. This type of presbytery arrangement, which combines early Christian and late medieval Byzantine architectural characteristics can be found in some newer Orthodox churches built in the world, e.g. in North America. This influence, which most probably came through the Serbian diaspora, is visible in the functional scheme proposed in the invitation to this competition, and it could have significant effect on the architectural composition of the eastern section of Orthodox churches.

The competition jury was chaired by the Bishop of Bačka, Irinej (Bulović), with the majority of members being architects. Thirty one designs were submitted for the competition, and three prizes awarded, along with four equally valuable acquisitions and one prize outside the competition requirements. The competition results and proceedings were published in a special edition of the

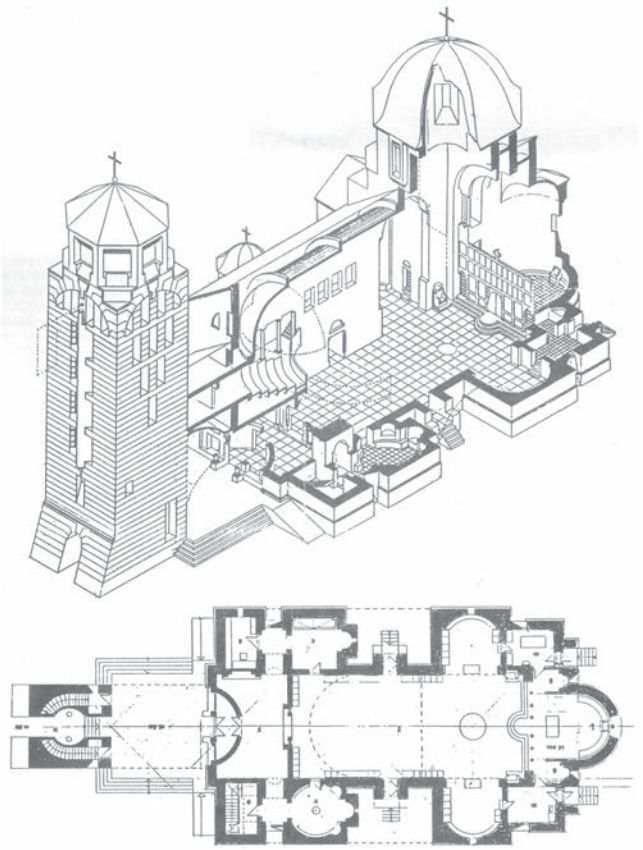

Figure 4. Temple in Čukarica, first prize – Miladin Lukić (Source: Forum, June 1995)

magazine *Forum* of the Union of Architects of Serbia dated June 1995.

Of the eight acquired concept solutions that were awarded prizes, six featured traditional style, and the first prize was granted to the project by Miladin Lukić, based on which the temple was built (Kadijević, 2009 and 2010; Kadijević and Pantović, 2011 and 2014). It was directly inspired by the Raška architectural school style, which is a rare case in contemporary Serbian church architecture (Figure 4).

The acquired design submitted by a team of authors led by Miodrag Ralević takes the dome from the traditional approach and, using it as the main feature, builds a recognizable form in a new manner by multiplying this element. The architect Blagota Pešić was the only one who proposed a completely non-traditional solution (Figure 5) while ensuring that the

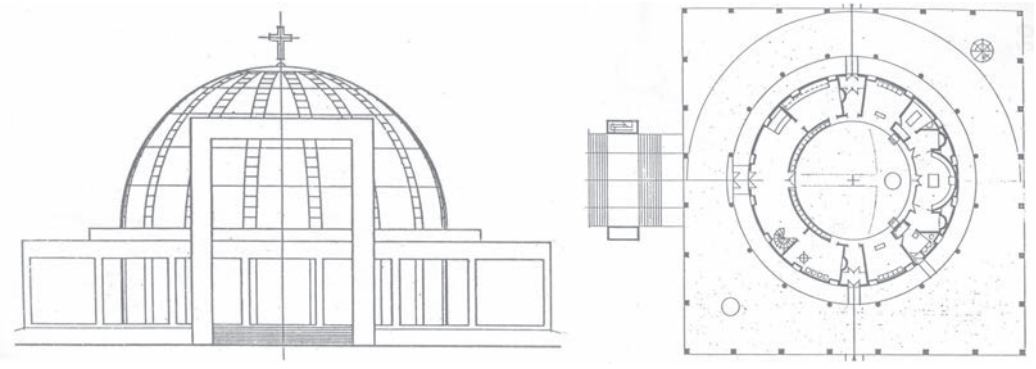

Figure 5. Temple in Čukarica, third prize – Blagota Pešić (Source: Forum, June 1995)

functional requirements were fulfilled by a unique rotunda. This design, which was awarded with the third prize by the jury, featured the dome only as a universal symbol and not a reminiscence of historical forms.

Competition for the Orthodox temple in New Belgrade

The second and, so far, the last open public architectural competition in Belgrade for an architectural and urbanist concept solution for an Orthodox temple and its accompanying facilities was called in 1997, again by the Archbishopric of Belgrade and Karlovci, in cooperation with the Association of Belgrade Architects and the Association of Belgrade Urbanists. The temple in question was for Block 32 in New Belgrade. This time, the competition was general, public and anonymous. The jury, composed mainly of architects, was chaired by the then Patriarch Pavle. As with the 1995 competition, the main objective was to obtain a concept solution for a temple which would become a new element in the city's identity. Solutions for the accompanying facilities were requested in the form of a survey. The solution was also required to ensure the composition unity and functional separation for the purpose of possible construction in phases. The relevance of the future temple was even higher because until then there was not a single Orthodox church in the New Belgrade area.

The first request was that the temple should be designed "relying on the tradition, central plan, no pillars beneath the dome". The requested orientation was east, with the path around the temple at least 4m wide. As per the urbanist and technical requirements from the competition documents (following the participants' questions, it was clarified that they were only a starting point), the axis deviation allowed from the east was up to 30°. The design requirement was a three-part temple consisting of a presbytery – altar area (with pastophoria), a nave and a narthex (with a room for selling and lighting candles, and a confessional and baptistery, as well as a connection to the choir gallery; the complex was planned to include one more baptistery), with a bell-tower inside the building or outside. In addition to the competition documentation, at the competitors' disposal were also selected books: *Orthodox Liturgics* (Mirković, 1965) and *Tradition and Contemporary Serbian Church Architecture* (Stojkov and Manević, 1995). Following the participants' questions, it was clarified that there were no conditions regarding the roof type and dome construction provided that interior painting of the temple was enabled and the central plan of the temple ensured. It was also determined that it would be a parish church. Subsequent clarifications also amended the provision in terms of revoking the urbanist and technical requirements related to the "Serbian-Byzantine style" of the temple, with the base shaped as a cross-in square or a free cross. The note that the staircase to the choir gallery may be in the entrance area as well as in the narthex created a dilemma about the spatial composition of the west part of the temple, as this suggested that the narthex is not the entrance part. The jury also underlined that the required iconostasis position should be of such height to enable unity of space and visibility of the wall paintings at the altar.

Fifty authors and teams took part in the competition (three designs were not considered due to their late submission), one prize was granted along with the four acquired designs and three special prizes. The results of the competition and the illustrations of the award-winning designs were published in the regular 40th issue of the magazine *Forum* and in a 6/7 issue of *UrBS* – the bulletin of the Serbian Town Planners Association and Association of Belgrade Urbanists. In view of the specific context of the New Belgrade modern architecture, this competition was an opportunity to fully examine the development possibilities of an Orthodox temple.

The first-ranked design of Nebojša Popović (Figure 6) served as the base for the later built temple (for a detailed account see Kadijević, 2010 and 2013a; Kadijević and Pantović, 2011 and 2014). It was designed in the spirit of Hansen's interpretation of tradition, with a post-modern approach to the facing which, as per the author's idea, should represent an "exhibition" of traditional motives within the construction elements highlighted on the surface. This author followed the proposed functional scheme, except that he designed the prothesis and the diakonikon inside the north and south pastophoria respectively, and not inside the central altar space – the sanctuary.

The acquired design of Snežana Ignjatović and Goran Ivanović was marked by a similar approach, as their

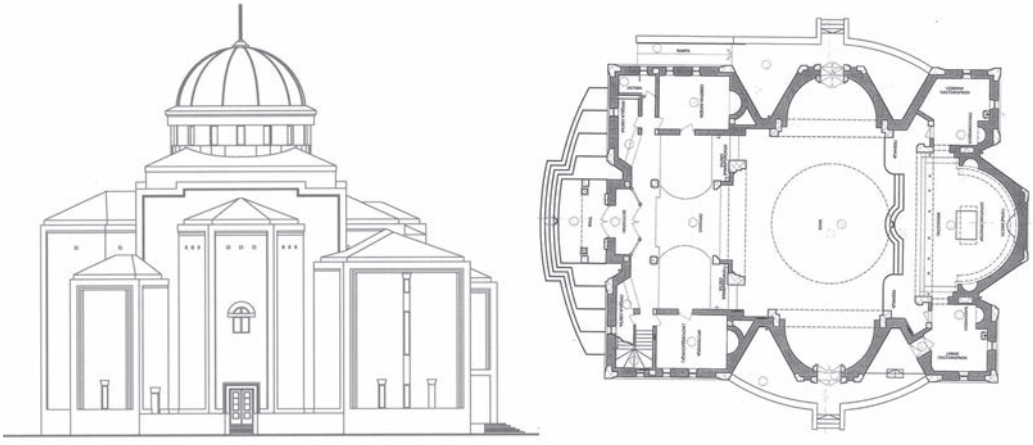

Figure 6. Temple in New Belgrade, first prize project and the church – Nebojša Popović (Source: Forum, 40; Folić, 2013)

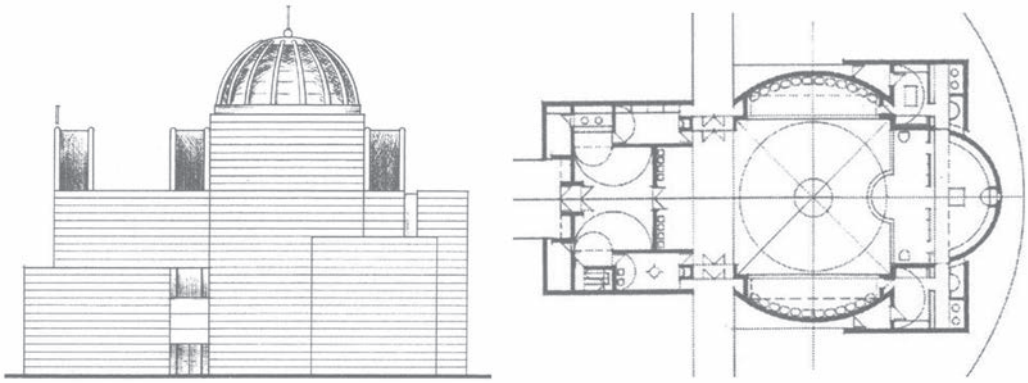

Figure 7. Temple in New Belgrade, acquisition – Blagota Pešić
(Source: Forum 40)

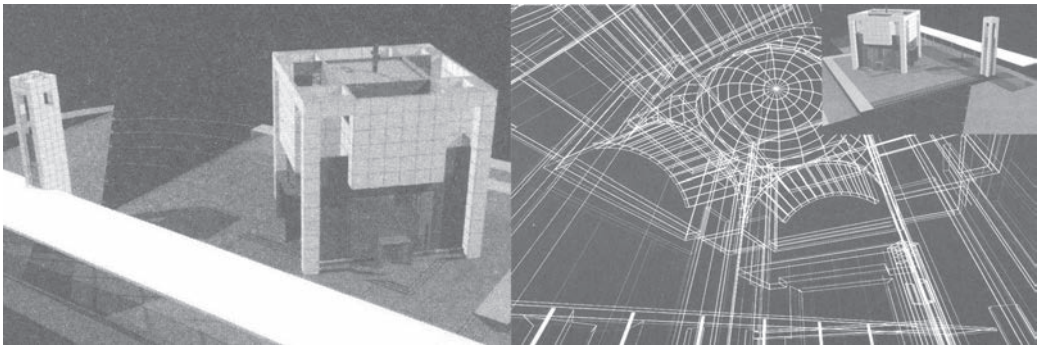

Figure 8. Temple in New Belgrade, special prize – Brajković, Šarović and Brajković
(Source: Forum 40)

post-modern adaptation did not rely directly on Serbian tradition. The solution for the dome of this rotunda is in some aspects similar to the project of Blagota Pešić for the temple in Čukarica. The concept solution of Ljubica Bošnjak and her team (Tatjana Jablanov and Nebojša Muidža), on the other hand, stands out due to the complete absence of contemporary architectural elements (except in the construction) and its resemblance to historical models, with the use of the traditionally shaped dome with a wavy cornice as one of the trademarks of her design works. Other designs represent attempts to more or less modernize traditional forms in different ways, which is particularly visible in the works of Blagota Pešić, whose design was granted acquisition (Figure 7), and the team of authors, Ljilja Brajković, Jelena Šarović and Miodrag Brajković, who were awarded with one of the special prizes (Figure 8). Pešić used cascading and a dome to design a church which is linked to tradition despite the modern facing and flat roofs. The design closest to the spirit of New Belgrade architecture is the one submitted by Brajković and Šarović as they started by combining the plan based on cross-in square and a free cross, and continued to shape the outer part of the temple into cubic forms and at the same time on the inside they designed arches and a dome. This design with its dual approach, traditionalist spatial concept and contemporary form, provided in the opinion of the jury "a significant contribution to exploring new forms in the church architecture development".

Competition for the Orthodox temple in Niš

In 1998, the local government of the City of Niš called a competition for the architectural concept solutions for an Orthodox temple at the UN Square in Niš, with the objective to select only one solution. The competition was not anonymous and was based on invitations to participate, with an unusually short deadline (30 days). The selection jury was appointed by the Secretariat for Urbanism and Utility Services and the Niš Diocese following the competition announcement, not before, as is the usual practice. The jury of seven members was chaired by the then Bishop of Niš, today's Patriarch Irinej, and comprised three architects. The design mandate defined only the dimensions of the future construction and the condition that the temple be designed in the spirit of Serbian church construction tradition, with no additional clarification.

Of the ten invited authors and teams, seven took part in the competition; however, all submitted designs were acquired, and out of the two short-listed ones, the first prize was awarded to the design by the architect Mandić (Figure 9). The project design was prepared, and the temple built based on this concept solution. It was designed as a single-spaced church with a dome and two bell towers on the west side. The altar consists of three parts, and from the north and south parts there are vestibules at the entrance to the nave. The temple's spatial organization relies on the tradition of the Raška construction style, particularly the Church of St. Nicholas near Kuršumlija. The building exterior was styled, without copying elements of medieval churches.

Competition for the Orthodox temple in Aleksinac

The competition called in 2003 in Aleksinac was unusual as its mandate included the project and the spatial solution for Brđanka City Park, accompanied by the concept solution for the parish church. This twofold focus had its impact

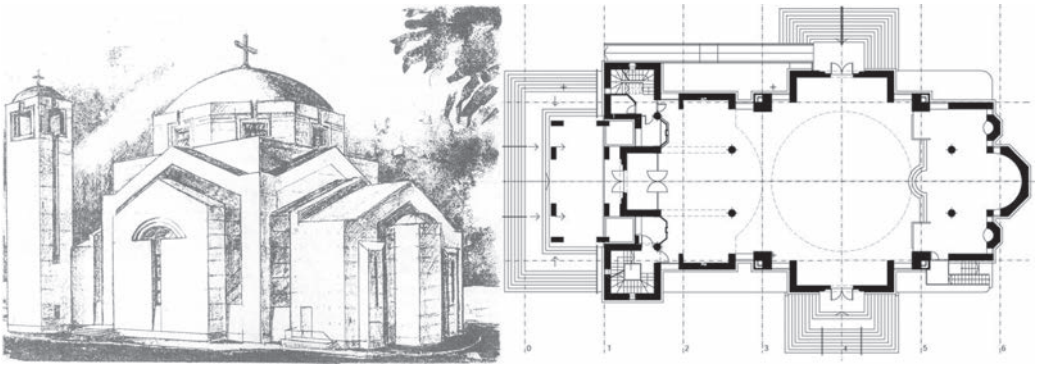

Figure 9. The Church of St. Emperor Constantine and Empress Helena in Niš – Mandić (Source: DAN archives)

on the authors who were not equally dedicated to solving both issues, which led to a controversial decision to build the church based on the second-ranked design (*Arhitekt*, 12, 2003: 3–11). Also, the jury at this competition did not include a single highly ranked official from the Serbian Orthodox Church. The competition was called by the Fund for Construction Land and Utility Services of the Aleksinac municipality and the Council for Launching the Temple Construction, in cooperation with the Niš Association of Architects (DAN). Even though the stated objective of the competition referred to investigating optimal possibilities for the location with the concept solution of the church, the assessment criteria did not particularly refer to the temple architecture, apart from the general note regarding harmony with the existing architecture and the relevant utilization, pointing to the conclusion that the accent was more on the solution for the park area than the temple itself.

Three awards were granted along with two acquisitions. All nine submitted designs were shown in the catalogue. In addition, the competition results were reviewed in the 11th and 12th issue of the magazine *Arhitekt* of the Niš Association of Architects. The author of the first-ranked design Dragan Živković introduced a novelty in his project which was assessed by the jury as an experiment; he based the entire temple on a dome, and the supporting construction relied on four high towers, so he offered a solution which relied on tradition only symbolically (Figure 10).

Subsequently, the design submitted by a team of authors including Perić, Stanković-Belimilanović and Golubović was selected as the base for the construction works, as it represented a traditional composition of a temple styled by contemporary architectural expression (Figure 11).

Competition for the Orthodox temple in Kruševac

The Serbian Orthodox Church Diocese of Niš in cooperation with the Directorate for Urbanism and Construction of Kruševac, the Kruševac Association of Architects and Union of Architects of Serbia, called a competition in 2005 for the architectural concept solution for a temple and its accompanying facilities on the Bagdala hill in Kruševac. This competition was anonymous. Its objective was to acquire a concept solution for the temple which would be a new element of the city's identity and to conduct a survey regarding the resolution of the accompanying facilities. The majority of the program was identical to the one defined for the New Belgrade temple, also including relying on tradition and the central plan solution, without pillars beneath the dome. Other mandate elements were not so detailed. In addition to the obligatory east-west orientation and the surrounding path with a minimum width of 4m, participants were also requested to design a prothesis and a diakonikon inside the temple next to the altar, as well as a confessional, gallery, shop and candle lighting area. The competition requirements placed the baptistery inside the church. A

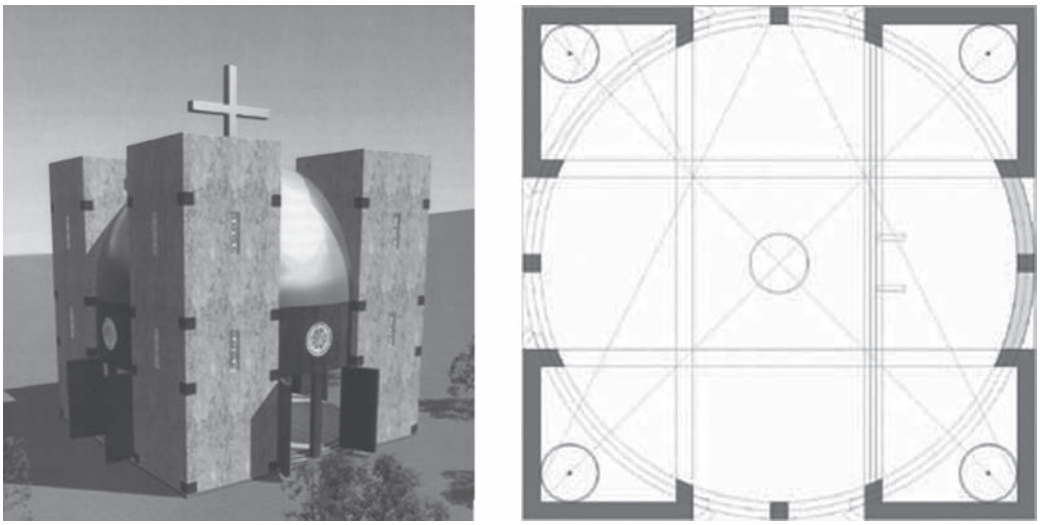

Figure 10. Church in Aleksinac, first prize – Dragan Živković (Source: Arhitekt, 12)

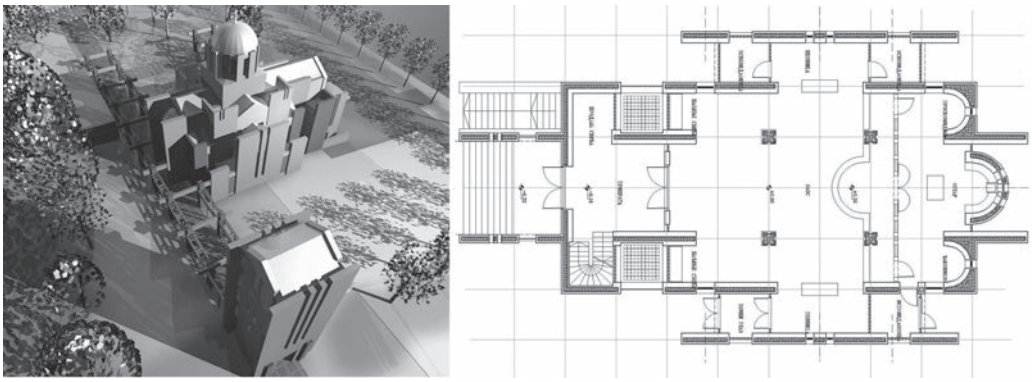

Figure 11. Church in Aleksinac, second prize – Perić, Stanković-Belimilanović and Golubović (Source: Arhitekt, 12)

crypt was optional in the competition call. Having a bell tower separate from the building was the preferred solution rather than one being inside. The selection was made by a jury comprised mainly of architects/professionals and chaired by the then Bishop of Niš, today's Patriarch Irinej.

There were nineteen designs submitted to the competition, one was excluded due to the breach of anonymity provision, and one award was granted, along with three equally valuable acquisitions; all designs submitted for the competition were published in the catalogue. The jury at this competition awarded designs which, to a certain extent, represented the three different approaches to the challenging task of designing an Orthodox temple in the modern age. The first-ranked design by Tatjana Purić Zafiroski and Irena Ilić is similar to traditional churches composition-wise, while the modernization was achieved by the modification of elements and the colouring (Figure 12). The design submitted by Dragan Bobić, similar to the work of Ljubica Bošnjak submitted to the New Belgrade Temple competition, was completely composed of traditional style elements, whereas Božidar Manić on the other hand used contemporary architectural language, remaining in line with the spatial program (Figure 13), as did the Rogan architects, who designed a completely non-traditional church with a monumental dome as the main element.

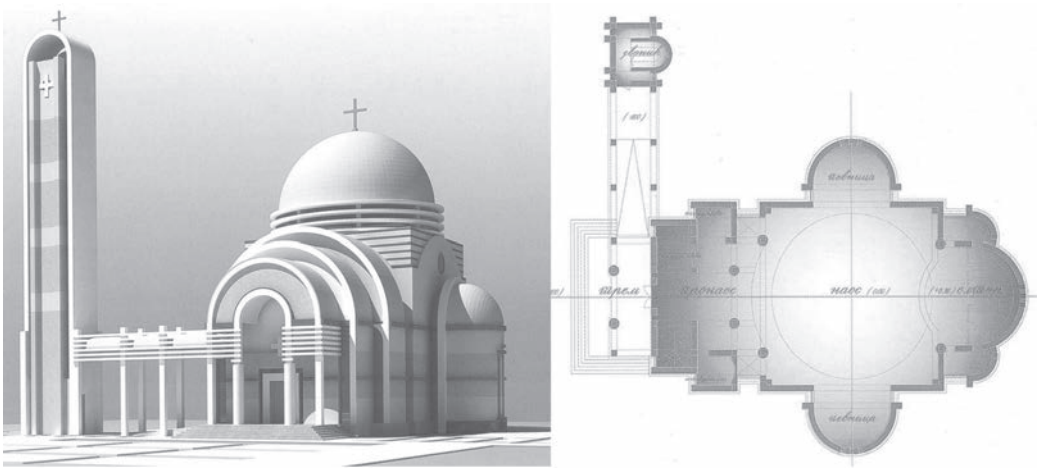

Figure 12. The Church on Bagdala hill, award – Purić Zafiroski and Ilić (Source: Competition catalogue)

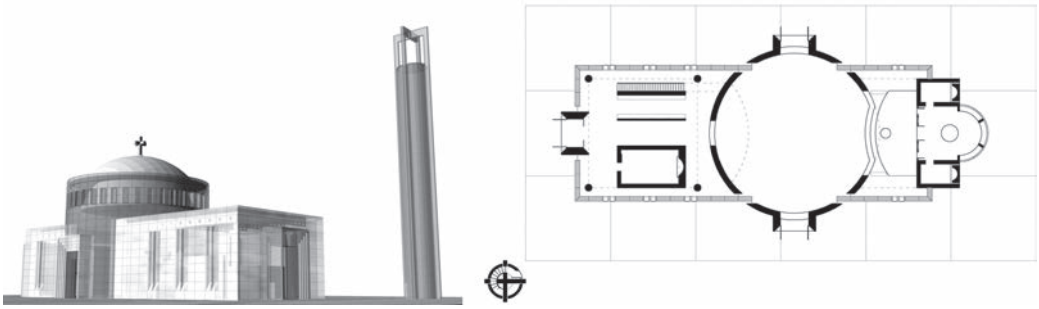

Figure 13. The on Bagdala hill, acquisition – Božidar Manić, consultant Igor Marić (Source: Competition catalogue)

CONCLUDING REMARKS

Based on the above, it may be concluded that the authors who took part in the competitions were guided by the clearly defined spatial requirements and the functional scheme of the temple. In addition, the competition callers set a dome as a key requirement in terms of form, while other elements of the architectural expression were to be chosen by the authors. The jury decisions regarding the first prize show the tendency to preserve the connections with traditional forms, also enabling their modernization, which might be contributed to by the fact that the jury compositions included mainly architects. The exception is the Aleksinac competition, although even in that case the jury gave a conditional priority to the second-ranked solution. "The jury assessed the design as optimally acceptable both from the standpoint of users – believers and professional circles: it sends a comprehensible and familiar message and makes a step forward in view of the architectural concepts within the specified subject" (Rašković and Medar, 2003: 4). Furthermore, the distribution of other awards, acquisitions and special prizes points to the existing awareness about the complexity of the issue, for various approaches were promoted, from copying and imitation, to modifying and transferring, to completely modern architectural expression, thus confirming numerous different possibilities for the future development of Serbian Orthodox church architecture.

Any attempt to classify designs from the competitions presented here has been dismissed based on the issue of the classification criterion. If tradition is set as a criterion, it is almost impossible to objectively measure the extent to which a design relies on tradition. It is particularly difficult to discuss similarities in terms of typology, as in the case of traditional forms, typology is to a great extent based on structural solutions which have become obsolete today. However, it is possible to make a general distinction among the three different designer approaches, which cannot be so easily separated in practice. The first would be the one completely based on traditional spatial solutions, forms and decorative elements. The main representatives of this style include architects Bošnjak, Jablanov and Muidža with the New Belgrade temple design and Bobić with the Kruševac temple design. On the completely opposite end of the spectrum, there are solutions with only a basic connection to the traditional models, with the dome designed as more of a symbol (as the dome was one of the competition requirements, it can be assumed that different solutions would have probably been provided in other circumstances). These include the designs of Blagota Pešić for the Čukarica church, the Brajković, Šarović and Brajković team for the New Belgrade church, Živković for the Aleksinac church and the Rogan architects for the Kruševac church. A potential fourth category comprising completely new models with no foundation in or similarity to the traditional approaches exists only in theory as there are no designs matching the description. All other concept solutions submitted for the competitions stand in-between the previously specified categories, some being closer to the traditional approach (e.g. Purić Zafiroski & Ilić for the Kruševac temple), others being closer to the modern style (e.g. Blagota Pešić for the New Belgrade temple, the Perić, Stanković-Belimilanović and Golubović team for the Aleksinac church and Manić for the Kruševac church). The first approach based on fundamental changes could be called radically modernizing, the second approach based on preserving and imitating existing solutions could be called conservatively traditionalist, and the third one based on moderate modernization – the compromising one. Further positioning of designs within the middle category may be determined by looking at individual parts and comparing how similar the architectural solutions are to their historical models, paying attention also to the proportion and symbolism. Such a detailed analysis could include the following elements: spatial organization and functional scheme; the composition; the architectonics; the facing, decoration, materialization, colour; the treatment of the apertures, etc.

Of all the above discussed works, there are few designs which deserve a prominent place based on their value and their specifics. These are both of the designs of Blagota Pešić, and the designs submitted by the team Brajković, Šarović and Brajković, as well as by Dragan Živković and the team Perić, Stanković-Belimilanović and Golubović. It is also worth mentioning that in an attempt to create new models, Živković went farthest from the traditional temple, keeping the symbol of the dome as the only link with tradition. On the other hand, Pešić's design of the new Čukarica church employs the dome as a symbolic, as well as a functional solution, which scheme-wise (a three-part altar, side kliroi and vestibules, developed narthex composition) corresponds to those used from the Middle Byzantine period. Brajković and Šarović deploy radical modernization of the external forms while preserving the common spatial concept in the search for innovative solutions, while Pešić's design of the New Belgrade church less radically modernizes the sacral architectural solutions. The team of authors Perić, Stanković-Belimilanović and Golubović remained closest to the medieval (today's "classic") models of an Orthodox church, showing that the moderate adaptation of forms can produce successful and contemporary solutions.

The standpoints expressed by the Church authorities[5] confirm that there is potential for developing new forms and models of the Orthodox temple, aiming at overcoming the current sacral architecture crisis. The issues debated in the early 20th century, following the competition for the Oplenac church and the St. Sava temple still remain unresolved, however nowadays there are no public debates on these subjects. Another issue that has been recognized in this and other areas of architectural activities is the lack of architectural critics' reviews. The conference Tradition and Contemporary Serbian Church Architecture organized by the Institute for Architecture and Urbanism of Serbia in cooperation with the Faculty of Theology in Belgrade back in 1994 has remained an important attempt to reverse the trend. This was further enhanced by the accompanying exhibition, as well as several articles published (see

[5] In the previously mentioned interview for the Official Gazette of the Serbian Orthodox Church, the then Episcope and later Patriarch of Serbia, Pavle says "It (The Orthodox Church, authors) does not consider that the existing and achieved aesthetics should be simply copied ... I believe, therefore, that we should go forward and find new artistic expressions."

Milenković J., 1995; Milenković B., 1996a, 1996b, 1996c, 1996d and 1997) and a series of interviews at the Faculty of Architecture held following the first post-war competition for a concept solution for a temple in Belgrade. These activities from the mid-1990s did not bring concrete results, so the issues remain open.

The theoretical research of the architecture of the Orthodox churches is limited due to the lack of studies on contemporary sacral architecture. Therefore, collecting even basic information presents itself as an important requirement for future activities in this area[6]. Further development of sacral architecture also requires a critical dialogue. As guidance for the development of future models, local competition practice can be used, along with student design projects and the contemporary experience of other Orthodox countries.

The practice of calling competitions for conceptual architectural solutions has proven to be important in church architecture, as well as in architecture in general, in the process of analyzing contemporary construction styles and ideas, and redefining the notions of modern and traditional. However, as Orthodox churches are rarely the subject of architectural competitions, their effect on the current construction practice is almost negligible.

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[6] The Schematism of the Serbian Orthodox Church is offering only basic data which are not the same for all dioceses, and most often refers only to the list of temples per diocese, without additional details (see Hrizostom, 2006).

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INSTRUMENTALIZATION OF ORIGAMI IN CONSTRUCTION OF FOLDED PLATE STRUCTURES - DESIGN, RESEARCH AND EDUCATION

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The paper deals with the origami used as an abstract tool to describe and represent the form and the structure of physical objects. In that respect, the potentials of this interdisciplinary technique as a medium of exploration of structural forms was introduced in the semester project done within the course Structural Systems at the Belgrade University, Faculty of Architecture. The technique was used as an interface to gain cognitive experience on spatial transformation and computational design. Throughout the intensive project period divided into three successive stages, the objective was to test method which enabled students to analyze geometrical principles of folding in order to apply these principles in the development of new designs. The generative algorithm inspired by the technique of paper folding assisted form-finding. Resulting shapes were verified by a production of small scale prototype models. The applied method, as a guiding design principle, facilitated formal exploration and augmentation of the design process. At the end of the course, students got cognitive experience on structural forms, while this simple technique delivered richness in terms of design solutions.

Key words: **origami, folded-plate structures, form-finding, computer aid geometric modeling, rapid prototyping.**

INTRODUCTION

The rapid evolution of technology and increase in complexity are continuously changing the design environment. The challenges we face involve the convergence of design process driven by the proliferation of the CAD/CAM systems and automated production processes. These technologies enable experiments based on computational generation and digital fabrication of structures unconventional in their form, typology, and aesthetics.

The increase in computational capabilities led to projects being conceived and elaborated in an integrated context in which architecture and other fields continuously exchange, analyze and produce diverse information. The expression of this condition is exemplified with design experiments in which architects practice discourses often borrowed from other disciplines. As the strict boundaries between disciplines are increasingly questioned and broadened, technology development and application, as well as incorporation of overlapping patterns, emerge as an essential vehicle for design exploration.

We approached the issue of the design of folded-plate systems by applying origami techniques in order to create proposals for steering design. Origami has evolved from being a craft to an interdisciplinary method *Origamics* (Stewart, 2007). With a wide range of applications origami proved itself as an advantageous tool for the development of different engineering and design solutions. During the last decades, trans-disciplinary studies in the fields of biology, nanotechnologies and automotive and structural design offered possibilities for the exploration of geometrical relations, new forms and structures. The amazing technical and artistic advancements, realized largely due to a growing mathematical and computational understanding and analysis of the subject (Hagiwara, 2008), and the increasing number of new examples, researches and exhibitions demonstrate that this ancient technique still has many prospects to be explored.

While the advancement of information theories and technologies found its interpretation in the design of

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architectural systems, leading architects to explore new form-function-structure relations, design problems became increasingly complex. Promoting development of new methods, media and tools that will facilitate such inquires became a very important issue. In that regard, this paper reviews sustainability of origami as a medium of inquiry into the design of folded-plate systems. Additionally, the paper indicates how origami could be of service for architectural design education as a potential interface to gain cognitive experience on spatial transformations, computational design, and shape-finding of structural forms. We tested the effectiveness of this approach through the semester project introduced in the course Structural Systems at the Belgrade University, Faculty of Architecture.

STATE OF ART

The idea to increase structural heights of sections by folding, and thus improve overall stiffness, was not applied before the time of the development of reinforced concrete in the XX century. The first hint of a folded-plate system was a hangar in Orly designed by Freyssinet in 1916 (Nestorović, 2000). The explanation of the static behavior and the studies on shaping possibilities implied wider application of folded-plate systems. Besides scientific researches done in the early 1950s, Moretti conducted experiments with paper models that were later continued by Flayshman. The results of tests confirmed great stiffness, structural fitness and feasibility of the system (ibid.). It should be pointed out that in folded surface systems, form, structural behavior, and construction techniques are interrelated. In order to sustain this consistency, the structural considerations should be regarded from the phase of design conception. Respectively, architects exploiting the folded structures need to have a fundamental understanding of the behavior of the rigid surfaces.

Structural System

Folded plates are thin structural surfaces that can achieve large spans due to the stiffening effect of folding. Even the simplest folded-plate system, consisting of two planar plates joined at a single fold line, when the ends are secured with rigid diaphragms, is remarkably stiff. The simple folded-plate can easily be arrayed to produce corrugated surface (Bechthold, 2008).

The system has two-way behaviors. In the direction of the primary span, the system behaves beam-like and approximate bending and shearing stresses can be derived in much the same manner as for ordinary beams. In the direction perpendicular to the primary span plates behave like slabs or members in bending, with each fold acting as support. By providing a rigid connection between plates at the fold strips, the system can be understood as a continuous beam or slabs with supports at the fold lines (Nestorović, 2000).

