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AVAILABILITY CLASSIFICATION FOR APPLICATIONS IN CONSTRUCTION PRODUCTION SYSTEMS: A REVIEW

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Abstract. *The aim of the paper is to improve availability classifications of components for application in construction systems. Construction production systems belong to project-based systems with serial-parallel structures with or without redundant components, and the availability function has a significant impact on the performance indicators of components and systems. The main indicators of function of the components are the availability, capacity, costs, and project time. A new approach to classification makes it possible to choose the most appropriate methodology for assessing component availability in the bidding phase, and managing company's machine park. The new classification approach was tested on a practical example. The results obtained confirmed the justification for extending the classical approach to the classification of the availability of components.*

Key words: *availability, construction component, component indicators, production system*

1. INTRODUCTION

Availability is key when designing industrial systems. The capacity of the (system) components and the system as a whole can be changed from a state of full operability to failure and reduced operability. The status of the components may affect the capacity, unit costs, and total costs, and project time. Estimating the availability of components in such situations is of great importance in the *bidding phase* [1], [2].

According to Eq.1, the general measure of availability is a *ratio* of usable/operational time to a total given period or cycle time [1], [2].

$$Availability = Operational\ Time/Time\ Period \tag{1}$$

Production systems exploit sets of elements and the interrelationships between them and their characteristics, in order to perform a function. This means that the connections between the components and subsystems are in accordance with the specificity of the production system, i.e. technological process.

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Construction production systems are a specific type of industrial system where temporality and uniqueness are key. This means that there are no two or more identical construction projects. Each construction project has a clearly defined start and, end of work in the goals set. Furthermore, there is no system for completing construction projects with an identical organizational structure [2].

Construction systems in the field of civil engineering, where highly mechanized work is involved are highly complex in terms of the production system's availability. This complexity is reflected in the specifics of the environment in which the building is performed, frequently with unknown total costs, functioning in open spaces, with production lines that are significantly distant from each other, variable durations in the construction time (from several months to several years), and fairly specific contractual relations between the investor and the contractor. [2].

The availability of system components, subsystems, and systems as a whole affects the probability of whether the system will operate successfully and the range of permitted deviations of the set criteria function in the given time and given environmental conditions. Their availability is predicted, estimated, and evaluated in direct relation to the bid level of the system (general, conceptual, and detailed bids) [2].

The significance of the availability function is gaining in importance in designing and analyzing production systems, and this is reflected in the simultaneous analysis of the reliability, availability, and maintainability.

Availability is a fundamental aspect in the performance of the maintained (repaired) systems. Also, availability is an indicator of the probability that the system/component will function satisfactorily, at any time when used under the specified conditions, where the time considered refers to the time of operation and the downtime[2].

The first classification of availability resulted in a division into two groups in terms of application to military components and systems [3]-[5]. The next extensions of the definition and classification were made with regard to application to military systems, also [6], [7]. In the 1980s, availability was applied to production systems, but without any improvement in definitions, nor in any additional knowledge about their classifications. The first works in the area of reliability, availability, and maintainability with new classifications of availability from the aspect of construction systems emerged in 1990s [8], [9]. Expanding the definition of production availability from application to construction components and systems created the conditions for additional research in this field [10]-[12].

The research of a large number of published works, professional literature, new standards, guidelines, and practical experience, influenced the selection of the subject research, i.e. modern approach for defining availability of construction components.

2. LITERATURE REVIEW

The first works on the reliability of components and systems emphasized the need for the maintenance criteria. Research in the field of system's maintenance in terms of the maximizing reliability values resulted in two maintenance approaches: reliability-centred maintenance (RCM) and availability-centred maintenance (ACM). These two approaches positioned availability as a measure of the reliability of the maintained systems. Maintenance criteria, with all the necessary logistical and administrative activities, opened a new chapter in an integral approach to reliability and availability analysis;

maintainability (M). The first works (1960s) in the field of integral access (RAM-Dependability) emphasized the importance of the availability function.

In the first availability classifications availability was simply classified into [3], [4]:

- A (t) – instantaneous or point availability
- A (T) – average up time or mean availability
- A (∞) – steady state availability

Further research in the field of repairable systems emphasized the need to divide the availability into two groups [5] in relation to:

- the time interval
- the downtime type

2.1. Availability as a function of the time interval

2.1.1. *Instantaneous or point availability – A (t)*

Instantaneous or Point Availability represents the probability that the system will be in operational condition at random time "t", that is, in the specified time interval [0, T]. Unlike reliability, current availability includes information regarding maintainability. In this case, the system will be operational at a time if the following conditions are met:

- The component functioned correctly from "0" to "t" with the probability R (t)
- The component has functioned correctly since the last repair in the "u" time, where:
  - 0 <u <t, with probability:

$$\int_0^t R(t-u)m(u)du \tag{2}$$

Where:

$m(u)$ - function of system recovery density

According to Eq. 3, the instantaneous availability is the sum of the two previous probabilities [5]:

$$A(t) = R(t) + \int_0^t R(t-u)m(u)du \tag{3}$$

2.1.2 Average up time or mean availability – A (T)

Average up time availability or mean availability is the proportion of time in system operation or the expected probability of system availability at time [0, T] [5]:

$$A(T) = \frac{1}{T}\int_0^T A(T)dt \tag{4}$$

2.1.3 Steady State Availability – A (∞)

Steady state availability is the limit value of the instantaneous availability of the function during the "t" time which tends to infinity:

$$A(\infty) = lim_{t\to\infty} A(t) \tag{5}$$

In industrial systems, as well as in construction machine systems and plants for the creation of project positions, steady state availability is most often used due to the sufficiently high total time (t) of the functioning of the system. In such situations, the time tends to infinity, thus it follows that the failure rate (λ) and the repair rate (μ), are the constant value, i.e.:

$$\lambda(t) = \lambda \tag{6}$$

And:

$$\mu(t) = \mu \tag{7}$$

In this case, it follows that:

$$A(t) = \frac{\mu}{\lambda+\mu} + \frac{\lambda}{\lambda+\mu} e^{-(\lambda+\mu)t} \tag{8}$$

Where:

$$A(\infty) = \frac{\mu}{\lambda+\mu} \tag{9}$$

Due to the status of the component, it follows:

$$A(\infty) = \frac{MTTF}{MTTF + MTTR} \tag{10}$$

Where:

MTTF - mean time to failure

MTTR - mean time to repair

The mean time to repair has been redefined in recent papers in this field as the mean time to restore (MTTRS) due to the additional time (ALDT) after the active component has been repaired and put back it into operation. It means that: MTTRS = MTTR + ALDT. According to Eq. 10:

$$A(\infty) = \frac{MTTF}{MTTF + MTTRS} \tag{11}$$

2.2. Availability as a function of downtime type

Availability as a function of downtime type, as well as availability as a function of time interval has its own classification [5]:

- A (i) - inherent availability
- A (a) - achieved availability
- A (o) - operational availability

2.2.1. Inherent availability – A (i)

Inherent availability is defined as the probability that the system in use under the given conditions will function satisfactorily at a given moment of time, without taking into account any planned or preventive repairs. The inherent availability relates only to the time of corrective repair of the system, assuming 100% availability of the personnel and repair equipment. This type of availability represents the fulfilment of the requirement for achieving the expected performance of the planned downtime in operation. The availability of the system component is[5] :

$$A(i) = \frac{MTTF}{MTTF + MTTR} \tag{12}$$

2.2.2. Achieved availability – A (a)

Achieved availability identifies the timing of preventive and corrective maintenance. It is determined by a detailed design closely defines the type, quantity, and timetable of equipment for timely repairs i.e. maintenance. The achieved availability can also be considered as a steady state availability which only considers the time of active preventive and active corrective repairs. Achieved availability can be expressed as the following equation[5]:

$$A(a) = \frac{MTBM}{MTBM + \overline{\overline{M}}} \tag{13}$$

Where:

MTBM - mean time between maintenance
$\overline{\overline{M}}$ - mean time of maintenance

This definition meets the requirements for reaching availability when downtimes are planned. The goal of availability of the repaired (maintained) system is to find extreme values of the function, in order for the system to be at the required level of operation. The resulting availability depends on the production system design that determines all possible scenarios during its operation and maintenance strategy.