The estimation of the system's stability is not always straightforward, especially in the case of complex assemblies. According to Bechthold (2008), one of the easiest ways to determine stability is by considering the elevation view parallel to primary span and checking for locations where the depth of the overall system is reduced to plate thickness. Because the out-of-plan bending strength of the plate is insufficient and unable to resist deformations, these areas will behave as hinges. The hinges could be avoided by providing adjacent folded plates necessary structural depth. Systems like three-hinge frames or arches are statically determinate and more relaxed with respect to differential support settlements and thermally induced stresses. Clearly, having more than three hinges any one-way will lead structural system to instability.

A variety of arrangements that use both triangular and quadrilateral plates could be applied to produce a range of solutions from curved, arch-, vault-, frame-like systems to continuous beams. Identically to the equivalent linear or curved discrete systems, arches, vaults and frames composed of folded-plate elements develop both horizontal and vertical reactions. Also, the formation of openings in the folded-plate system should be located exclusively in zones of moderated bending moments and shears, generally near the neutral axis or plane. Creation of closely spaced large openings might change the nature of the structural system from a plate to a Virandeel truss or frame. Another possibility, as seen in the Yokohama Ferry Terminal designed by Foreign Office Architects, is the replacement of plates by triangulated trusses (Bechthold, 2008). In this case the combination of trusses with thin steel sheets creates a hybrid shear resistant system that is equivalent to a plate.

Origami as Architectural Design Methodology

The contemporary use of origami is not restricted to craft. At the same time it could serve as a problem-solving method, as a tool for education, or for the purpose of diverse design applications. While, traditionally, origami was designed through heuristic techniques based on folder's instincts, understanding mathematical and geometrical pattern relations are essential parts of current studies (Nestorović *et al.*, 2012). In the context of mathematics, origami forms can be considered as the mapping of tessellations into the 2D and 3D space (Sorguç *et al*., 2009). In general, these tessellations are divided from applying isometric and/or similarity transformations of lines and line shapes in the 2D space.

The development of most of origami patterns it established on a *grammar,* consisting of shapes (lines and angles), and *grammar rules*. Mostly, the geometry is based on Huzita's Axioms (Khademzadeh and Mazaheri, 2007), Maekawa's Fundamental Theorems (Maekawa, 2008), Muira's Patterns (Miura, 1994, 1997), Kawasaki Theorems (Hull, 2002), as well as theorems and axioms proposed by many other mathematicians. Lang was the first to convert these axioms and theorems into algorithms that contributed to the achievements of more complex origami forms and development of commercial software (Lang, 1994, 1996, 2004).

In the quest for both aesthetically appealing and structurally efficient solutions, architects have been searching for new form-structural relations and exploring new design tools. Form-structural duality of origami that enables control of spatial relations recommends this technique as possible design tool to facilitate that search. Numerous researches on application of origami in structural design, for example,

studies of kinetic and deployable structures (Ebara and Kawaguchi, 2003) or biomimetic researches (Vincent, 2000; Hachem *et al.*, 2004; Hagiwara, 2008; Kobayashi *et al.*, 1998), confirm potentials of this technique.

In architectural practice origami usually finds application in the design of surfaces and kinetic structures. Besides mentioned Yokohama Port Terminal (Moussavi, 2009), the Colorado Springs Air Force Academy Chapel by SOM represents another well-known example of folded-plate building in which the diagrams and structural relations of origami can be traced easily (SOM, 2011), as well as the folded dome of the Assembly Hall of the University of Illinois designed by Abramovitz, or the roof of the American Institute for Concrete in Detroit by Yamasaki (Nestorović, 2000). Another example, the Chapel in St Loup, designed by Local architecture and Mondana in collaboration with the IBOIS, demonstrates the feasibility of the application of scientific researches in design practice (Buri and Weinand, 2008).

Origami could be applied in the design of deployable structures. Diagrams developed in origami can be considered as the relation of *links* which are designed to yield either a translational or rotational displacements without locking problems. Even complex origami folding diagrams can be easily folded and unfolded with a single stroke of a force in a stable way, exemplified by *folding egg* prototype constructed from a low-cost recyclable material by B. Yeh form Kinetic Design Group at the MIT (Sorguç *et al*., 2009).

Material and Construction Techniques

The thinness and geometry of folded-plate structures represent a challenge for construction, making traditional methods and techniques often inadequate. The production of complex geometries has always been difficult for an industry attuned to orthogonal forms. Economic needs often limit construction and consequently the design of intricately folded surfaces imposing multiplication of identical elements.

The development of digital design and fabrication techniques are opening new opportunities for construction of folded shapes. A wide range of approaches includes the use of prefabricated formwork elements, 3D digital models in the prefabrication of elements, the application of high-speed CNC for both shaping of elements and formwork, as well as origami-like strategies to create overall complexity using simple, planar elements that can be easily varied in size (Bechthold, 2008). There are tendencies to move construction in a controlled prefabrication environment more favorable for digital production, as well as studies on the on-site automated construction.

Origami has a potential to provide a prototype and construction algorithm as well. The example is the idea of *folding concrete*, patented by Wheen (1980). The feasibility of this idea was tested through the fabrication of large scale prototype *concrete origami* at the Harvard University Graduate School of Design (Bechthold, 2008). In a study done by Banghay (2000), origami was exploited to help the decomposition of virtually constructed objects for the CAM manufacturing. Furthermore, aid in reverse engineering represents another possible field of application.

The development of high-performance materials also brings prospect in the design and construction of folded-plate system. Glass technology, ultra-high-strength fiber concrete, and polymer composites are starting to be introduced in construction. However, the first schemes are promising and will surely lead to new developments in the folded-plate architecture extending pallet of currently applied materials. On the other hand, origami also inspired methods used in the development of nano-materials (Stellman *et al*., 2005), that in the future might find application in the building industry.

DESIGN RESEARCH

A very direct and spontaneous perception and comprehension of geometry and rigidity of folded plate structures can be achieved simply by folding paper. Correspondingly, the technique has always been inspiring for the application in educational processes. Fröebel used paper folding in kindergartens to teach geometry and promote the sense of aesthetics in his pupils (Lister, 2003, 2004). Albers used similar methods in the preparation class for the Bauhaus to make his students discover the relationship between materiality, geometry and structure (Albers, 1952). Currently, there are numerous courses at different architectural schools and workshops which allow students to explore these form-structure-space concepts both in real and virtual context. Driven by the similar motivations we introduced this method in the semester project at the second year course Structural Systems at the University of Belgrade, Faculty of Architecture.

Project Procedure

Throughout the intensive project period, the objective was to test the method, which enabled students to analyze geometrical principles of folded-plate structures and to apply them in the development of new designs (Nestorović *et al*., 2012) (Figure 1).

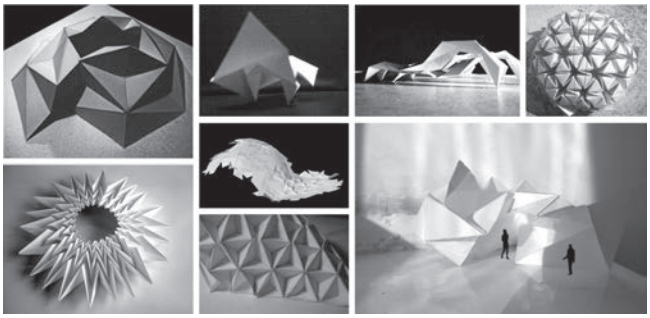

Figure 1. Design concepts proposed by the students of the University of Belgrade, Faculty of Architecture (Source: processed by authors)

In order to strengthen the design process the project was divided into three successive phases: analysis, transformation and elaboration, where each stage was built upon the results of the previous one (Figure 2). In order to obtain the overall picture, the phases of the procedure will be illustrated using one example of the folded-plate design solution for the pavilion.

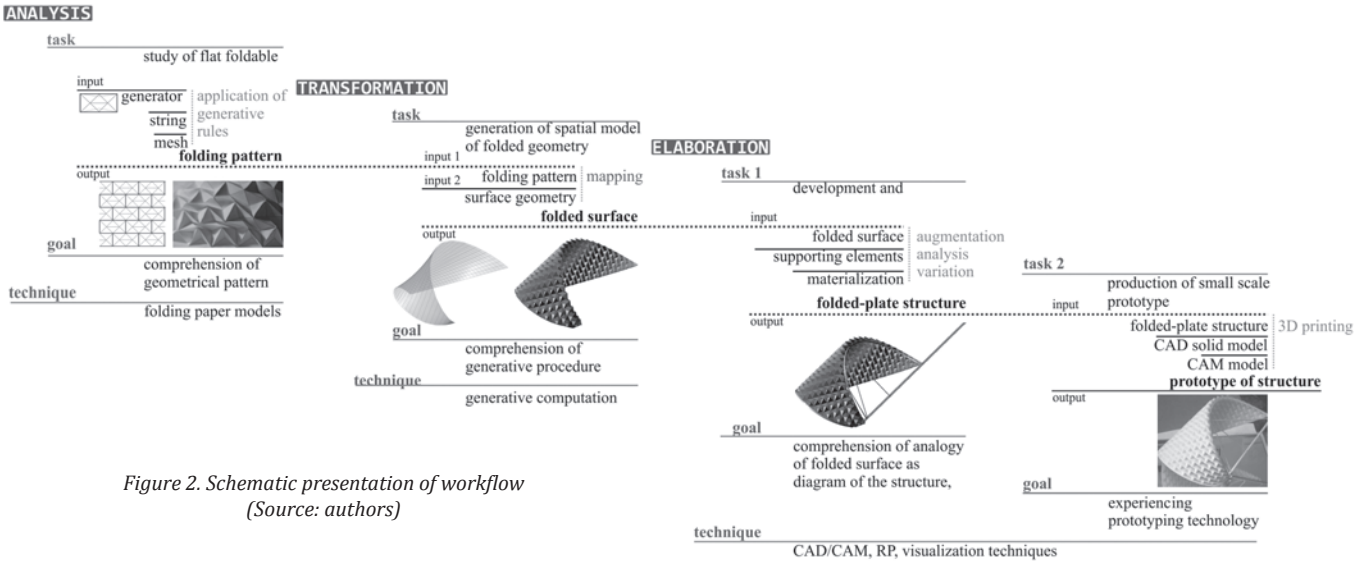

Figure 2. Schematic presentation of workflow (Source: authors)

Analysis

During the first stage geometrical and structural principles were analyzed. Students divided in groups were tasked with studying diverse foldable tessellations by making physical models. The production of a series of folded paper models enabled the exploration of formal and spatial advantages of the technique and its application in the context of architectural design. The goal of this part of the project was to identify some interesting folding patterns that have potential to be implemented in the design. In that respect, different folding patterns, tempting for architectural application, were exploited, such as Yoshimura pattern (Diamond Pattern), Miura Ori pattern (Herringbone Pattern), Diagonal pattern, patterns with polygons, etc. (Jackson, 2011). These patterns are mostly based on a combination of simple folding and reverse folding techniques, in which a series of straight valley and mountain folds are bent by the reverse folds to form corrugated surfaces.

Understanding mathematical and geometrical relations were an essential part of these studies, starting with the selection of fundamental units of patterns – generators. The application of diverse generative rules on generators resulted in the production of strings and mashes. Meshes were then translated into folding patterns, i.e. diagrams which indicated mountain folds, valley folds and flat folds (Figure 3).

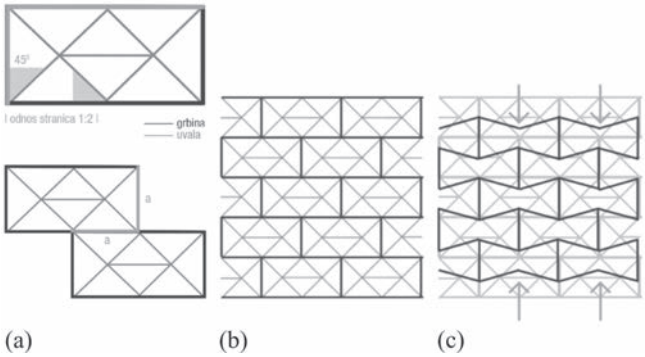

Figure 3. Generator (a), mash (b), folding pattern (c) (Source: authors)

Manipulation of generic parameters and generative rules resulted in creation of folds (Figure 4).

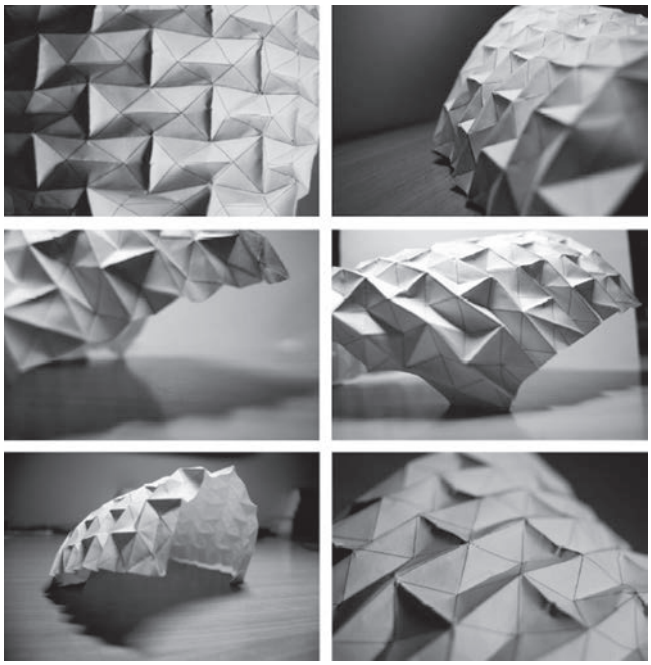

Figure 4. Folded paper models (Source: processed by authors)

Transformation

In the phase of transformation the selected folding patterns were mapped on defined architectural geometries in order to form models of space structure. With the purpose of creating diverse architectural shapes by using folds, classes of geometric types (Pottman *et al*., 2007) and their compositions were used as an underlying geometry. This part of the study was aimed at the analytical understanding of the chosen geometries which resulted in their generation by the CAD software. Exploring the potentials of origami as an algorithmic tool for form-finding was main objective of this phase.

The mapping of the folding pattern on defined reference geometry was implemented by exploiting the concept of

hinge lines (Mitra, 2009). Hinge lines connect nodal points in which four or more fold lines meet and define and control the degrees of freedom (DOF) that fold surfaces geometrically possess. By operating with their length and shape in the 3D space it is possible to define specific fold configuration. Surface geometries could be approximated by grids of lines as wire models. Correspondingly folded surfaces can be represented by a grid of control lines that govern them. The advantage of these properties was used in the mapping procedure (Figure 5).

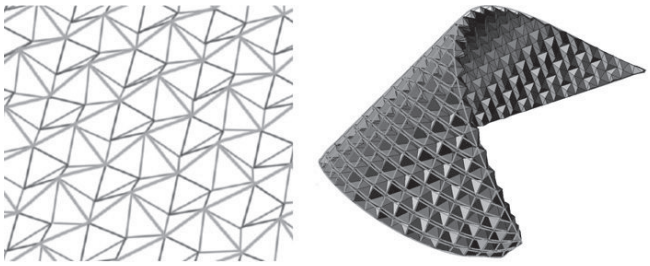

Figure 5. Mapping of fold tessellation on architectural geometry (Source: processed by authors)

Studies showed that some folds had more DOFs than others, and could fit varied forms. Also, though they were generated using same or similar generators, certain folds were ideal for particular forms and not the others (Nestorović *et al*., 2012). Additionally, applied generative method allowed rapid creation of different forms that can adapt to specific project conditions.

Elaboration

In this phase, based on the geometry model of folded surface, the design solution for folded-plate structure was elaborated and presented by the application of diverse techniques. The focus was on the relations between form-structure and construction-materialization. The goal was the transformation of folded surface diagram in real rigid structure composed of appropriate structural elements (Figure 6).

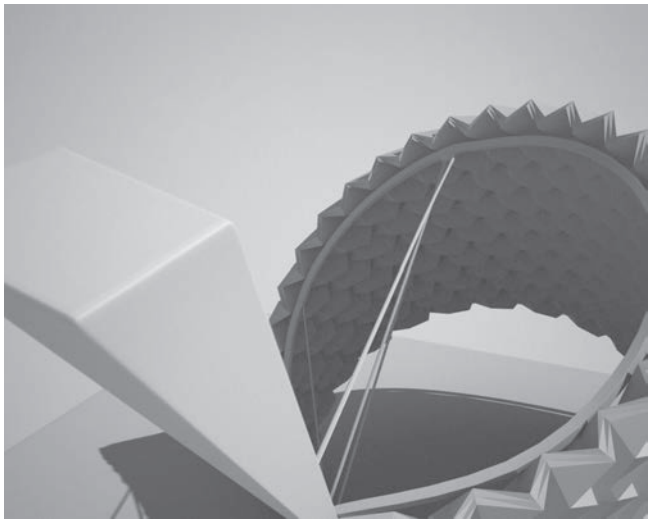

Figure 6. 3D preview of final structure (Source: processed by authors)

In order to transfer diagram into a structure (transition from geometry, which is purely abstract, to material surface, which is physical), one needs to study the system on different levels and understand its behavior and properties affected by geometry, shape, material, structural behavior, etc. That is the reason for implementing analysis and evaluations of structural behavior in this phase of the project. Also, details such as connections and assembling methods were suggested. Finally, the building of small scale prototypes, by the 3D printing technology simulated transposition of the geometries to material constructions.

Geometry Modeling

A constant advancement of the CAD re-emphasizes the importance of geometry, facilitating experimentation with diverse concepts in computational design context, including origami. Construction of 2D diagrams of origami, potentially yielding non-standard grid forms in the plane, offers a new platform for designing innovative mesh configurations and modeling of folded-plate systems.

Generating Folding Pattern

After choosing a folding pattern interesting for further elaboration, the next step was to define reference surface geometry which will represent the final state of free-form folded surface. The surface is mathematically represented as a NURBS surface (Piegl and Tiller, 1997).

Free-form geometry applied in the example is from the class of ruled surfaces. Those surfaces are generally defined by two diretrix NURBS curves $C_1(u)$ and $C_2(u)$ of equal degree, on the same knot vector. These curves guide the motion of a generatrix lines $C_g(v)$. Thus generated ruled surface $S(u,v)$ actually represents a linear interpolation between curves $C_1(u)$ and $C_2(u)$, and could be un-rolled in the plan (Figure 7).

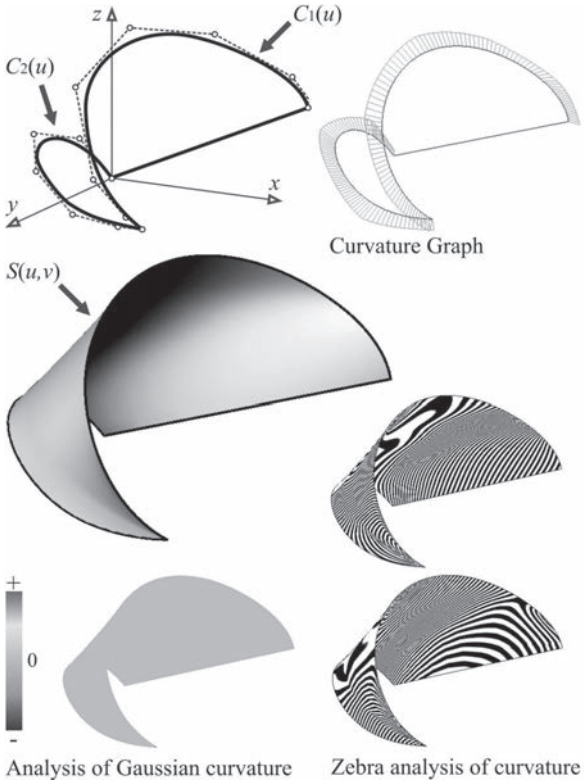

Figure 7. Reference surface geometry (Source: processed by authors)

The generic NURBS surface was the input (reference) geometry introduced to the algorithm which will plot a folding pattern on it. The folding pattern was previously selected after running the generator through a sequential process of string and folding pattern generation iterations, between all diverse possible folding patterns of that generator.

The algorithm includes the following steps:

1. A subdivision of the reference surface domain by a grid of interpolation curves. The density of curves is based on the resolution of desired folded form. The grid of the interpolated curves should match the grid of hinge-lines of folded surface. Based on the selected folding pattern inner and outer hinge-lines should be differentiated.
2. Offsetting inner hinge-lines and adjacent points.
3. Generation of a series of points in association with the reference surface at the intersection of hinge-lines as basic generative geometries.
4. Based on the selected folding pattern connection of points with straight line segments – edges of triangular plates.
5. Generation of triangular plates of folded surfaces. (Figure 8)

We considered important design parameters of folded-plate systems, such as the angle between adjacent plates and the size of the plates. These parameters determine the overall depth, configuration, and consequently, structural behavior of the system. A compromise between practicality and structural efficiency are angles in the order of 70-110 degrees. Increasing angles will cause an insufficient stiffness of the system. Additionally, the approximate depth to span ratio for simply supported system ranges from L/8 to L/15 for concrete system, and L/7 to L/12 for plywood folded plates. Pre-stressed concrete system can be more slender. Parametric linking of the folded surface with hinge-lines enables the modifications of the folded surface by the manipulation of hinge-lines (length, shape, DOF). Changing the depths of creases or their frequencies allows the exploration of structural behavior and spatial qualities.

Small Scale Prototyping

Besides standard presentation methods, a rapid prototyping technology was applied for the production of the 3D physical models. Rapid prototyping (RP) is a term used to denote technologies, conditionally speaking, for fast production of the 3D physical models based on geometry defined by the CAD software (Dimitrov *et al*., 2006). Due to its advantages, the technology initially developed for industrial production found its application in different fields. In architecture, the RR is suitable for the visualization and testing of ideas in different stages of design, and as a step preceding digital production of large scale prototypes and real structures. The assumption is that in the future digital production technologies will have wider application in the building industry (Khoshnevis, 2004).

Prototyping Technology

All RP techniques have in common that physical models are produced progressively by addition of thin layers of material, in the process referred to as the Additive Fabrication (AF) or Layer Manufacturing (LM). Currently available technologies greatly differ depending on the time required for the model production, properties of the applied material, production costs, finishing quality, etc. (Dimitrov *et al*., 2006). The selection of adequate technology depends mainly upon the purpose of the model. In this case we applied the Selective Laser Sintering (SLS) technology (Deckard, 1986). The reason for the selection of this technology was its facility for making very complex geometries directly from the CAD data. The SLS uses a laser as its power source to sinter powdered material, and create a solid structure, i.e. mass that has a desired 3D shape. In comparison with traditional methods of construction of architectural mock-ups, the advantage of the RP is unquestionable.

Construction of Small Scale Prototype

The construction of the prototype included following goals:

1. To communicate and evaluate design concepts efficiently;
2. To demonstrate feasibility of structure based on the purposed geometry; and
3. To get some first-hand experience with the prototyping method.

Two main considerations had to be taken into account: material properties and limitations and process limitations.

For the production of the prototype we used the Spectrum Z^{TM}510 device, from the class of high precision functional modelers. This printer has the following properties: (1) build speed 2-4 layers per minute; (2) build seize 254X x 356Y x 203Z mm; (3) material – high performance composite; (4) layer thickness 0.89-2.03mm; (5) resolution 600 x 540 dpi. The device is supported by a system software that accepts models in the STL, VRML and PLY file formats as input (Figure 9).

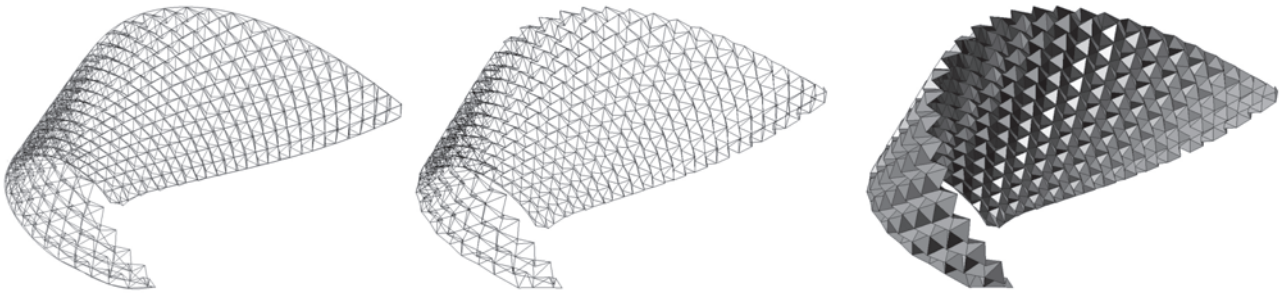

Figure 8. Generation of complex folding structure
(Source: processed by authors)

Figure 9. ZPrinter®510- device used for the fabrication of the model (Source: authors)

The process included following steps:

1. Model preparation included the conversion of the 3D solid model of folded-plate structure generated in the CAD software in the STL file format. The folded-plate was assigned a standard wall thickness of 2mm.
2. The model was sliced into 2D parallel layers of the standard 0.1mm thickness.
3. Transfer of the model to the machine for calculating a build path, i.e. the most efficient way to print the model.
4. Transfer of information about each layer to the processing head of the machine, and the model production by adding material in a layer-by-layer fashion. The laser selectively fused powder material by scanning cross-sections generated from the 3D digital model on the surface of a powder bed.
5. After each cross-section was scanned, the powder bed was lowered by one layer thickness, and a new layer of material was applied on top. The process was repeated until the model was complete.

During the construction, the model was surrounded by un-sintered powder, not requiring supporting structure, which facilitated the fabrication of complex geometry. Supporting arches, pylon and rod ties were made of steel and painted (Figure 10).

CONCLUSION

Revising origami as a medium of exploration and consideration of origami diagrams as a meta-language for the development of visual algorithms of design patterns and forms could result in a new cognitive experience. As illustrated by this research, origami diagrams have potential to provide meshes of structural forms. Augmented into the 3D space, they generate classes of structures and structural elements with a proper structural stability. Diagrammatic relations might be regarded as a guarantee of structural order and stability. Further on, patterns developed in the diagrams can be experienced in the virtual or physical medium. On the other hand, not all forms are suitable, so

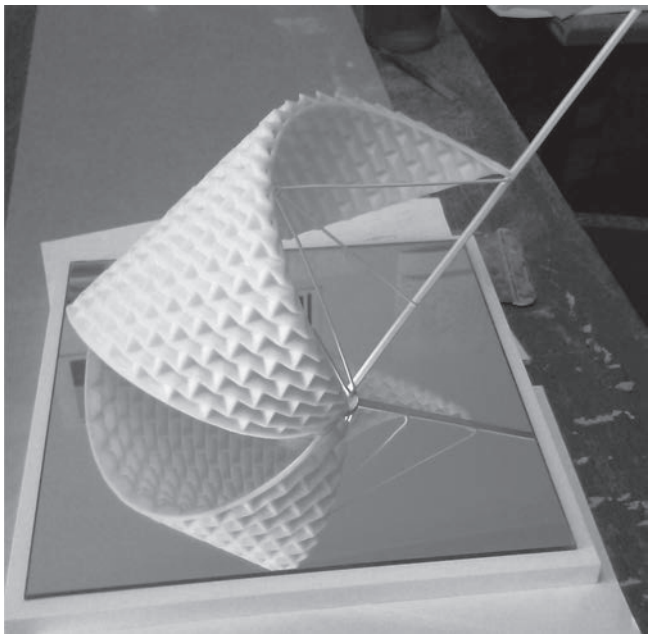

Figure 10. 3D printed small scale prototype (Source: authors)

careful analysis is usually required to satisfy all spatial, formal and structural needs. However, it is possible to state that the idea of the implementation of origami design methodology facilitates architects to extend the vocabulary of structural forms.

The presented examples have illustrated that origami can be considered as a prospective design exploration tool that enables formal and structural studies in constrained design conditions and the advancement of the design process. At the end of the course, as it was anticipated, students became aware of the geometry of folds as a source of inspiration. They developed new areas of competence with regard to structural design methodology, and exceeded themselves in terms of interesting designs. Our future expectation is that we will build upon our experience with a multidisciplinary, integrated design approach and see exciting results in terms of innovative project proposals. In that respect the research is left open-ended.

Acknowledgments

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CREATION OF VIRTUAL 3D MODELS OF THE EXISTING ARCHITECTONIC STRUCTURES USING THE WEB RESOURCES

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Digital three-dimensional models of the existing architectonic structures are created for the purpose of digitalization of the archive documents, presentation of buildings or an urban entity or for conducting various analyses and tests. Traditional methods for the creation of 3D models of the existing buildings assume manual measuring of their dimensions, using the photogrammetry method or laser scanning. Such approaches require considerable time spent in data acquisition or application of specific instruments and equipment. The goal of this paper is presentation of the procedure for the creation of 3D models of the existing structures using the globally available web resources and free software packages on standard PCs. This shortens the time of the production of a digital three-dimensional model of the structure considerably and excludes the physical presence at the location. In addition, precision of this method was tested and compared with the results acquired in a previous research.

Key words: **three dimensional models, existing buildings, web resources, free software packages.**

INTRODUCTION

Computer modeling of existing objects (buildings or structures) provided by numerous software solutions has its wide range of applications in science and practice: architecture (Styliadis, 2007; Stojaković and Tepavčević, 2011; Pejić *et al*., 2012; Chane *et al*., 2013); civil engineering (Armesto *et al*., 2009; Elaksher, 2013; Walsh *et al*., 2013); urbanism (Tack *et al.*, 2012; Heo *et al.*, 2013; Musialski *et al*., 2013); geology (Turowski *et al.,* 2013; Fonstad *et al*., 2013; Lato *et al*., 2013); mechanical engineering (Menna *et al*., 2011); video games and movie industry, medicine (Berretti *et al*., 2013), archeology (Haydar *et al.*, 2011; Kersten and Stallmann, 2012; Kochi *et al.*, 2013; Rawashdeh, 2013); safety of people and goods (Gonzalez and Gomez, 2009) etc.

The basic prerequisite for creating presentations of virtual architectonic structures is the existence of a suitable digital 3D model. Creating a three-dimensional model can be done by different methods depending on the type of a building, available equipment, prior knowledge, time available and presentation purposes. The choice of the appropriate method is directly determined by the type and availability of the data necessary to create spatial 3D models. Therefore, we distinguish between three-dimensional virtual models generated on the basis of:

- A newly constructed building;
- An existing building.

Due to the variety of recorded buildings, there are different methodologies and technological approaches in the process of making three-dimensional models of architectural structures. The choice of the appropriate method depends on the following parameters (Krasić and Pejić, 2014):

- **Goal of research** – the purpose of digitalization determines the required quality and type of documents. The documenting process can be conducted for the purpose of obtaining information about the structure of the building, analysis of deformity, two-dimensional and three-dimensional presentation of the structure, creating a virtual reality, the assessment of the value of the structure, etc.
- **Required geometrical precision and visual quality** – various techniques produce a different degree of geometrical accuracy. Certain tasks require a high visual quality which is realized by applying adequate textures from the digital documentation.

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- **Physical characteristics of the structure and its environment** – parameters such as the size and accessibility of the structure and its environment determine the method and type of recording. The methods used for recording small, medium and large structures differ, just as of those which are inaccessible to recording, to a lesser or greater extent.
- **Available budget** – application of certain digital methods can be unavailable because of the cost of the equipment needed or poor cost-efficiency of the time needed to perform the activity (Ortiz *et al*., 2006).

Three-dimensional models of existing buildings and urban structures are used for the purpose of visual presentation, documentation and archiving their physical structure or for the implementation of various analyzes. In the architecture, models are equally useful for the design processes and modeling of the existing buildings, presentations of surroundings employed in new projects, as well as the urban structure of some locations. Models are of importance in cultural heritage documentations, reconstructions or restorations of buildings damaged during time or inaccessible ones. Contemporary analyses concerning: insulation, shadow spreading, acoustics, thermal imaging, etc. (Pejić *et al*., 2013a) can be more efficiently carried out with 3D models of existing urban structures or buildings.

Each one of the applications of 3D models of existing buildings involves various levels of details and realistic presentations of virtual model's textures. Regarding the variety of objects, locations, or desired level of details, different methods and methodologies in documenting the design process are available. Three dimensional models of buildings, originated from simple methods of manual data collecting (measurements) and drawings, have been developed to advanced technologies offering the automatic generation of 3D elements, or entire objects, as well as urban entities (Pejić *et al*., 2013b). Virtualization based on manually collected geometrical dimensions takes a lot of time and is outdated because of high costs when big projects are concerned. These 3D models have no color nor realistic textures, i.e. details (ibid.). In comparison with traditional models, contemporary digital methods of laser scanning (Lato *et al*., 2013; Murphy *et al*., 2013; Santos *et al.*, 2013; Yang *et al*., 2013) and photogrammetry (Barazzetti *et al*., 2010; Remondino and Rizzi, 2010; Stojaković and Tepavčević, 2011; Vallet *et al*., 2011; Pejić and Krasić, 2012; Musialski *et al*., 2013; Ozgun, 2013) provide very accurate presentations of object's characteristics containing the following analyses: surface, structure (construction), behavior in certain conditions, as well as realistic visual presentation.

The photogrammetric method gives us information about 3D structure obtained from 2D photographs (Pejić and Krasić, 2012). Photogrammetry is a technique of representing and measuring 3D objects using the data stored on 2D photographs, which are the base for rectification. At least one dimension and two projections are necessary to obtain information about three space coordinates, that is, from two photographs of the same object its true size can be determined and a 3D model constructed (Stojaković, 2008).

The main scientific contributions of this paper are creation, presentation and deviation testing of web-recourse based photogrammetry method for 3D model creation. The goal of the paper is to investigate possibilities for the creation of virtual 3D models of the existing architectonic structures using exclusively what is available on the internet and the method of photogrammetry. The main idea is to compare this web-resource based approach with traditional semi automatic photogrammetry method in order to demonstrate the possibility for time saving with minimal dimensions deviations of a 3D model compared to a real building. The entire procedure is presented through the case study of the creation of the model of a multi-family housing building in 15, Krivi Vir Street in Niš, Serbia. Also, a comparative analysis of the dimensions of the obtained 3D model with the actual dimensions of the building was made and a deviation obtained was 2,9%. This is acceptable if the building is used for visual presentation or analysis which do not require a high degree of precision.

MATERIALS AND METHODS

The development of contemporary hardware and software allowed the creation of web services with different purposes. The browsing of photographs on the internet is possible on almost every site, while the photograph sharing services (Panoramio, 2015; Flickr, 2015) are very popular. These photographs can be used for the creation of 3D models of the existing buildings using the photogrammetry method. The problem with such sites is that certain locations, interesting for the users (buildings having historical or architectonic importance (Marić, 2012; Alfirević, 2011)), can have a large number of photographs, while on the other hand some private individual buildings do not have any photographs on the internet. In 2007, Google company started the "Street View" project, which implements panoramic street view of many locations in the world into "Google Maps" and "Google Earth". This service has been available in Serbia since 2014 and covers the cities of Belgrade, Niš and Novi Sad. This method provides the acquisition of photographs from the locations which are not very popular, using web services. Based on the globally available photographs, it is possible to create a proportional, photorealistic 3D model in the unknown scale. It is necessary to know at least one length in order to create a digital model in a known scale. There are numerous services for navigation and positioning in the real world which use very precise maps with the satellite (Bing Maps, Google Maps, Google Earth) or aerial images (Gis Niš, 2015) of the terrain. These free resources can be used for acquiring the actual dimensions of the buildings which are necessary for the determination of the model scale.

This is a presentation of the working method (system) for the creation of 3D models of the existing architectonic buildings using exclusively free data available on the internet and free 3D modelling software packages. Based on the earlier authors research, it was concluded that it is best to use the software package SketchUp (SketchUp, 2015) for this purpose. The reason for this is the comprehensiveness of the functions available in the free version of the software. The module for the creation of the model using semi-automatic photogrammetry is an integral part of SketchUp software (Krasić and Pejić, 2014). The greatest advantage in

respect to other softwares of this type is the direct link with "Google Maps", "Google Earth" and "Street View" services. It makes it easier to use in comparison with other software packages and ideal for the production of three-dimensional models of the existing architectonic structures using the photogrammetry method.

This paper presents a system for the creation of 3D architectonic models of the existing buildings using photogrammetry, using a free version of the software package SketchUp and of openly accessible web resources.

CASE STUDY

The entire procedure was conducted on the example of a house in Krivi Vir Street in Niš using exclusively free and openly accessible data from the internet and implementing free software packages. The system is divided into four phases:

- Acquisition of photographs;
- Creation of the model using photogrammetry method;
- Determination of the model scale; and
- Detail modelling.

Acquisition of photographs

Creation of a 3D virtual model using photogrammetry method requires photographs. Since the goal is using data available on the internet exclusively, it is necessary to search the photograph sharing services. When it comes to unimportant or unknown buildings, the search including its name can pose a problem; this was the case of the house in Krivi Vir Street in Niš. For that reason it is better to use the web services for photograph sharing which allow their search using the geographic location. The "Google Maps" service was used for this paper, allowing search using maps (Figure 1). Upon finding location, it possible to search the photographs using the "Panoramio" sharing service or the "Street View" service. For the purpose of having a precise and detailed model, it is necessary to choose as a good quality photograph as possible, preferably taken from the corner of the building. The photo must be downloaded for further usage.

Creation of the model using the photogrammetry method

For the creation of a 2D digital model of the building, a free version of SketchUp 2014 software package was used. The photograph of the building downloaded from the internet was imported to the SketchUp software, where using the semi automatic ground photogrammetry a 3D model was created. After importing the photo, using the photogrammetry module, perspective vanishing points were determined and the origin of the coordinate system was positioned (Figure 2). After that, by using the basic SketchUp modelling tools, all the surfaces making up the building were drawn. After drawing the spatial volume of the building, the textures found in the photographs were projected on the model surface. Since the photograph shows only two facades of the building, a 3D photorealistic model of the part of the building in an unknown scale was obtained.

Determination of the model scale

It is necessary to determine a scale for the obtained 3D model. The photogrammetry method yields the proportional 3D model, so it is necessary to know only one length to determine the scale. By using web services employing aerial or satellite imaging for map display, it is possible to measure the distance between two points on the map with high accuracy. The more detailed the map, the less error in the model scaling will occur. In the case of the house in Krivi Vir Street in Niš, "Google Maps" service was used, because of its direct link with the "SketchUp" software in which the model was created. After finding and importing of the part of the map on which the building is located, the photograph of the location in 1:1 scale was obtained in SketchUp (Figure 3). On the basis of this map, the building was proportionately enlarged and rotated so as to coincide with its location on the map. After this procedure, the 3D model of the building in actual (1:1) scale was obtained. Simultaneously, the 3D model obtained its geographical coordinates, which can be used for downloading the contents (Street View) which require geo-location of the model or for conducting further analyses (shadow casting) or presentations (Google Earth).

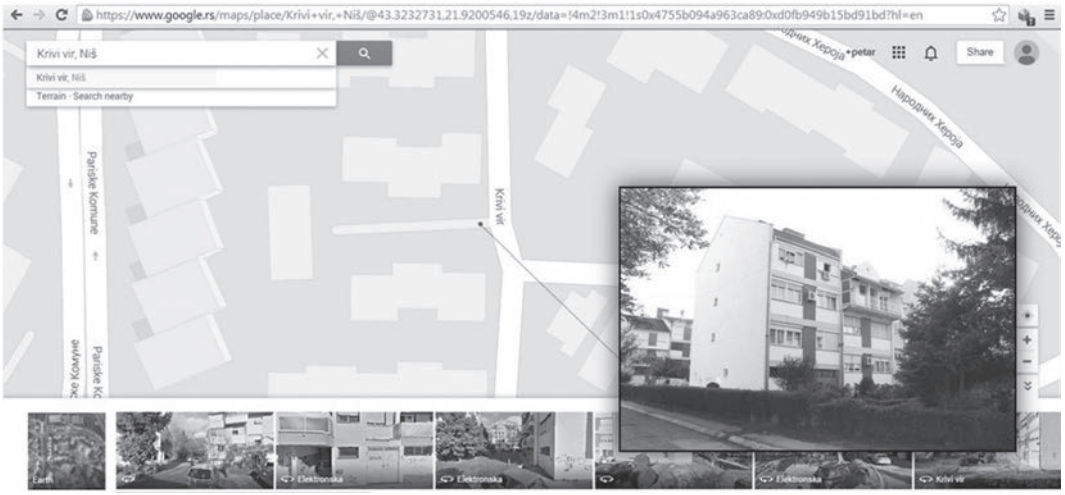

Figure 1. Photograph search using the Google Maps web service (Source: authors)

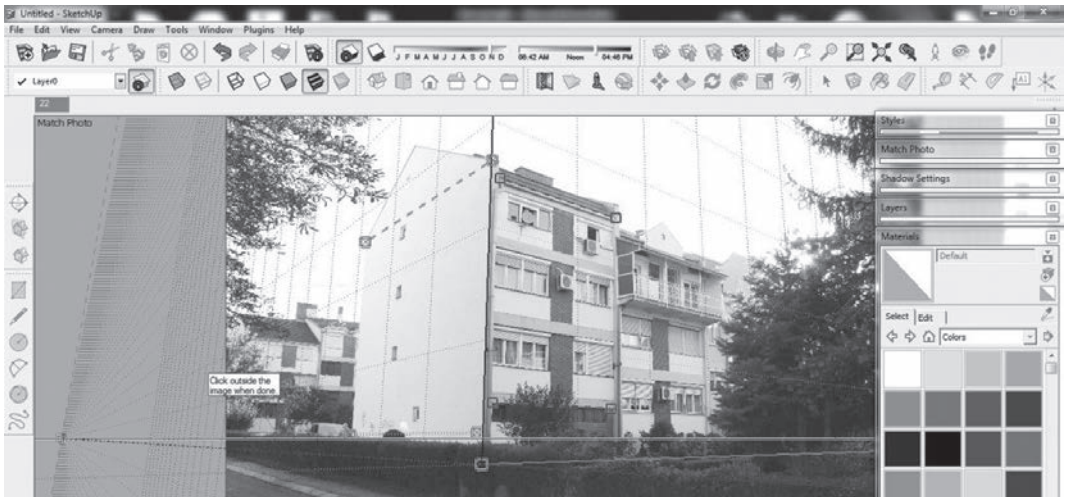

Figure 2. Adjustment of the finishing point of the perspective image
(Source: authors)

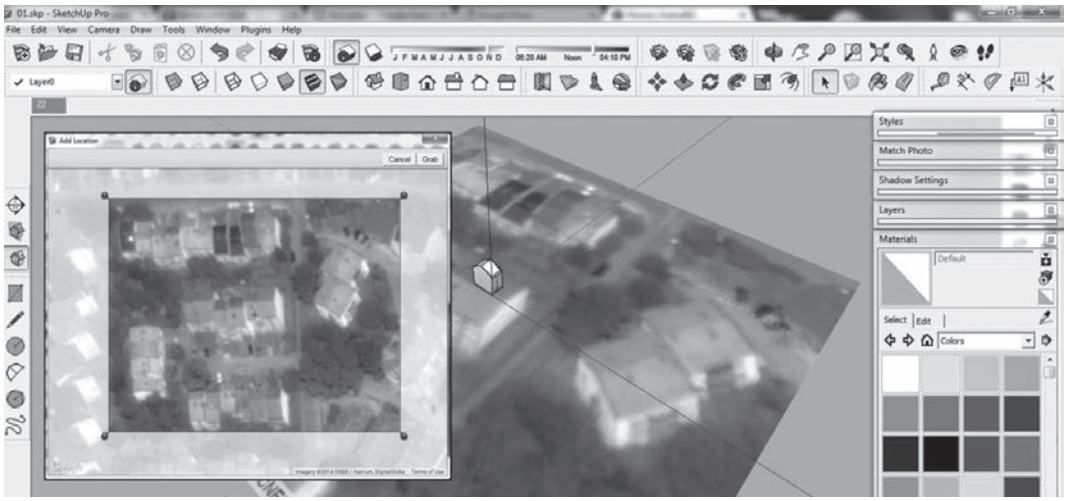

Figure 3. Adjusting the scale
(Source: authors)

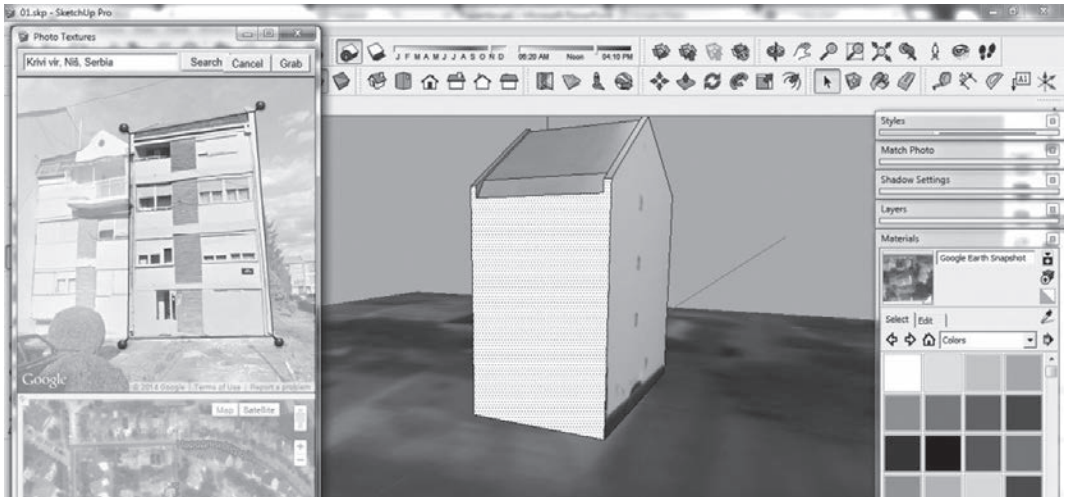

Figure 4. Usage of "Street View" service
(Source: authors)

Detail modelling

The model obtained in this way is often not sufficiently detailed, or (as in our case) not all the facades are created. The presented structure in Krivi Vir Street in Niš borders the adjacent building with one façade, while three remaining facades are free. Based on the procedure described up to now, a 3D photorealistic model of two building facades was created. For completion of the model, it is necessary to create a third façade (Figure 4). For its creation, a direct link of the "SketchUp" application with "Street View" service was used.

After starting the application, the location of the building was found on the map in the lower portion of the web browser, while in the upper part it was possible to perform a virtual "walk" along the streets and find the presentation of the missing part of the building. After that, it was necessary to select the region with the missing part of the structure, and project the photograph directly on the 3D model of the building (Figure 4). The link with the "Street View" service was very useful for the option of viewing the building from several angles and for downloading directly the parts of the textures which were missing or were concealed by other buildings or vegetation on the initial photograph.

RESULTS AND DISCUSSION

The final result of the presented web resource photogrammetry procedure is a photo-realistic 3D "solid" model (Figure 5) of a multi-storey house in Krivi Vir Street in Niš.

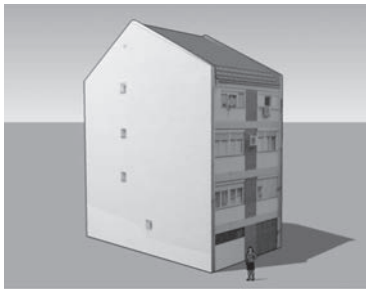

Figure 5. 3D model of the building (Source: authors)

A model obtained in this way can be used further for various purposes (Pejić *et al*., 2013a):

- It can completely replace the physical archives using digital files with the same characteristics;
- Digital data can be used for various kinds of scientific analyses and tests;
- It can help in understanding, presenting and learning about architectonic, engineering and town planning qualities of a certain locality.

The obtained "SketchUp" model can be easily shared using the web and presented to all internet users employing Google Earth and 3D Warehouse with whom the software package "SketchUp" has a direct connection (Pejić and Krasić, 2012). The digital models of the existing building obtained in this way are very suitable for presentation using the Augmented Reality system (Pejić *et al*., 2014) due to the file size and photo realism. They can be implemented when presenting the newly designed architectonic buildings in order to display the real environment in which the building will be constructed. By employing the in-built algorithms in the "SketchUp" software package and using the 3D models obtained in this way, it is possible to conduct the solar analyses (Stevanović *et al*., 2009) of shadow casting or of their impact on the thermal performance of adjacent structures (Krasić *et al*., 2013).

Accuracy of the obtained model

In order to determine the precision of the displayed method, the actual and model dimensions were compared. Control measurements of 12 distances (d_1-d_{12}) were performed on the house in Krivi Vir Street in Niš. The measuring of distances between the same points was performed on the model obtained by the semi-automatic photogrammetry method.

After that the percentage of deviation of each distance of the model in respect to the actual length was calculated and displayed (Table 1). The average value of deviation is provided at the bottom of the table, and it amounts to 2,9% for semi-automatic photogrammetry method.

Table 1. Control measurements and deviations of distances from the model

Distance mark	Length [cm]		Deviation in comparison with the actual length [%]
	Real (measured)	Model	
d_1	641	640	0,15
d_2	1163	1200	3,20
d_3	641	640	0,15
d_4	234	245	4,70
d_5	116	115	0,86
d_6	291	280	3,78
d_7	635	650	2,36
d_8	467	490	4,92
d_9	274	280	2,19
d_{10}	110	115	4,54
d_{11}	257	245	4,67
d_{12}	242	250	3,30
Average value of deviation percentage			2,90

The deviations obtained in this research in comparison with those obtained in other researches (Erickson *et al*., 2013) are higher because of the impact of the human factor and the usage of web photographs and lower quality maps. For that reason, in some areas such as architecture, archeology and protection of cultural heritage, there are higher deviations than in other areas (Remondino *et al*., 2012; Krasić and Pejić, 2014).

CONCLUSION

The main characteristic of the presented web resource based photogrammetry method procedure is the usage of free, globally available data. Demonstrated procedures for creating a 3D model of existing buildings prove that web resource based photogrammetry is possible to implement in practice. The presented procedure for the creation of 3D models of the existing buildings in comparison with the other semi-automatic photogrammetry systems (Pejić *et al.*, 2013a) has one main difference. It is time and work saving due to no need for a physical visit to the location for data collecting because all data are acquired from the internet.

By implementation of this concept, the architects can maximally simplify the model production process of an existing structure. Due to the development of web technology, it is no longer necessary to visit the location of the building, because all the necessary data can be obtained

through the internet. Also, the usage of only one software package which allows complete model production, scaling and geo-locating represents an additional improvement. An average dimensions deviation of 2,9% for the created virtual model in comparison with the real structure is within the acceptable limits.

All this leads to the conclusion that a 3D model of existing buildings obtained using the presented procedure can be used for various purposes in architecture, such as digitalization of archive documents of the existing structures or for the presentation of architectonic, civil engineering and town planning qualities of a certain location. Digital 3D models can also be implemented for different kinds of scientific analyses and tests, such as the shadow casting analyses or thermal analyses.

The biggest limitation of the presented procedure is if there are no photographs of the desired building. The potential problem is if the location is not covered by the "Street View" or similar services which is most important for the production of geometrically complex models. For that reason, it is difficult to find the data on the internet for the location outside big and important cities. The further technological development of hardware, software and internet will contribute to the simplification and overcoming of these problems.

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THE NEED OF HARMONISING THE ADMINISTRATIVE AND THE FUNCTIONAL METROPOLITAN AREA: THE CASE OF BELGRADE

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The aim of this paper is to highlight the lack of correspondence between the administrative borders of the Belgrade region on the one hand, and its functional gravitational area, on the other. The paper seeks to define the boundaries of the functional area of Belgrade using several available criteria, where the key one is the body of data on the daily commuting of the employed population, students and pupils. In Serbia, commuting was taken into consideration as a criterion for delimiting urban areas, or an instrument in planning and achieving a decentralised and balanced regional development only in the most recent generation of spatial plans. Compared to the boundaries of the functional area, the current, inadequate, administrative boundaries of the Belgrade region reveal problems in the consolidation of the metropolitan region and they have a negative effect on the planning of this area, as well as on the territorial cohesion in Serbia.

Key words: **metropolitan, commuters, functional gravitation, spatial harmonisation, Belgrade.**

INTRODUCTION

Belgrade has always been a driver of development and prosperity in Serbia. It is beyond any doubt that Belgrade, with its administrative area, has a much stronger regional potential at various levels – international, national or regional – than it used to have in the past. The reasons for this may be found in external factors. Some drawbacks of the regional territory of Belgrade have to do with political circumstances, particularly those in the last decade of the twentieth century (the civil war and the disintegration of the former Yugoslavia, as well as the embargo imposed on our country by some members of the international community). First of all, the city's economic resources were exhausted, it was functionally disoriented, weakened, as there were no investments whatsoever from national or international financial sources. Those circumstances had direct repercussions on the territory of Belgrade and Serbia.

One of the key development factors in the Belgrade area would be to define its administrative boundaries appropriately. Throughout history, the boundaries of Belgrade's administrative area were conceptualised following different principles and objectives without a clear scientific elaboration and methodological base. The changes of administrative boundaries, especially in the 20th century, are considered to be a factor that has not only affected the city's development, but also its importance for the regional development of the national territory and its role in determining the centralisation level or the polycentricity index, etc., as compared to international urban centres. Although it is quite clear that it is difficult to outline administrative and functional boundaries along the same lines, the lack of coherence between them may cause multiple problems in spatial planning (Andersen, 2002).

As it has already been pointed out in theory[2] and practice, defining a metropolitan territorial unit within its administrative boundaries should be based on the concept of nodal regionalisation. In modern spatial planning, functional urban areas are recognised as an instrument of a balanced regional development. In the analysis of the gravitational impact, the most commonly used indicators are those related to population movements. In urban geography studies, population movements within an area of gravitational influence are expressed quantitatively through the share of commuters in the employed population of a settlement or in the total number of daily incoming commuters of the analysed city.

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[2] Vresk, 2002; Tošić *et al*., 2009; Tošić, 2012; Veljković, 1998.

The Administrative Area of Belgrade, which is in formal legislative terms called the "City of Belgrade" (CoB), covers Belgrade (settlement), with its ten city municipalities, and seven municipalities added to this area, thereby becoming city municipalities. However, the CoB has been defined with the purpose of solving numerous problems and it follows the territorial boundaries of municipalities, particularly along the boundary of the Autonomous Province of Vojvodina (as a subnational macro-region to the north of Serbia); it has not been based on demographic, socioeconomic, spatial and functional components and indicators. Also, commuting was not used as a criterion in defining the CoB.

PREVIOUS RESEARCH

There are various methods for defining nodal regions or urban gravitational areas, no matter whether they refer to metropolitan regions or medium-size cities which have a role of regional centres at a national level.

The first scientific explanations of the position of cities in spatial-functional entities appeared in the second half of the nineteenth century and the beginning of the twentieth century. In the previous phases of development, nodal character was considered to be a result or a sum of interactions that occurred between a node and other nodes in space (Haggett, 1972). Under the influence of Berry (1967), Garrison (1956), Pred (1977), and particularly the Oxford School of Human Geography, nodality was determined based on the "threshold" of the minimum of functions concentrated in a settlement and the number and the maximum distance of their users (Tošić, 2012). Indicators of population mobility were introduced in scholarly literature as daily urban systems (Berry, 1967) and the concept was defined as an area around the city where convergent commuting occurred (Bourne, 1975), or a space that faced intensive population mobility between the place of residence and the place of other socio-geographic functions (Goodal, 1987). Since the mid-twentieth century, some characteristics of these migrations have had a multiple impact, which has been relevant for the study of European and global relations (Gottmann, 1961; Hall *et al*., 1973; Boustdet, 1953; Coombes *et al*., 1988; Green *et al*., 1986; Karlsson and Olsson, 1999; Andersen, 2002; Aguilera, 2005; Artis *et al*., 2000; Willis 2010). In the Western Balkans context, Vresk (1994) identified two types of the impact zones of a city based on the metropolitan area of Zagreb: the first with more than 50% and the second, wider one, with more than 20% of commuters in the total employed population.

As far as the countries outside the European continent are concerned, the identification of urban systems has been undertaken systematically in the USA, where the territory was divided into 171 urban systems (Berry, 1973) based on the level of development of labour and commuting functions. By the end of the twentieth century, various indicators for defining the urban area were used. Other classifications of the US urban systems are reported in Killian and Tolbert (1993), and Tolbert and Sizer (1996), "where the US is divided into commuting areas and labour market areas." Also, it has long been posited that the best rural development strategy may be urban development, as rural areas can benefit from nearby urban agglomerations through commuting (Berry, 1970; Henry *et al*., 1997; Moss *et al.*, 2004; Partridge *et al.*, 2007; Polèse and Shearmur, 2006; Shearmur and Polèse, 2007). The impact of spatial planning on workers' commuting time was examined on the example of Chinese cities (Zhao and Lü, 2009).

In Serbia, the body of knowledge on population migrations and commuting presented in academic discussions and papers is partial – both spatially and thematically, and studies dealing with this topic are scarce and usually lacking in accuracy (Stamenković and Gatarić, 2009; Lukić, 2006).

In Serbian geography and demography, the phenomenon of commuting is not taken into consideration when determining the impact zones of a settlement. It is also true that relevant statistical data for this type of research were missing until the 1981 Census. Due to this, surveys were used as a data source. They were not comprehensive and their results were too limited in scope to enable the understanding of functional and spatial relations in the studied territories.

Also, daily urban systems have been used as instruments in planning and implementing a decentralised and balanced development of Serbia or its sub-entities only since a few years ago, when the latest generation of regional spatial plans and the national spatial plan were developed. In the current national spatial plan, as of 2010, functional areas are treated in accordance with the EU practice: as functional urban areas determined taking commuting into account. However, the analysis was not performed at the settlement level, but rather at the municipal level. It should be borne in mind that municipalities in Serbia are among the largest, in terms of size and population, in Europe (507.8 km^2 and 43,000 inhabitants on average).

ADMINISTRATIVE CHANGES OF THE COB

In the Kingdom of Serbia, in the early 20th century, the surroundings of Belgrade had the status of an autonomous administrative unit, as a district of Belgrade with 697,000 inhabitants and an area of 2,025 km^2.

After World War I, the Kingdom of the Serbs, Croats and Slovenes, subsequently the Kingdom of Yugoslavia (from 1929), was established and Belgrade became the capital, losing its boundary position due to the integration of the province of Vojvodina (which had previously been part of the Austro-Hungarian Empire). This enabled a more balanced development of the city that extended on both sides of what had previously been the border-rivers – the Danube and the Sava, and not only to the south, to the hilly Šumadija region, but also to the west, to the Srem and Banat plains in Vojvodina. Before World War II, two towns in Vojvodina – Zemun and Pančevo, were integrated in the Belgrade capital administrative region.

However, after World War II, the idea of establishing physical links between Belgrade and Zemun was put into practice through urban planning schemes, by drying the wetlands that had covered the area between the two cities and creating new land for construction. In the early 1960s, the enlargement of what was then the CoB was accomplished by the inclusion of four southern municipalities into the

urban area. On the other hand, Pančevo (a town to the northeast, within a 15-kilometer distance from Belgrade) and its municipality area were excluded from the CoB. Although Pančevo was strongly linked with Belgrade in various development aspects, it became an isolated urban settlement. Finally, in 1970, the CoB got its present form with the inclusion of another two municipalities, located in Šumadija, to the south.

Nowadays, the CoB contains 17 city municipalities. According to the results of the most recent population census in Serbia (2011), it had an area of 3,222 km^2, a population of 1,639,121 in 157 settlements, whereas Belgrade had 1,166,763 inhabitants.

The reasons for the enlargement of the CoB were numerous. The inclusion of a small territory in Banat, located on the north bank of the Danube River, was done in order to solve the problem of food supply in the city, since the fertile plain hosted large areas of agricultural land and food industry. On the other hand, beyond some political reasons, Zemun was included in the CoB due to the fact that the civil airport in Surčin and the military airport in Batajnica were on the territory of this municipality. The issue of water supply was solved by the inclusion of the Sava riverside. The issue of electricity supply was solved by the inclusion of two municipalities on the territory of Šumadija. The resulting administrative metropolitan area was a result of political decisions made in the period when it was formed, and it does not correspond to the concept of a functional and metropolitan urban area. The strengthening of the legal rights of autonomous provinces prevented a northward enlargement of the CoB, into Vojvodina (Bojović, 1999).

With the new territorial organisation of the Republic of Serbia (2007), the City of Belgrade (CoB) – within the boundaries outlined above: the inner urban area[3] with the Belgrade region, i.e. the defined administrative area – were granted the status of an autonomous macro-region (corresponding to the level of NUTS 2 in the European nomenclature of statistical territorial units). By the Law on Regional Development in 2009, four other regions were defined, apart from the Region of Belgrade, without further implementation. With the Law on the Capital City, adopted in 2008, this area was granted a degree of autonomy in the Republic of Serbia. The Law defines its responsibilities, territorial organisation, organisation of public services and institutions, forms of direct participation of citizens, as well as other issues relevant to the rights and obligations of the CoB. The City has the right to create its development policy and to apply for European funds with the aim of improving cohesion, competition and cooperation, so as to achieve a more balanced development, a better structural organisation and an improved social infrastructure. As far as the management of spatial planning is concerned, the city's municipal responsibilities are reduced significantly on the territory of the CoB[4], compared to other local governments in Serbia. Among other things, this hinders the adoption of spatial and urban plans.

[3] The inner urban area is the territory that encompasses Belgrade (settlement), its ten city municipalities, as well as 26 neighbouring settlements that belong to these city municipalities.

[4] City municipalities are not local self-government units. The CoB is the only self-government unit. (The Statute of the City of Belgrade, Official Gazette of the City of Belgrade, No. 39/08).

THE BOUNDARIES OF THE COB IN THE PLANNING DOCUMENTS OF SERBIA

In order to show the complexity of this problem and clarify points relevant to defining the CoB, we will quote some solutions proposed in planning documents – urban plans of Belgrade and regional spatial plans of the CoB, as well as national spatial plans in different periods:

1. Belgrade's urban region defined in the *1950 Master plan* (GUP – General Urban Plan) *of Belgrade* covered a wide area of Banat, including Pančevo, as well as parts of Srem and Šumadia, and it had a territory of 200,841 ha. The urban region defined in this document has never been established in practice, particularly as regards the large area located on the left bank of the Danube River, in Banat (Stepić, 2003).

2. In the *1972 Master plan* (GUP), the wider and the inner gravitational zones of influence were defined, but the administrative area corresponded to its today's counterpart, with the exception of two municipalities in Šumadia, to the south. In the 1972 GUP, it was stressed that the area located on the left bank of the Danube River, in Vojvodina, was not activated due to natural reserves, which were not suitable for settlement. The attitude and action of the Autonomous Province of Vojvodina did not allow Belgrade's expansion and development on the other side of the Danube (Stojkov and Tošić, 2003). It is indicative that the urban entity and municipality of Pančevo in Vojvodina, to the northeast of Belgrade, retained its boundary position, while maintaining strong economic and intensive commuting links with the Belgrade agglomeration (Derić and Smiljanić, 2004).

3. The most recent *Master plan* (GUP) *of Belgrade*, adopted in 2003, is focused only on the inner urban area, covering 72,602 ha.

4. The working materials drafted in 1975 while preparing a plan that was eventually not adopted (Šećerov, 2012) sought to determine the functional region of Belgrade, though in a framework considerably wider than that delimited by the present administrative boundaries. It was supposed to include 44 municipalities from the surroundings of Belgrade. The plan according to which Belgrade was to cover such a wide area, defined in this way, has never been put in practice, principally for political reasons. In the 1960s, Belgrade entered the post-industrial phase with the development of tertiary and quaternary sector activities. In the 1970s, the policy largely destroyed the tertiary sector inside the City, while the official attitude towards individual business led to the "expulsion" of small enterprises, which would further form an economic base for the surrounding centres in Vojvodina and create better conditions for business and entrepreneurship in that area. In this way, Belgrade also influenced the urbanisation of the neighbouring Srem area in Vojvodina. State interventions in the planning of the construction of chemical industry facilities in Pančevo, which served the needs of the capital city, resulted in stronger economic ties between the two cities, which were for decades forced to be separated by administrative boundaries. The boundaries between

Belgrade and Vojvodina still hinder the development of the city's functional area (Bojović and Borovnica, 1998).

5. Another option for defining Belgrade's metropolitan area, which may be considered as the functional area, was presented in the *2004 Regional Spatial Plan of the Administrative Area of the City of Belgrade* (revised in 2011). Seven bordering municipalities were identified, as well as the municipality of Ruma in Srem, in Vojvodina (nine municipalities in the revised plan).

6. The *1996 Spatial Plan of the Republic of Serbia* defined six macro-regional centres in Serbia and indicated potential areas of their influence. According to Serbian scholarly and professional circles, Belgrade's zone of influence was unjustifiably expanded to the east and to the west, so as to coincide with Serbia's international borders. To the north and to the south, the boundaries ran along the lines separating Belgrade's zone of influence from those of the cities of Novi Sad and Kragujevac.

7. The current *Spatial Plan of the Republic of Serbia 2010–2020* contains proposals related to functional urban areas. The extent of functional urban areas (FUA) was determined based on commuting in municipalities and criteria that take into account demographic factors, the level of urbanisation, the share of population working in agriculture, etc. Belgrade is identified as the centre of international importance corresponding to the category of MEGA 4[5] (potentially MEGA 3) that should encompass additional six units of local self-government in the territory of Vojvodina.

The Programme of Implementation of the Spatial Plan of the Republic of Serbia presents the concept of an information system for monitoring and evaluation of spatial development at the national level. The theme "spatial planning" includes a package "spatial structures", which should contain data about FUA and MEGA in Serbia. Data processing within the spatial development information system could be useful for decision and policy makers in the domain of spatial planning and this could also lead to a better and more appropriate defining of the *Belgrade metropolitan area*.

CRITERIA FOR DEFINING THE METROPOLITAN AREA OF THE COB

Based on available data and knowledge and taking into account the results of international and national scholarly studies and planning documents (Vresk, 2002), the results of a comprehensive analysis of convergent commuting between urban centres, the level of urbanisation and functional transformation of settlements in their surroundings and the necessary travelling time using transport networks (i.e. the distance between settlements), the following relevant, necessary and sufficient criteria that should be taken into consideration in defining the metropolitan area of the CoB have been identified:

1. the share of convergent commuting to Belgrade from the surrounding settlements (within or outside the CoB);

2. the share of agricultural population in the settlements; and

3. the distance between the settlements and Belgrade.

Several indicators are used in identifying functional gravitational areas and "…two of them should be particularly highlighted: daily movement of employees and the share of non-agricultural population. They are taken into account in most models used in identifying functional areas" (Vresk, 2002).

Table 1. Criteria for determining Belgrade's gravitational zones of influence

CoB - settlement	Share of commuters in active population	Share of agricultural population in active population	Distance in km (time necessary to commute)
I zone	≥ 50%	≤ 25%	≤ 20 (to 30 min.)
II zone	30-49%	26-50%	21-40 (to 60 min.)
III zone	10-29%	26-50%	41-60 (to 90 min.)
IV zone	two conditions fulfilled		
V zone	one condition fulfilled		

Source: the original author's method

Five gravitational zones of influence are identified taking into account the share of commuters from the surrounding settlements in the active population, the share of agricultural population in the active population, and the distance of settlements from Belgrade (Table 1 and Figure 1).

In the area covered by the five zones, there are 248 settlements: 156 (63.4%) belong to the CoB, while 92 (36.6%) are outside the CoB – in the province of Vojvodina (79 settlements) and in Central Serbia (13 settlements).

The passages to follow present an analysis of Belgrade's surroundings taking into account all of the cited criteria in order to define the Belgrade metropolitan area. This type of research was first made possible after the Census of 2002. However, census data required special processing.

The territory of Serbia is extremely polarised, especially due to the role of Belgrade. This is confirmed by the fact that Belgrade is the commuting destination for 13.9% of total commuters in Serbia.[6]

As far as commuting inside Belgrade (settlement) is concerned, 340,149 inhabitants commute on a daily basis between the place of residence and the place of work, the place of residence and the place of education, and *vice versa*. The number of people involved in convergent commuting to Belgrade is 108,046, which makes one-fifth of Belgrade's active population (21.58%), and they mostly come from settlements within the CoB. On the other hand, 16,732 people commute in the opposite direction (leaving Belgrade) daily.

Almost 50,000 people from 26 settlements located in city municipalities whose territory partially belongs to Belgrade's inner urban area (Čukarica, Voždovac, Palilula and Zemun) commute on a daily basis. There are 41,580 people commuting on a daily basis from the outer city municipalities of the CoB towards Belgrade. Out of 13,480

[5] MEGA – Metropolitan European Growth Area in accordance with the ESPON 1.1.1 project

[6] The number of commuters whose destination is Belgrade is analyzed in this paper in relation to the total active population of the settlement of residence; the agricultural population was excluded since they do not commute.

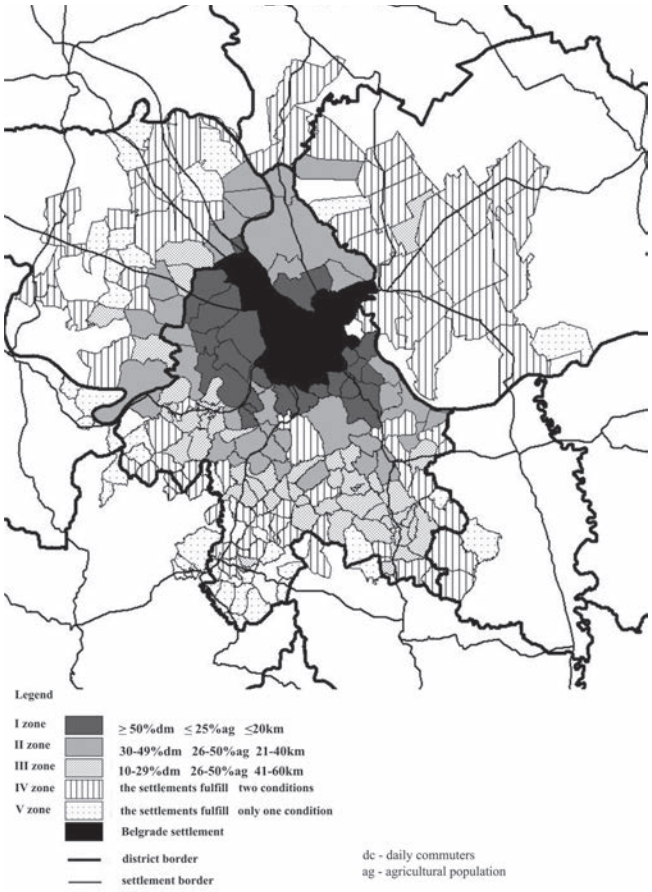

Figure 1. The zones of Belgrade's gravitational influence[7]
(Source: Specially processed data, Statistical Office of the Republic of Serbia)

commuters from the north who travel daily from the territory of the Autonomous Province of Vojvodina towards Belgrade, more than a half have the place of residence in the Municipality of Stara Pazova (to the northwest of Belgrade on the way to Novi Sad), the village of Pećinci and the town of Pančevo (with more than 1,000 commuters each). A small share of commuters (3.28%) come from the territory of Central Serbia outside the CoB (Table 2).

Along with the hindering effect of the boundaries towards the province of Vojvodina, the gravitational influence of Belgrade is weaker in the northwest due to the impact of the second largest city in Serbia – Novi Sad, located at an 80 kilometre distance from Belgrade. Although Novi Sad is more than five times smaller in terms of population, the number of convergent commuters to that central settlement equals a half of convergent commuters to Belgrade. Several settlements that are closer to Belgrade have far more commuters to Novi Sad than to Belgrade. On the other hand, the presence of power facilities to the southwest and south of Belgrade – a thermal power station at only 30 km and a mining complex at only 50 km from Belgrade, largely enabled local employment and reduced the intensity of commuting to Belgrade. The cited reasons, including the relatively unsatisfactory accessibility to Belgrade from the south, have contributed to an increased share of rural commuters to municipal centres in the periphery of the CoB.

The convergent commuting system may be divided into several zones by grouping the territories of settlements that have similar migration characteristics defined based on the intensity of commuting (Figure 2):

1. the zone of intensive influence, where more than 70% of the active population commute on a daily basis to Belgrade, from 19 settlements;

2. the zone of strong influence, where 50–70% of the active population commute on a daily basis to Belgrade, from 26 settlements;

3. the zone of medium influence, where 30–49% of the active population commute a on daily basis, from 40 settlements;

4. the areas of weak influence, where 10-29% of the active population commute to work centres on a daily basis, from 61 settlements;

5. the periphery of the commuting system, where less than 10% of the active population commute on a daily basis to Belgrade, from 102 settlements.