2.2.3. Operational availability A (o) - basic definition

Operational availability is a measure of the average availability over a period of time and includes all experienced sources and causes of delays as well as downtimes (administrative, logistic, organizational, etc.). Operational availability is the availability through which the system has passed, and is based on current events that are taking place in the system.

Preliminary availabilities are based on estimates, as well as the models of the system that is in the function of statistical distribution of time. Operational availability can be expressed as the relationship between the time in operation and the total time of the system. Mathematically, operational availability is determined by Eq. 14[1] - [6]:

$$A(o) = \frac{MTBM + Ready\ Time}{(MTBM + ReadyTime) + MDT} \tag{14}$$

Where:

MDT - mean down time
Ready Time - component is available and ready to operate

Operational availability is the lowest limit of performance that is experientially determined (by observing the system in operation) for the given projected capacity and other pre-specified criteria. When there is a high probability of the availability of a system with which the system will achieve the set goal, then the construction technology developer expresses the desired availability, i.e. *project availability.*

2.2.4. Operational availability - new approach

Additional divisions have been made with the new approach for defining operational availability within MTBM and MDT times. Namely, MTBM has been divided into the time when the component is available and in operation. MDT has also been divided into TCM, TPM and ALDT, i.e. according to Eq. 15 [6], [7]:

$$A(o) = \frac{OT + ST}{OT + ST + TCM + TPM + ALDT} \tag{15}$$

Where:

MDT – mean down time
OT – operational time
ST – standby time
TCM – total corrective maintenance time
TPM – total preventive maintenance time
ALDT – total administrative and logistic time

Comparing expressions 14 and 15 reveals the following:

$$MTBM + ReadyTime = OT + ST \tag{16}$$

While,

$$MDT = TCM + TPM + ALDT \tag{17}$$

This approach for defining operational availability provides a more detailed insight into the availability of the component in terms of the causes that led to the state of hibernation of that component. Also, different costs and capacities are associated with each given time [2].

2.3. Production availability

Due to its specific definition and similarity with operational availability, i.e. the availability of the system through which it passed, production availability (PA) deserves a special analysis approach.

Defining production availability differs from the previous definition of availability in terms of the time intervals and the type of delays. The production availability of the technological process is analyzed through efficiency, utilization, and basic availability of the following capacities and the states in which the component can be found [7]:

- maximum capacity
- nominal capacity
- reduced capacity
- stand-by state
- state of failure

Production (equivalent) availability (PA) can be defined as "the ratio of the equipment's equivalent operational time to a total given period, during which a system achieves a process output that is equivalent to its maximum dependable capacity" [7], [12]. Thus:

$$PA = \sum \left(\frac{To \times n \times MDC}{T \times MDC}\right) \tag{18}$$

Where:

To – time of component function at maximum capacity
MDC – maximum dependable capacity
n – ratio of process output
T – total time period

Equation 19 can be adopted as the *basis* for a proposal of the production *availability* model for *construction components*:

$$A = \frac{\sum_{i=1}^{n_o} h_i \times n_i}{\sum_{i=1}^{n_o} h_i} \tag{19}$$

Where:

h_i – time intervals for the available component with maximum, reduced and zero capacity
n_i – ratio between the actual (q_{act}) and maximum construction capacity (q_{max}) of the component

2.4. Availability standards

Because of the importance of the reliability, availability, and maintainability, as well as the related attributes, there are hundreds of associated standards. Some are general but more are specific to domains such as automotive, aviation, electric power distribution, nuclear energy, rail transportation, and software. Standards are produced by both governmental agencies and professional associations, and international standards bodies such as:

- The International Electro technical Commission (IEC), Geneva, Switzerland and the closely associated International Standards Organization (ISO) - IEC 60050-191:2015
- International Standards Organization (ISO), Earth-Moving Machinery - Machine Availability Vocabulary - ISO 8927 - 191
- The European Committee for Standardization (CEN) - EN 61703:2016
- The Association Française de Normalization (AFNOR) - X60-500
- The British Standards Institute (BSI) - BS 4778

- The American National Standards Institute (ANSI) - ASTM F 2446 - 04 (2018)
- Deutsches Institute Für Normung (DIN) - DIN EN 61703:2017-8
- The Japanese Industrial Standards Committee (JISC)
- The Russian National Standards (ГОСТ) - P 27000 - 2009
- The Serbian Institute for Standardization of Serbia (ISS) - SRPS EN 61703:2018
- Governmental Agencies – primarily in military and space systems (MIL STD-721B, MIL HDBK- 781, MIL STD-781C, DoD 32351- H, DoD - Guide for Achieving Reliability, Availability, and Maintainability - 2005
- Other national institutes for standardization

By analyzing all the definitions of availability, it can be observed that there are small differences that depend on the type of literature (military, industrial). For a comprehensive definition of availability for components and systems that are expected to be operational over a period of time (minutes, days, years), the following may be adopted:

Availability is the probability that a component/system, when used under stated conditions (operating mode and environment) will operate satisfactorily at a given point in time.

The basic mathematical definition of availability (A) is [7]- [12]:

$$A = \frac{UpTime}{TotalTime} = \frac{UpTime}{UpTime + DownTime} \tag{20}$$

2.5. Availability guidelines

Unlike standards, guidelines contain examples from practice with additional explanations. The most cited from the researched field are:

- The Institute of Electrical and Electronic Engineers (IEEE), New York, NY, USA, Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability and Productivity - IEEE 762 - 2006
- The Society of Automotive Engineers (SAE), Warrendale, PA, USA - SAE J 199
- Verner Deutscher Ingenieure - Rihtlinen - VDI 3423
- AMT - The Association for Manufacturing Technology, Production Equipment Availability - A, Measurement Guideline, USA

IEEE definitions and classifications do not differ substantially from the above standards. VDI 3423 and AMT guidelines refer to production components and systems, and represent an important guidance from the point of view of the application to project-organized systems. They therefore merit a special approach in presenting definitions and expressions for the availability of components and systems.

2.5.1. VDI 3423 - Technical Availability of Machines (VT) and Production Lines

According to Eq. 20, the technical availability, the percentage of operational time during which a component/machine is available for production without any technical shortcomings is [13]:

$$V_T = 100\% - \left(\frac{T_T}{T_B} \times 100\% \right) = \left(1 - \frac{T_T}{T_B} \right) \times 100\% \tag{21}$$

Where:

T_T – technical downtime

T_B – occupied time

The technical downtime T_T is the sum total of all downtimes resulting from shortcomings in the design and construction. Examples of such shortcomings are [13]:

- inadequate quantity and quality of material
- poor design or construction
- poor documentation
- need for corrective maintenance
- waiting for spare parts
- waiting for service personnel
- test runs serving for fault location
- test runs after fault rectification

The occupied time - T_B is that time within the period under consideration for which any utilization of the machine or plant is planned. According to Eq. 21, [13]:

$$T_B = T_N + T_O + T_T + T_W \tag{22}$$

Where:

T_N – utilisation time

T_O – organisational downtime

T_W – maintenance time

The utilisation time - T_N is the time in which the machine operates in full capacity.