The decline of agricultural population in the active population of the settlements surrounding other towns in Serbia has often been used as an additional criterion in determining the zones of gravitational influence of towns. This indicator began to be used as soon as data were available and it has been considered as the key indicator of settlements' functional characteristics and the level of their territorial development. The share of agricultural population, as well as its changes, can be brought into a relationship with the degree of urbanity of a settlement and the process of urbanisation. These data indirectly outline the boundaries of the areas of cities' gravitational influence, as they largely depend on the extent of population movements, i.e. convergent daily commuting.

The process of deagrarization between 1981 and 2011 was intensive in the CoB, but also in other parts of Serbia. It was even more intense in the 1960s and 1970s, in the period of intensive industrialisation.

[7] All settlements that belong to Belgrade's convergent commuting system have been analyzed, as they constitute a continuous entity; the settlements in which there are no commuters to Belgrade have not been analyzed within the framework of Zone IV, although they meet the conditions related to the other two criteria.

Table 2. Belgrade's convergent commuting system

Place of residence of commuters	**CoB**	Inner periurban area	Outer periurban area	**Wider area of influence outside the CoB**	Settlements of Central Serbia outside the CoB	Settlements in Vojvodina	**Total**
Number of commuters	**90,908**	49,327	41,581	**17,141**	3,659	13,482	**108,049**
Share in total number of commuters in %	**84.23**	45.71	38.52	**15.77**	3.28	12.49	**100**

Source: Specially processed data, Statistical Office of the Republic of Serbia

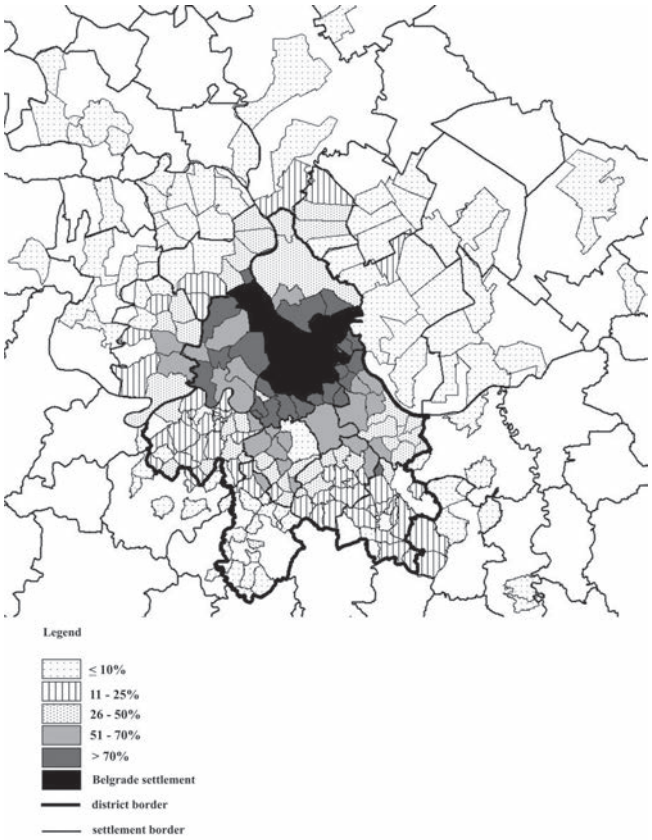

Figure 2. Belgrade's convergent commuting system (the share of commuters to Belgrade in the total active population of the settlements) (Source: Specially processed data and Census of Population – Activities, Statistical Office of the Republic of Serbia)

Table 3. The number of settlements with the percentage of agricultural population in the total active population

Share of agricultural population in total active population		Number of settlements		Change of the number of settlements
		1981	2011	2011-1981
≤ 10%	in the CoB	11	49	38
	outside the CoB	2	13	11
11-25%	in the CoB	25	29	4
	outside the CoB	5	16	11
26-50%	in the CoB	36	54	18
	outside the CoB	15	41	26
> 50%	in the CoB	84	24	-60
	outside the CoB	70	22	-48

Source: Census of Population – Activities, Statistical Office of the Republic of Serbia

In 1981, the share of agricultural population in the surrounding settlements within the CoB was 35.4%, to decrease to 19.5% in 2011. These data can be brought into a relationship with the increase in the number of settlements with a lower share of agricultural population, and vice versa: the number of settlements (108) with more than 50% of agricultural population increased considerably (Table 3). The share of agricultural population in settlements increases as the distance from Belgrade increases (Figure 3). On the other hand, those settlements, as a rule, have less convergent commuters to Belgrade (Figure 2).

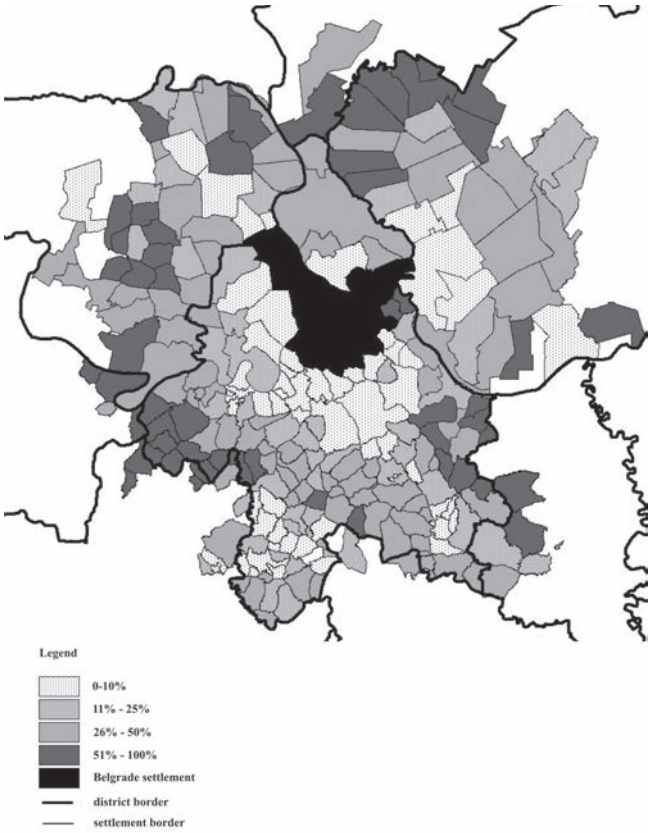

Figure 3. Settlements with the share of agrarian population in the total active population (Source: Census of Population – Activities, Statistical Office of the Republic of Serbia)

The indicator of a settlement's location based on the distance from Belgrade in defined zones is given in the kilometre length of the shortest distance, i.e. the length of the route of the best quality road. Due to the relatively bad or uneven quality of roads in the area surrounding Belgrade, as well as due to a different pressure on roads, i.e. an uneven accessibility from certain parts of the surrounding area, it is difficult to estimate correctly the time distance of settlements. Therefore, it is rarely taken as a relevant indicator in Serbia. The distance of 30 minutes corresponds on average to a 20-kilometre route. The smallest number of the observed settlements (31) are located at the distance up to 20 km from Belgrade, and the most of settlements (97) are at a distance between 41 km and 60 km (Table 4). Only 10 settlements, based on the cited criteria, are at a distance of more than 70 km from Belgrade.

CONCLUSION

Although the issue of functional and spatial relations and links between a city and its regional surroundings is not fully resolved, most authors believe that the concept of nodal or functional regionalisation is the most appropriate model for delimiting the role of a city in regional territorial integration. As the starting point, the criterion of convergent commuting is used for cities, together with the functional characteristics of neighbouring settlements, the distance between settlements, etc. This makes it possible to define the metropolitan borders, as shown on the example of Belgrade.

Table 4. The distance of settlements from Belgrade

Distance in km		Number of settlements
≤ 20	in the CoB	29
	outside the CoB	2
21 - 40	in the CoB	44
	outside the CoB	34
41 - 60	in the CoB	60
	outside the CoB	37
> 60	in the CoB	23
	outside the CoB	19

Source: The Belgrade Tourist Area, map R 1:200.000, COPYRIGHT, Geokarta, Belgrade

In this paper, the metropolitan area of the CoB is defined using a model that takes into account three indicators related to the settlements in the surroundings of Belgrade: the share of convergent commuters in the total active population, the share of agricultural population in the total active population of these settlements and the distance between these settlements and Belgrade. The results obtained based on this model suggest the following conclusions:

- the influence of Belgrade certainly goes beyond the administrative boundaries as they are defined;
- Belgrade should have a more central position in the metropolitan area, which would enable its optimal functioning in the area of its gravitational influence; however, Belgrade, within its present boundaries defined since 1970, has a peripheral (northward) position imposed by the administrative boundary of the province of Vojvodina;
- if the boundaries of the area of gravitational influence coincided with the demographic, economic and functional strength of the city, then some municipalities in Vojvodina would be part of the CoB, rather than the province of Vojvodina.

Having in mind the size of the territory added to the CoB, its enlargement was more intensive to the south, towards Šumadija; in this territory, the process of expansion was not only unhindered, but was rather aimed for and fostered by Belgrade for multiple reasons, as explained above.

Although the law which defines the administrative boundaries within the Republic of Serbia makes this impossible to achieve at the moment, planning documents relating to the CoB also suggest the enlargement of the administrative area of the city, first of all into the territory of Vojvodina. Both internal and external factors – Serbian and/or European policies of boundary delimitation – have so far presented a limiting factor in the process that would lead to achieving this objective.

Limited by the administrative boundaries to the north, towards the province of Vojvodina, Belgrade could constitute its metropolitan area if there were political will and enthusiasm to take proper actions. Urban policy has to do with the use of public service facilities, communal infrastructure, defining public transport lines, etc. The development policy of the surrounding settlements is also burdened by the fact that Belgrade's responsibilities are limited to the area within its administrative boundaries. This problem has been even more pronounced in recent years, having in mind an increased population density and, accordingly, population movement to the north of Belgrade's functional area.

Bearing in mind that it is difficult to determine any territorial boundary so as to meet all criteria, the improvement of interregional and inter-local links should be taken into account. This approach could contribute to interregional development. Although networking and interregional cooperation are desirable and necessary, not only as part of the measures of the EU regional policy, but also within the Regional Spatial Plan of the Administrative Area of Belgrade, it is our opinion that this process could not help overcome the mentioned problems caused by the discrepancy between the administrative and functional boundaries. On the other hand, there is a risk of the discontinuity of the metropolitan area, which may have a negative influence on its competitiveness, having in mind the polycentric development at the European and South-East European scale.

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ARCHITECTURAL COMPETITIONS AND THE ISSUE OF THE AUTONOMY OF ARCHITECTURE: THE CASE OF TERAZIJE TERRACE

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Terazije Terrace in Belgrade and many different architectural projects for this space produced over the last almost 90 years are the subject matter of the analysis. The research is conducted with the aim to recognize and present diverse currents in the development of an architectural scene and shed light on the role of architectural competitions in these complex flows. The 1929-1930 competition won by Nikola Dobrović, as well as the 1968, 1991 and 1998 competitions with the awarded projects are the focal point of the paper as the samples of architectural practice significant for the understanding of the relations between the treatment of "grand architectural themes" and the dominant orientation of a local architectural culture. The theoretical framework refers to contemporary theoretical debate on the autonomy of the discipline (Somol and Whiting, 2002; Aureli, 2008; Hays, 2010; among the others).

Key words: **Terazije Terrace, architectural competitions, modernism, autonomy of architecture.**

INTRODUCTION

Terazije Terrace is a space in the very center of Belgrade, specific as a place that connects very diverse ideas originating from different moments in the architectural history of the 20th century. Having been the subject matter of numerous architectural competitions and commissioned projects, this partly empty urban block served as a spatial framework and an inspiration for many architects of the Serbian, the Yugoslav and the international scenes to make their proposals for the future development of the city center.

Linked directly to Terazije Square, the central point of the Belgrade downtown, the sloped area of Terazije Terrace opens itself up to the view of and towards the river Sava and the far horizons in the west (Figure 1). As the main axis of the city center (Kalemegdan – Terazije Square – Slavija Square) lies partly on a ridge, there are several points along that line from which the attractive views of the surroundings could be opened.

According to Kovaljevski (1930), after the Committee for the Development of the Master Plan of Belgrade had officially marked the place for a terrace-belvedere in 1923, in the place that, as against Terazije Square, opens itself up between the hotels "Moskva" and "Balkan", the city government started repurchasing the land of the sloped terrain towards Kraljice Natalije Street in order to form a new public space for the purpose of building the terrace.

The making of the Master Plan was preceded by an international urbanistic competition in 1922. Among the awarded and mentioned entries, six proposed a terrace-belvedere in the place where Terazije Square opens itself up towards the Sava Slope (Vuksanović-Macura, 2014). This happened due to the fact that the competition brief suggested as advisable that such public spaces should be incorporated into the proposals of the Master Plan. Later, the Report on the Master Plan included the ideas about the repeated motif of the terraces located at Kalemegdan Fortress, Terazije Square, areas of Kosančićev venac, Topčider Hill and the Plateau of Vračar. These series of terraces have never been realized, just as has been the case with many other valuable planned conceptions (Maksimović, 1980).

According to the known data from 1901, the idea of the reconstruction of the urban block of Terazije Terrace in the form of a public space with the accompanying public objects dates back to the time when Dimitrije Leko pointed to that space as a representative one, suitable for building a new Parliament which could thus, dominate over the extended Terazije Square (Ibid.).

In 1910, the architect Jefta Stefanović proposed the same place as a possible location for a new Town Hall, stating that it was one of the most beautiful sites for such a kind of edifice. As Vuksanović-Macura (2013: 156) noticed, there

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was no reliable information whether these first ideas were accompanied by drawings or projects. Given that fact, one of the perspective drawings comprised by Chambon's 1912 Plan is considered to be the first drawing of the idea of Terazije Terrace. Since this plan was a free vision of a future city rather than a proper regulation plan, the drawing of the area of Terazije Square and Terazije Terrace was also a kind of an imagined romantic setting inapplicable to the actual urban situation.

Figure 1. The contemporary view over Terazije Square and Terazije Terrace towards the Sava river and the parts of New Belgrade (Source: http://belgradecat.com/page/4/, accessed 27th May 2016)

Viennese architects Emil Hoppe and Otto Schönthal made a design for Terazije Terrace in 1921, according to Vuksanović-Macura (2013), possibly as a commission by the Bank of the Danube Society (Banka Podunavskog Društva). In this beautifully drawn eclectic proposal, the space of the Terrace is designed in a series of oval green areas (with decorated little pavilions and terraces) and the streets around them. At the top point of the Terrace, a belvedere with border colonnades was proposed (Figure 2).

Figure 2. Emil Hoppe and Otto Schönthal, Terazije Terrace, perspective view, 1921 (Source: Vuksanović-Macura, 2013)

The 1923 Master Plan opened the possibility of the realization of the idea of Terazije Terrace as an open plaza with a view of the horizon in the west, and a set of buildings on the lateral sides. The plan proposed three cascades of the open area in the axial composition, flanked by different kind of buildings – "in the upper group – those for public offices, and in the lower group – those for the restaurants, the pubs, the cinema and so on" (Maksimović, 1980: 251).

In one period of time, lively polemics against the possible location of the future Town Hall filled the pages of Belgrade newspapers. In an article published in the Politika in 1927 (The Town Hall and Terazije Terrace, 1927), Terazije Terrace was indicated as a possible site for this purpose. Additionally, a detailed description of the program of the building was given, which referred to the entire space between Terazije Square and Kraljice Natalije Street. According to that program, municipal architect Jan Dubovi made a sketch of the building, which obviously largely influenced the future competition brief which we will return to later. In 1928, the same architect made a project for the temporary development of the space of the terrace by constructing an object on its side, at the top of Balkanska Street, conceived as "a multifunctional space with a public reading-room, a journalists' club and the City Museum" (Milašinović Marić, 2001: 33).

However, the preparation for the competition was continued, although in 1929 there was still a part of the land to repurchase in order to complete the necessary area according to the plan. The public had already been under the influence of the propagated idea that the site was one of the most beautiful in the city and that its future joining to the public space of Terazije would secure the most beautiful way of its development and extension (Competition for Terazije Terrace, 1929).

THE 1929 COMPETITION: A MODERNIST BREAKTHROUGH

The Competition Brief and the Results

In August 1929, only seven months after the Kingdom of the Serbs, Croats and Slovenes had changed its name into the Kingdom of Yugoslavia and the dictatorship of King Aleksandar Karađorđević had been announced, an international ideas competition was opened for the architectural solution to Terazije Terrace. After the 1922 competition for the Master Plan, that was the first new contest of an international character expected to lead to a solution to that important urban location in Belgrade. The results were published in June 1930. The winner of the competition was the architect of the younger generation, Nikola Dobrović, with his design under the password "Urbanismus" (Figure 3). Out of the twenty-five submitted entries, ten were awarded prizes or mentions by the competition jury. About one-half of the entries came from abroad. Nikola Dobrović himself sent his work from Prague, were he was starting his career of an independent architect, after having successfully worked at prominent architectural offices for several years.

Having in mind the dominant tendencies on the Serbian architectural scene, the building policy in general, as well as the taste of an average citizen, the vision that Dobrović proposed was the one of a radically new image to envisage in the very center of the city. Branko Popović, one of the jury members, wrote a lengthy article on the competition results for the capital's newspaper Politika, emphasizing that, speaking from the architectural point of view, Dobrović had

made the extension of Terazije Square "substantially modern and monumental, even in its tiniest detail" (Popović, 1930: 112). Describing the winning design, Popović testified that it "solves the problem of the terrace in a radical way. The terrace itself as well as the buildings flanking it, span over the whole area to be treated. The terrace extends almost to the building line in Kraljice Natalije Street, which transforms it into a grandiose, raised plaza." (Ibid.: 112).

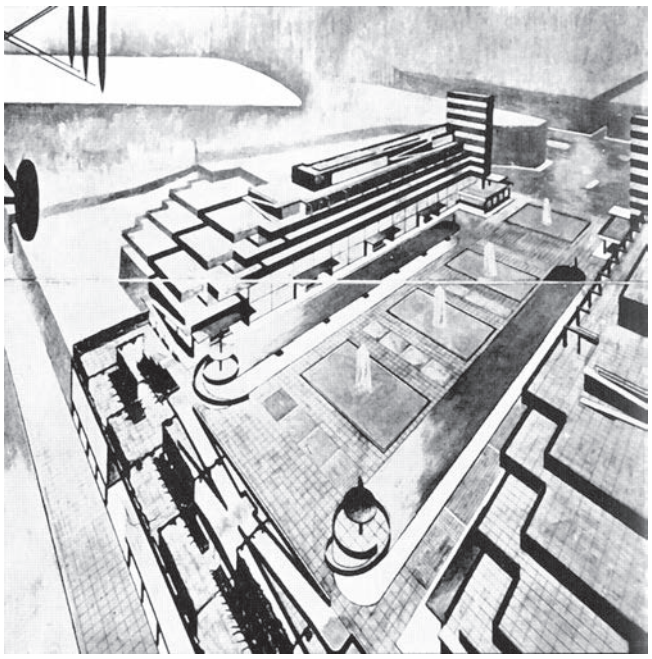

Figure 3. Nikola Dobrović, Terazije Terrace, competition project, perspective, 1929-1930
(Source: Perović and Krunić, 1998: 28)

It is worth noting the tone of Popović's text, glorifying the winning proposal, especially, as Manević (1979: 221) points out, having in mind that, as a prominent member of the competition jury, Popović himself had a significant role in defining the criteria for the evaluation of the works and in making the final decision on the distribution of the awards.

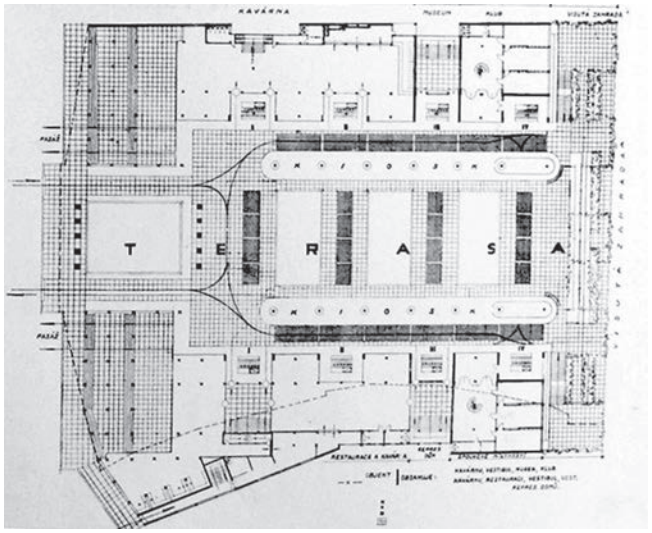

Figure 4. Nikola Dobrović, Terazije Terrace, competition project, the plan of the terrace level, 1929-1930
(Source: Perović and Krunić, 1998: 27)

The general criteria for the evaluation and preferences of the jury become even more obvious once we are aware of the fact that three of the four awarded designs are clearly modernist. The design made by the professor of Munich Polytechnics, O. Kurc, awarded the second prize, was an exception. The overall expression of his architecture was monumental, serious and not deprived of a certain pathos. The third awarded solution came from Prague, where it had been made by Croatian architect Mijo Hećimović, who had done it together with his colleague Gustav Bohutinski. The published drawing testifies to the architecture of a radically modernist conception, formed from the large cubes, also proposing a huge terrace over the whole depth of the block, in a manner even more radical than the one in Dobrović's proposal. The design that received the fourth award was the work by the architects Branislav Marinković and Dragoljub Jovanović, and was also conceived as a dominantly modernist architecture, although clearly playing with the classical motifs of the plaza, the gate and the belvedere.

Among the six mentions, there were very different architectural approaches which, all taken together, contributed to the diversity of the conceptions the competition had collected as the answers to its program. Besides the modern ones, there were a lot of eclectic, or conservative designs, among which there were some that did not adhere to the competition brief and closed the view of the river. According to Zoran Manević, as well as many other authors, modern architecture won the competition and the winner himself was the best one among the modernist proposals. According to Ljiljana Blagojević (2003: 116), "the crucial point of the rejection of modern architecture and planning in Belgrade could be explained by the example of the winning competition project for Terazije Terrace".

The significance of and the ideas lying behind the winning proposal

There is no doubt that Dobrović's design for Terazije Terrace is the most famous non-built modernist project in Serbia. Many authors stressed its crucial significance for the introduction of the ideas of modern architecture to the local architectural scene. Miloš Perović (2003: 130) argues that, in comparison with the projects of a similar program, the competition designs for Alexanderplaz in Berlin, dating from 1928, and the complex of the Rockefeller Center in New York, Terazije Terrace by Dobrović was more organized and more successful in combining multiple different functions (Figure 4), bringing at the same time an image of a pure and transparent structure.

What is of special interest for the subject matter of this paper is the following question: What exactly is the autonomous contribution of an architectural competition and the set of ideas behind the proposed projects to a local culture, to the way of defining the urban issues and the urban planning policy?

As we have mentioned earlier, two years before the competition a local newspaper had published a detailed description of the possible program of the future complex on Terazije Terrace (The Town Hall and Terazije Terrace, 1927). The multi-purpose buildings grouped into a simple scheme as demonstrated by Jan Dubovi's illustration together form

a monumental terrace with laterally placed volumes. The way of funding was also proposed – the municipality would only participate by providing the land for the construction, while different private companies would find an interest in investing in this multifunctional edifice.

Dobrović's answer to the competition brief was direct and fully met all its requirements. Moreover, the basic difference between his design and the other good-quality projects at the same competition is an impressively clear, simple and ordered functional scheme, as the basis for the beautifully designed architectural form authentically modern in all its elements. Describing his intentions underlying the project, Dobrović (1932: 114) gave a list of its key goals:

In the first place, the following should be introduced: 1) traffic in the city center should be regulated; 2) the concentration of crafts, the commercial and the cultural activities; 3) citizens' recreational activities; 4) new-aesthetic moments; 5) the economic aspects; 6) the elimination of housing for rent from the downtown area.

This list was immediately followed by an extended description of the regulation of pedestrian circulation on and around the site, through the building, in all possible directions – vertically, horizontally and up-and-down the slope – which was remodeled and incorporated into the interior of the building under the terrace. He writes about the motivated circulation of users, presenting the project as a device for the regulation and distribution of the flow of people, as well as for the efficient and complementary overlapping of many diverse functions. Writing about Corbusier's project for Centrosoyuz in Moscow, J. L. Cohen emphasizes the fact that Corbusier frequently used the term *Circulation* to describe the core idea of this project. Corbusier elaborated on this: *"Architecture is circulation.* Think what it means. It condemns academic methods and sanctions the principle of *pilotis*" (as cited in Cohen, 2008: 54).

We can argue that, apart from all its formal qualities which clearly distinguish the winning project by Dobrović as the most consequent modern architectural conception the Serbian public had faced until then, its overall intrinsic logic and the set of ideas it presented could be the most important novelty to be absorbed by the local culture. It is quite another question whether that culture has the capacity to embrace and truly comprehend those ideas so that it could make use of them, in the first place.

'AN INTEGRATED VOID'[2] AND THE DISTORTED ECHOES OF DOBROVIĆ'S DESIGN

Vuksanović-Macura (2013: 161) states that the fact that Nikola Dobrović's project was incorporated into the 1939 Master Plan as an older solution was an unprecedented event, having in mind that there were some newer proposals, among which those from the international competition for the design of Terazije Square organized in 1937.

The above-mentioned competition took place at the same time as the competition for the reconstruction of the space of today's Republic Square, and together they brought a significant number of new architectural concepts about the potential directions of the city center development.

After the Second World War, Nikola Dobrović, as the new Belgrade Chief Urbanist and the director of the Urban Department of EPC (Executive People's Committee), made new efforts to reanimate the subject of Terazije Terrace and his project from 1929, proposing a significantly remodeled solution in 1946, in which the stretching of the gesture through the urban tissue, starting from Terazije and going all the way to the river, became dominant.

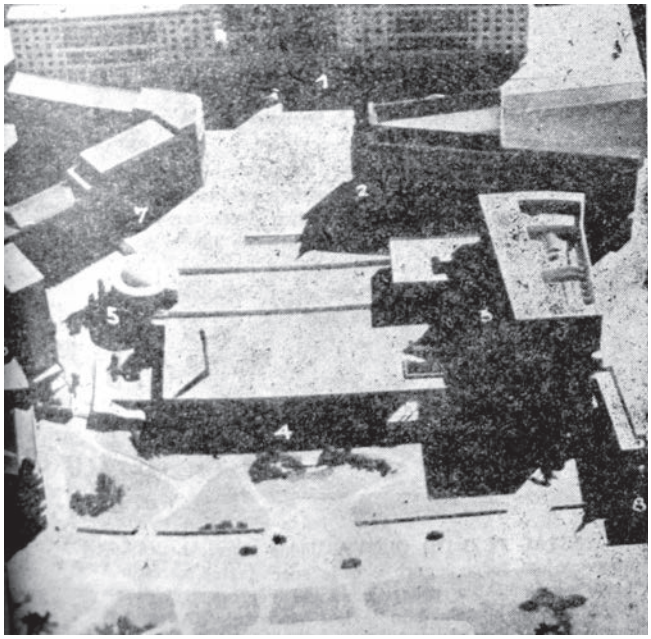

Figure 5. Vladeta Maksimović and Vido Vrbanić, Terazije Terrace, project, model, 1951 (Source: B.S., 1951)

After Dobrović had left the Urban Department, this institution did work on a new Master Plan for Belgrade, which was officially accepted in 1950. The Plan was designed under the leadership of Miloš Somborski, and within it, the architect Stanko Mandić made a new project for Terazije Terrace, which proposed a connection between the pedestrian surface of Terazije and the highest level of the Terrace, so the tunnel under it could interconnect Prizrenska and Balkanska Streets. Under the surface of the Terrace, a simple singular mass of an object is designed, which consumes only the upper part of the block between Terazije and Kraljice Natalije Street, reducing significantly the extent of construction on the site compared to Dobrović's solution.

In the very next year, architectural magazines gave an insight into a new project for the Terrace by the architects Vladeta Maksimović and Vido Vrbanić, made within the Belgrade Design Institute (Projektni zavod IONO Beograda) (B.S. 1951; Social Architectural Objects, 1951). This project incorporates the recommendations of the new Master Plan and proposes a dominantly horizontal structure with two low annexes positioned laterally and asymmetrically, playing the role of the visual and functional connectors between the existing objects and the newly-designed structure (Figure 5). The main function of the object under the terrace is the

[2] Refer to Ljiljana Blagojević (2003: 123)

one of a cinema, intended for 1,500 viewers, and with a restaurant. The lower part of the block surface was designed as a park, with the idea to make a natural connection to the future green axis stretching down the slope through the urban tissue. The same as in the cases of other earlier projects, this one has also remained unimplemented in reality.

The next opportunity to survey the professional community emerged in 1968, when the competition for the urban design of Belgrade downtown – from Kalemegdan Fortress to Slavia Square – was announced. In this competition two projects were awarded the first prize: the one designed by the architects Stojan Maksimović and Borko Novaković from Belgrade (Figure 6), and the other designed by Feđa Košir, an architect from Ljubljana, Slovenia (Petričić, 1968).

Figure 6. Maksimović and Novaković, Terazije Terrace area, competition project, site plan, 1968 (Source: Petričić, 1968)

Both designs, as well as the other awarded ones, proposed monumental dimensions of the space of the Terrace, which, directly following Dobrović's example, stretched in cascades towards the river Sava. Thereby, Maksimović and Novaković's project comprised the radial repetition of this direction, multiplied four times, with a focal point on the circular plaza at the foot of the Sava Slope – designed as a kind of a connector to the "new entering point of the downtown" (Maksimović and Novaković, 1968), in the location of the main railway station. In the Slovenian architect's work, a vigorous, linear stroke of the extended Terazije Terrace was used as one of the elements in giving a new shape to the silhouette of the city – "the horizontal texture of the terraces and esplanades with a view of Srem" (Košir, 1968: 45).

In a significant number of other awarded and mentioned projects the complex architectural treatment of the public space of the Terrace had been used mainly without any monumental masses of the built tissue, but with the whole system of the terraces, in symmetrical order, with the main direction axis (Bežan, Mušić and Starc; Stojanović; and others), or in the geometry of a certain move aside (Đokić, Petrović and Lukić).

The idea of Terazije Terrace as an urban location of special significance for the urban development of Belgrade had confirmed itself as being deeply rooted in the local architectural scene, and this competition managed to engage yet another generation of Serbian and Yugoslav architects.

The persistence of an idea about specific space and its potentials could be also understood as an immanent potential of an urban place to use the artifact of architecture (or an architectural design) to imprint into the urban tissue the ideas and relations autonomous from the ever-changing policies of the urban development (as Aureli (2008) interprets the ideas of Aldo Rossi).

THE 1991 COMPETITION: OLD IDEAS FOR NEW TIMES

In the year when the final breakup of Yugoslavia had already started, the competition was announced for the architectural solution of two office buildings, in the locations of 1a Prizrenska Street and 2 Balkanska Street, and the design of the public space of Terazije Terrace. The first prize went to the architects Slobodan Mića Rajović and Zoran Nikezić, the second prize was awarded to the architect Milan Lojanica and the third to the team of architects – Stojanović, Tmušić and Lončar (Terazije Terrace, 1991). The reason for the competition was obviously the appearance of an influential private investor ready to build at the site (Mitrović, 1991).

Both of the highest-ranked projects were designed completely in a postmodernist manner, using the complex decomposition of the form and the repetition of the typical architectural elements – the column, the wall, the window, architrave, pergolas and so on, employing the skill of the well-known compositional methods of the postmodern era.

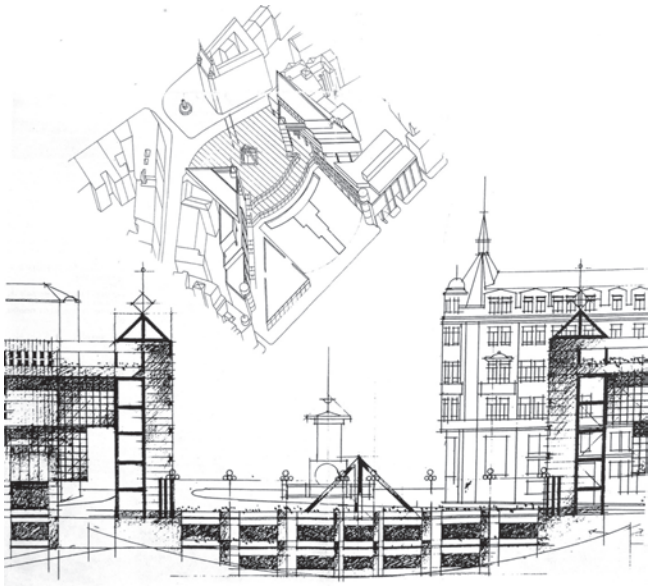

Figure 7. Rajović and Nikezić, Terazije Terrace, competition project, perspective view and elevation, 1991 (Source: Terazije Terrace, 1991)

In the winning project, the basic spatial conception combines the recognizable theme of the cascaded lateral masses with a shortened version of the terrace – as proposed in the 1950 and 1951 projects, as well as in some later solutions. Besides, it is clear at first sight that it also applied the idea of the gate, originally introduced by Dobrović, formed by placing two pylon-towers in the space of the park (Figure 7).

The password of the project was "Twin Peaks", and its textual part provides an additional piece of evidence for the significance this compositional motif had for the authors. The theme was joined with other usual postmodernist motifs – the accentuation of the massive wall, here furnished by granite tiles (Rajović and Nikezić, 1991), perforated partly with the small windows, and the use of the cascading masses, diagonally shifted here, in the directions of the connecting elements between the main body of the building and the tower.

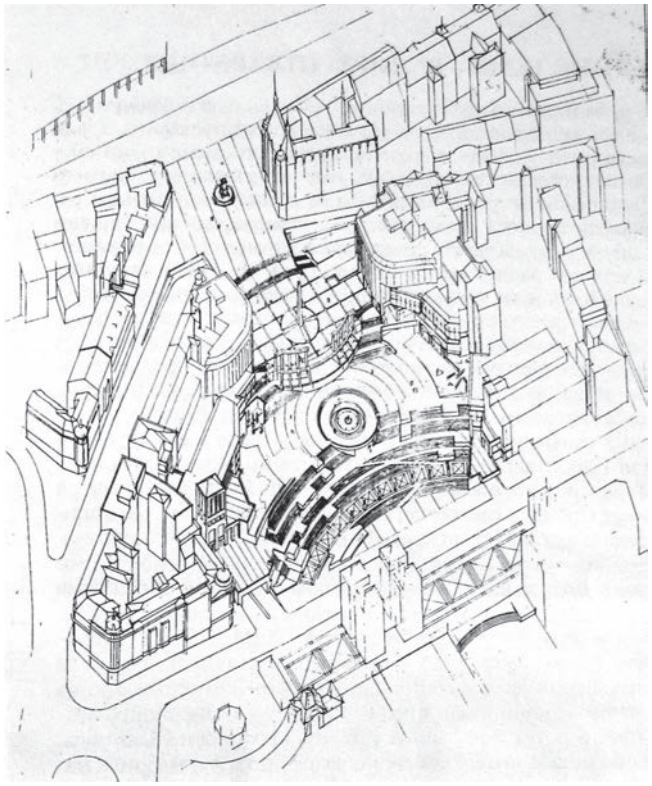

Figure 8. Milan Lojanica, Terazije Terrace, competition project, perspective view, 1991
(Source: Terazije Terrace, 1991)

The second prize went to a proposal of an even more complex expression, using the themes of the postmodern vocabulary. The side forms are made of different elements, grouped into a kind of a continual flow, switching from concave to convex, leaving the middle space axially organized around the sequences of the central motifs – the fountains, the obelisk, the colonnades framing the view, and so on. Taken as a whole, this was a solution primarily engaged around the issue of the composition of an urban space, insisting on an architecture forming a series of micro-ambiances (Figure 8). It uses historical reminiscences, such as the reconstructed old fountain from Terazije Square (Lojanica, 1991: 2) and aims to create likable spaces using the local architectural archetypes – "the porch, back-street colonnades, the chardak, balconies, eaves, etc." (Ibid.: 4).

The prolonged controversy over the realization of the winning project was harsh. It involved different groups of citizens and professionals. One of the main objections was the one indicating the excessive volume of the construction planned in the area of the park, whereas some existing facilities in poor condition occupied the front of the streets, e.g. the building at 1 Prizrenska Street (Mitrović, 1993). Some architectural magazines even published the proposals for the remodeling of the winning design (Popović, 1993).

However, when the Terrace is in question the 1991 competition was the absolute exception from the rule, , since it had the execution of an object as the final outcome. The building in 2 Balkanska Street arose along the left side of the slope, down the hill, giving a new shape to the location.

In his book *Architecture's Desire*, K. Michael Hays (2010:1) argues:

Architecture comprises a set of operations that organize formal representations of the real (...) and hence, rather than merely being invested with an ideology by its creators and users, it is ideological in its own right – an imaginary "solution" to a real social situation and contradiction (as Louis Althusser's take on Jacques Lacan puts it); that is what is meant by its "autonomy".

We could argue that the 1991 competition was a demonstration of an evident inertia at the local architectural scene, which acted as if perpetually engaged with postmodern themes of form, composition and symbolism. In this context, the autonomy of architectural discourse was employed only as a basis for the formal exercises. The scene as a whole missed a good opportunity to offer relevant "solutions" to the social and urban contradictions of their time.

THE 1998 COMPETITION: A NEW ANSWER TO THE OLD QUESTIONS

Hesitant about the adoption of the final solution for the central part of the location, the local authorities announced a new architectural competition for Terazije Terrace in September 1998. The winners of the competition were the team of architects: Karolina Damjanović Grujičić, together with Zorica and Boris Penušliski. According to the jury, their work successfully met all the requirements of the competition brief. Still, this solution has also remained unrealized.

However, another project is remembered as the most provocative and the most vigorous design of this competition (Figure 9). Awarded the second prize, this work had been designed by the architectural team: Dejan Miljković, Branislav Mitrović, Gordana Radović, Zoran Radojičić and Marina Šibalić. In their report, the jury stated that, among other significant advantages of the solution, there were also: "the simplicity, strength and attractiveness of the concept, based on the traditional understanding of Terazije Terrace in creating the identity of Belgrade's spaces and the image of the city, as established by Dobrović's concept" (Društvo arhitekata Beograda and Savez arhitekata Srbije, 1999: 3). Further on, along with the functional qualities, the jury also praised the exciting image of the structure, with the potential to leave a deep imprint in the spatial memory of the citizens, "with a tendency to become the most dominant architectural motif of the overall perception of Belgrade" (Ibid.: 3).

In their text accompanying the competition project, the authors gave an extensive citation of Dobrović, instead of widely explaining the project itself. It is very indicative which quotation they chose – the well-known sequence where Dobrović elaborates his experience of Belgrade's Genius loci, and his critique of local urban planning and architecture as focused on unimportant themes and without any broader vision. In the context of the competition, this citation can be understood as a way to effectively stress the qualities of the project – it should lead to the conclusion that this project offers a new answer to all the old questions: it solves an architectural problem, it is not hairsplitting, and it takes the role of a new symbol of the city.

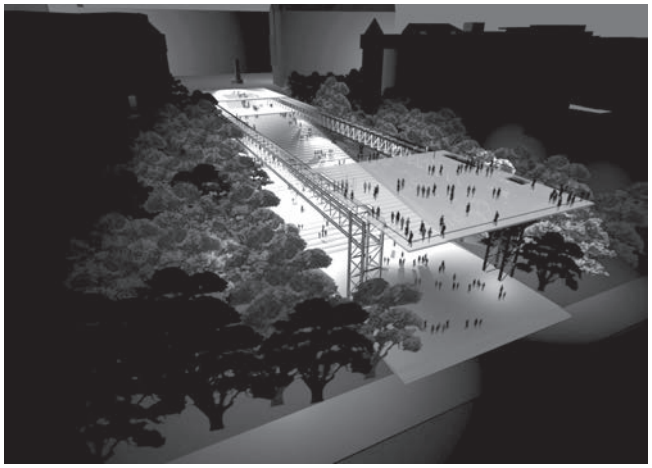

Figure 9. Dejan Miljković and the team, Terazije Terrace, competition project, perspective view, 1998 (Source: courtesy of D. Miljković)

In the case of the 1998 competition program, the architectural problem of the Terrace which Miljković and the team had to solve was somewhat different from Dobrović's problem. The building in the location of 2 Balkanska Street was to be realized, and the project for the other one was intended for realization. The central slope of the block was supposed to be an attractive public space, as well as a functional link to all necessary access communications to these two buildings that would eventually form its architectural framework.

This issue, along with the other two key aims (non-hairsplitting and the creation of a new symbol of the city), were solved in one simple expressive gesture – introducing a huge bearing metal structure with a terrace raised radically – at the most distant point from Terazije Square, with the idea to conquer that place in the air (which intrigued citizens' imagination in the 1930s, proposed by Dobrović's daring design).

Ten years after this competition, new city authorities announced yet another context for an architectural solution to the central part of the Terrace, above Kraljice Natalije Street. The jury extended the competition in the second round, after which the first prizes were given – one went to the ARCVS studio (Branislav Redžić and the team) and the re:a.c.t studio (Grozdana Šišović and Dejan Milanović). Although different activities connected with the potential implementation of one of these projects are still topical (in 2016), the final shape of this space, or at least a new temporary intervention, is nowhere in sight.

CONCLUSION

Gaining an insight into the part of the architectural history of Terazije Terrace (Table 1), and especially focusing the research on the competition projects from different periods, we can conclude that those many efforts and reflections in service of the creation of a new, better and up-to-date city center have left a small mark in space, but have made a significant impact on the local architectural milieu.

The 1929-1930 competition can be understood as the crucial moment of the breakthrough of modern architecture into the provincial architectural scene of Belgrade, although Dobrović's vision has unfortunately never been realized. Many authors share the view that competitions can serve as great opportunities for the promotion of new ideas, regardless of whether the proposal in question is awarded or not. The usual example is Corbusier's 1927 design for the competition for the League of Nations in Geneva. He and other modernists lost the competition, but won the day, eventually, through the further promotions of their ideas.

In the case of Dobrović, the competition was won, but the realization has never come, due to different reasons, among which the resistance of the local conservative forces was probably the most significant one. However, the autonomous contribution of his architecture has left its mark on the cultural heritage in the form of the set of unprecedented ideas about a place, a city and its potential development.

The 1991 competition reflected a certain disorientation of the architectural scene of the period. The highest-ranked projects could be understood as negotiating with a brutal and overwhelming urban reality beyond control, where the conflict between the private and the public interest was hard to soothe by virtue of an architectural project. The outcome was possibly even better than its odds were.

In 1996, the competition project that shook the scene was an indicative sign of a new fresh wave of architectural ideas, which introduced itself through the work and way of thinking of the new generation of Belgrade architects. Referring to the architectural theory of 'the post-critical practice', which emerged at the 'fin de siècle', we can argue that this project shows all the main signs of the *projective* (as defined by Somol and Whiting (2002)) behavior – it simplifies the problem, acts performatively and uses the autonomous game of architecture to give new, unexpected and attractive solutions to a spatial situation. The competition surely was a unique opportunity to propose an architecture of this kind in the most effective way, and to possibly help open the door to the ongoing shift of ideas and new architectural discourses.

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Table 1. The chronology of activities on planning and designing Terazije Terrace

year	project/competition	client / jury	author / awarded	organizer/(reference)
1897			Andra Stevanović – stresses the importance of the site	
1901			Dimitrije Leko – argues for the building on this site	
1910			Jefta Stefanović – proposes the site for the future Town Hall	
1912	Chambon's Plan	the first known drawing of the project for T.T.	Alban and Alfred Chambon	
1921	A design project	Bank of Denube	Emil Hoppe and Otto Schönthal	
1921-1922	**International Competition for the Master Plan of Belgrade**	Dobra Mitrović, Dragutin Đorđević, Vlada Mitrović, Ranislav Avramović, Pera Popović, Milan M. Jovanović, Vlajko Popović and Branko Popović, French architect Chiflot, Swiss arch. Edmond Fasio and engineer Duc	**I prize –** **3xII prize ex-aequo** Rudolf Perco, Erwin Ilz, Erwin Böck (*Singidunum Novissima*); Auburtin et Paranty (*Urbs Magna)* – **T.T.;** Emerih Forbah (*Santé, beauté, commerce et traffic*) **2xIII prize ex-aequo** Jozef Briks (*Sveti Sava*) – **T.T.** ; Gustav Blum (*Danubius*) - **T.T.** **3xIV prize ex-aequo** Julie Zaborcky and Josif Woytka (*Vojvoda Mišić*) – **T.T.**; Roger Bolomey and Ion Davidescu (*Impartial*); Albert Bodmer, Fritz Schwarz, Uroš (*Oj na more*) - **T.T.** **4 x mention:** *Prestonica Karađorđevića* – **T.T.** *Beograd 1918-1948; Sapienti Sat*; *Forum* (Hoppe and Schönthal)	Municipality of Belgrade
1923	Master Plan of Belgrade		*The first official planning document which regulates Terazije Terrace*	
1927	A sketch		Jan Dubovi – A proposal presented in newspapers	
1929-1930	**International Competition for the design of Terazije Terrace**	Branko Popović, arch., Klementije Bukavac, eng.;Đura Bajalović, arch., Đorđe Kovaljevski, arch.	**I prize** Nikola Dobrović (Prague) **II prize** O. Kurc and Ivan Savković (Munich) **III prize** Mijo Hećimović and Gustav Bohutinski (Prague) **IV prize** Branislav Marinković and Dragoljub Jovanović **6 mentions** Dušan Babić (Belgrade), Alfred Libig (Lajpciga), Strižić Višnjevački (Berlin), Karlo Leher (Berlin), Adolf Miaman (Dresden), Jovan Radenković (Paris)	Municipal Court
1930			Đorđe Kovaljevski – temporary arrangement design (partly built)	
1937	**International Competition for the Design of Heir of the Throne Square**	Branko Popović, Đura Bajalović, Milan Nešić, Svetozar Geniči, Mihailo Radovanović	**I prize –** **II prize** Marcel Pinchis and Grigore Hirsch (Bucharest) **III nagrada x 2** Josef Wentzler (Dortmund); Ivan Rik (Belgrade)	Municipality of Belgrade
1939	Master plan		Đorđe Kovaljevski and Danica Tomić-Milosavljević	
1946	project revision		Nikola Dobrović – revision of the project from 1930.	
1950	Master Plan		Stanko Mandić – design for Terazije Terrace	Town Plan. Direc.
1951	Design project		Vladeta Maksimović and Vido Vrbanić supervision team: Dragiša Brašovan, arch.; Đorđe Lazarević, eng.;Miladin Prljević, arch.; Miloš Somborski, arch.; Bogdan Ignjatović, arch.; Bratislav Stojanović, arch; Josiš Najman, arch.	Design Institute of Belgrade
1959	Design solution		B. Anđelković and A. Stjepanović	
1967-1968	**Competition for the urban design of the central part of Belgrade – from Kalemegdan to Dimitrije Tucović Square**	Pranko Pešić, arch, Zdenko Kolacio, arch., Ivo Kurtović, arh., Miroslav Marković, eng., Mihajlo Mitrović, arch., Milorad Pantović, arch., Branko Petričić, arch., Jovan Sekulić, Marko Šlajmer, arch., Ivan Taumban, arch., Lazar Trifunović, Aleksandar Đorđević, arch., Ratko Vujnović, eng., Leon Kabiljo, arch. Josip Svoboda, arch.	**I and II prize** - Stojan Maksimović and Borko Novaković - Feđa Košir, (Ljubljana) **III and IV prize** - Aleksandar Đokić, Vladimir Petrović and Petar Lukić - Marjan Bežan, Braco Mušić and Nives Starc, (Ljubljana) **I group of mentions:** Vojislav Mačkić, Dimitar Vanov, Rafail Vlčevski, (Skoplje); Miroslav Nikolić; Vladimir Bjelikov, Vladimir Božičković, Sima Miljković, Smilja Kanački, Petar Popović; Uroš Martinović **II group of mentions:** Nedeljko Borovnica; Vladislav Ivković, Ranko Trbojević, Gradimir Bosnić **III group of mentions:** Hranislav Stojanović; Mladen Anđel, Ivan Piteža, Edvin Šmid, Vlado Šobat, (Zagreb)	Town Planning Department of Belgrade, Belgrade Land and Development Public Agency; Society of Yugoslavian Architects and Union of Urbanists of Yugoslavia
1991	**Competition for two office buildings and the central part of public space of Terazije Terrace**	Mihajlo Mitrović, Aleksandar Stjepanović, Dragoljub Bakić, Konstantin Kostić, Miodrag Ferenčak, Borivoje Cvejić, Vesna Matičević, Kosta Karamata, Miodrag Filipović, Anđelija Josipović, Aleksandra Banović.	**I prize** Slobodan, Mića, Rajović and Zoran Nikezić **II prize** Milan Lojanica **III prize** Branislav Stojanović, Branka Tmušić, Vesna Lončar **2 mentions:** Ružica Božović-Stamenović Aleksandar Marinković, Dušan Pantelić, Milan Rakočević, Marko Savić, Dragan Stamenović; – Miloš Bobić **3 lower mentions:** Nikola Žarković, Đorđe Mitrović, Jovan Mitrović; – Vladislav Ivković, consultants–co-authors: Stana Dimić, Darko Radović; – Rafali Vičevski and Nataša Vičevska, Skoplje	Yugoslavia Commerce, Belgrade; Society of Belgrade Architects, and Society of Belgrade Urbanists
1998	**Competition for the design solution of central public area of the part of Terazije Terrace**	Milan Božić, Violeta Karić, arch., Miodrag Cvijić, arch., Jovanka Đorđević Ciganović, arch., Hranislav Milanović, Zoran Jakovljević arch., Zlata Jarić, arch., Sava Forkapić, arch., Radivoje Dinulović, arch., Dragana Bazik, arch., Zorica Savičić, arch.	**I prize** Karolina Damjanović-Grujić, Zorica Penušliski and Boris Penušliski **II prize** Dejan Miljković, Branislav Mitrović, Gordana Radović, Zoran Radojčić, Marina Šibalić **III prize** Marijan Đulinac, Milan Đurić, Dejan Miletić, Borislav Petrović, Ivan Rašković, Aleksandar Tomić, Miljan Šišović **3 mentions:** – Slobodan Mića Rajović, Zoran Nikezić – Zoran Dmitrović, Petar Zaklanović; – Vesna Nadeždin-Ljubičić, Miloš Đorđević **special commendation outside the competition conditions:** Branislav Jovin, Ivan Nikolić	EN-JUB (Energoprojekt HK and Jugobanka AD), Evropa Internacional Insurance Company along with: Union of Serbian Architects, Society of Belgrade Architects
2006-2007	**Competition for design of public space of Terazije Terrace from Terazije Square to Kraljice Natalije Street**	Bojan Kovačević, arch., Jelena Radivojević, arch., Svetlana Ivančević, arch., Marijana Strugar, arch., Dragan Praštalo, Đorđe Nedeljković, arch., Vlada A. Milić, arch.	**2x I prize ex-aequo:** ARCVS Beograd (architects: Branislav Redžić, Marija Marjanović. Suzana Popović, Dragana Žarković, Vesna Milojević, Bojan Spasov, Boris Muhović, Zoran Milovanović, Dragan Ivanović, Zoran Đurović; landscape arhc.: Mirjana Štulić); Re:ACT – Grozdana Šišović and Dejan Milanović **III prize:** Milan Maksimović and Dragan Marinčić **2 mentions:** Vasilije Milunović, Marina Dimitrijević, Ivana Šimković; – Dušan Lajović, Svetolik Lukić, Aleksandra Vukićević, Branka Ukropina and Gordana Gogić	Belgrade Land and Development Public Agency; *Mali kolektiv - ETB doo*; Society of Belgrade Architects and Society of Belgrade Urbanists

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ARCHITECTURAL DRAWING IN THE PROCESS OF VISUAL RESEARCH: THE NEW SCHOOL CONCEPT OF THE REPRESENTATION OF SPACE

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The viewpoint of architect Đorđe Petrović on drawing as a research process, driven by his work at the Faculty of Architecture, University of Belgrade within the field of architectural drawing, is to be taken as a starting point for the analysis of the process of visual representation of architectural space in this paper. The analysis is primarily focused on the relevant period from the beginning of the seventies, when the concept of the *New School* was formed, and Petrović introduced the concepts of *visual research* and *visual communications* to the curriculum, in his reassessment of the role of architectural drawings as a purely technical and information resource. The basic methodological question concerns the interpretation of the concept of *visual research*, conducted within the reformed curriculum, as well as its position in the then socio-cultural context and in relation to the actual practice of the time and the period that preceded it. Looking at the drawing as a powerful means of representations of space, the paper discusses architectural discourse determined by architectural drawing as the product of social and theoretical practice, similar to the hypothesis of Henri Lefebvre, presented in his work *The Production of Space.*

Key words: **architectural drawing, visual research, visual communications, New School (of architecture), representations of space.**

INTRODUCTION

The system of the *New School* of architecture was created by the process of structural changes in the teaching program at the Faculty of Architecture, University of Belgrade, in the early seventies of the twentieth century. Although the reform involved radical shifts of the entire teaching program, where some courses were integrated, but most were considerably abridged, one of the consequent changes occurred in the field of research of architectural drawing. It may be noted that until the said period, architectural drawing was studied as a technical skill and necessary craft for each architect, what an architectural drawing basically is – a way for architects "to present a shape that they want to build" (Vitruvije, 2006: 12). However, in the *New School* period, the study of architectural drawing took on a more complex notation, whereby a drawing was regarded as an integral part of the research process. Studied in *Visual Research* and *Visual Communications* courses, whose teaching program was conceived and directed by Prof. Đorđe Petrović, the drawing became the basis of considerations of architectural space. Therefore, the main object of the research is architectural drawing as a means of communication and representation, while the research question refers to the process of study and interpretation of the function of drawing in the context of higher education at the Faculty of Architecture in Belgrade, with special reference to the period of the reformed lectures after 1970, when the said changes are observed and implemented in this field.

Basically, the work is divided into two parts, both different in their structure and methodological approach to research. [1] The first part refers to a historical overview and scientific analysis of the developments in architectural drawing within the teaching program for architecture at the University of Belgrade. In this historical review, the concept of the teaching program for the *Architectural Drawing* course is analyzed. The concept was implemented after 1959, when the subject was taken over by Đorđe Petrović. After this period, innovations in the teaching program can be analyzed and they will achieve their final recognition and shaping in the reformed teaching program of the *New*

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Figure 1. Architectural forms of different historical epochs; students' works, 1960s (Source: Office for Visual Communication Archives, UBAF)

School; [2] The second part is analytically focused on the theoretical interpretation of the teaching concepts on the *Visual Communications* and *Visual Research* courses in the environment of the *New School*, and in relation to the practices of that time. The dominant practices of the sixties and seventies, when it comes to architectural drawing, can be seen in the futuristic and Utopian projects designed in order to criticize Modernism, because in the decades following the Second World War "it reinterpreted its goals, striving to form a physical environment that would meet the emotional and material needs of people" (Blagojević, 2007: 175). Bearing in mind that through these Utopian drawings, Henri Lefebvre's[2] idea of the production and representation of space, determined by social relations can be easily observed (Soja, 1996: 42), the aim was to explore to which extent Petrović's interpretation of the role of architectural drawings was similar to Lefebvre's theses.

CLASSES OF ARCHITECTURAL DRAWING AT THE FACULTY OF ARCHITECTURE, BELGRADE, FROM 1959 TO 1970

Although there had been a long tradition of studying drawing within Belgrade higher education in the field of architecture, before the 1960s, drawing was perceived only as a technical skill and necessity (Krstić, 1951; Petrović, 1996). After Professor Branko Krstić left the Faculty, from the academic year 1959/60, the course *Architectural Drawing* was entrusted to architects Branislav Milenković and Đorđe Petrović, then young assistant professors.[3] As already mentioned, during this period Petrović implemented many changes, which were reflected in innovative graphical analyses and in the research of unique architectural elements and shapes of various historical epochs and civilizations. Moreover, all graphical representations included a variety of geometric analyses, such as anthropometric, modular or proportion systems, which gave the entire process of making a drawing an analytical and research character (Figure 1). This concept introduced by Petrović was the result of his scientific and research activities in the domain of folk architecture and the theory of proportions.[4]

During this period, almost each academic year brought changes and innovations in the research of architectural drawing. This trend is observed on the basis of renaming the course title *Architectural Drawing and Forms* in 1966, which, according to Petrović was a necessity so that the name of the course "conformed to the essence of long-term changes" (Petrović, 1965: 5). This change is seen as a significant moment in the development of teaching architectural drawing, as well as in the interpretation of the role of drawing in the educational process at the Faculty of Architecture, University of Belgrade. Unlike the previous practice, when drawing was just a technical means of expression, now his research character took its shape. By the official adoption of the new course name, in which the term *forms* became institutionalized in the context of the term *architectural drawing*, a gradual introduction of the drawing of reduced geometric shapes and abstract compositions into the teaching process took place (Figure 2). This was considered by Petrović as one of the grounds for creative research based on architectural drawing (Petrović, 1972c: 7).

Although this concept had its complete formulation in the reformed curriculum of the New School, it is important to emphasize that the changes that would represent the fundamental basis for the development of the field of architectural drawing within the reform in the seventies could be felt in the second part of the sixties. The characteristic of this period was, precisely, the growing presence of reduced and more geometrical forms, which conceptually proceeded from earlier graphic representations of architectural forms from the history of architecture. This tendency primarily stemmed from the architectural practice of the period, as

[2] Henri Lefebvre (1901-1991), French philosopher and sociologist of neo marxist orientation. He felt that the space is a social product and he is also the first to use the term 'right to the city'.

[3] They led the course until 1964 together, when Milenković was transferred to the *Design Department* and accepted the course *Elements (the basics) of Design*, while Petrović continued to independently manage and create the curriculum for *Architectural Drawing* (Petrović, 1996: 98).

[4] Before Đorđe Petrović became a teacher on the course *Architectural Drawing*, he was assistant to professor Aleksandar Deroko on the *National Architecture* course, therefore their habilitation work was in the field of national architecture – *National architecture: bay windows and chardaks (1955).* His interest in the field of folk architecture, Petrović summed up in the study of theories and the system of proportioning, resulting in a published study *Theorists of Proportions* in 1967, and a doctoral dissertation on the topic *Arshine: dimensional, proportional and meteorological analysis by arshine of the elements of the structural wooden skeletal system (half-timbered) in the Serbian folk architecture of the nineteenth century,* defended in 1971.

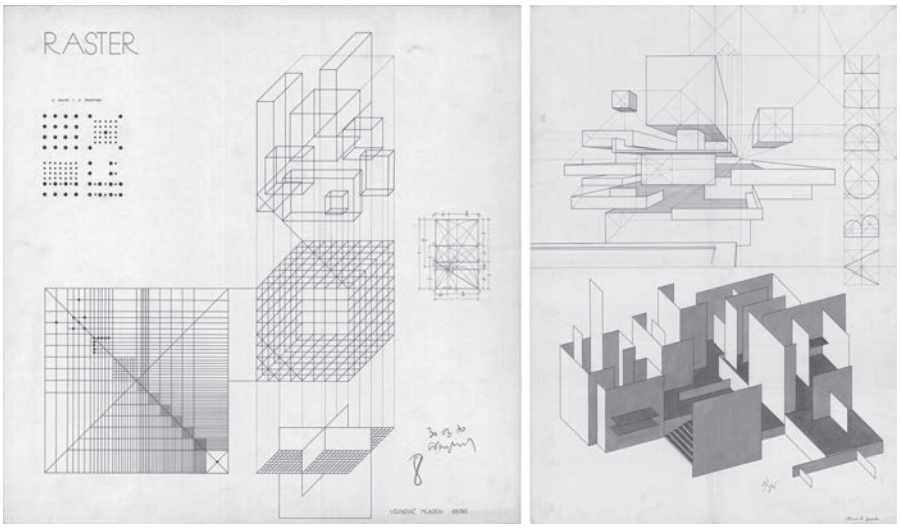

Figure 2. Abstract and reduced forms; students' works, 1970
(Source: Office for Visual Communication Archives, UBAF)

well as from methodological, educational and theoretical concepts within the domain of architectural form, space and environment, which will be discussed in the next part of this paper.

NEW SCHOOL CONCEPT AND THE POSITION OF ARCHITECTURAL DRAWING WITHIN THE REFORMED CURRICULUM

The context of the creation of the *New School* arose from the social and political circumstances in the world, which also had their strong echo in the former Yugoslavia. Under the influence of these changes, as well as rapid technological and economic development, accompanied by student protests in 1968, a favorable environment for the reform of the society and university education in general was created (Mladenović, 2008: 179). The *New School*, officially established in 1970, promoted "the concept of an optimized, intensive teaching program during a three-term system, based on the direct and continuous relationship between students and lecturers" (Savić, 2006: 16). Four-year studies were divided into two cycles, the first two years were general for all students (*cycle I*) and in the next two years (*cycle II*) they could make a choice between: the designing sector and urban planning sector. The aim was to systematically make the teaching program less demanding in order to avoid earlier problems related to the excessive workload for students, when only those who were most gifted and most persistent managed to complete their studies within the time foreseen by the curriculum (Bošković, 1996: 53). According to Bogdan Bogdanović, the creator of the reformed School and at the same time its dean, "the Faculty has substantially changed the character of its interests and joined a group of the most modern schools in the world, which are no longer only concerned with the study of the complex craft of architecture, municipal and composition problems of urban planning, but they focus themselves to strictly scientific research and systematization of the environment" (Bogdanović, 1971: 2). The lectures took place in smaller groups – boxes, with the support of their mentors, which entirely fit into the humanized picture of an entire education system in which "the *New School* became a part of the new social reality, with which it opened a dialogue and did not represent the reality unto itself" (Folić, 2012: 22). In the environment of a new methodological approach to teaching, full attention was directed to students and their needs, and each student had at their disposal their own work place, and every teacher was completely available to students at any time.

It is important to emphasize that Đorđe Petrović, due to his pro-reform orientation, as well as his integrated experimental and theoretical tendencies in the process of research, "represented one of the dominant figures in the School in the early seventies" (Mladenović, 2008: 181) and took an active part in its conception. In a multi-disciplinary context, the teaching in the field of architectural drawing, under the leadership of Petrović, experienced rapid expansion. All innovations regarding the teaching program and its methodology, which were permanently introduced in the previous decade, were even more comprehensively developed and improved during the *New School* period. The teaching was structured within two courses: in the first year the *Visual Communications* course was in the first and second trimester, while second-year students attended the *Visual Research* course during all three trimesters of the academic year. Within these courses, Petrović "managed to build a very specific and advanced visual concept in the field of architectural drawing, which, from an aesthetic point of view, leant toward the world's current trends in design, as well as the specifics of Bogdanovic's local visual paradigm" (Mladenović, 2008: 181). In the formation of the programming framework for the *Visual Research* and *Visual Communications* courses, the teaching programs were reduced on purpose and the teaching units were simplified, so that students could devote more time to practical research, and confirm the research at a theoretical and scientific level.

VISUAL COMMUNICATIONS AND *VISUAL RESEARCH*: INTERPRETATION OF THE CONCEPT OF SYNTHESIZED AND MULTIDISCIPLINARY RESEARCH

The courses – *Visual Communications* and *Visual Research* represented a specific educational platform through which the students acquainted themselves with the area of

architectural drawing, technical modalities of the creation of architectural drawings, and also with its research settings that allow you to experience "space as a form of visual communication" (Anonim, 1971: 57). Although the courses had separate curricula, they aimed towards the same continuous unity, which was studied throughout the entire first study cycle (except in the third trimester). Therefore, there will not be any rigid demarcation between the concepts of *Visual Communications* and *Visual Research* in this paper, and the framework of teaching programs shall be considered as a single database which produced a thesis on architectural drawing as a process of visual research on the representations of space (Lefebvre, 1991).

Interpretation of the role of architectural drawing in the context of visual communications concept

This part of the research is focused on the interpretation and analysis of the role of architectural drawings in the context of the concept of visual communications, with the aim of its determination within Lefebvre's interpretation of the representations of space. Moreover, when it comes to architectural drawing, the analyses in this paper are mostly based on Đorđe Petrović's standpoints, which are presented in his work *Visual Communications* (1972b).

It has already been stated that in the period of the *New School* architectural drawing was not perceived only as a technical means of project representation, but also as a way of exploring the visual characteristics of a given space. However, apart from this innovation, which was specific for the period of reformed teaching, it should be emphasized that in the process of studying architectural drawing, full attention was paid to the analysis of the position of drawing in a broader social context. Visual communications were aimed at directing students to understand etymological and semiotic values of architectural drawings. Although this subject matter directly bordered with certain philosophical discourse, which certainly was in accordance with the *New School* concept and its humanistic profile, it was an inevitable part of the educational process based on which a correlation between an architectural drawing, as a communication gesture, and the environment was established. In order to understand the share and importance of visual communications and graphic representations in the context of the living environment, it is necessary to recognize its instruments. This is where the importance of visual communications, which are a direct product of the human heterogeneous environment, comes to the fore. Petrović defines them as follows:

> [Visual communications] include broad areas of human communication and mass visual culture in mutual indivisibility, overlapping and combining images, signs, symbols and letters. It is the totality of our visual environment or set of all urban and natural forms or objects, three-dimensional, two-dimensional, multi-colored or monochrome, static, dynamic or kinetic in different levels of existential space of human environment, that is, its mass media. (Petrović, 1972b: 7)

The complex notion of human environment is implied from this interpretation of visual communications, which leaves space for a multi-layered understanding of space as a complex system of visual communications. This point of view, in a certain way, coincides with Lefebvre's thesis on (social) space as a product of more diverse social factors, or practices. This is even further confirmed in the context of the space of visual communications, because it serves as a tool of thought and of action, which are unique products of social space (Lefebvre, 1991: 26). Moreover, the *space of visual communications*, as a specific synthesis of cognitive processes, can have its *abstract* frames, having in mind that, as Lefebvre points out, "epistemological thought constructs an abstract space" (Lefebvre, 1991: 24).

By observing architectural drawing, and drawing in general, as an inseparable part of every great civilization, and its changes in different epochs, as well as its adaptations to technological and cultural frameworks, Petrović comes to his modern position that is integrated into the overall system of visual communications. "The role of visual communications in architecture in only one part has a task to, besides the other things, develop aesthetic sense in the scientific field of chorography, that is, to study and analyze the representations of spatial ideas, in addition to codified projection systems and architectural signs, symbols and letters" (Petrović, 1972b: 8). Herein, Petrović uses the term *chorography*, which is in some ways similar to the process of creating a drawing, and in general it is the representation of space at one level. This process Petrović interprets as "the phenomenon of optical and physiological perception of space, so the thoughtfulness of the forms that arise in the imagination of the builder are reflected. It is preceded by the study and analysis, and it is the relation [of architects, builders] towards a program, form organization, set and space or the human environment and more narrow environment" (Petrović, 1972b: 15). The importance of integrated observation of the process of creating architectural drawing in the context of visual communications has its own advantages in terms of developing creative abilities, including sensory sensitivity, the ability of abstraction, synthesis and transformation, the originality of individual expression and the ability to coherently organize experience based on interaction. A complex understanding of architectural drawing, and, most importantly, its determination as a means of the representation of space, can be seen in Petrović's extensive, explanation:

> [Architectural drawing] represents (...) Architectural drawing is built in a planimetric manner and it has material meaning (...) Architectural drawing is symbolic, it speaks, it is architectural handwriting. It is the first visual experiment of a builder, indivisible from the personality and measurable. It is always volumetrically dimensional. It is continuously present in research, studying, organization and realization [production] of architectural space. Architectural drawing is primarily utilitarian and constructed (...) Architectural drawing also has a *research character* because its purpose and intent are strictly determined. (...) it must represent a conceived form in reality, true to scale, precisely. (...) architectural drawing permeates even technical or scientific related areas. As a rule, it is modified according to the established canons, current symbols, it expresses the style of the epoch, and it can never be irregular. This drawing provides architecture with a primary feature to *present*, represent and document or make schemes, to displays it graphically. (Petrović, 1972b: 16-17)

These exposed viewpoints directly indicate the representative power of a drawing, which opens the way for the critical analysis of space, which it *represents*, or *produces*. "We may be sure that representations of space have a practical impact, that they intervene in and modify spatial *textures* which are informed by effective knowledge and ideology. Representations of space must therefore have a substantial role and a specific influence in the production of space" (Lefebvre, 1991: 42). Therefore, the whole process of visual research involves not only its visual patterns, but a wide range of theoretical aspects that are generated by such visual expression.

The drawings of the London group *Archigram* definitely represent one form of such visual experience, whose representative character by far surpassed their hypothetical, spatial context. Their projects 'the Plug in City' and 'the Walking City' are some of the most important and the most publicized conceptual projects from that period, and as such represent a powerful means of representation of social space (Figure 3 and 4). For Arhigram "the drawing was never intended to be a window through which the world of tomorrow could be viewed" (Webb, 1999: 1), nor the future of architecture, but just a way of "injecting noise into the system" (Frempton, 2004: 280). For them, the architectural drawing was more than a completed building because it was a unique way of propaganda (Greene, 1999: 3).

This is exactly why these tendencies and can be viewed through the drawings of Utopian projects from the sixties and the seventies, which were subversively oriented towards post-war modernist practice. Such examples are the projects of *The Situationist International* and the French group *Utopie*, Italian *Superstudio*, then Buckminster Fuller, as well as the modular projects of Japanese *the Metabolists*.

Architectural drawing in the context of visual research and its analogy with present practices

In this segment of the paper, architectural drawing as a result of the process of visual exploration is analyzed. The main objective is to establish critical analogies with the practices of that period, which were, as already indicated, based on the drawings of Utopian visions. It is important to emphasize that the *Visual Research* and *Visual Communications* courses

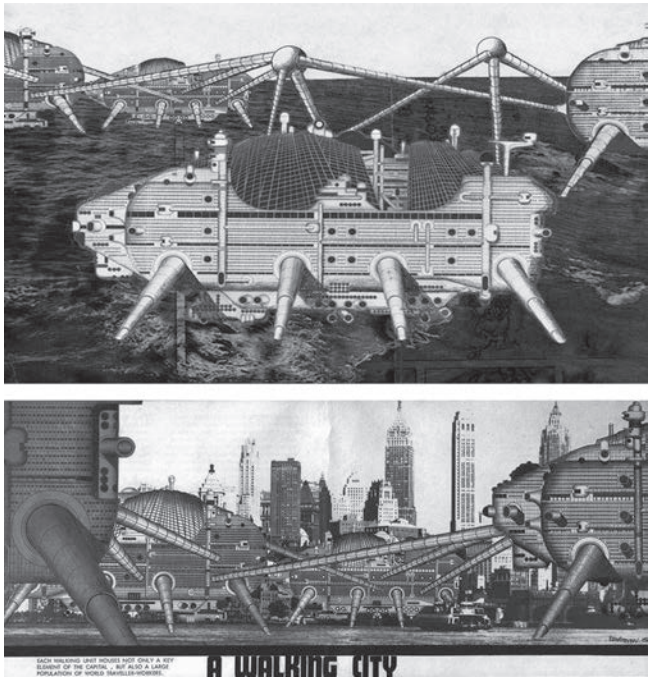

Figure 3. Walking City; Ron Herron (Archigram), 1964-70 (Source: pinterest.com)

did not generate drawings that might be aesthetically and visually expressive like the works of *Archigram* or graphically detailed like the drawings of *Metabolists* for the projects of certain megastructures. Two aspects that had influence could be identified. The first relates to the fact that the courses belonged to the field of architectural drawing, and therefore there were no thematic units that would imply a detailed breakdown of a certain design brief; the other aspect has already been mentioned, and it is reflected in the conscious reduction of tasks, with the aim of enabling detailed analysis of the solutions reached and research into as many experimental variations as possible. However, regardless of the primarily visual and formal distinction, in this segment of the paper aims to examine the thesis of conceptual and theoretical analogy between the program base for the *Visual research* course and the already mentioned Utopian practices of that period. The basic standpoints are based on the theoretical and experimental

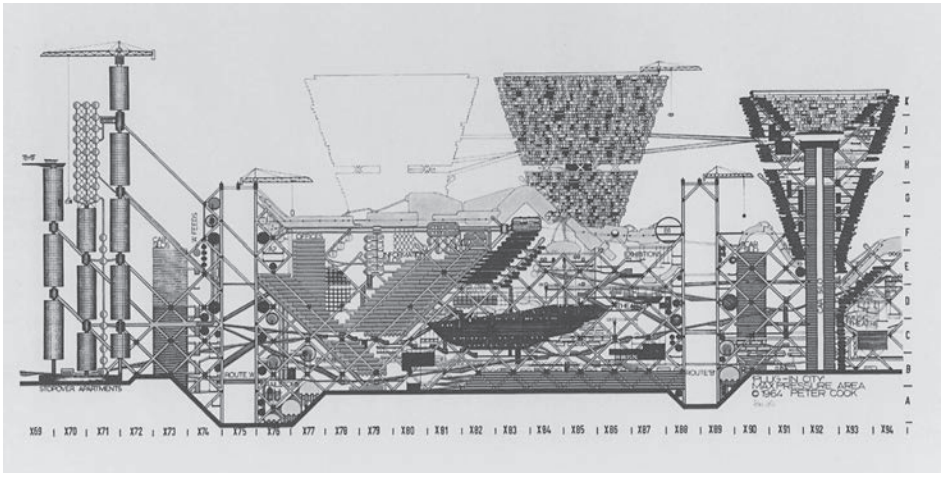

Figure 4. Plug in City; Peter Cook (Archigram), 1964 (Source: pinterest.com)

assumptions that Đorđe Petrović introduced in his book *Visual Exploration of Human Environment and Urban Design* (1972a), which was also the course textbook. In order to emphasize the importance of visual research in the then reformed environment, in the introductory part of the publication, in the text under the heading *The Explanation to Students of the New School*, Petrović stated the following:

> In the broad field of visual communications, processes and research methods are observed in various aspects and their interaction with the superiority of intellectual approach. VISUAL RESEARCH is the flow of activities accessible to contemporary study, suitable to achieve connections with different optical structures that support the development of creative abilities in the organization of the visual experience and originality of individual expression. Three-dimensional visual experience allows, among other things, the very idea of a form of environment, analysis, organization or synthesis of the level of architectural space and its interaction (Petrović, 1972a: 6).