The organisational downtime - T_O is the sum total of all downtimes caused by organisational shortcomings:

- energy shortfall
- lack of work pieces
- lack of tools
- insufficient training

This also includes downtimes which are caused by shortcomings in plant operation, or ensuring the process.

The preventive maintenance time - T_W includes any work to be done according to the maintenance schedule:

- scheduled servicing
- routine maintenance
- test runs following preventive maintenance

This guideline also contains a form for recording downtimes.

2.5.2. AMT - Production Equipment Availability - A Measurement Guideline

This guideline defines all the times in which the components of the production systems can be found, according to Figure 1, [14]:

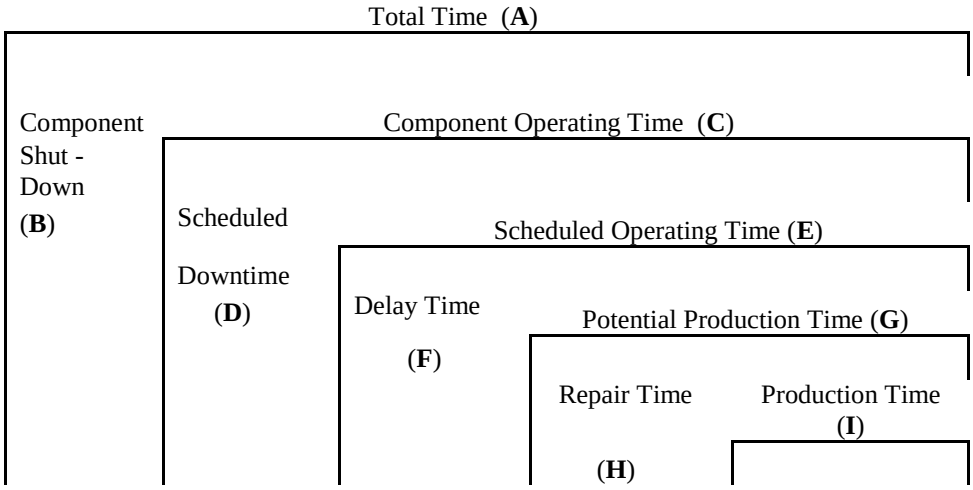

Fig. 1 Component Availability Parameters

Component availability is defined as the percentage of potential production time (G) during which equipment is operable, that is, operations are not prevented by component malfunction (or process difficulties in turnkey systems) [14]:

$$EquipmentAvailability = \frac{ProductionTime(I)}{PotentialTime(G)} \times 100\% \tag{23}$$

This guideline also introduces the term "overall availability". According toEq.24:

$$OverallAvailability = \frac{ProductionTime(I)}{ScheduledOperatingTime(E)} \times 100\% \tag{24}$$

3. COMPONENT AVAILABILITY MANAGEMENT IN CONSTRUCTION PROJECTS

Managing the availability of components / machines in construction projects involves:

- defining and classifying the availability function
- establishing a database of the availability of components from previous work (operational availability – A_o)
- predicting the project availability (A_p) of components
- determining the current availability of components at the end of the project and business year
- analysis of current and projected values
- updating the database with new values of current (operational) availability

3.1. Defining and classifying equipment availability

The availability of a construction machine or plant is the probability that will perform the function at a random time t, that is, at a given time t of the interval [0 - T].

The basic equation of availability according to Eq. 25 is:

$$A = \frac{OperationalTime + StandbayTime}{OperationalTime + StandbayTime + DownTime} \tag{25}$$

The component may be available, but without a function due to the failure of other parts of the system. Specifically, the component can be found in the following states:

- operational time with maximum capacity
- operational time with reduced capacity
- stand-by time (component is available with zero capacity)
- down time (component is in the state of outage or under scheduled or unscheduled maintenance)

This means that Eq. 19 needs to be modified to differentiate the time in which the component has the capacity of zero. Namely, the times "h_i" belong to the different capacities of the components (zero, reduced and maximum) in the case of an available component. The times "h_j" belong to the capacities of the zero value when the component is not available. So, the term for the production availability of a component of construction production systems can be adopted according to the Eq. 26:

$$A_{ocurrent} = \frac{\sum_{i=1}^{n_O} h_i \times n_i}{\sum_{i=1}^{n_O} h_i \times n_i + \sum_{j=1}^{n_f} h_j} \tag{26}$$

Where:

n_o – the times in which the component is available with different capacities

n_f – the times in which the component is unavailable

This approach to defining availability provides a realistic view of the cost of components for all the states in which the component can be found.

Equation 26 is the consequence of the expansion of Eq. 15 for the operational availability of a component from a cost perspective. By observing the time in which the component functioned and ignoring the oscillations in capacities, it follows that:

$$A = \frac{OT + ST}{OT + ST + TCM + TPM + ALDT} = \frac{\sum_{i=1}^{n_O} h_i \times n_i}{\sum_{i=1}^{n_O} h_i + \sum_{j=1}^{n_f} h_j} \tag{27}$$

3.2. Assessment of equipment availability

The first estimates of availability in the field of technical systems were based on the determination of statistical distributions for failure time and repair time [3]. Due to the long enough time in which the production systems function, probability distributions reach a statistical equilibrium, which means that production processes are in a steady state [8], [9]. The availability of components in such cases would be estimated on the basis of Equation 10, while the given time in the equation can be determined by the frequency balancing method.

Taking into account the life cycle of the components (LC), three characteristic periods are observed in which these components function. In fact, the life cycle of the components consists of early, constant, and late failure rates (λ). Each construction system consists of components with different stages in the life cycle which is non-homogeneous in terms of the age of the components. This feature of the components and systems leads to the modification of the frequency balancing method so as to increase the accuracy of component availability estimates. The results obtained did not differ significantly from the application of the frequency balancing method and the Monte Carlo simulation method [1], [2]. Specifically, when there are data on availability from the previous work (operational availability), then the availability estimates for periods *I*, II and III can be made on the basis of Eq. 28, 29 and 30 [1], [2].

Equation 27 is used to estimate the project operational availability of components (A_{po_I}) from period I [1], [2]:

$$A_{po_I} = (A_{O,aritmetic \cdot mean} + A_{O,\max}) / 2 \tag{28}$$

Equation 28 is used to estimate the project operational availability of components from the middle part of the life cycle (period II) [1], [2]:

$$A_{po_{II}} = max\left|A_{O,\,aritmetic \cdot mean}, A_{O,\,last \cdot year}\right| \tag{29}$$

Equation 29 is used to estimate the project operational availability of components from the last part of the life cycle (period III) [1], [2]:

$$A_{po_{III}} = A_{O,\,last \cdot year} \tag{30}$$

3.3. Algorithm / procedure for equipment availability management

The management of the availability of components / machines (C_{ij}) of construction production systems is shown in Fig. 2. For "i" and "j" the following applies:

$$i = 1,2,..., n \tag{31}$$

$$j = I, II, III \tag{32}$$

Where:

n – number of system components

I, II, III – life cycle periods of components

A_{oij} – operational availabilities from data base according to Eq. 26

A_{poj} – estimated component operational availability according to Eq. 28, 29, 30

$A_{ocurrent}$ – current component operational availability (availability after project completion) according to Eq. 26:

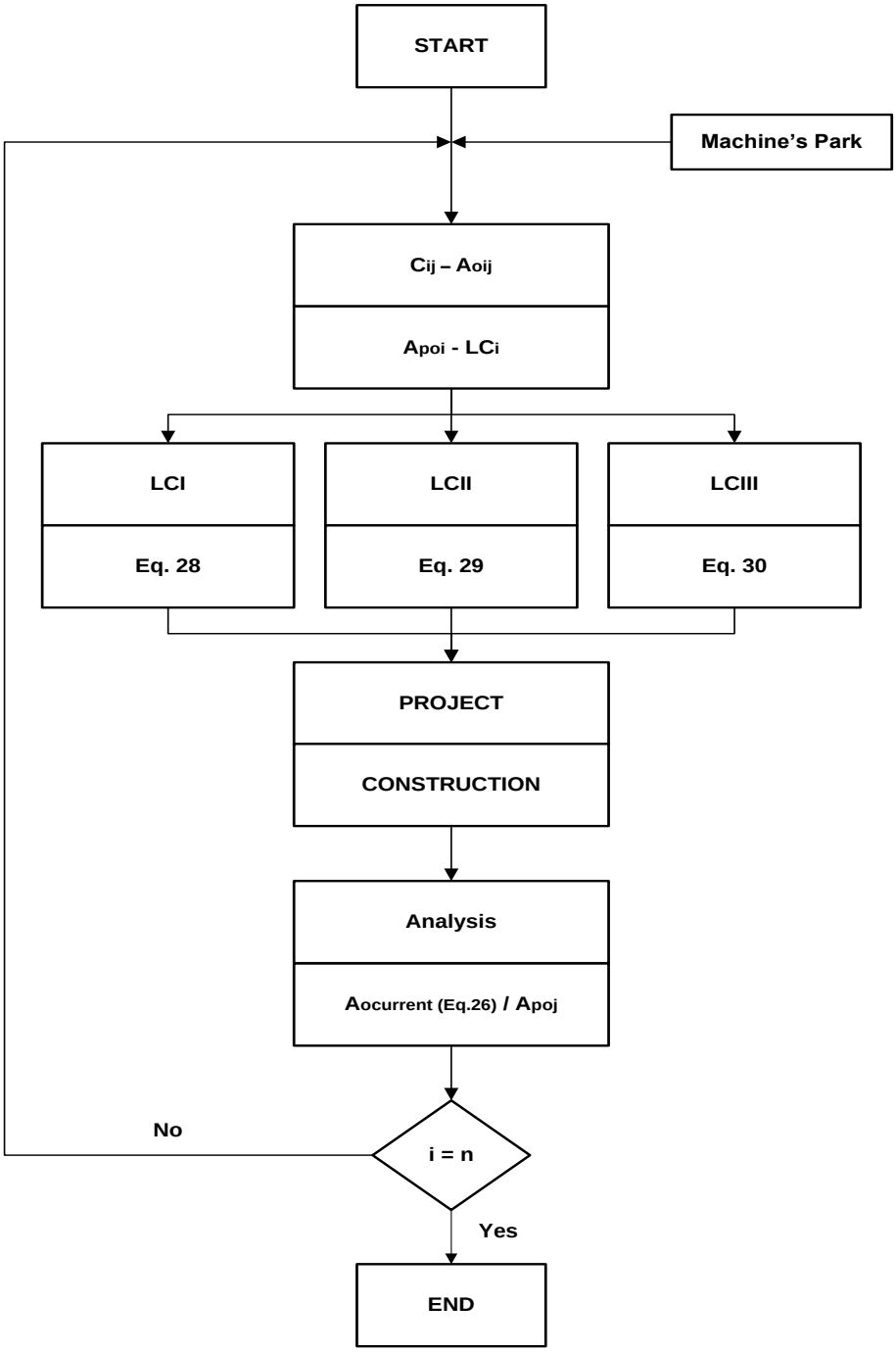

Fig. 2 Algorithm / procedure for equipment availability management

4. ILLUSTRATIVE EXAMPLE

In this section, the component production availability discussed above is illustrated with an example from the data base of an asphalt plant from a road construction company (Vojvodinaput-Zrenjanin).

The asphalt plant has a maximum capacity of 100 tons per hour (t/h) and has produced 92,780.00 tons of bitumen bounded materials for a period of 1077 hours. The planned hours of work with the nominal capacity were 92,780.00 / 90 = 1031 hours. In the period of question, according to Eq. 26, the plant was under the following conditions:

- maximum capacity $Q_{max} = 100$ t/h, $h_1 = 180$
- nominal capacity $Q_{nom} = 90$ t/h, $h_2 = 370$
- reduced capacity $Q_{red} = 85$ t/h, $h_3 = 488$
- stand by $Q_{stb} = 0$ t/h, $h_4 = 22$
- state of outage $Q_{out} = 0$ t/h, $h_5 = 17$

Capacity as a function of time for component availability is illustrated in Fig. 3.

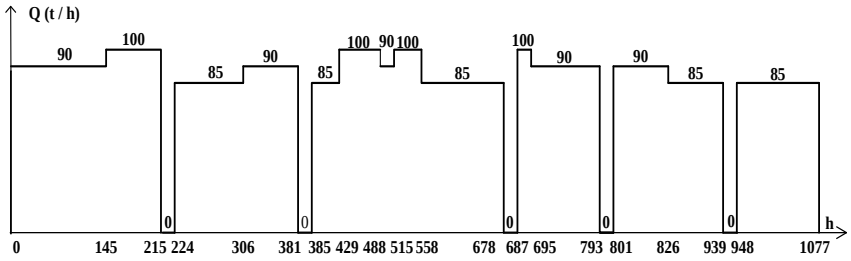

Fig. 3 Ratio between capacity and time as a function of plant availability

Figure 4 shows the planned amount of work (Q) and events (E) related to oscillations in capacities during the project.

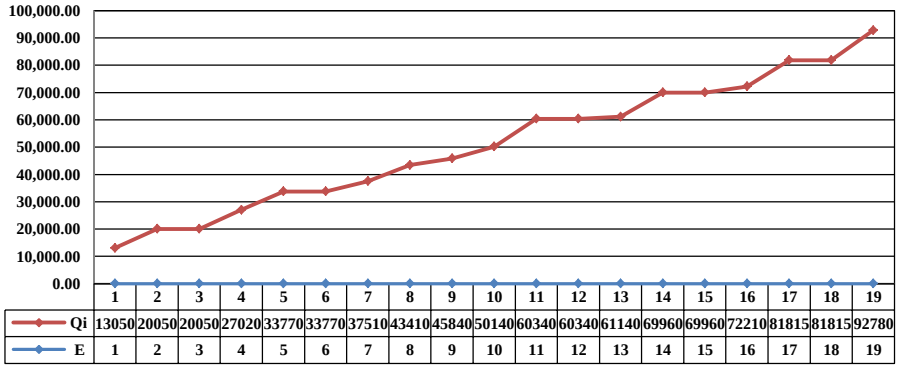

Fig. 4 Planned quantity of work as a function of capacity variation

According to equation 26, the production availability of the component is:

$$A_{ocurrent} = 1031/1077 = 0.9573$$

According to equation 29, the estimated production availability of the component is (see appendix):

$$A_{poj(II)} = 0.9555$$

The difference between the current and estimated availability is:

$$A_{ocurrent} / A_{poj(II)} = 0.9583/0.9555=1.0029,$$ i.e., 0.29 %

5. Discussion and Conclusion

The choice of the appropriate equation for the production availability of construction system components is influenced by oscillations in the capacities that are constantly presented in practice. Also, the separation of the time when the component is in a stand-by and a failure, i.e. at times when it is available and does not perform the function (ST) and the time when it is in failure (MDT). This approach is justified by the different costs that belong to the specified times and obtaining real data on the operational availability of the components / machines. Operational availabilities are the part of a database on the behaviour of components from the previous work.

Using the classic approach to defining the availability according to Eq.20 and not respecting the oscillations in capacities and availabilities when the component does not perform its function, the availability value is:

$$A = (1077\text{-}22\text{-}17)/1077= 0.9638$$

This approach creates a misconception about the behaviour of the component and increases the risks in the cost estimation in the bidding phase.

Also, by applying Eq.15, which recognizes the availability when the component does not perform the function (ST), but does not respect time with different capacities, it may consequently have the above mentioned omissions. Namely:

$$A_o = (1077\text{-}22)/1077=0.9796$$

We believe that the equation proposed in this work for determining the operational availability of production components in project-organized (construction) systems (Eq. 26) is both appropriate and effective In fact, the test result obtained, which varies by 0.29% in relation to the estimated value, i.e. 2.9 ‰, confirms the feasibility of using an equation and assessment methodology based on the non-homogeneity of construction systems in terms of the different life cycles of the components.

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APPENDIX

Table A.1 shows the operational availabilities with elementary statistics of the tested component/asphalt plant from the data base of the company for road construction-Vojvodinaput-Zrenjanin.

Table A.1 Operational availabilities of the asphalt plant during the research period

Component	Asphalt Plant W - 100				
Year / Parameter	MTBF	MTTR	λ	μ	A_o
2005	92.80	4.00	0.0108	0.2500	0.9587
2006	102.77	4.46	0.0097	0.2241	0.9584
2007	96.56	4.78	0.0103	0.2093	0.9531
2008	118.67	5.33	0.0084	0.1875	0.9570
2009	126.50	6.33	0.0079	0.1579	0.9523
2010	138.80	6.40	0.0076	0.1563	*0.9534*
Minimum	92.80	4.00	0.0076	0.1563	0.9523
Maximum	138.80	6.40	0.0108	0.2500	0.9587
Variation interval	46.00	2.40	0.0032	0.0937	0.0064
Arithmetic mean	112.68	5.22	0.0091	0.1975	***0.9555***
Mid interval	115.80	5.20	0.0092	0.2032	0.9555
Deviation from the right	135.68	6.42	0.0107	0.2444	0.9587
Deviation from the left	89.68	4.02	0.0075	0.1507	0.9523

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KLASIFIKACIJA RASPOLOŽIVOSTI SA ASPEKTA PRIMENE NA GRAĐEVINSKE PROIZVODNE SISTEME: PREGLED

Cilj rada je unapređenje postojećih klasifikacija raspoloživosti komponenata sa aspekta primene na građevinske sisteme. Građevinski proizvodni sistemi pripadaju projektno organizovanim sistemima sa serijsko paralelnom strukturom, sa ili bez redundantnih komponenata i funkcija raspoloživosti ima značajan uticaj na pokazatelje performansi komponenata i sistema. Glavni pokazatelji funkcionisanja komponenata su raspoloživost, kapacitet, troškovi i projektno vreme. Novi pristup klasifikaciji omogućuje izbor odgovarajućeg pristupa proceni projektne raspoloživosti i upravljanju mašinskim parkom kompanija. Novi pristup je testiran na primeru iz prakse. Dobijeni rezultati potvrdili su opravdanost za proširenje klasičnog pristupa klasifikaciji proizvodne raspoloživosti komponenata.

Ključne reči: *raspoloživost, građevinska komponenta, indikatori komponenata, proizvodni system*

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MEASUREMENT OF USER SATISFACTION IN VERTICAL PEDESTRIAN MOVEMENTS

UDC 72.052.8

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Abstract. *This research study examines the human relationship with the staircase, the vertical circulation tool, in terms of user satisfaction. In the literature, the lack of papers dealing with user satisfaction in detail within the scope of dimensional competence necessitates this study. The satisfaction values of the stair users and the variables affecting these values, and at the same time, the realisation of the satisfaction analysis of the existing national stairway standards constitute the main objective of the study. For this purpose, 400 user satisfaction surveys were conducted in two different application areas and analysed by Statistical Package for the Social Sciences software. According to the findings of the research, the stairs chosen in the application areas are designed in accordance with national stairway standards. Users expressed their dissatisfaction with normal-to-weak-weighted negative feedback on the variables of visual admiration, dimensional competence, safety and fatigue. Finally, the existence of the relationship between the variables affecting the user satisfaction is examined; recommendations based on user satisfaction for staircases design are offered.*

Key words: *Vertical Circulation, Stairs, User Satisfaction, Pedestrian Motion, National Stairway Standards*

1. INTRODUCTION

The relationship between human and structured environments, pedestrian movements and social behaviour are examined and expressed especially based on spatial perception [1]. According to Bacon, spaces and environments do not take on significance without time and movement; therefore, they are expected to encourage users activate and excite design elements [2]. The examination of urban space design studies reveals an aim to leave continuous and uninterrupted effects on people who move within the spaces [3].

The concept of pedestrian movement is also important in vertical circulation, which has existed since the beginning of human life. Vertical pedestrian movements are provided by simple staircase examples in primitive life. With today's architecture and technological

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facilities, these movements are provided by systems such as elevators, escalators and ramps. These elements, which provide vertical pedestrian movement with fixed or movable systems, are expected to create positive psychological effects, as well as physical features such as providing the shortest possible and least exhausting connection. Some studies evaluated this question in terms of design and cognition and examined it both in the spaces where the pedestrians move constantly and in the space scale [4]. In other words, these elements are expected to make human movement, especially wayfinding more efficient, which brings satisfaction to the pedestrian [5].

Human-vertical circulation relationships and developments in architecture necessitate user satisfaction in the creation of human-oriented design. However, this consideration is often neglected in architectural elements that are designed to satisfy the human being. Considering this situation, it is necessary to focus on user satisfaction in vertical circulation elements, which are used intensively in daily life. The literature review revealed that user satisfaction was emphasised in the studies on the pedestrian movements. However, a detailed study on user satisfaction in vertical circulation elements was not found.

Stairs have their own basic geometry and rules that depend on the physical characteristics of people. The structure of the stairs should be shaped according to the structure of the human body [6]. Staircases have been designed with consideration for these elements. Over time, the basis of the dimensional measures of the stairs have been preserved and only minor changes have been made for improvements.

Vitruvius stated the ideal dimensions with the temple stairs. According to this example, the riser height should be 23-25.5 cm and the tread widths should be 46-51cm or 1.5-2 step width. Later, different dimensions were determined for more comfortable movement on stairs [6]. While different riser heights and tread widths have been observed in different regions, the balance between these measurements unchanged. From this point of view, some international and national standards in current use are presented in Table 1 and Table 2.

Today, technological advances tend to improve the quality of life by making it easier. These developments have led people to settled and inactive lifestyles that cause health problems. In this context, many exercise behaviours that we perform in daily life are solutions to health problems.

The use of stairs constitutes an example of short, repetitive exercise behaviour. Stair-climbing behaviour, especially against gravity, is considered a strong physical exercise [14]. The importance of the use of stairs as a physical activity is emerging in consideration of the protective role of exercise for many diseases such as cardiovascular diseases, diabetes and cancer [15]. The United States Department of Health and Human Services proposed the increased use of staircases to be one of the 100 life-changing steps against obesity [16].

Experimental studies have been performed to improve the behaviour of stairs and their frequent use in daily life. When the studies were examined, it was observed that users wanted to create behavioural changes through orientation signs, posters, images or texts on the strips. In these studies, visual stimulants were found to have positive effects on increasing the use of stairs [17]. Different commands and clues were frequently used on the stairs to increase stair-climbing behaviour [18]. In a similar study [19] that considered the demands of users, it was suggested the existence of elements such as easy access to the ladder area and aesthetic features improved the stairs and made them more attractive. In another study on university structure, an 8.2% increase in total staircase use was achieved through the aesthetic features of the stairs and visual orientation signs [20]. In another study [21], the use of stairs increased from 27.7% to 31.2% with visual footprint guidance and to 43.6% with the use of health messages. While modern social trends and technologies affect the quality of life, they create an inactive lifestyle with negative health results [22]. The

persuasive negative effects of technology will be reduced by the effect of technology and create a social impact by altering the attitudes and behaviours of people [23]. For this purpose, next to the escalator in Odenplan Metro station in Stockholm, a social staircase design with a musical staircase concept was applied. This design increased the use of stairs by 66%, which led to the development of different social behaviours of users [24].