In this brief explanation, not only is the concept of the Course perceived, but also the principles of the *New School* structuring, which were, as previously seen, based on a multidisciplinary approach to research, and the relationship between a man and the environment. It is the *man – environment* determinant that was crucial in the formulation of the program for the *Visual Research* course. The entire teaching program was based on the visual research of polyhedral cell systems, which Petrović defines as a "more complex and more intellectual type of spatial order" (ibid.: 35). Choosing the basic construction unit – a polyhedron, and with its modular multiplication, complex spatial compositions were the result. This approach in the research was very suitable for creating architectural forms, which could, but did not necessarily have to, make an associative connection with the real architectural space. The potential of the process can be observed in the fact that these "forms of research are in constant confrontation of imagination and technical and structural characteristics of the system. (...) Such visual experiments reveal new, up to that point unforeseeable possibilities of different ways of combining and arranging basic system cells into individual groups" (ibid.: 37).

Petrović partly found the grounds for his views on the cell system and its continuous change in time, as well as the potential in the process of urban development, in Richard Thomas' work, presented in the publication *Three-Dimensional Design: A Cellular Approach*. By analyzing these cognitions in the context of current technologies, Petrović stated the following:

> The significance of a cell in the environment system appears as the cell design principle and construction in developed areas of the world and penetrates into everyday use in big cities, or it will happen in the near future for the following reasons: the development of information, rational construction techniques, use of materials, city design, computers, etc. It seems that, according to Thomas, preliminary research favors the idea of four-dimensional urban clusters that are planned to expand in three dimensions, and they change in time – the fourth dimension. (Petrović, 1972a: 36).

Clusters, as defined by Thomas, are nothing but modules, representing main potential of variability in cell systems. The variability of these structures and their various alternative solutions are the benefits that can be inhibited through the drawing itself and used in a creative process. Đorđe Petrović completed his knowledge of cell systems with Lawrence Anderson's thesis, presenting them in his article *Anderson's Theory of Modular Approach*. In this article, Petrović pointed out that "these new elements [modules], although pre-planned, allow full flexibility of future forms. All previous considerations point to some basic principles for the creation of new modular approaches, not only in building design, but also in designing human environment" (Petrović, 1971: 49). Stressing the importance of modularity mentioned by Anderson, Petrović underlines its importance "as a means of visual discipline for the organization of industrial processes and for giving space certain features that would be retained under new conditions. Thus the idea of the module becomes alive again and the focus is on the fact that it allows for growth and changes" (ibid.: 49).

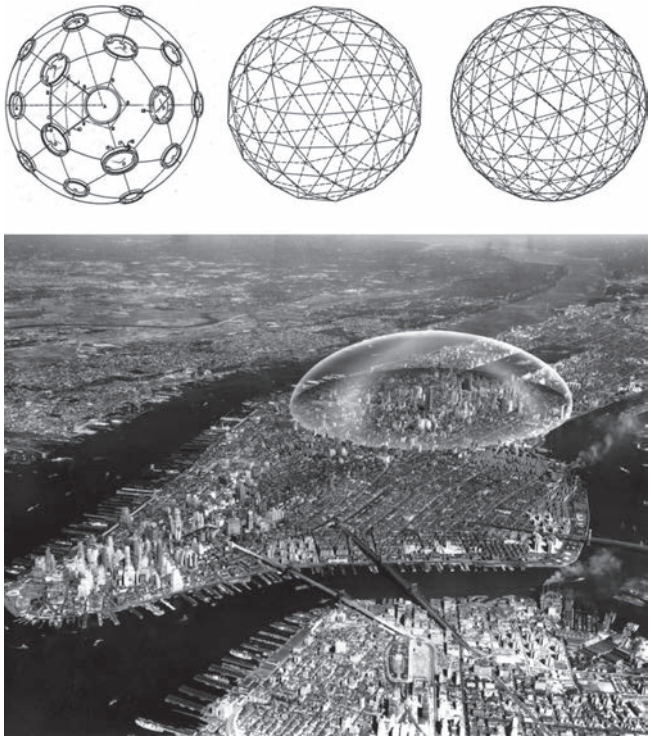

Figure 5. Pneumatic dome over Manhattan; Buckminster Fuller, 1967 (Source: pinterest.com)

It is clear that in the modular setting a drawing is recognized as a way of exploring the visual attributes of the human environment. If we go back to Lefebvre's space manufacturing, it is certain that we can make a symbolic parallel with his thesis on the representations of space that are alive and volatile (Lefebvre, 1991: 42), which is a unique feature of the modular principle in the process of space design. Also, it can be seen that this method of structuring space can be directly compared with the Utopian visions of Archigram, as well as the projects of Metabolists or Buckminster Fuller. Their projects are urban mega-structures that essentially have one compositional cell multiplied according to the modular system. One of Fuller's most important utopian

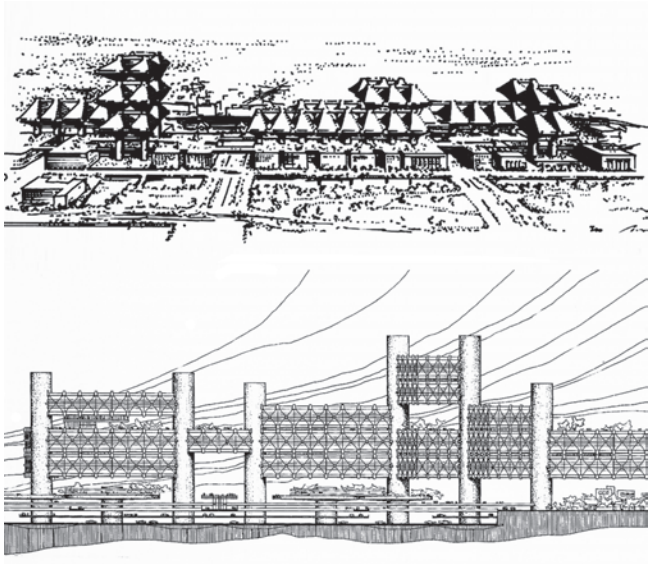

Figure 6. Clusters in the Air; Arata Isozaki, 1964 (Source: pinterest.com)

projects is the 'Pneumatic dome over Manhattan', and it was just conceived as a huge structural dome that should ecologically protect the center of New York (Figure 5). On the other hand, Japanese architects Metabolists, faced with the problem of overpopulation and guided by the desire to create an authentic national identity since theirs had been compromised by the destruction of the Second World War, designed the project 'plug-in' mega-structures, which are in terms of their concept close to the projects of Archigram (Ross, 1978: 55). Characterized by its variability, Japanese mega-structures secured that much needed "flexibility of the new society" (Lin, 2010: 92). Although some of the projects by Metabolists were implemented, most of them remained at the level of Utopian drawings and models, and one of the most authentic is certainly Arata Isozaki's project 'Clusters in the Air' (Figure 6). Accordingly, there is a clear parallel between these practices and the structured compositions in *Visual Research* course because such forms, which are essentially reduced and abstract, were the basis for the creative and visual research of space through architectural drawings, according to Petrović (1972c: 7).

However, in terms of the representations of space, drawings that are done in the course do not have a precisely determined profile, although they are designed with a tendency to form *alive* and *variable* structures. For further understanding of this viewpoint, Lefebvre's thesis relating to the critical analysis of space through its *formants* can be helpful, where, among other things, we recognize *visual formant*, which assumes that "space has no social existence independently of an intense, aggressive and repressive visualization" (Lefebvre, 1991: 286). Although representations of space have a very important role in the production of space, in case of drawings created in *Visual Research* course – this epilogue is missing, because they are not generated by direct ideological and repressive context. However, it can be concluded that these drawings could ultimately establish a correlation with mental space, keeping in mind that Petrović's theoretical assumptions are compatible with the ideas of the representations of social space that can be observed in the drawings of the above mentioned Utopian projects. Finally, we should not forget the fact that the drawings in the *Visual Research* course were created for the visual review of architectural sets, which were primarily of research character (Figure 7). In such a constellation, the aesthetic and form purity of a drawing and its reduction to the immanent features of space become understandable (Figure 8).

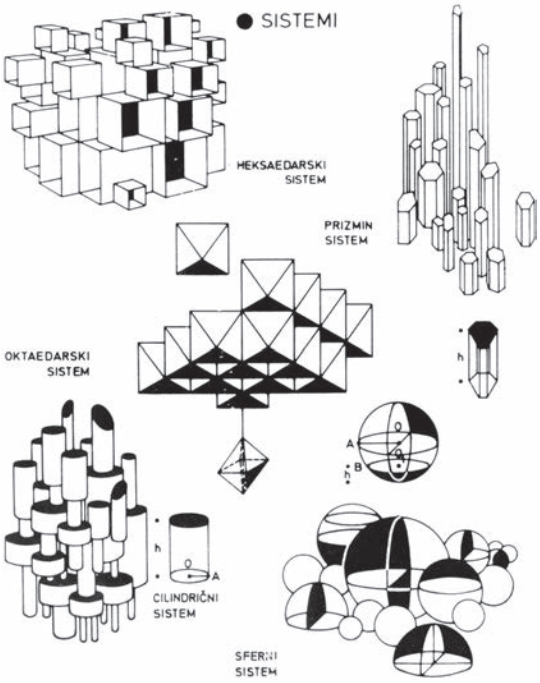

Figure 7. Concept of polyhedral cellular systems; Đorđe Petrović, 1972 (Source: Đorđe Petrović, 1972)

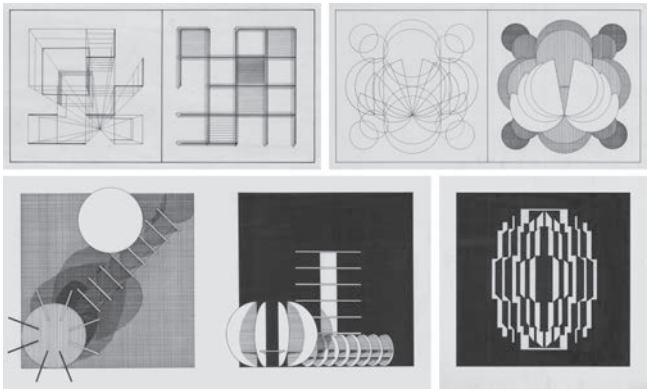

Figure 8. Visual research of spaces; students' works, 1972 (Source: Office for Visual Communication Archives, UBAF)

FINAL REMARKS AND CONCLUSION

The concept of the *New School* was applied until 1973, after which this educational platform was abandoned (including the 1972/73 academic year). "Being too liberal for the state education system and the social-political situation, this study concept did not survive the test of time" (Savić, 2006: 16). The same fate befell *Visual research* and *Visual Communications*. Also, in the same period, before the end of 1974, Đorđe Petrović left the Faculty and went to Canada, where he continued with his theoretical and artistic work.

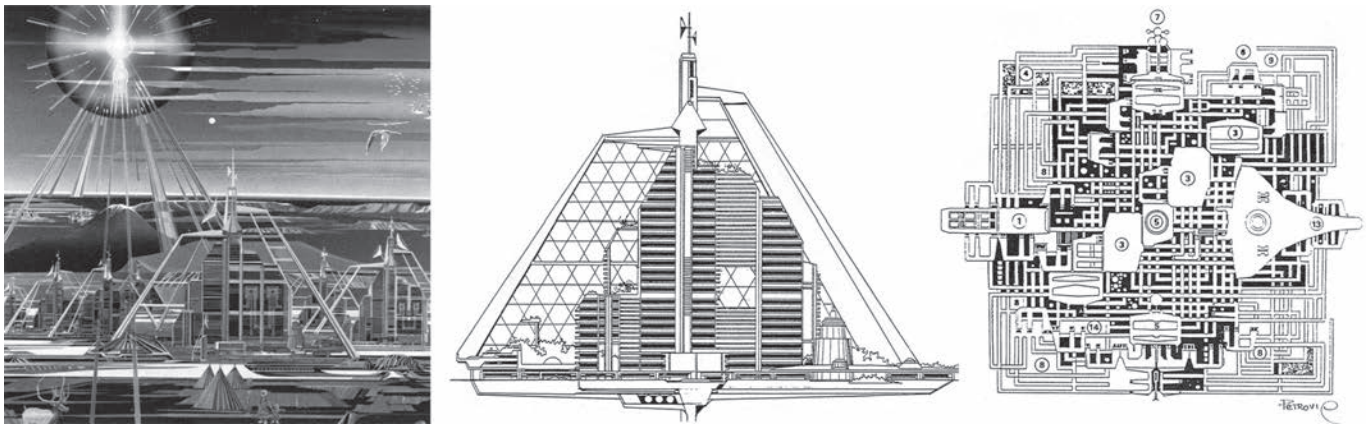

Figure 9. Nordopolis I; Đorđe Petrović, 1986
(Source: Private collection of the Petrović family)

During the eighties, he was focused on the conceptual design of futuristic cities – *Nord 2002*[5], in the inaccessible vastness of the Canadian north (Figure 9 and 10), and he also devoted himself to drawing and painting futuristic cosmic environments. This unique futuristic architecture, as a radical shift of Petrović's practice, but also a kind of analogy with his earlier theoretical work, represents a significant thematic framework for further research.

Although the *New School* period lasted for a very short time, for just three years, a number of structural changes were introduced in this period within the teaching program of architectural drawing. Drawing was not regarded only as a technical means for plan representation, but it became an integral part of the research process in the field of architectural creation. It can be concluded that the result of such tendencies was the overall social context, which incorporated advanced technologies in the field of architecture and the increasing use of modular elements, as well as a modern educational concept, involving the multidisciplinary character of lectures focused on the relationship between architecture and the environment. In this environment, drawing became a powerful tool for the representations of space, which could have its own social reflections. The Utopian and futuristic projects of that period indicated that architectural drawing can have a special role in the process of the representation of social space. This standpoint is primarily important due to the formation of a modern theoretical platform focused on architectural drawing and the visual representation of the practice of architectural creativity.

Today, in the era of digital communications and mass media, the standpoint which determines a drawing as "an end in itself, as a fully realized, self-sufficient work of architecture" prevails (Kipnis, 2001: 12). In this context, it is completely "clear that the road to high quality architectural practice leads through critical alternatives, debates, research and theoretical consideration, that is, through diverse and non-manipulative discourse in all areas of architectural operations" (Blagojević, 2009: 18). Architectural drawing has certainly become inevitable discourse within the representations of theoretical and practical work in the field of architecture.

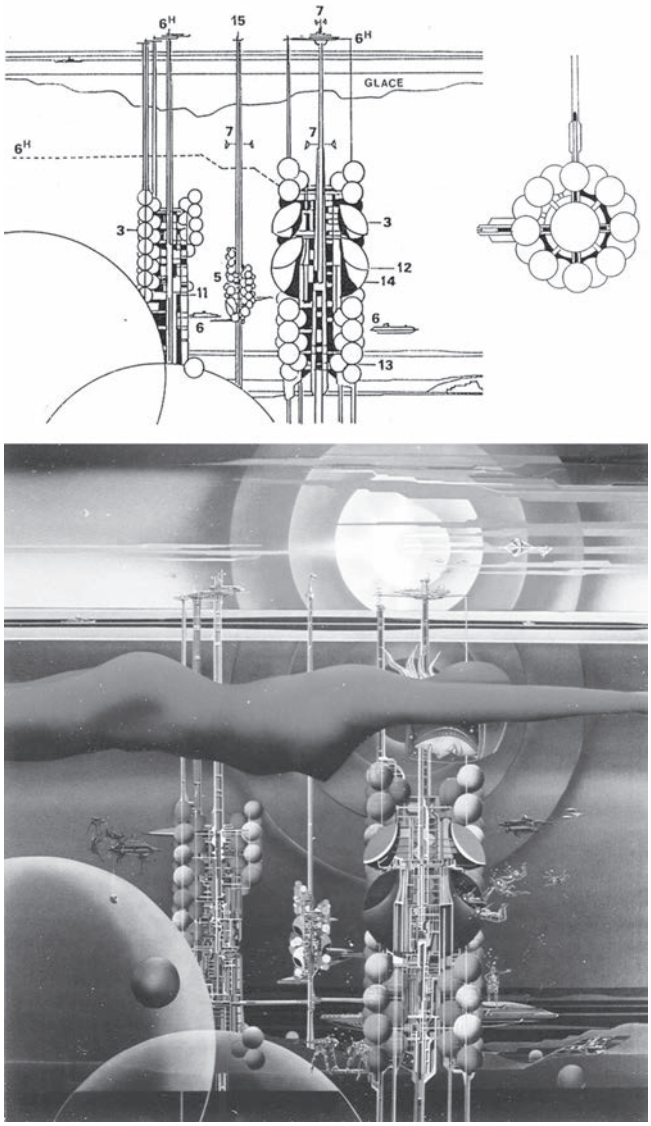

Figure 10. Sub-Marinopolis; Đorđe Petrović, 1986
(Source: Private collection of the Petrović family)

[5] Conceptual project *Nord 2002* included 12 models of micro-habitats: *Nordopolis I, Nordopolis II, Igloopolis, Hydrogenopolis, Oceanopolis, Sub-Marinopolis, Arcticopolis, Cosmic Base of CSA (Canadian Space Agency), Trening center of CSA, Atlanticopolis, Inuitopolis, Cosmopolis.*

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REGIONAL FACTOR OF SUSTAINABLE DEVELOPMENT OF RURAL SETTLEMENTS OF KALNA AND MINIĆEVO AT THE FOOT OF THE STARA PLANINA MOUNTAIN

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Developmental potential of rural settlements of Kalna and Minićevo should be reviewed in the wider context of the area in which they are located. The natural resources of Stara Planina mountain, as a special purpose area focused on tourism and agriculture, represent the basic components for sustainable development of the mentioned settlements. The heritage of autochthonus, traditional rural architecture and sacral buildings, together with natural resources potentials, represent attractors for the development of a specific form of rural tourism. This research paper presents an analysis of the options for the development of rural tourism in the territory of Knjaževac municipality, aimed at sustainable development of rural settlements of Kalna and Minićevo. The basic idea of the paper is for Kalna and Minićevo to become the centres towards which the population of smaller surrounding villages will gravitate: towards Kalna as a potential tourism centre and towards Minićevo as a transit tourist settlement with accompanying public and other services. The purpose of the paper is not to offer a solution that would completely eliminate economic and demographic changes, but to review different options for the development of rural settlements that could keep up with modern social needs.

***Key words*: rural settlements, Stara Planina mountain, rural tourism, sustainable development.**

INTRODUCTION

The rural settlements of Kalna and Minićevo, in Knjaževac municipality in Timok region, are situated in the territory of the "Stara Planina mountain" Nature Park and tourism region which is suitable for tourist activities from the aspect of developmental possibilities. In this sense, the Stara Planina mountain presents a regional factor of their sustainable development. The settlement selection criterion is based on the geographical position of the aforementioned settlements, but also on the fact that they used to be municipal centres.

The research has included two settlements different in the time they emerged, their functions and positions as they, considering their character, generate different possibilities for the rural tourism development. Minićevo, located in the lower part of Stara Planina mountain, and Kalna, located in the higher part of the mountain, are two diametrically opposite settlements which have different possibilities for development regarding their natural resources and cultural and historical values.

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The decrease of agriculturally active population in the territory of Stara Planina mountain requires drafting of new development strategies which could have a positive impact on the economic structure of households in this area. Tourism as an engine of development in the context of modern society can improve the social and economic position of the local population. Stara Planina mountain has specific developmental capacities from the natural and cultural point of view, which can certainly be used for the purposes of a potential tourism offer (Milijić *et al.*, 2009).

The development of tourism in this sense would contribute to a more comprehensive integration of rural settlements in contemporary social trends. This, naturally, relates to the settlements which have appropriate capacities. However, it should be kept in mind that the majority of settlements in this area consist of households populated with old individuals, as well as that many of them have less than 100 inhabitants (Mitrović, 2015).

Tourism in rural areas implies a whole set of activities, services and facilities provided by the local community and population, with the purpose of creating additional income sources. In line with this, capacities and options for

rural tourism activities are defined by natural, cultural and anthropogenic factors. Depending on these, rural tourism can focus on the development of nature-based activities such as hunting, fishing, mountain climbing etc., or on the development of rural tourism aimed at familiarizing tourists with village life.

This paper analyses the possibilities for the rural tourism development aimed at sustainable development of rural settlements and creation of secondary centres, using the example of settlements Kalna and Minićevo which belong to the territory of Knjaževac municipality. Having in mind that the aforementioned settlements structurally belong to the category of small rural towns, the existence of appropriate infrastructure favours the option of transforming them into economic and administrative centres of surrounding villages.

The contribution of this research paper is defined by the improvement of the existing sustainable development strategies which recognize rural tourism primarily as one of the tools for revitalization and development of rural settlements. The settlements concerned are viewed in this paper as a part of the wider area of Stara Planina mountain which, owing to its natural resources potentials, as a regional resource, can be used from the aspect of development of rural settlements in its territory.

Our research is based on the assertion that sustainable development of rural settlements in Stara Planina mountain can be attained through mutual integration of several settlements on a functional basis, which in turn can enable their coordinated development. Rural tourism development in that sense is used as a starting point, with the idea of integrating a tourist offer, easier entry on the market, and integrating new functions in the settlements.

If we consider the basic determinants of sustainable rural tourism development, the settlements of Kalna and Minićevo have acceptable capacities from the aspect of natural values. The existence of municipal infrastructure is one of the basic parameters, since it enables the rehabilitation or construction of facilities that could satisfy specific contemporary lifestyle needs.

Essentially, the task of this research paper is to indicate the possibility of linking several rural settlements in the goal of common tourist activities. The basic idea of the paper is for Kalna and Minićevo to become the centres towards which the population of smaller surrounding villages will gravitate, which would provide an easier entry in the tourism market and placement of the values of natural, traditional and cultural heritage of this area (Figure 1).

This paper is not aimed at promoting sustainable development at all costs, in case that there are no objective capacities for it. Sustainable development of settlements of Kalna and Minićevo is primarily aimed at rural tourism development aligned with the capacities of individual households, as well as the existing natural, cultural and historical values of the immediate surroundings.

The demographic trends in Knjaževac municipality are characterized by negative birth rate, ranging from 10 ‰ to 15.5 ‰ (Mitrović, 2015). We should also note the distinct trend of migration to larger centres which has a negative impact on the age structure of settlements (Devedžić and Stojilković-Gnjatović, 2015)(Table 1).

Table 1. Number and percentage of population aged 65 and more in the total population according to the 2011 Census

Region	In total	65 years and over	%
South and East Serbia	1563916	303006	19.37

Source: Devedžić and Stojilković-Gnjatović, 2015

A large number of settlements in Knjaževac municipality are in the phase of demographic decline. Knjaževac municipality belongs to those Serbian municipalities which contain the highest number of settlements with the population of 100 or less (Mitrović, 2015). Out of the total of 85 settlements, only one is classified as urban, and 52.1% of population lives there. As far as the rest of municipal population is concerned, 34.4% live in the settlements located in lower hills, and 9.5% in higher mountains (Sibinović and Martinović, 2010).

This research aims to connect Stara Planina mountain villages within the framework of rural tourism activities

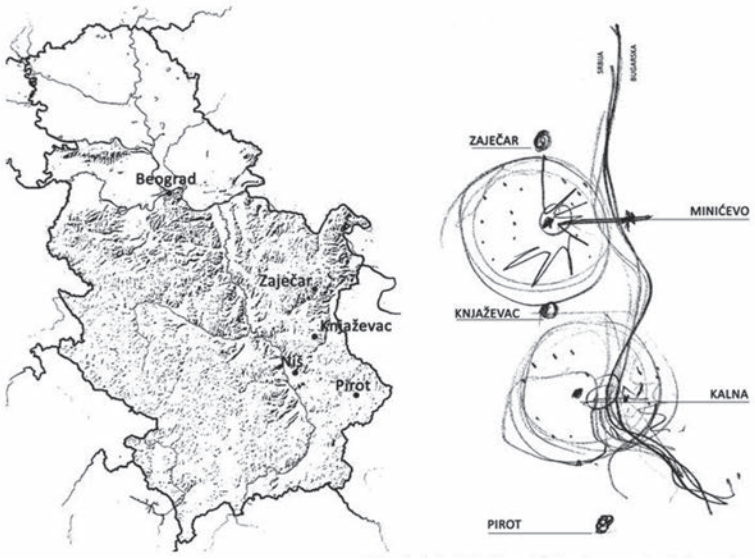

Figure 1. Minićevo and Kalna as gravitation centres
(Source: http://www.kartasrbije.net/karta%20srbije.html; proccesed by authors)

with the trend of further development. The purpose of the paper is not to offer a final solution which should be followed and which would direct the development of all settlements in the area. The basic idea relates to the establishment of a network of those rural settlements which (economically speaking) have authentic natural, cultural and historical potential for sustainable tourism development.

RURAL ECONOMY DIVERSIFICATION: TOURISM AS A FORM OF SUSTAINABLE DEVELOPMENT

In this research paper, the diversification of rural economy is formulated from the aspect of tourism development as a form of sustainable development. Agriculture no longer presents a sustainable economic activity, and the size of active agricultural population in the territory of Knjaževac municipality keeps declining every year, which creates a need for discovering new sustainable development models (Table 2). In this context, we should strive to an integrated tourism and agricultural development to enable the retention of active population in these areas. The introduction of new tourism-related activities could, to a certain extent, preserve the agricultural production. Such a practice would simultaneously engender the introduction of new facilities in the villages, with the aim of improving the living conditions of local population.

The development of new activities in rural areas can contribute to the specific increase in income of the local population. Such practice can redefine existing relations, introducing new models in terms of rural development (Knickel *et al*., 2009).

Sustainable development largely depends on the position of Kalna and Minićevo settlements, but also on immediate vicinity of Stara Planina mountain centre of tourism. Their integration into the tourism offer of the Stara Planina mountain centre can contribute to the improvement of organic farming, primarily in terms of the direct placement of agricultural products to tourists. In this context, the position and degree of infrastructural development of these settlements also implies the existence of certain organizational and technical conditions of the tourism offer of the settlements themselves.

Tourism development is accompanied by general social development, which causes the social, economic and cultural relationships to have a considerable impact on the direction of its development. Sustainable tourism development in Serbia remains in its initial phase, where its legal framework is being harmonized with EU legislation (Orlović-Lovren *et al.*, 2013). However, such practice does not reflect the real situation (Maksin *et al.*, 2011).

The baseline of sustainable development is provided in Agenda 21 of the UN Charter which generally relates to environmental protection. The Charter is the cornerstone of all European sustainable development strategies. According to this document, economic and social sustainability are the most important segments of sustainable development.

Economic sustainability implies the ensuring of economic baseline at all social strata. Social sustainability, on the other hand, apart from respecting fundamental human rights, also relates to inclusiveness aimed at poverty reduction, i.e. as a support to social and territorial cohesion and increased employment opportunities.

In this context, the strategic development of rural settlements gains specific importance. Ensuring social and economic living conditions in rural settlements, besides its impact on improvement and development of potentials for tourism, can also influence the resolving of the issue of the natural and cultural heritage protection, which is in line with the 2007 Agenda for a Sustainable and Competitive European Tourism, ASCET.

Knjaževac municipality falls into the category of municipalities with the lowest average income in the Republic of Serbia. This average is even below the one for the region of Eastern and Southern Serbia. (Table 3) The high poverty rate in Stara Planina mountain villages goes in favour of the aforementioned claims on the necessity for inclusion of settlements from this area in the contemporary development flows.

The tourism development can contribute to ensuring a relative financial security (Đorđević-Milošević and Milovanović, 2012). The area of Knjaževac municipality can be used in this sense, primarily because it has different options for the development of mountain, natural and rural tourism. Analysed from the aspect of new tourism trends, stationary stay of guests in a single location is no longer dominant. Accordingly, the development of rural tourism in villages gained importance over the last few years.

Table 2. Total agricultural population in the regions of East and South Serbia, 2002-2011

Year Census	Settlement type	Total population	Total agricultural population	Active agricultural population	Percentage of agricultural population in total population (%)
2002	Total	1965611	222288	151488	11,31
	Urban	927697	8414	4292	0.91
	Other	1037914	213874	147196	20.61
2011	Total	1563916	123647	76796	7,91
	Urban	816749	6147	3429	0.75
	Other	747167	117500	73367	15.73

Source: Mitrović, 2015

Table 3. Average income for March 2016 by regions

Region	City of Belgrade	Vojvodina	Šumadija and West Serbia	East and South Serbia	Municipality of Knjaževac
Average income for March of 2016.	79 380	60 566	52 107	54 882	43 423

Source: SORS, 2016

Sustainable rural tourism development has several important criteria that need to be met. Beside natural and cultural factors, human resources and the so-called capital factor are equally important factors in the process of establishing a sustainable rural tourism development.

The capital factor implies a certain level of entrepreneurship, infrastructure, loan accessibility etc., while human resources, on the other hand, primarily relate to the number of inhabitants in the settlements, as well as the level of their technical and other capacities for tourism-related activities. If any of the aforementioned factors are not established, the very concept of sustainability becomes essentially damaged.

The development of Serbian rural areas in the modern society implies contemporary methods by which individual households or whole communities could be revitalized from the aspect of a balanced development of social, economic and spatial factors (Pucar and Josimović, 2010).

In this context, rural tourism could contribute to a balanced relationship between agriculture and other rural activities. Individual rural economy could be initiated as an additional source of income, primarily because this would present a way for individual households for placing their agricultural products.

Of course, rural tourism in Serbia cannot be directly compared to the experiences of other European countries, but Serbia's natural resources potentials could make its tourism offer closer to theirs. This especially relates to the rural settlements in the so-called "priority tourism regions", among which we can certainly highlight the area of Stara Planina mountain (Pucar and Josimović, 2010).

According to the 2011 Master Plan for Sustainable Tourism Development in the Republic of Serbia, the rural tourism development is defined primarily as an economic, social and environmental priority (*Master Plan for Sustainable Tourism Development in the Republic of Serbia,* 2011). The Plan essentially represents a model for diversification of rural economy which can provide financial security to a larger number of households. Accordingly, the number of households largely depends on the tourism offer in the observed area.

Agriculture should not be rejected as an outdated model of rural development. Innovation in terms of entrepreneurial skills in agricultural sector can contribute to the advancement (Ploeg *et al.*, 2000). Rural tourism development in this direction should be used with the aim of improving incentives, for example, organic agriculture.

STARA PLANINA MOUNTAIN AS A SPECIAL PURPOSE AREA

The Republic of Serbia has numerous possibilities and capacities for the development of different types of mountain tourism (Krunić *et al.,* 2010). According to the Spatial Plan of the Republic of Serbia, the high mountain part of Stara Planina mountain is defined as a primary tourist destination with all-year round tourism offer within the zone of tourism cluster of Eastern and Southern Serbia (*Spatial Plan of the Republic of Serbia 2010–2020*). Accordingly, it is a considerable potential which can be used, from the aspect of a specific form of tourism-related activities, by the settlements in this area (*Law on Tourism 2009*).

Stara Planina mountain as a nature park covers parts of territories of municipalities of Dimitrovgrad and Knjaževac, as well as of the cities Pirot and Zaječar, and creates a natural border with The Republic of Bulgaria in the east. The largest number of cadastral municipalities, 39 of them to be more precise, belongs to Knjaževac (*Spatial Plan for the Stara Planina Mountain Nature Park and Tourism Region*, 2008).

High percentage of pastures is typical for the agricultural land in the area of Stara Planina mountain (45.2%). Vineyards and orchards are the most valuable agricultural resources. Mountain areas are characterized by the disappearance of agriculture, where depopulation is named as the primary cause for this phenomenon (*Spatial Plan for the Stara Planina Mountain Nature Park and Tourism Region, 2008*).

The lack of developed services in the majority of Stara Planina mountain settlements is also a result of poor demographic situation, as well as a result of economic, technical and infrastructural underdevelopment of the existing rural settlements. Such a situation results largely in the facilities which are removed from contemporary social standards.

The area of Stara Planina mountain is characterized by wooded areas owned by the State (approximately 57.4%). The Spatial Plan identifies the variety of forest, meadows and endemic communities, the majority of which belong to rare species. This area is managed by PE "Srbijašume" and the Hunting Association of Serbia, i.e. eight hunting clubs. As far as hunting is concerned, the area is considered to be underdeveloped due to a low number of small and big game, but also due to the lack of concern for the protection and preservation of rare and endangered species (*Spatial Plan for the Stara Planina Mountain Nature Park and Tourism Region, 2008*).

Regarding the issue of business activities, the Spatial Plan specifies that the area of Stara Planina mountain has entered the transition process, adapting to the needs of modern market. The economic structure is characterised by the decline of social product and the increase of unemployment rate, which are the most important indicators of the current economic stagnation.

On the other hand, the tourism offer of relevant municipalities is underdeveloped and lacks any functional linkages. The tourism development in this area remains at its initial stage. The accommodation facilities are rare or practically non-existent outside of municipal centres. The existing tourism infrastructure in the territory of Knjaževac municipality is limited to a sports centre with a swimming pool, sports grounds in Rgoška banja, ethno centre in the village of Inovo near Kalna, a hotel with a ski trail at Jabučko Ravnište, and a mountain lodge on the Babin Zub peak.

The most important tourism resources in the area of Stara Planina mountain are its natural resources potentials. Owing to a low number of inhabitants, the specific ecosystems have been well preserved. Nature is disturbed minimally, but due to the accelerated decline of agriculture in this region,

the survival of pastures and meadows has been brought into question, because they are slowly being suffocated by weeds.

The cultural properties located in Knjaževac municipality have been well documented and are protected units; however, as such they are insufficiently visible to the modern society. The tourism potential of this cultural heritage may, in this sense, represent a starting point for future tourism development in this area.

The Stara Planina mountain's potential should be observed as a whole. Partial reviews would lead to negative impact of tourism on the nature and environment (Maksin *et al.,* 2011). This is exactly why the analysis of the options for development of rural settlements in this area was researched through the aspect of tourism development in Stara Planina mountain (Milijić *et al.,* 2009).

RURAL SETTLEMENTS OF KALNA AND MINIĆEVO AS CASE STUDIES

The changes in economic activities, settlement hierarchy and the introduction of new functions are the main characteristics of the transition process. Thus, it is necessary to identify a model for sustainable development of the analysed settlements which could take the role of secondary centres of tourism development in the Stara Planina mountain region.

After reviewing the available capacities for rural tourism development in the framework of this research, Minićevo and Kalna have been defined as logistics centres with the necessary contents of public and other services. By offering technical, infrastructural and administrative support to smaller neighbouring villages, they would take a role of secondary centres in relation to Knjaževac, Zaječar and Pirot as urban settlements.

Kalna is potentially the secondary tourism centre and a place for accessing the high-mountain tourism complex of Jabučko Ravnište – Golema Reka in the territory of Knjaževac municipality. In this context, the rural settlements in the gravitation area of Kalna can be important for the development of organic farming as an essential segment of sustainable rural development.