Table 1 Comparison of Dimensional Properties of International Stair Standards [7, 8, 9, 10].

	ADA Standards (Americans with Disabilities Act)	BS 5395-1:2010 (British Standards)	BOCA (Building Officials Code Administrators)	DIN 18065 (Deutsches Institut für Normung)
Riser Height and Tread Widths (cm)	Riser Height: min. 10 cm. max. 18 cm. Tread Widths: min. 28 cm.	Tread Widths: 2R+T= 60 cm.	Riser Height: min. 10 cm. max. 18 cm. Tread Widths: min. 22.8 cm. Suggested Angle: 25 cm.	Riser Height: min. 14 cm. max. 19 cm. Tread Widths: 2R+T= 59 cm.~ 65 cm. min. 26 cm. max. 37 cm.
Stair Width (cm)	-	-	min. 91cm.	min. 80cm.
Landing Length (cm)	-	min. 85 cm.	-	-
Angle of Staircase (deg)	-	15° ~ 55° Suggested Angle 42°	-	-
Handrail Height (cm)	86.5 cm. ~ 96.5 cm.	min. 85 cm.	86 cm. ~ 96 cm.	80 cm. ~ 115 cm.
Headroom (cm)	-	min. 200 cm.	min. 203 cm.	min. 200 cm.

Table 2 Comparison of Dimensional Properties of National (in Turkey) Stair Standards [11, 12, 13].

	Planned Areas Zoning Bylaws	İstanbul Municipality Zoning Bylaws	Ankara Municipality Zoning Bylaws
Riser Height and Tread Widths (cm)	Riser Height: Without elevator: max. 16 cm With elevator: max. 18 cm. Tread Widths: min. 28 cm.	Riser Height: in housing: max. 17 cm. in other structures: max. 16 cm. in outdoor stairs: max. 15 cm. Tread Widths: min. 27 cm. in housing: min. 27 cm. in other structures: min. 29 cm. in outdoor stairs: min. 32 cm.	Riser Height: Without elevator: max. 16 cm With elevator : max. 18 cm. Tread Widths: min. 28 cm. in housing: min. 28 cm. in other structures: min. 30 cm. in outdoor stairs: min. 35 cm.
Stair Width (cm)	in housing: min.120 cm. in other structures: min.150 cm.	in housing: min.120 cm. in other structures: min.150 cm.	in housing: min.120 cm. in other structures: min.150 cm.
Landing Length (cm)	in housing; min.120 cm. in other structures; min.150 cm.	in Housing; min.120 cm.	in Housing; min.120 cm.
Angle of Staircase (deg)	-	-	-
Handrail Height (cm)	number of steps >5; 90 cm	number of steps >5; 90 cm	number of steps >5; 90 cm
Headroom (cm)	-	-	min. 210 cm.

2. METHOD

In this part of the study, the relationship between the stairs and the user satisfaction of the vertical circulation elements was evaluated.

As a first step, field observations were made in the designated area. Dimensional properties of the stairs on the two selected application areas were determined and compared to national and international stairway standards. Surveys were conducted to measure user satisfaction and perform statistical analysis of the collected data. These questionnaires, with 11 Likert types and 2 multiple-choice questions, aim to determine the level, dimensional competence and safety of the stairs. Finally, the completed current survey data underwent regression and correlation analysis with the SPSS 19 programme. The data were examined for answers to the following hypotheses:

- There is a positive relationship between the dimensional properties of the stairs and the users' feeling of fatigue.
- There is not a relationship between the gender of the user and the safety of the stairs.
- There is a positive relationship between the dimensional properties of the stairs and the aesthetic-visual appreciation.
- There is a relationship between the aesthetic-visual appreciation of the stairs and the user's gender.

2.1. Case Study

Suleyman Demirel University's central campus was chosen for this field study. As a result of the preliminary observations, two vertical circulation areas with intensive use within the central campus of SDU boundaries and dimensional characteristics of the areas were determined.

2.1.1. *West Campus- Application Area A*

The selected area of application on the SDU West Campus is on an important pedestrian axis (Figure 1) and serves a large part of the West Campus (rectorate building, student affairs office and most engineering structures). The application area was observed for five days in April, 2017. Preliminary observations indicated that the lowest pedestrian intensity in the application area was between 14.30 and 15.30 and the maximum pedestrian intensity was between 16.30 and 17.30, as presented in Tables 3a and 3b.

Fig. 1 West Campus- Application Area A

Table 3a Application Area - A 14.30-15.30 Pedestrian Density Analysis

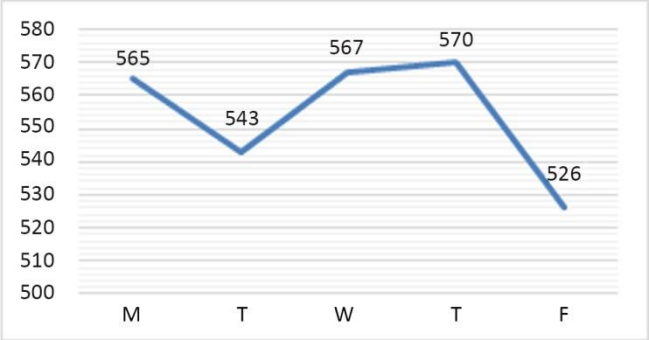
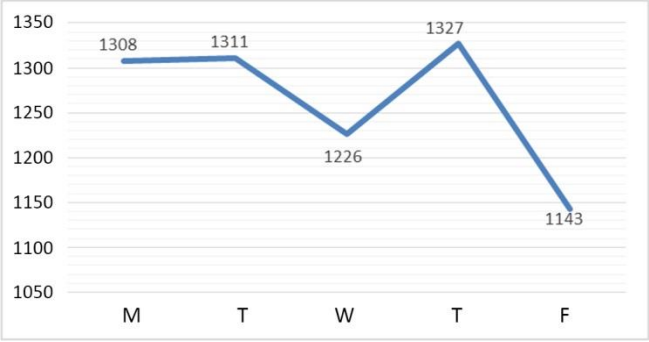


Table 3b Application Area - A 16.30-17.30 Pedestrian Density Analysis



The staircase in the application area consists of 50 steps. The stairway has the same size and 17 cm riser height in each step. Tread widths are 30 cm and 32 cm. The width of the stairs continues to be 5 m until the last eight steps, at which it decreases to 3 m. The staircase has 24 landings with an irregular distribution of 290-300 cm in width. Handrail heights are 75 cm.

2.1.2. *East Campus- Application Area B*

The selected application area on the SDU East Campus is on a pedestrian axis with intensive use (Figure 2). This axis is a continuation of the bridge connecting the West Campus and the East Campus and serves a large part of the East Campus (library and central classrooms structure). The application area was observed for five days in April, 2017. Preliminary observations indicated that the lowest pedestrian intensity in the application area was between 10.30 and 11.30 and the maximum pedestrian intensity was between 08.30 and 09.30, as presented in Tables 4a and 4b.

Fig. 2 East Campus- Application Area B

Table 4a Application Area - B 08.30-09.30 Pedestrian Density Analysis

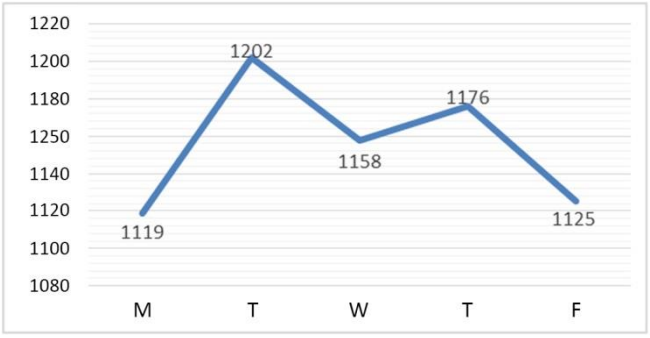
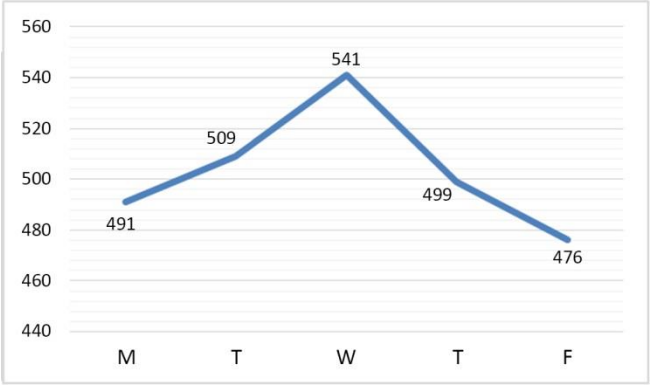


Table 4b Application Area – B 10.30-11.30 Pedestrian Density Analysis



The staircase in the application area consists of 56 steps. The riser height of stairs is 17 cm, with the exception of the last 17 steps, which are to 14 cm. Tread widths are 38 cm. The width of the stairs is 4 m. The staircase has 15 landings with an irregular distribution of 175-210 cm in width. Handrail heights are 75 cm.

2.2. User Satisfaction Survey

The vertical circulation satisfaction survey begins with questions about gender, age and education level in order to determine the demographic characteristics of the users. These questionnaires, with 11 Likert types and 2 multiple-choice questions, aim to determine the level, dimensional competence and safety of the stairs.

The survey was separately performed for the SDU West Campus application area A and the SDU East Campus application area B. Analysis studies were conducted for each application area.

2.2.1. *West Campus- Application Area A*

The vertical circulation satisfaction questionnaire was completed by 200 users. Of these participants, 193 volunteers were valid and seven volunteers were considered invalid. The sample group consisted of 90 men and 103 women. This group has an average age of 21.33 years. In addition, Cronbach's alpha value was determined as 0.819 as a result of a reliability analysis performed on the feedback surveys.

2.2.2. *East Campus- Application Area B*

The vertical circulation satisfaction questionnaire was completed by 200 users. Of these participants, 185 volunteers were valid and 15 volunteers were considered invalid. The sample group consisted of 91 men and 94 women. This group has an average age of 21.85 years. In addition, Cronbach's alpha value was determined as 0.833 as a result of a reliability analysis performed on the feedback surveys.

3. RESULTS

In this study, the factors affecting the satisfaction of the stairs were examined and analysed. In the first stage, national and international staircase standards were examined and property dimensions such as stair width, riser height and tread width were obtained.

- The maximum value of the riser height of the stair is approximately 18 cm depending on the area characteristics in compliance with national and international standards.
- The minimum value of the tread width is 28 cm by national standards; by contrast, different minimum values of the tread width are accepted by international standards.
- National standards set the minimum value of the stair width as 120 cm for residential buildings and 150 cm for other buildings; by contrast, the minimum value of the stair width is 91 cm by Boca Standards (1995) and 80 cm by DIN 18065 (2015).
- Handrail height is specified as 90 cm by national standards. International standards set handrail height between 85 cm and 96.5 cm.
- There is not enough data to compare the national and international standards for headroom, landing length and staircase angle.

The properties of the two different staircases were evaluated according to the above-mentioned standards. The evaluation results are as follows:

- Riser heights are 17 cm in application area A, whereas riser heights are 14-17 cm in application area B. These values are compatible with national stairway standards.
- Tread widths are 30-32 cm in application area A, whereas tread widths are 38 cm in application area B. These values are partially compatible with national stair standards.

- Stair widths are 5 m in application area A, whereas stair widths are 4m in application area B. These values are compatible with national stairway standards.
- The handrail heights, measuring at 75 cm in both application areas, are compatible with national stairway standards.

3.1. Application Area A Survey Results

- The stairs were deemed visually and aesthetically poor by 37.8% of participants.
- The majority of participants found the adequacy of the dimensional properties of the stairs fair (31.6%) or poor (42.5%).
- The riser heights were described as fair by 40.9% and satisfactory by 29.5% of participants.
- Participants characterised the tread widths as dimensionally wide (40.4%) and fair (26.4%).
- The stair widths were described as dimensionally wide by 49.2% of participants.
- Most participants rated the safety of the stairs as fair (38.3%) or good (satisfactory) (33.2%).
- Feelings of fatigue after completing between 11 and 20 steps during stair ascent and descent were reported by 25.9% of participants. Feelings of fatigue were reported by 67.3% of participants at the ascent midpoint.

According to the above-mentioned survey values, it is observed that user satisfaction with the staircase is insufficient. In addition, it is thought that the variability of the dimensional properties between steps of the staircase contributes to user dissatisfaction.

3.2. Correlation Analysis for Application Area A

The correlation value between the gender of the user and the aesthetic and visual appreciation of the stairs was determined as 0.099 (Table 5). This value indicates that there is an extremely weak relationship or no relationship between the two variables.

Table 5 The relationship between of gender- aesthetics and visual appreciation

		gender	appreciation
gender	Pearson Correlation	1	,099
	Sig. (2-tailed)		,170
	N	193	193

The correlation value between the dimensional properties of the stairs and user fatigue was determined as 0.690 (Table 6). This value indicates that there is a positive and high degree of relationship between the two variables.

Table 6 The relationship between of dimensional properties of stair and user fatigue

		dimensional properties	user fatigue
dimensional properties	Pearson Correlation	1	,690
	Sig. (2-tailed)		,000
	N	193	193

The correlation value between the gender of the user and the safety of the stairs was determined as 0.038 (Table 7). This value indicates that there is an extremely weak relationship or no relationship between the two variables.

Table 7 The relationship between of the gender of the user and safety of the stairs

		gender	safety of the stairs
gender	Pearson Correlation	1	,038
	Sig. (2-tailed)		,602
	N	193	193

The correlation value between the dimensional properties of the stairs and the aesthetic and visual appreciation of the stairs was determined as 0.539 (Table 8). This value indicates that there is an extremely weak relationship or no relationship between the two variables.

Table 8 The relationship between of dimensional properties of stair and the aesthetic and visual appreciation of the stair

		Dimensional Properties of Stair	appreciation
Dimensional Properties of Stair	Pearson Correlation	1	,539
	Sig. (2-tailed)		,000
	N	193	193

3.3. Application Area B Survey Results

- The stairs were deemed visually and aesthetically poor by 37.8% of participants same as area A.
- The majority of participants found the adequacy of the dimensional properties of the stairs fair (49.7%) or poor (28.1%).
- The riser heights were described as fair by 44.9% and satisfactory by 28.1% of participants.
- Participants characterised the tread widths as dimensionally wide (42.2%) and fair (35.1%).
- The stair widths were described as dimensionally wide by 37.8% of participants.
- Most participants rated the safety of the stairs as fair (37.8%) or well (satisfactory) (31.9%).
- Feelings of fatigue were reported by 27.0% of participants after completing between 11 and 20 steps during stair ascent and descent. Feelings of fatigue were reported by 70.0% of participants at the ascent midpoint.

3.4. Correlation Analysis for Application Area B

The correlation value between the gender of the user and the aesthetic and visual appreciation of the stairs was determined as 0.035 (Table 9). This value indicates that there is an extremely weak relationship or no relationship between the two variables.