Minićevo does not have that significant tourism potential, but, on the other hand, its position is suitable for developing transit tourism towards Stara Planina mountain from the direction of Zaječar towards Kadibogaz border crossing, excursion sites in the low mountain parts of Stara Planina mountain and Tupižnica, mainly in summer. For this reason, the development of Minićevo is mainly oriented towards the improvement of production on small and medium-sized farms with the aim to supply the tourism offer of Stara Planina mountain and also to supply other markets.

The rural settlements located in hilly and mountain areas of Stara Planina mountain are attractors for the development of specific forms of tourism. The potentials of smaller settlements generate a functional entity which establishes a common direction for economic development. A coordinated development and joint goals, on the other hand, enable complementary sustainable development of a wider area of Knjaževac municipality.

The relevance of this research has been defined by the transition period which initiates the introduction of new activities aimed at potential economic sustainability of rural settlements in the analysed area. The transition phase defines an ideal framework for the establishment of a specific development model.

The rural settlements with the economic development potential in the form of existing infrastructure and the solutions for use of space, according to this paper would be classified as future tourist villages. The value of their natural and cultural heritage would make them an important part of the wider area of Stara Planina mountain as a tourist attraction (*Spatial Plan of the Republic of Serbia 2010-2020*). The settlements which should be noted in this regard are Potrkanje, Petruša, Ošljane, Jelašnica, Bučje, Ravna, Koželj (gravitating towards Minićevo)and Balta Berilovac, Aldina Reka, Ravno Bučje, Donja Kamenica, Gornja Kamenica (gravitating towards Kalna) (Figure 2).

As far as the protected natural areas in Knjaževac municipality are concerned, we should highlight "Draganište" nature reserve as a representative of alpine spruce community and "Golema reka" as an example of preserved mountain beech forests, protected by law since 1981. When listing natural potential, we should also name springs located mostly in mountain ranges more than 1,600 meters above sea level, which can be attractive as natural phenomena (*Spatial Plan for the Stara Planina Mountain Nature Park and Tourist Region, 2008*).

According to the Spatial Plan for Stara Planina mountain, Knjaževac municipality is characterised by a certain number of unregistered units and individual, traditionally constructed buildings in some settlements, but also by two archaeological sites. This heritage can become a part of a tourism offer.

The Spatial Plan for Stara Planina mountain identifies villages in mountain areas as preserved traditional units and cultural heritage sites. The rural settlements have mostly kept the autochthonous values and applied materials, justifying their role as attractors for the development of specific types of rural tourism (i.e. ethno-villages).

As far as the preservation of traditional rural architectural heritage is concerned, special attention should be paid to villages of Balta Berilovac (Knjaževac), Topli Do and Gostuša (Pirot) which could be important for tourism as ethno-units in the wider area of Stara Planina mountain. The establishment of concept of an ethno-village as a museological form can present this traditional heritage to the modern society.

A presentation of the local community's historical development can be important for understanding the cultural significance of these settlements in the wider context of Stara Planina mountain. Especially when having in mind the fact that there are few ethno-parks in Serbia organized in line with the generally accepted principles that objectively present vernacular architecture (Marić *et al.*, 2010). The expansion of the so-called ethno-villages most often presents a misuse of this concept, degrading the cultural heritage, primarily through the use of inadequate building materials.

Figure 2. Knjaževac tourist map
(Source: http://www.toknjazevac.org.rs/wp-content/uploads/2015/01/Karta-Balta-Berilovac-1.jpg)

On the other hand, the cultural and historical resources located in Knjaževac municipality mostly belong to the heritage of sacral architecture. The most important cultural monuments in the analysed territory include the monasteries of Holly Trinity in Gornja Kamenica (15th century), Church of Our Lady in Donja Kamenica (14th century), and the monastery of Suvodol near Minićevo built in the 13th century. However, we should also mention other important cultural monuments that are not located in the municipality, but in its immediate surroundings, such as the Monastery of St. George in Temska near Pirot, built in the 11th century.

The smaller rural settlements, such as Ravna, have important historical monuments dating back to the Roman period (Figure 4). The diversity of cultural and historical heritage favours this paper's assumption that by uniting several settlements at a functional level, in this case the tourism development, we can achieve a coordinated economic development.

The aforementioned natural and cultural heritage potentials of Stara Planina mountain sites can represent the cornerstone for future tourism development, while giving Kalna and Minićevo the role of recipients. Hence, tourism as a secondary branch of economy can trigger the economic development, which would primarily be reflected in individual agricultural production. In this way, the households would be able to place their agricultural products to tourists who decide to try the local healthy food.

The geographical position of Kalna and Minićevo settlements is such that they are physically located in the midst of many settlements, having the diverse natural, historical and cultural resources. Good road infrastructure additionally contributes to the settlements to become economic and administrative centres (Simonović, 1970).

Minićevo belongs to the category of clustered settlements. According to its spatial and geographical characteristics, it represents an important link between smaller rural settlements and larger centres, such as Knjaževac. The location of the settlement, near the Kadibogaz border

Figure 3. (on the left) Montain lodge in village of Dojkinci, Pirot
(Source: http://www.juznasrbija.info/lat/turizam/na-staroj-planini-kod-dojkinaca-najbolji-planinarski-dom-u-srbiji.html) and
Figure 4. (on the right) Remains of roman baths in Ravna village, Knjaževac
(Source: https://ssl.panoramio.com/photo/50846652)

crossing in Bulgaria, makes it unique from the aspect of road connections to both countries, which can be important in the context of further development and advancement of tourism.

The cross-border link to Bulgaria and the improvement of tourism in this area can contribute to sustainable local rural development. In this context, the Spatial Plan for the Stara Planina Mountain identifies the specific intergovernmental agreements signed between Serbia and Bulgaria as examples of positive practice in the field of economic development and cultural cooperation between the two countries (e.g. "West Stara Planina Mountain" Project).

The rehabilitation of the former army border post and its transformation into a mountain lodge in Dojkinci village near Pirot, funded by the programme for intergovernmental Serbian-Bulgarian cooperation, is another example of the best practice. The lodge is a base intended for nature enthusiasts and encourages the perseverance in efforts aimed at future improvement of alpine tourism in this area (Figure 3).

Until 1965, Minićevo was the centre of municipality, so it occupied a very important economic and administrative position. Its location between two larger urban settlements makes it a potential secondary centre and a hub for numerous smaller villages in Knjaževac municipality. The potential for sustainable development of the settlement is evident precisely in the possibility for strengthening its position as a secondary centre in the network of settlements, which would improve the living standard and the needs of local population considerably.

On the other hand, Kalna has also been a centre of municipality consisting of 14 settlements until 1965. In 1963, uranium was discovered in the village of Grabovnica, near Kalna, and it was considered that this discovery would launch an economic revival of this area. The infrastructure underwent great improvements, and considerable efforts were invested in the construction of public facilities and workers' colonies. The construction of the mine and the adjoining settlement was halted after only two years, which caused demographical movements and migrations mostly towards Knjaževac and Zaječar, as larger centres.

As far as tourist facilities are concerned, a ski-tourist centre was built in 2011 in Kalna, at Jabučko Ravnište to be more precise, and there are plans for its further development in the form of new facilities. The newly built hotel, however, remains an only example, so the relevant development is slow-going.

When compared to Minićevo, Kalna is another extreme. According to the 2011 Census, the population of the settlement was 289 people. This is practically a dying village. However, its good infrastructure and facilities can be used for a potential settlement revival. Its location, between Pirot and a newly constructed winter tourism centre in Stara Planina mountain, can be important for its future position of a secondary tourism centre.

Through exploitation of Stara Planina mountain's natural resources for the purposes of rural tourism, Kalna could become a reception centre for nature and sport enthusiasts, as a kind of alternative to the existing hotels in Jabučko Ravnište. We can conclude that the tourism development in Kalna and Minićevo can partially initiate the economic development of these settlements, but it is not practically possible for it to become the main engine of that economic development. The main development criterion remains defined by human resources, which additionally excludes the practically dying villages from contemporary development possibilities.

Kalna as a potential secondary tourism centre should also have an accommodation capacity to support the accommodation capacity of the Stara Planina mountain resort. It should also have a single information-tourist base (visitor information centre) that would include the rural settlements in the gravitation area of Kalna and certain public and other services that would primarily meet the needs of the local population (e.g. post office, health centre, different commercial contents, etc.). Regardless of its different position and concept of sustainable development as a transit tourism centre, it is necessary for Minićevo to have the same contents, primarily because it is a part of an international transit direction.

CONCLUSION

Sustainable development of rural settlements in mountain areas has a specific spatial and environmental significance. The configuration of the terrain mostly limits developmental options of these areas, and tourism, in this sense, represents an acceptable form aimed at encouraging the development of different economic activities, primarily because it can be adapted to the needs of local population.

The contemporary concept of sustainable development of rural settlements in mountain regions is primarily based on the achievement of an acceptable relationship between the living standard and economic activities of local population. The market for placement of local products can be created if this is taken into consideration. The creation of conditions for rest and relaxation and representation of local natural and cultural heritage remain, to a certain degree, a secondary element (Maksin *et al*., 2011).

In practice, it is impossible to completely stop the depopulation of rural areas. However, the tourism development can improve the social and economic circumstances of individual households. The concept of tourist activities in rural settlements of Kalna and Minićevo is defined in a secondary sense as a support to the existing capacities, e.g. the newly constructed hotel complex at Jabučko Ravnište.

The rural settlements of Kalna, Minićevo and those similar to them, have lost their rural character, making them economically undefined. The loss of their central role has also contributed to an additional reduction in population, not forgetting migrations towards city centres and the negative birth rate trends. In this context, tourism can contribute to the establishment of the economic cohesion of the analysed settlements.

The research advocates the launching of a strategy for the development of rural settlements in mountain regions. Since such settlements belong mostly to the preserved traditional

communities, the features of autochthonous architecture can be an attractive part of the tourism offer. The concept of development of the settlement of Kalna is defined by the immediate vicinity of the tourism centre in Stara Planina mountain, which can contribute to the development of tourism offer of this settlement in the function of a secondary tourism centre. Minićevo, on the other hand, should base its concept of sustainability on a transit and inter-state connectivity with Bulgaria, as a transit tourist settlement, thus providing the possibility to consider the overall potentials of Stara Planina mountain on both sides of the Serbia-Bulgaria border.

In this paper we have reached a conclusion that sustainable tourism development represents a good form of economic revival of the analysed settlements, which will literally change their character by establishing the features of secondary village centres as administrative and economic hubs. This development model, in a certain way, can stop the negative trend of economic stagnation.

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PARTICIPATORY ENGAGEMENT IN URBAN DESIGN PROCESS: THE CASE OF AN URBAN SETTLEMENT IN MALTA

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Public participation in urban design matters goes beyond public consultation, a useful tool which is being reduced to endorsement of documents prepared by bureaucrats in national development planning agencies. Effective engagement of the public at an early design stage is useful for having a socio-economic and environmental sustainable urban design. Based on a case study from Malta, this paper provides insight on how residents are the prime movers of an urban planning issue involving the re-development of the site where their residences are located. Through fieldwork surveys and interviews with the residents, data of the site and the surrounding environs was collected. The design team mapped and interpreted the findings. In light of the results derived and taking cognizance of the concerns of the general public and national developmental and environmental planning policies, an urban design proposal was prepared. The resultant layout was a co-designed solution of the team with the residents in full respect not only of existing socio-economic realities of the community but also of the natural environs, the geophysical context of the site. Furthermore, although more compact than the present, the proposed layout is more environmentally sensitive and socio-economically sustainable.

Key words: **participatory engagement, urban design process, co-design, re-development, Malta.**

INTRODUCTION

Urban settlements are a living laboratory of interface to a varying degree between the built and the unbuilt. Settlements are the resultant of interaction between the socio-economic and the natural environs, a context which offers opportunities and challenges (Alberti *et al.*, 2003). In the past two decades, research relating to the importance of public participation in the planning process, now a foregone consideration in the endorsement of all public planning documents, became more pronounced. It is now widely accepted that resident engagement in urban planning is beneficial to the individual and to the community at large, and to development of a given urban initiative itself (Wood *et al*., 2002; Ohmer, 2008; Gaventa and Barrett, 2012; Wilkie and Michialino, 2014). The locals are the prime movers in planning policies and actions, the ultimate owners of any official adopted planning scheme(s) and/or development planning project(s). Participatory co-production is a guarantee that not only a given document is circulated for public consultation, but that the final document itself is the result of input from all parties concerned. An effective illustration on how this can be developed is through the design of an action plan and/or a masterplan for a given zone. Participatory co-production in the preparation of such documents reflects not only the individual and community needs, but will result in remarkable co-design.

The focus of this paper is the importance of participatory engagement in the urban design processes; public engagement had formed a spatial solution which addresses the environment in its totality. It is based on a case study from Malta, the largest island in the Maltese archipelago. It relates to the redesign of the caravan site at GĦadira, one of the many camping sites on the island, sites which eco-inspired lobbies have been strongly against for over the past two decades. The location of the GĦadira caravan site is on a sloping terrain close to Mellieħa Bay (Figure 1).

In terms of the classification of typology of participation undertaken, proposed by Pretty and Hine (1999), the participatory engagement involved in this study at GĦadira is interactive. Unlike participation through consultation, whereby the engagement of the locals is to derive their opinions on which the design team drafts a proposal which may, or may not, involve same, in participatory engagement locals participate and are the prime movers for the formation and formulation of the resultant urban settlement.

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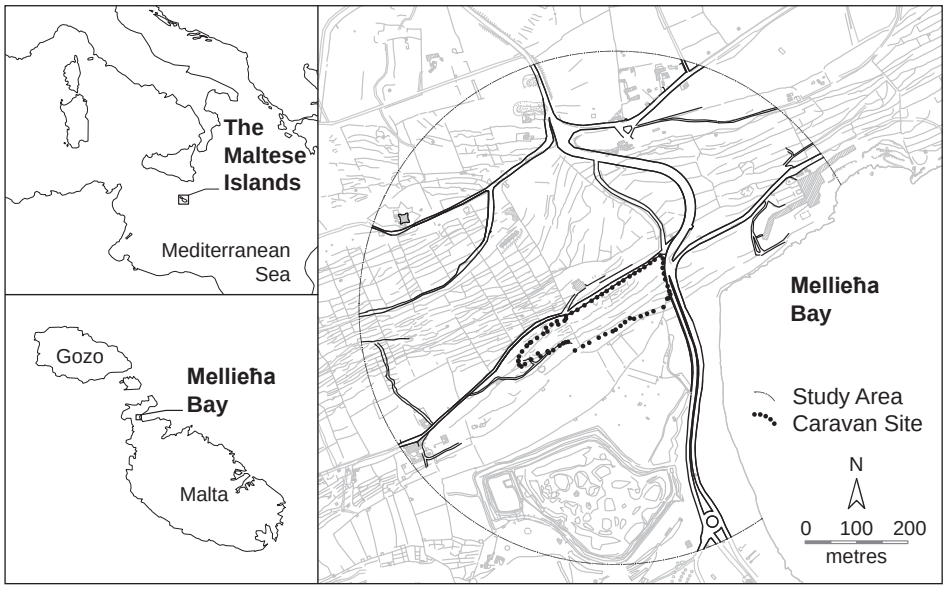

Figure 1: Site location plan

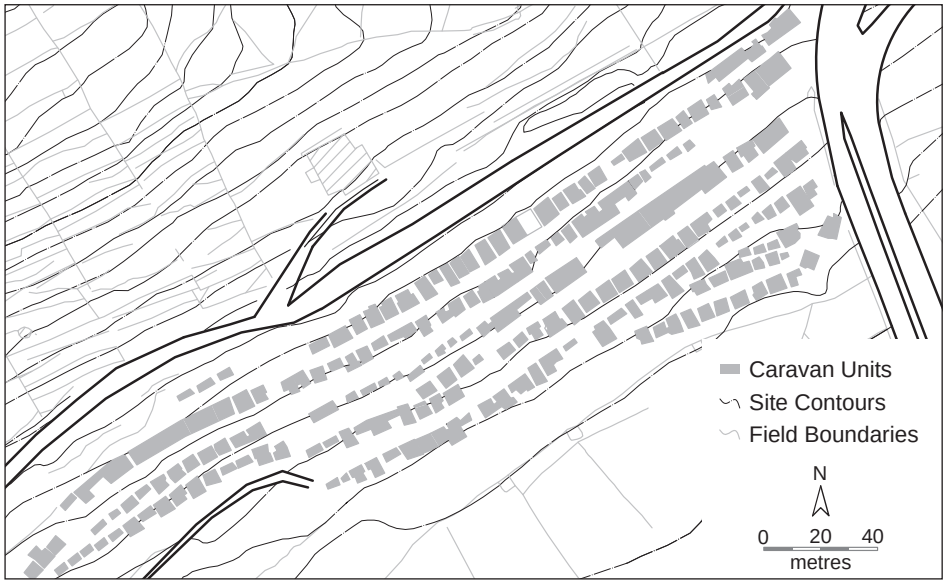

Figure 2: Layout of the caravan site at GĦadira

Given the eco-sensitive location, an appreciation of the study area was deemed imperative: it is outside the development zone with a significant visual impact, it is close to a Foresta 2000 and a Natura 2000 sites to the north and south respectively. Parameters which were identified as crucial for re-developing the site are the existing land uses, geology and pedology, ornithology and ecology, transport and visual impact.

The caravan site is a settlement which was legally established in the later 1970s (Assoċjazzjoni tas-Sidien tal-Caravans u Bangalows, 2008). The originally approved layout was not followed by the caravan owners and, over the years, it had sprawled in a liaise affaire manner (Figure 2), breaching both national development planning and sanitary legislation. From a touring camping site with caravans on wheels, it ended up with some units erected in load-bearing masonry structures. In 2009, the Association of Owners of Caravans at GĦadira resolved to propose a re-design of the existing settlement. It had long been considered essential to develop an artistic impression on how the current site may be redeveloped through an environmentally sensitive design proposal. Fundamental for a sustainable urban design solution was the preparation of a masterplan for the area. The urban design methodology developed, taking full cognisance of the existing socio-economic and geophysical fabrics, it was applied to design a blueprint for the re-development of the settlement. The proposed urban planning layout is the result of designing through consensus, a co-design with the residents in particular and the community at large.

METHODOLOGICAL APPROACH

Objectives

The philosophy adopted for the upgrading of the site aims at integrating the environmental setting with the residents' requirements. It was deemed essential that a balance between the environmental backdrops, community needs and provision of essential public services, sustainability and

security, is formulated. This was attained through a design process which takes into account:

1. the characteristics and constraints arising from the existing physical and ecological environments, thus determining the natural elements present at the site;
2. the establishment of a qualitative social profile of the community living at the caravan site, an exercise which helped identify existing nodes connecting human; and
3. integration of the existing nodes within a proposed urban design layout which connects with the existing natural elements of the site.

Fieldwork

To establish the main natural elements, a quantitative land use analysis of a study area measuring 500 metres radius centred on the caravan site was undertaken (Figure 1). Such an area was deemed sufficient for an environmental impact assessment in Malta, an island measuring 27.4 km in length by 14.5 km in width. Desk studies and ground surveys, both undertaken in August 2009, were limited to this boundary. Ground surveys tend to carry an error in the interpretation and estimation of the superficial area for each land use; however their basis is sufficient for the purpose of this study. Planning policies pertaining to the area and the conservation status of the main cultural and ecological features of the area were identified as part of the integrated setting.

To gain an understanding of the profile of the community at GĦadira caravan site, a qualitative data collection method was applied based on one-to-one interviews with the residents at their respective caravans.[2] The interviews were not just a source of data collection but an inquiry. The residents not only discussed issues at the site, but were encouraged to share possible solutions and actions which needed to be addressed in the proposed design. The sample was the entire community. The interviews were undertaken over the months of July and August 2009, the peak months of the summer season. The design team interviewed circa 85% of the population, a percentage which effectively qualifies as a census.

DESCRIPTION OF THE STUDY AREA

Land Use

Mellieħa Bay is one of the most popular leisure venues and an important tourist landmark in the Maltese Islands, housing a number of kiosks along the coastal road. The area is reached by Triq Marfa, an important thoroughfare, since it leads to Ċirkewwa, and thence to Gozo, the second largest island of the archipelago.

The various land uses within the study area are listed in Table 1 and plotted in Figure 3. Although the main landscape feature is the long sandy beach, the area is predominantly arable, or in its natural state, with only one fifth of the land area being built-up. Developments legally permitted are mainly directly linked to maritime and/or touristic activities, namely the Mellieħa Bay Hotel built in 1976, and the caravan site, the subject of this research, which comprises circa 3% of the study area. Animal husbandry units and farmhouses at the south-west sector reflect the rural nature of the area. Torri Sta Agata, better known as Torri l-Aħmar, is a seventeenth century military outpost about 300 metres north-west of the caravan site.[3]

Table 1: Land uses within the study area

Land Use Type	Area (m^2)[a]	Percentage (%)[b]
Caravan site	19 943	2.9
Beach	33 687	4.9
Bird sanctuary	63 960	9.4
Foresta 2000	58 439	8.6
Agricultural land	129 312	18.9
Afforested area	54 687	8.0
Ecological area	19 753	2.9
Torri l-Aħmar	5 354	0.8
Built-up area	120 982	17.7
Abandoned land	177 301	25.9

a. The percentage error of the observations made during the ground surveys is approximately proportional to the extent of the area under study
b. Percentage was calculated as a fraction of the total study area

Around 42% of the arable land is abandoned, while 13% is afforested, especially the northern sector of the study area. Most of the trees were planted to camouflage the residential units, as windbreakers to fields and to substitute abandoned land. Such trees counteract the soil erosion present and consist largely of Pinus halapensis, Ceratonia siliqua and Acacia sp. These species, except for Acacia sp., are protected as per *Legal Notice 12 of 2001* (Laws of Malta, 2001). To further strengthen this trend and to act as food for migrating and wintering bird species, BirdLife Malta created Foresta 2000 exactly to the north of the Caravan and Bungalow site, with the aim of establishing a woodland consisting exclusively of Mediterranean tree species (Gatt and Role`, 2008).[4]

Geology and Pedology

The geology gives rise to the current landscape with the clay forming a gently rolling landscape, partly cultivated, and now forming part of the Foresta 2000 initiative. Upper Coralline Limestone Formation, the youngest of the Tertiary formations present in the Maltese Islands, outcrops in nearly 75% of the study area (Office of the Prime Minister, 1993). Faults run west-east through the area; outcrops of the Blue Clay Formation are sandwiched between two faults. The members of the Upper Coralline Formation present are Gebel Imbark, Tal-Pitkal and Mtarfa (Pedley *et al*., 1976; Pedley, 1978). The Pitkal Member, a member partly exploited by the quarrying industry for the production of concrete aggregate, outcrops at the location of the existing settlement at GĦadira site. Globigerina Limestone Formation is present along a small stretch on the north-eastern part of the study

[2] A resident cannot own more than one caravan at GĦadira site (Assoċjazzjoni tas-Sidien tal-Caravans u Bangalows, 1981).

[3] This cultural heritage site is managed by Din l-Art Ħelwa, a non-governmental heritage organisation, and is open to the public.

[4] BirdLife Malta engaged Din l-Art Ħelwa and PARC, the afforestation department within the Ministry for Rural Affairs and the Environment, as partners in the initiative with the aim of establishing a nature park at the area stretching to Iċ-Ċumnija.

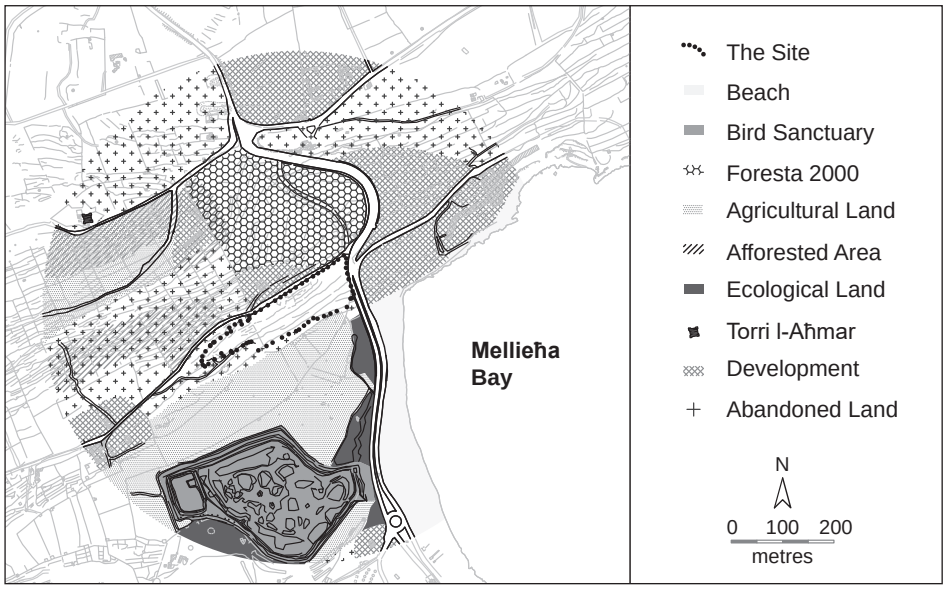

Figure 3: Land use plan

area. Quaternary deposits are recorded in the area currently occupied by the nature reserve.

In arid and semi-arid regions such as the Maltese Islands, soils reflect the geological strata. Lang's classification was used in this study due to its direct correlation to the parent material, topography and anthropogenic interference (Lang, 1960). Upper Coralline Limestone Formation is associated with terra soils, Blue Clay Formation with carbonate raw soils and Globigerina Limestone Formations with xerorendzinas. Thus, at the northern sector of the study area where the Upper Coralline Limestone outcrops, Tax-Xaghra series occurs and the carbonate raw soil San Lawrenz series is present where Blue Clay surfaces. The band of soils where the caravan site is located was originally anthropogenic, mainly comprising of Inglin complex. Anthropogenic disturbance can be identified either by random variations in the surface soil colour, or by non-intimate mixtures below the uniform surface layer. L-Inglin Complex is found along the valley sides with strong terracing and is usually carbonate raw soils mixed with rock flour and terra soils.

Ornithology and Ecology

Declared a bird sanctuary in 1978, the GĦadira wetland comprises about 9% of the total land area. By virtue of *Legal Notice 41 of 2003* (Laws of Malta, 2003), the ornithological and ecological importance of the wetland was highlighted and hunting and trapping in the area surrounding it was banned. The GĦadira wetland is a rare and endangered habitat in Malta and is an important stop-off point for migrating birds. It is classified as a Special Area of Conservation of International Importance.

Along the coast and bounding the bird sanctuary is a strip of Arundo donax as part of the GĦadira sand dune, an area of ecological significance. Both the bird sanctuary and the sand dunes are scheduled as Sites of Ecological Importance Level 1 and a RAMSAR Site – Wetland of International Importance and a Special Area of Conservation. The rest of the bird sanctuary and the sandy beach are scheduled as an Area of Ecological Importance Level 3 and Level 4 respectively. A general presumption against development prevails in Areas of Ecological Importance (Planning Services Division, 1990). Given that the bird sanctuary is a Natura 2000 site, any proposal for developments requires careful analysis.

Transport

The site is located east of Triq Marfa, the regional road leading to the Ċirkewwa harbour, the locality in the north of Malta from where the ferry service to Gozo operates. This ferry, which crosses the channel every 45 minutes and in larger intervals during the night, provides crossing on a daily basis for hundreds of vehicles, cars and trucks, and a few thousand people in the off-peak season. During long public holidays and the summer season, local and overseas tourists cross in larger numbers and the volumes of vehicles, including coaches for the transit of tourists, increase significantly. This road runs through the study area and along Mellieħa Bay, a very popular sand beach with the residents of central and northern Malta. Off this road, there are a number of secondary roads to the east leading to Mellieħa Bay Hotel, whilst to the west to a number of rural roads, including the one through the GĦadira caravan site. Most vehicles at the caravan site are light cars; refuse collecting vehicles which need not to go through as collectors are located just at the entrance to the site.

Visual Impact

In contrast to the derelict residential units further uphill which are camouflaged by trees, the caravan site is not screened. It is easily viewed from the main thoroughfare, especially given the topography of the area and the fact that minimal effort was undertaken to make it blend with the surrounding landscape. On the other hand, the site is situated in such a way that residents of the caravan site can absorb the full panorama of the area: the bird sanctuary, Mellieħa Bay and the town of Mellieħa.

DEVELOPMENT PLANNING WITHIN THE STUDY AREA

Development Planning History

Development planning policies are developed to regulate land use. They are useful tools to control urban sprawl into

the surrounding landscape (Njegovan, 2008; Zeković *et al*., 2015). Development planning history of the study area since 1992, when the *Development Planning Act* was enacted, is characterized by planning consent granted for (1) the upgrading of public infrastructure relating to utilities and transport network, (2) extensions to existing agrarian activity and (3) to establish tourist complexes, including platforms, to some existing licensed kiosks. Applications relating to the construction of new kiosks, placing of tables and chairs to existing licensed kiosks, new agricultural stores, boundary walls and to works related to caravans, were consistently turned down. Also, applications for the installation of satellite dishes were refused except on existing tourist establishments. Development planning applications, which to-date are still pending, mainly relate to the upgrading of public transport infrastructure and to extensions to existing licensed tourist-related establishments.

Relevant Local Planning Policies

The main planning policy document which regulates the region where the caravan site is located, is the *North West Local Plan* (Malta Environment and Planning Authority, 2006). In terms of Policy NWCO 6, no development will be allowed within the wetland and along the strip of land containing Arundo donax. Furthermore, in line with Policy NWCO 8, the Malta Environment and Planning Authority is in favour of extending the existing bird sanctuary.

The agricultural land surrounding the wetland is assigned as an Area of Agricultural Value and it has to comply with Policy NWAG 1 which aims to safeguard arable land. The entire northern sector of the study area is assigned as a Major Recreational Area. As per Policy NWRE 1, such areas are subject to management and action plans. The relevant action plan relevant to the study area is the *Marfa Action Plan* (Malta Environment and Planning Authority, 2002). The zoning covered by this action plan lies just north of the caravan site. The land in the northern sector of the study area is assigned for agriculture, and thus subject to *Marfa Action Plan* Policy MAG 1 which aims at protecting irrigated agricultural land.

The *North West Local Plan* delineates part of the northern sector of the study area as garigue, thence it has to comply with policy NWCO 13 which protects such areas and prevents illegal activities such as soil dumping and off-roading. Of special relevance to this research is Policy NWML 18 of the local plan which addresses the GHadira Isthmus. This policy underlines the need to resolve competing spatial demands on GHadira Bay and its environs through environmental conservation and management, including the landscape. It emphasises the importance of protecting the area against unsustainable development.

RESULTS AND DISCUSSION

The Proposed Urban Layout

The overall infrastructure, physical and social, of the settlement was remodelled to take into account the topography and the ecological and socio-economic realities. Environmental considerations drawn from the fieldwork were fundamental in the re-design of the urban layout (Table 2). The existing and proposed design considerations are tabulated with respect to land uses, geology and pedology, ornithology and ecology, transport and visual impact. Also stated are the respective proposed mitigating measures and, where applicable, relevant current local planning policies. The resulting co-design of the caravan site embodied a strong social concern and low-cost, sustainable technology. The community residing at the caravan site is a long established, closely knitted neighbourhood.

Mapping the outcomes of resident engagement (Gaveta and Barrett, 2012) is fundamental for an urban design developed through participatory engagement. The rigorous one-to-one, face-to-face meetings with residents and regular meetings with the Association whose committee members are the active informal leaders of the community, proved to be an effective exercise in engaging the residents in the re-design of the existing caravan layout. The resulting proposed urban settlement is a site sensitive design (Figure 4). It is not just an urban design taking into account the responses of the

Table 2: Considerations impinging on the design of the proposed layout

Parameter	Existing Considerations	Proposed Design Considerations	Mitigating Measures	Applicable Policies[c]
Land use	Natural heritage predominates; 20% of land is built-up	No extension to existing footprint of site	Design which blends with the existing natural environs	NWAG 1 NWRE 1 NWML 1
Geology	Upper Coralline Limestone (Tal-Pitkal Member) outcrops on site	Though of inferior quality, this limestone can be utilized as aggregate in concrete	New caravan units to make use of this limestone excavated on site.	none
Pedology	Anthropogenic soil is present on site	Anthropogenic disturbance is allowed	Any soil type can be used in green areas	none
Ornithology	Bird sanctuary will be further extended	No disturbance which effect bird species	Not applicable	NWCO 8
Ecology	Special Area of Conservation Importance	No disturbance during and post construction of the settlement	No further urban sprawl into the existing landscape	NWCO 6 NWCO 13 NWML 18
Transport	Most residents use private transport	Introduce underground car parking spaces	Green roofs to cut down on air pollution and serve as insulant	none
Visual impact	Site located in a panoramic terraced landscape	Proposed design has to be stepped to follow original site contours	Redesign of site has to compliment the site in terms of materials, texture and colour	none

c. Applicable *North West Lokal Plan* policies

Figure 4: Proposed layout of the caravan site at GHadira

residents through public consultation; it is the development of a solution through participation of the residents engaged in the design process. Furthermore, although it is not an official planning document, the developed solution forms the basis of a development brief for the area, a provision contemplated in local planning legislation. Such briefs are issued by the planning regulator in Malta to develop ad hoc planning policies for a given site (Bianco, 1999).

The focus of the resulting layout was not on a single caravan unit space, but on the relationship of such units to the wider settlement and to the site. The way each unit relates to one another is a response to the physical characteristics of the site. The re-location of each unit was noted not only with respect to the physical infrastructure, but also in relation to the social infrastructure of the existing settlement. The spaces, be it the private terraces of the individual units and/or the public access routes and open areas, articulate an important dimension of human/social activity. Without this dimension, the notion of community being the family or the neighbourhood will not be present, resulting in a soulless place.

Included in the proposed layout was the relocation and redesign of the premises of the Association, a small building which is a point of reference to the managing committee of the settlement. The building also serves as a multipurpose place to cater for community driven initiatives. Open spaces were likewise relocated and redesigned for gathering of the community, whether religious or otherwise.

Building Density

In the proposed redesign of the caravan site, which contained circa 85% of the existing footprint, are included 344 units, which is 46% more than the existing number on site. The 15% of the footprint which will not be developed will be reinstated back for agrarian uses with reconstructed terraces rooted in the concept of landscape archaeology. The resulting building density on site was increased by 42% (Table 3).

The impacts of increased building density are a main highlight in any debate in urban design and planning discourse. An increase in building density is often coupled with an increase in urban density and/or urban sprawl. Such augmented increments are inversely proportional to socio-economic and environmental sustainability (Newman and Kenworthy, 1999). Higher building densities generate higher vehicular traffic volumes, thus giving rise to traffic congestion and the associated increase in air pollution. Green roofs were introduced, an effective measure which mitigates the adverse impact of traffic generated pollution in a tangible, sustainable manner (Wu *et al.*, 2003). A recent study on the effect of urban density, green areas and mobility patterns, with respect to the quality of the urban environment, supports this intervention in the co-designed masterplan for GHadira (Verani *et al.*, 2015).

Table 3. Percentage variation between existing and proposed layouts

	Existing	Proposed	% Difference
Caravan units	236	344	+ 46.0
Site footprint[d]	20,000 m^2	17,000 m^2	- 09.4
Building density[e]	85m^2/unit	49m^2/unit	+ 42.0

d. Stated to two significant figures
e. Existing car parking spaces are within the site footprint, whilst in the proposed layout they are underground

Due to the increased number of units as per proposed layout, a significant increase in population density was envisaged. Although such a density is usually discouraged, especially in highly populated countries like Malta, it is beneficial in both environmental and political terms. The status of caravan sites in Malta is similar or worse than the site at GHadira. Most units are not only in breach of planning and public health legislation, but are erected on public land without any prior notification and/or authorization from the Malta Government Property Department. Politicians are very sensitive to the fact that residents are equivalent to votes; their number is what matters at election time (Reichhardt, 2004).

Consecutive governments in Malta have long been aware of such squatters and other infringements being undertaken

on public land. The political scenario in Malta has been dominated since 1966 by two main political parties. The electoral system in Malta is based on proportional representation by means of the single transferable vote. Given the closely knitted, extended family structure in Malta, every vote counts. The ripple effect of a political decision significantly impinges on the political spectrum. The collateral damage that any political decision relating to say, GĦadira caravan site, may have on the electorate is circa a half of the quota sufficient to elect a candidate of either political party to the national parliament.

Central Government administration considered the setting up of another camping site in the rural area further west of GĦadira site. This implies further agrarian and ecological land being taken up for development and for other provisions required for the supporting infrastructure. This is a cost on the public coffers to accommodate a number of residents who wish to reside in caravans during the summer season. Thus, the proposed layout with the significant increase in the number of units strikes the proverbial two birds with one stone: it caters for additional caravan spaces, hence scoring political points, without exploiting the existing natural environment.

Traffic and Waste Management

Vehicular traffic and parking at the caravan site as at present, is (1) a hazard to pedestrians, (2) a source of confusion given the reckless parking and (3) a source of traffic generated air pollution by vehicles driven at low speeds. Thence, to improve traffic management and parking on site, underground parking provisions were introduced in the proposed layout. This removes vehicular access, an index for sustainable urban environment (Newman and Kenworthy, 1999), within the existing settlement. Furthermore, material excavated from the site to form the underground parking spaces will be utilized in the concrete manufacture of buildings erected on site instead of the present caravan units, thus cutting down on (1) inert waste from the construction site (2) utilizing similar industrial mineral resource from elsewhere and (3) the environmental and financial costs involved in transportation of the excavated or building material.

Another dimension which was brought up through the meetings with the committee members of the Association was domestic waste management on site. Although refuse skips are regularly emptied, there exists a problem of odour generated from organic waste. This odour, a problem further augmented by the hot scourging sun characteristic of central Mediterranean summer climate, is a nuisance for both residents at the site and passers-by. To address this issue, waste chutes were introduced at a number of locations within the layout. These chutes are linked to compartments at the underground parking level which can be easily accessed by small refuse collecting vehicles.

CONCLUDING REMARKS

Participatory engagement offers the intrinsic advantage that residents feel that they belong to the final product, the urban settlement. The interaction between the socio-economic, ecological and geocultural environs, which provide the urban and development planning opportunities and challenges (Alberti *et al.*, 2003; Aina *et al.*, 2013), were the grounding of the design approach adopted in the redesign of the existing caravan site. The resulting main conclusions are listed hereunder:

1. The co-design of the proposed urban layout for GĦadira caravan site is an effective exercise which illustrates the significance and tangibility of actively involving the locals in planning their built-environs (Cohen *et al.,* 2008; Ohmer, 2008). The resulting layout is more compact than the one existing on site and, despite of a significant increase in building density, it is environmentally sustainable and socio-economically sensitive;

2. Whilst taking into account the prejudice of the general public, the eco-inspired lobbies in particular, and addressing their concerns, the proposed urban design also takes into account (i) the needs of the community which established itself at this location nearly four decades ago, (ii) the existing characteristics of the site and (iii) the constraints arising from environmental and developmental planning policies. The proposed layout was indirectly co-designed with individual residents of the community through their respective participatory engagement in the urban design process; and

3. Given that the settlement is already present, originally parasitic, the proposed redesign of the same is mutualistic and aims to enhance rather than relegate the characteristics of the site through the mitigation of arising impacts on the surrounding environs. It is grounded in the local parameters arising from the place, scale, occupiers and general public.

The proposed redesign of the existing settlement at GĦadira caravan site is a coherent and effective proposal and calls for an improvement of existing urbanization through a symbiotic relationship between the society and the built environment.

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THE IMPACT OF INFRASTRUCTURE PLANNING IN SPATIAL PLANS ON CARRYING CAPACITY ASSESSMENT IN MOUNTAIN TOURIST AREAS

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This paper analyses the impact of infrastructure planning on carrying capacity assessment in mountain tourist areas, aiming to define the procedure, as well as to present an algorithm that could enable the application of carrying capacity methods in the process of developing planning documents. This would, in addition to the common practice of the hitherto used research methods, pay appropriate attention to the impact of infrastructure systems. In this regard, the paper first presents the basic theoretical and methodological problems of carrying capacity assessment, and then it considers the basic characteristics of evaluating carrying capacity in mountain tourist areas. Following this is a review of the basic principles of infrastructure planning, which gives practical recommendations for the infrastructure planning process in mountain tourist areas, with a particular emphasis on the impact of infrastructure on carrying capacity assessment. The example of Tara National Park, a mountainous area in Serbia which served as a place for verification of this procedure, shows the need to review the current planning solutions defined for this protected area.

Key words: **carrying capacity, spatial plans, infrastructure planning, mountain tourist areas.**

INTRODUCTION

In spatial and urban practice, infrastructure has not always been treated in accordance with its position and role in organized and settled space, and it has often been considered to be a set of technical systems with an underlined functional dimension, often without integral links with other activities on some territories.

The assessment of carrying capacity is extremely important to tourism and other kinds of development of diverse natural areas, including mountain areas, which are particularly fragile and abundant in natural heritage. This is particularly true if the area is protected or planned for protection.

This paper aims to study the impact of infrastructure planning (except transport infrastructure) in spatial plans on the assessment of carrying capacity in mountain tourist areas, namely, it aims to enhance the spatial planning process, and emphasize the role and impact of infrastructure systems on the overall development of mountain areas and the activities taking place in them, taking into account foreign and local good practice.

CARRYING CAPACITY OF SPACE: THEORETICAL AND METHODOLOGICAL ASPECTS

There have been a number of attempts to give a precise definition of the carrying capacity of space. Several definitions will be presented here, which are similar in many aspects, but also different.

Mathieson and Wall (2006) define carrying capacity as the maximum number of people that can be present in a specific location without inducing an irreversible change or degrading the physical environment and without significantly endangering the quality of recreational experience. Similarly, according to Lješević (2002), carrying capacity involves the number of users that a specific area can accommodate in a specific time period without irreversible physical or environmental degradation, or degradation that could lead to a reduction in tourism in a given area or location. The Federation of Nature and Natural

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Parks of Europe – EUROPARC interprets carrying capacity as the ability of an ecosystem to self-maintain and to support the unlimited development of human activities, with no negative feedback effects (Jovičić, 2011). Coppock and Duffield (1975) proposed a general qualitative definition, which implies that carrying capacity involves the level of use that an area can sustain for the purposes of tourism without an unacceptable degree of change to the characteristics and quality of the resources, or the recreational experience itself. Such a definition allows different aspects of reflection on carrying capacity (physical, ecological, economic, anthropogenic and psychological), where each aspect causes a different measure of capacity, mainly incomparable to the measure of another aspect or the measure of the same aspect in a different domain (Dabić and Milijić, 1997).

Maksin-Mićić (2007) defines carrying capacity as an integrated view of the environmental capacity, the natural and manmade resources in an area, the different spatial needs for developing specific activities, and the functions and development of local communities. Accordingly, its basic components are: environmental capacity, psychological tourism capacity (the maximum degree of tourism that does not bring about a decrease in the quality of the tourism experience) and the socio-cultural capacity of the local population (the maximum degree of tourism development which does not disturb the way of life, culture or customs of the local population).

According to Castellani and Sala (2012), the assessment of carrying capacity of an area cannot be unique for each tourist destination, but several factors should be considered. Therefore, apart from the availability and limitations of the natural and physical resources, it is necessary to take into account the characteristics of the management system, the prevailing types of tourism in a studied area, the local stakeholders' perceptions of specific issues (e.g. their concept of crowding), as well as other local conditions and features. For the above-mentioned reasons, certain authors (Lindberg *et al*., 1997, McCool and Lime, 2001) suggest that the question "How many is too many?" should be replaced by "How much change from the natural conditions is acceptable given the goals and objectives of a specific area?"

The purpose of the assessment of carrying capacity (Bilen and Bučar, 2004) is finding optimal measures and actions that can permanently protect the natural heritage and ecological characteristics of an environment, as well as the existing balance, structure, ethno-social and other characteristics of the local population, and the dominant system of cultural values. Accordingly, it is especially important to restrict the development of tourism to the carrying capacity level which protects its natural heritage, protects the population and their basic cultural and other structural characteristics, and protects the economic value of an area. The degradation and saturation of natural and anthropogenic resources are thereby prevented and furthermore, the attractiveness of those resources is preserved, as well as the intensity of their activity, which enables sustainable development, namely, development that will ensure permanent use of a specific area without disturbing the basic natural heritage and living conditions of the local population.

The World Tourism Organisation (UNWTO) has defined three dimensions to the evaluation of carrying capacity (Jovičić, 2010):

- Ecological capacity entails the maximum degree of tourism carrying capacity without ecological degradation and it includes a complex consideration of factors;
- Psychological capacity involves the maximum degree of carrying capacity from the viewpoint of the number of tourists, their activities and built facilities, without a decrease in the quality of tourists' experience. It cannot be easily determined because the perceptions and attitudes of visitors on the mentioned factors differ;
- Socio-cultural capacity means the maximum development of tourism which does not impair the way of life, culture or tradition of the local population. The problem comes from the fact that the local population often wants to change their way of life by way of developing tourism.

Apart from these levels of assessment, some authors have also distinguished the tourism/recreational or the functional evaluation of carrying capacity, which is based on the interaction between the parameters of the resources and their levels of use, their type, the space and time variations in the tourism activities, the behaviour of the users, perception of the quality of resources etc. Hence, the functional assessment of carrying capacity partly integrates the above-mentioned levels of physical, economic and psychological capacity, and implicitly, the key factors of ecological capacity, with mostly quantitative expression of the physical and economic aspects, and with the use of certain standards of capacity. Moreover, there are difficulties in introducing quantitative capacity standards for tourist areas for different types of tourist activities, which are increasingly under the influence of various unquantifiable factors (circumstances, mood, education, fashion, individual opinions etc.), and which increase as the environmental care of (even intact) natural areas increases (Bovy and Lawson, 1977).

The carrying capacity should therefore combine the different dimensions of capacity, which the experts in this area have mostly agreed on, although they disagree on the methods for its assessment. Hence, there are different mathematical formulae for the capacity of tourist resorts (Jovičić, 2011).

It must be noted that some authors oppose the term 'calculation' of the capacity, pointing out that the capacity can only be assessed or predicted according to predetermined conditions or factors, which additionally result in changes in the environmental conditions and thereby in environmental systems (Jovičić, 2010).

Carring capacity evaluation in spatial plans for mountain areas

The carrying capacity in mountain tourist areas is evaluated according to the basic principles of carrying capacity assessment, depending on the special orographic characteristics of the mountain's natural conditions and resources, i.e. depending on the special activities for tourists that are possible only at these destinations. According

to Dabić (2011), due to the more modest scientific acknowledgements on the nature of mountains (high ones in particular), in relation to the more accessible natural areas, biologists and ecologists are usually reluctant to define even the basic quantitative criteria and indicators of the capacity of nature compared to the activities that take place there. Hence the conditions and parameters for determining the carrying capacity of mountain areas are often descriptive and/or general environmental requirements, or they are subjective qualitative evaluations of the current capacity, unable to solve the real issues of carrying capacity.

Since mountain (especially high mountain) tourist resorts have been primarily promoted as the development cores of winter tourism, the determination of their capacity and the overall planning of their development are mainly based on the criteria and indicators of winter sports and recreation in winter conditions (Dabić, 2011). At the peak of mountain tourism in the middle of the 20th century, mountain resorts were promoted as such, but the importance of this diminished when the focus turned towards more moderate and rational concepts, which entailed the all year-round use of mountain tourist destinations, thus reinstating the importance of summer mountain tourism, which had been unjustifiably neglected.

The carrying capacity for winter sports as the key aspect of the capacity of a high-mountain tourist resort is determined by evaluating its natural potential for alpine skiing, since it is the most popular and economically the most important contemporary activity related to winter sports and mountain recreation (Maksin *et al*., 2011). The potential of alpine skiing is conditioned by the availability, size and quality of alpine ski resorts where a commercially significant number of high-quality ski slopes can be placed, with rational construction costs of a ski transport system, measured in terms of the number of simultaneous skiers. In the planning process, the capacity of an alpine ski resort is determined first globally, and then at regional, sub-regional, and local levels.

The criteria for determining the carrying capacity of an alpine ski resort are determined by the following parameters: skiers' requirements; the physical and technical conditions of alpine ski slopes; the technical and economic conditions of the ski transport system; and the increasingly strict demands regarding environmental protection. The capacity of a mountain area for the supply of other winter tourism activities (tour skiing, Nordic skiing, ice skating etc.), given that they are generally of a smaller scope and importance, is usually not determined by calculation, but mainly normatively, in relation to the established capacity of the alpine ski resort (usually through the percentage in relation to the number of alpine skiers, i.e. they enter the quota of other users, which is 40-50% of the total users of the winter tourism centre).

The capacity of the summer tourism supply in mountain areas is higher in physical terms than the capacity of the winter supply, in view of the considerably higher accessibility of the area in summer conditions when there is no snow, and there are no low temperatures, strong winds etc. However, due to biological occurrences and processes in the vegetation period, when flora and fauna are fully active, the ecological capacity, especially in high-mountain areas, is objectively lower than in the winter period, namely its natural elements are more vulnerable. At the same time, a rich summer supply is the key factor for a relatively balanced year-round use of mountain areas, so its capacity is an important criterion for the contemporary economic justification and feasibility of high-mountain and middle-mountain tourist resorts. The capacity is checked by the evaluation of programming and planning alternatives for mountaineering, mounting biking, horse-riding, sport fishing, mountain waters recreation, grass and artificial surface skiing, paragliding and similar activities, hunting, rural tourism supply etc. The capacity of the above-listed individual activities is evaluated mostly subjectively, namely, empirically on the basis of previous experience (Dabić, 2011). Unlike high-mountain and higher middle-mountain areas, lower middle-mountain areas and low mountains can, depending on the climate and other natural characteristics, have a higher demand during the summer season, so the evaluation of the capacity of these areas has to be more complex in relation to the existing and potential activities and amenities related to tourism.

A study of the capacity of the suitable alternative locations for a tourism accommodation centre completes the physical capacity of the mountain tourist area in terms of the number of users. The purpose of the carrying capacity of a mountain area for an accommodation centre is mainly in the availability of natural locations favourable for transport accessibility, tourist accommodation, public amenities and sports and recreation (by area, latitude, slope, sunshine duration, protection against the wind, torrential floods, floods and avalanches, attractiveness and preservation of landscape etc.) As the key criteria for determining the carrying capacity of the accommodation for overnight users, the following are usually considered (Maksin *et al*., 2011): the availability of new and old locations in and outside the settlements and the centre that are convenient for the accommodation and recreation of tourists; the suitability of the visual and physical contact with the tourism supply in the area; transport accessibility; the strengths and weaknesses of the infrastructure in the area; and the existing or planned capacity of the infrastructure.

When the development of a tourism centre, subregion or region exceeds the carrying capacity according to the established criteria (either because it had not been carefully planned or evaluated or because the plan was not followed), measures for keeping or reducing that level of pressure by users should be implemented. These measures may include: restricting arrivals, especially of day-trippers (car park limitations, a ban on certain vehicles, high or differentiated prices, introduction of tickets etc.); limiting further construction; introducing a planned timetable of tourist and recreation activities; improving management standards; and the supervision, protection, and development of new, alternative destinations (Dabić, 2011). When planning documents developed for mountain tourist areas reveal that the carrying capacity has been exceeded, it is necessary to incorporate some of the measures mentioned in them and to insist on their priority in relation to other plans and measures.

THE MAIN PRINCIPLES OF INFRASTRUCTURE PLANNING AS A BASIS FOR SPATIAL PLANNING

The infrastructure is indispensable for performing activities in a regulated area, i.e. it is the basis for the existence and development of a specific regulated area. It is a largely spatial category, strongly connected with geospace and conditioned by it, and it has to be observed as a unique sum of the other systems forming "the system of systems".

The standard process of infrastructure systems planning entails several interconnected steps (Grigg, 1988):

- Identifying the problem is the first step, which refers to finding the causes of existing difficulties;
- Setting goals is the next step, which is crucial in planning, and particularly complex because different participants in the infrastructure system management have different systems of values;
- Forming alternative solutions is the next, creative step, which cannot be completely left to computer technology and modelling systems, given that creativity exceeds the limits of the obvious alternatives. This step refers to technical, financial, organizational and management options;
- The evaluation of alternatives is a scientific process that involves system-analysis, economics, impact analysis and political judgement. This is a process for which it is necessary to use computer technology and modelling systems for a cost-benefit analysis, for finding the impact of the alternatives, the characteristics of charging etc. The selection of alternatives is definitely a dynamic process which involves the decision maker's flexibility and acceptance of other options if the circumstances require such;
- The selection of a preferred alternative refers to the development of ways to prioritise and present the decision maker's alternative. The next step is not a step in the planning process as it is a discretionary step reserved for the decision maker.

The infrastructure planning process starts with a comprehensive review of the existing and projected infrastructure requirements (Žegarac and Arsić, 1999). The assessment of requirements is an evaluation of the total current needs for the construction and maintenance of separate infrastructure systems, and it is a part of the planning-programming-financial process leading to a usable definition of the requirements. This differs from simply wishes or demands expressed for infrastructure services.

The approach to the analysis of infrastructure requirements and the method used for the construction, renewal and/or replacement of infrastructure in existing practice is mainly general and should be replaced by a more positive approach based on the importance of infrastructure for the total productivity, and the possible influence that infrastructure has on the economic and other development processes in the area (Đorđević and Lukić, 2004). The construction, expansion and/or upgrading of infrastructure should not be carried out in an abstract and non-selective simple way, but in particularly specified areas in order to help specific users.

In a similar way, Lukić and Đorđević (2007) indicate that "planned and programmed infrastructure development" in more developed countries is networked with the planned and programmed development of all other spatial structures. It is very important to note that the development of spatial plans is preceded by the development of infrastructure sector strategies, programs and projects, which are a requirement for the solutions defined in spatial plans. The methodology in the process of infrastructure system planning has a set chronological order: Defining problems – Generating alternatives – Evaluating the alternatives – Selecting the best alternative – Solution requirements.

INFRASTRUCTURE PLANNING IN SPATIAL PLANS FOR MOUNTAIN TOURIST AREAS

Taking into account the above-mentioned and with respect to the general principles of planning sustainable tourism in mountain areas, some practical guidelines for infrastructure planning in spatial plans of mountain tourist areas are given below as recommendations for direct application in planning practice.

First of all, it should be noted that the infrastructure planning process can vary depending on whether the area in question is a mountain area where tourism development is yet to be planned so there is no infrastructure, or there is minimally built or inadequate infra- and superstructure, or it is an area where tourism development has been initiated and there is a built or partly built infra- and superstructure in use for the purposes of tourism.

In each situation, the basic and most important input for further infrastructure planning is a planned evaluation of carrying capacity, regardless of whether or not the mountain area is protected or planned for protection. Mountain areas are very susceptible to the influence of anthropogenic activities ensuing from tourist activities in the area.

Now, as an integral part of the planned carrying capacity evaluation, it is necessary to conduct detailed and precise field research, which will indicate the possibility of using the existing and/or potential (mostly local) sources for different types of infrastructure systems. In the mountain areas where tourism is already working, it is necessary to collect detailed data and requirements from the authorities, organizations and companies managing some types of existing infrastructure systems in the planned areas, and in their immediate or more distant surroundings because of the necessity/possibility of connecting to the existing or planned regional or main systems. In the mountain areas where the tourism process has not yet been initiated, and there are no built facilities of infra or superstructure, great importance is given to the data and conditions from the relevant institutions that refer to the existing and planned regional and major (magistral) infrastructure systems in the immediate or more distant surroundings of the mountain area, in addition to the data obtained by field research, as they are the basis for the infrastructure of the mountain area. If the infrastructure systems in the immediate or distant surroundings are not at a suitable level, we need to initiate their development through the planning documents for larger spatial units (regional spatial plans, municipal

spatial plans, sectoral studies, infrastructural programmes, concepts and strategies etc.).

An important issue should be pointed out here, which is the possibility of inadequate cooperation (not always and not for all of the systems) between a planning document developer and the relevant authorities, organizations and companies that provide the requirements and data in the infrastructure domain. This may often lead to wrong conclusions and the inappropriate planning of some infrastructure systems within a spatial planning document. It is therefore necessary to define clearly and precisely the jurisdiction (who should provide data and requirements), procedures (deadlines, finances etc.), and obligations (what to prepare and how) in this domain through regulations both from planning field and from the legislation that regulates the functioning and development of the relevant infrastructure systems. Furthermore, as an example of good practice, individuals and/or teams from relevant institutions in charge of preparing data and requirements should engage in part of the planning process or in the planning team, in order to comprehend the actual problems in the tasks.

The application of the data and conditions from the domain of infrastructure systems, using a suitable procedure for evaluating the carrying capacity (coordination with ecological, socio-cultural and other conditions and requirements, existing/planned facilities of the superstructure etc.) can only lead to a preliminary carrying capacity. To be exact, the defined normatives for the infrastructure of a mountain tourist area[2] should be applied to the so-called preliminary carrying capacity, in order to get the necessary infrastructure capacity for individual systems and appropriate spatial entities within the total planned area.

The necessary capacities should be compared with the conditions and real possibilities for ensuring the infrastructure capacity, which should be considered both spatially (by relevant spatial entities) and temporally (infrastructure provided in stages). In this way, we can calculate the total potential capacity of infrastructure and capacity for individual infrastructure systems. It should be noted that besides the necessary favourable characteristics of traffic accessibility, the possibility of a suitable water supply system, i.e. of providing both drinking and technical water is vital for the carrying capacity. The other infrastructure systems of technical character have some but significantly less influence, because with sufficient financial resources, they can be provided easily, adequately and reasonably fast.

If the potential infrastructure capacity is smaller than the required capacity, the preliminary carrying capacity should be corrected (reduced): the potential infrastructure capacity determined in the previously described way (considered spatially and temporally. i.e. through considering the possibility of developing different phases) should be in a ratio with previously defined and accepted normatives for the infrastructure of a mountain tourist area, and the preliminary carrying capacity is corrected through the reduction of the planned capacity so the final capacity of the planned area is reached. It is then considered in accordance with the possibilities for infrastructure and superstructure both spatially (by individual spatial entities) and temporally (by different construction stages of infrastructure and superstructure).

If, during the spatial planning process, new data or facts occur which require a correction of the preliminary carrying capacity, it is necessary to reconsider the set strategic decisions and defined basic and individual development goals for the planned area, and if necessary, harmonise them, which can sometimes lead to the repetition of the whole spatial planning process.

If the possible infrastructure capacity is in accord with the required capacity, the preliminary capacity is also its final carrying capacity.

After the previous steps, practical "physical" solutions and structures are defined with the potential consideration of alternative and/or variable solutions.

It should be noted here how important it is that the planning process should, in addition to spatial and urban planners, experts in charge of individual infrastructure systems, relevant experts (the representatives of infrastructure systems management and other members of the planning team, representatives of the local authorities etc.), also include the local inhabitants, general public, economic and other entities, and potential investors etc. Thus, any substantial changes to the defined planning solutions can be avoided during the next step of making and adopting the planning documents when the participation of the public is defined by law and regulations. Otherwise, the whole planning process might be repeated.

In accordance with the infrastructure planning in spatial plans for mountain tourist areas, the authors of this paper have defined a corresponding algorithm (Figure 1) for practical use in spatial planning for mountain areas, noting that this procedure can be applied in the planning process of other (protected or planned for protection) areas that require a carrying capacity assessment.

An analysis of several spatial plans for special purpose areas was carried out for protected mountain areas in Serbia. It established that an estimation of the space carrying capacity is an exception rather than a rule, depending on the attitude of the plan's developer, as the current regulations in this domain do not specify it as an explicit obligation. Regarding the connection of the border carrying capacity and the planned/potential infrastructure capacity in the plans analysed, practical estimations were only done for individual infrastructure systems in the areas of Kopaonik and Stara planina[3]. Nevertheless, almost all of the plans contain at least a declarative commitment to respecting the border carrying capacity, although it has not been defined.

[2] Defining normatives for the infrastructure of a mountain tourist area is of vital importance for infrastructure planning, but they will not be elaborated on here due to the complexity of this field that requires special and detailed integrated and sectoral expert research.

[3] This methodology was developed and applied in the Institute of Architecture and Urban&Spatial Planning of Serbia (the Institute has produced spatial plans for those mountains). Besides that, they are working on integral and problem research/study for the mountain areas of Serbia.

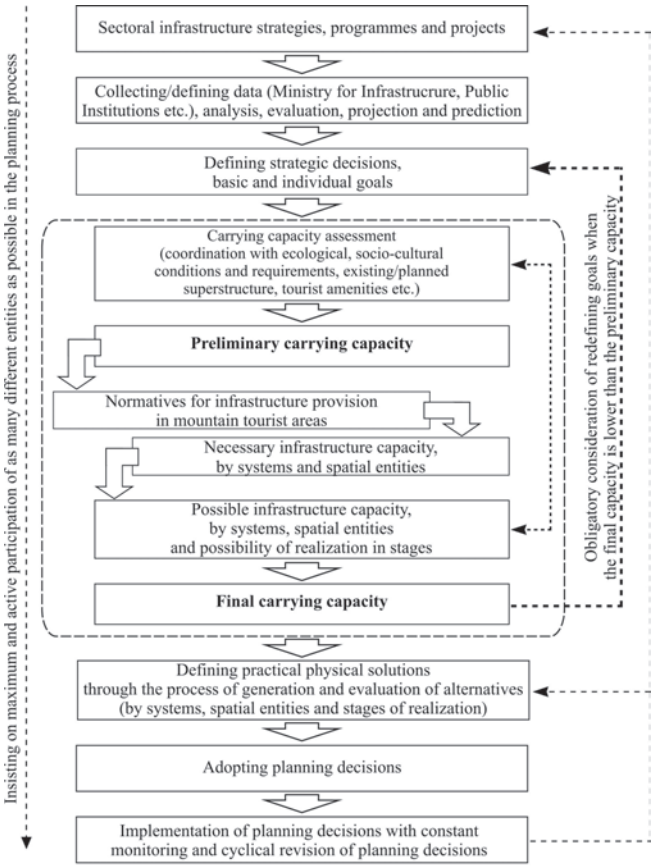

Figure 1. Infrastructure planning process in spatial plans in mountain tourist areas with a special emphasis on the carrying capacity evaluation

In accordance with the previously proposed algorithm, here is a simplified example of a carrying capacity evaluation for the area of Tara National Park regarding the possibility of a water supply, and taking into account the planning solutions in the Spatial Plan of Special Purpose for Tara National Park (2010), and in the Master Plan of Tourism Development with the Business Plan for Tara Mountain and Its Surroundings (Horwath and Horwath Consulting, 2007), with a note that these documents do not include a carrying capacity assessment.

Tara National Park is in the westernmost point of the Republic of Serbia, and it covers the area bordered by the flow of the River Drina, between Višegrad and Bajina Bašta, consisting of the Zvezda, Crni vrh and Ravna Tara mountain ranges. In the east, the area is separated by the River Solotuška and the Ponikve highlands, and in the south by Kremanska and Mokrogorska valley. The area of Tara National Park is regulated by the Law on National Parks (2015), and it covers 24,991.82 ha, with 3,323.92 ha in the first degree of protection, 8,514.39 ha in the second degree of protection and 13,153.51 ha in the third degree of protection (Figure 2).

The border capacity of the area of Tara National Park in this example is carried out for the whole year, without a separate consideration of the winter and summer periods, and bearing in mind a relatively small potential for the construction of larger ski resorts. To define the border capacity, the following normatives were adopted: 0.25 users per hectare in the zone of first degree protection; 0.5 users per hectare in the zone of second degree protection; and 2 users per hectare in the zone of third degree protection. These normatives are lower than those typically used for protected mountain areas[4], since accessibility is a significantly limited characteristic of the landscape in the area of Tara National Park, especially in the first zone of protection. This is also due to the dispersive distribution, large distances and the existing and planned tourism zones being limited in size by protected areas.

The application of previously defined normatives to the areas of suitable protection regimes defined by law, results in the preliminary carrying capacity of the area of the National Park Tara being 31,400 users. The application of empirical

[4] In the Spatial Plan of Special Purpose for Kopaonik NP (2009) the following normatives were used for the summer period: 1 user/ha for the first degree of protection, 1.5 users/ha in the second degree of protection and 2 users/ha in the third degree of protection, and the Amendments to the Spatial Plan of Special Purpose for NP Kopaonik - the Draft plan (Institute of Architecture and Urban & Spatial Planning of Serbia, 2016), also for the summer period: 0.5 users/ha for the first degree of protection, 1 user/ha in the second degree of protection and 4.1 users/ha in the third degree of protection.

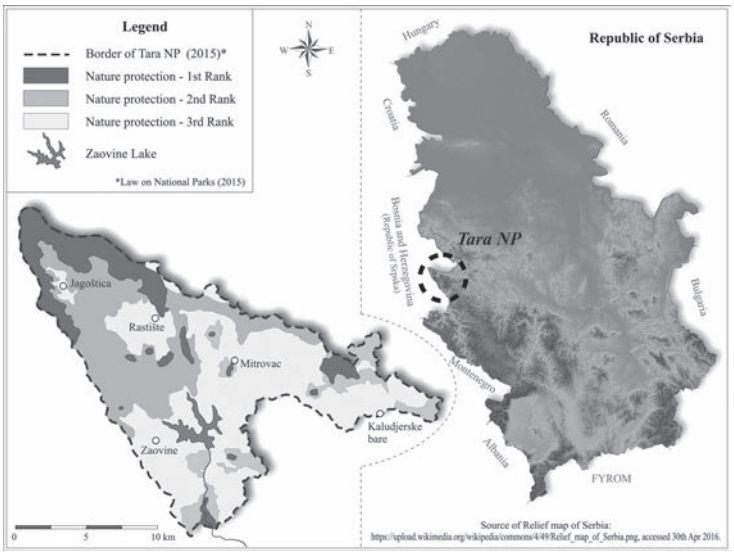

Figure 2. Tara NP, Nature protection rank and the position in the Republic of Serbia (Source: processed by the authors)

norms for the share of overnight tourists in relation to day-trippers and employees, and the consideration of the specific characteristics of the observed area, as well as the defined planning solutions, can result in an estimation of the number of users by certain categories: 12,500 overnight tourists, 13,900 day-trippers from the areas outside the NP, 2,000 employees (15% of beds and employees outside tourist accommodation), 3,000 other permanent inhabitants in settlements within the area of the NP.

If we apply the adopted normatives for water consumption to the estimated number of users in different categories of users (determined in an analysis of a larger number of planned documents developed for similar areas): 400 l/u/d (liters per user per day) for the accommodation capacity, 10 l/u/d for day-trippers, 150 l/u/d for employees, 250 l/u/d for inhabitants, 100 l/u/d for tourist spots and 75 l a day for a head of cattle, we get the total need for water for the area of Tara NP, which is at its maximum about 83 l/s. The Spatial Plan of Special Purpose of Tara National Park (2010) envisages for this national park (except for smaller isolated zones), the water supply from the system "Tarski vodovod" with its spring in the Kruščica accumulation, with a total projected capacity of 80 l/s (Figure 3). At first sight, the planned/potential capacity of the water supply system approximately satisfies the previously determined carrying capacity of the area in question.

However, the Tarski vodovod water supply system is, according to the spatial plan, also the basis of water supply for other areas around Tara NP, such as the settlements of Kremna and Mokra Gora, and parts of the settlements Kaluđerska bara, Solotuša and Zaovine, with their own accommodation capacity, other tourist amenities, population etc. Furthermore, the normatives applied for determination of the preliminary carrying capacity are far stricter than those usually used for such areas. For that reason, we can conclude that it is necessary: (1) to correct the preliminary carrying capacity of the area of the Tara NP in accordance with the possinbility of a water supply or (2) do suitable research in the direction of the possibility of enlarging the capacity of the Tarski vodovod water supply system and using the water from the Zaovine accumulation for these needs. According to the results, it is necessary to make corrections and amend the existing planning solutions.

CONCLUSION

Within the stages of the elaboration process of planning solutions, the planned carrying capacity evaluation is of special and often vital importance for adequate spatial planning in mountain tourist areas. It is a part of the planning process, which is, besides defining the normatives and standards for infrastructure provision of the tourist area, vital for infrastructure planning in spatial plans. It is therefore essential to formulate extensive methods and research procedures which will estimate and then monitor the carrying capacity in mountain tourist areas, taking into consideration as many relevant and primarily measurable indicators, so as to enable a timely reaction in case of unfavourable and/or undesired changes.

Taking into account the above-mentioned, through consideration of basic theoretical and methodological principles of the field of carrying capacity assessment, the characteristics of the planned evaluation of carrying capacity in mountain tourist areas, and the presentation of the basic principles of infrastructure planning in spatial plans, practical recommendations have been given, i.e. a suitable algorithm for the application of spatial planning, namely, the

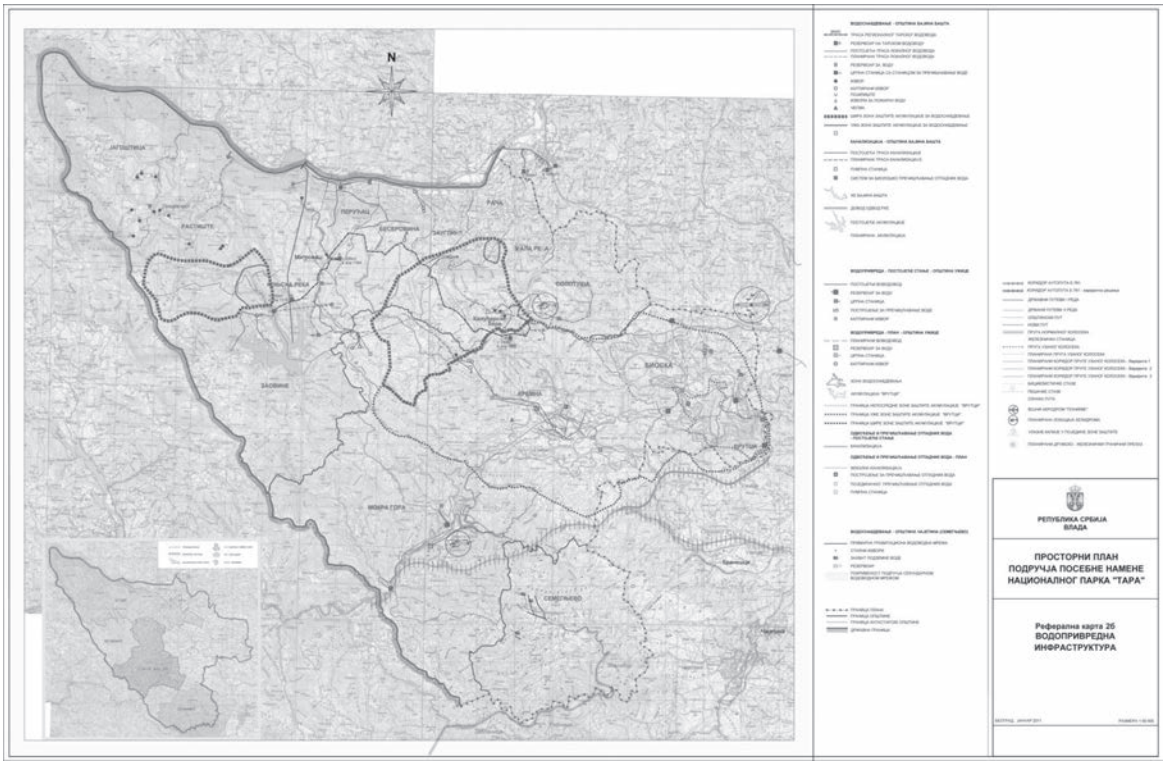

Figure 3. Spatial Plan of Special Purpose for Tara NP, Referral map 2b: Water management infrastructure. (Source: Spatial Plan of Special Purpose for Tara NP (2010))

procedure of infrastructure planning in mountain tourist areas. The novelty in the proposed procedure involves the fact that when the carrying capacity has been assessed and coordinated with ecological, socio-cultural conditions and requirements, the existing/planned superstructure, tourism amenities etc., then the required and also the potential infrastructure capacity are considered (with the use of normatives and standards for infrastructure provision), as well as their influence on the space carrying capacity.

Considering the current practice in this area, the authors have analysed several spatial plans developed for protected mountain areas in Serbia, with a specific display case evaluation of the space capacities in the area of Tara NP, where it was found that a review of the current planning solutions is necessary.

It must be noted that the application of the proposed algorithm is not restricted to mountain tourist areas, but the same procedure may be applied in the planning process for other areas in need of carrying capacity assessment.

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