Table 9 The relationship between of gender- aesthetics and visual appreciation

		gender	appreciation
gender	Pearson Correlation	1	,035
	Sig. (2-tailed)		,220
	N	185	185

The correlation value between the dimensional properties of the stairs and user fatigue was determined as 0.623 (Table 10). This value indicates that there is a positive and high degree of relationship between the two variables.

Table 10 The relationship between of dimensional properties of stair and user fatigue

		dimensional properties	user fatigue
dimensional properties	Pearson Correlation	1	,623
	Sig. (2-tailed)		,000
	N	185	185

The correlation value between the gender of the user and the safety of the stairs was determined as 0,019 (Table 11). This value indicates that there is an extremely weak relationship or no relationship between the two variables.

Table 11 The relationship between of the gender of the user and safety of the stairs

		gender	safety of the stairs
gender	Pearson Correlation	1	,019
	Sig. (2-tailed)		,794
	N	185	185

The correlation value between the dimensional properties of the stairs and the aesthetic and visual appreciation of the stairs was determined as 0.558 (Table 12). This value indicates that there is an extremely weak relationship or no relationship between the two variables.

Table 12 The relationship between of dimensional properties of stair and the aesthetic and visual appreciation of the stair

		Dimensional Properties of Stair	appreciation
Dimensional Properties of Stair	Pearson Correlation	1	,558
	Sig. (2-tailed)		,000
	N	185	185

4. Conclusions and Recommendations

People prefer to use escalators and elevators to stairs as vertical circulation tools. Stair-climbing is exhausting and requires effort. Current studies to increase the use of stairs have been insufficient in increasing usage preference and lasting user satisfaction due to the lack of examination of the dimensional deficiencies that cause fatigue.

Based on the effects of the dimensional properties of the stairs on user satisfaction, the dimensional standards determined by the different societies were examined. These standards, which should be determined depending on the anthropometric dimensions of people, generally have close values. It is a universal problem for societies with anthropometric differences to use similar stair standards. Therefore, a field study was conducted considering Turkish stair standards. Although the selected areas are in line with the Turkish stair standards, they are inadequate in terms of user satisfaction. Their dimensional inadequacies have been specifically mentioned by the users. This indicates that the existing Turkish stairway standards do not comply with the national anthropometric structure and that similar results may arise on different country standards.

The study findings result in the following recommendations:

- Attempt to increase stair user satisfaction by focusing on dimensional competence rather than visual and aesthetic aspects, contrary to studies in the literature.
- Discuss and improve existing stairway standards by examining the anthropometric dimensions of societies within the scope of dimensional competence.
- Perform the necessary dimensional improvements to ensure user satisfaction on existing stairways.

These recommendations are the basis for future work. These changes will remove the tiring, frightening and unhealthy aspects of vertical pedestrian movement for users. Making the use of stairs exciting and safe will permanently increase their use.

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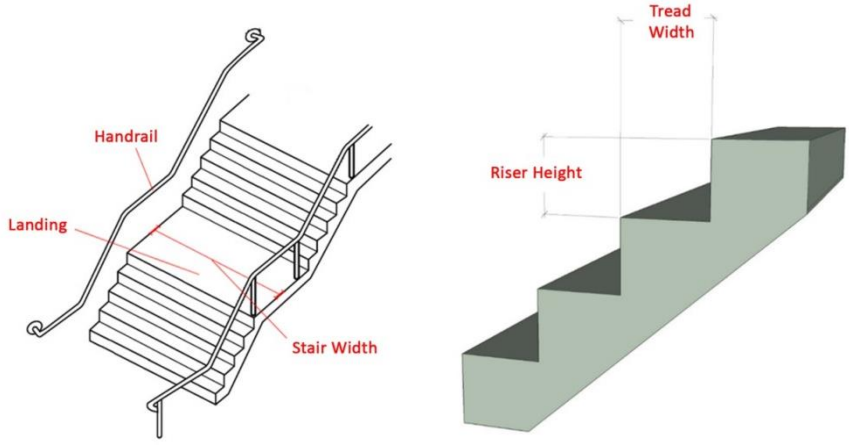
APPENDIX - 1
USER SATISFACTION SURVEY

Gender: Female □ Male □

Age:

Level of Education / Occupation:

Sample stairs and definitions



Please answer the following questions related to the staircase of the campus where you live and are using approximately everyday. (1*2*3*4*5)

1. Please evaluate of the design of stair aesthetically.
Very poor ① Poor ② Fair ③ Good ④ Excellent ⑤

2. Please evaluate of the functionality and comfort of stair.
Very poor ① Poor ② Fair ③ Good ④ Excellent ⑤

3. Please evaluate of the dimensional competence of stair.
Very poor ① Poor ② Fair ③ Good ④ Excellent ⑤

4. Please evaluate of the riser height of stair. (Low: very poor, high: excellent)
Very poor ① Poor ② Fair ③ Good ④ Excellent ⑤

5. Please evaluate of the tread width of stair. (Narrow: very poor, wide: excellent)
Very poor ① Poor ② Fair ③ Good ④ Excellent ⑤

6. Please evaluate of the stair width. (Narrow: very poor, wide: excellent)
Very poor ① Poor ② Fair ③ Good ④ Excellent ⑤

7. Please evaluate safety of the stair.
Very poor ① Poor ② Fair ③ Good ④ Excellent ⑤

8. If you do not think the stairs safe, please state your opinion on the reason.
□ - Stair has many slope
□ - Stair has different riser heights and tread widths
□ - The stair does not have enough lighting
□ - The stair does not have enough handrail heights
- Other reasons.....

9. Please evaluate visual liking of the stair.
Very poor ① Poor ② Fair ③ Good ④ Excellent ⑤

10. If you don't like the stair visually, please give your opinion on the solutions.
□ - Different railing designs can be selected.
□ - Landscaping can be differentiated.
□ - Different stair designs can be selected.
- Another opinion.....

11. Which vertical circulation tool do you prefer instead of stair?
Elevator □ Escalator □ Ramp □ Another …….

12. Are you tired of ascent - descent?
Yes □ No □

13. Which steps are you getting tired at?
□ 0-10
□ 11-20
□ 21-30
□ 31-40
□ 41-50

MERENJE ZADOVOLJSTVA KORISNIKA VERTIKALNIM KOMUNIKACIJAMA ZA PEŠAKE

Ovo istraživanje ispituje odnos ljudi i stepeništa, koje je instrument za vertikalnu komunikaciju, u smislu zadovoljstva korisnika. U literaturi je malo radova koji se detaljno bave zadovoljstvom korisnika pravilnim dimenzionisanjem, što je bilo povod za ovu studiju. Vrednosti zadovoljstva korisnika stepeništa i promenljive koje utiču na ove vrednosti, i sa druge strane analiza zadovoljstva korisnika postojećim nacionalnim standardima za stepeništa čine glavni cilj ove studije. U tom cilju je anketirano 400 korisnika u dva rejona i ankete su analizirane korišćenjem Statističkog paketa softvera Društvenih nauka. Prema nalazima istraživanja, odabrane stepenice u datim rejonima su projektovane u skladu sa nacionalnim standardima za stepenište. Korisnici su izrazili svoje nezadovoljstvo i dali normalno do slabo ponderisanu negativnu povratnu informaciju o promenljivima kao što su vizuelno dopadanje, pravilno dimenzionisanje, bezbednost i zamor. Konačno, ispituje se postojanje odnosa između promenljivih koje utiču na zadovoljstvo korisnika; daju se preporuke zasnovane na zadovljstvu korisnika stepeništima.

Ključne reči: *vertitkalna komunikacija, stepenište, zadovoljstvo korisnika, kretanje pešaka, nacionalni standardi za stepeništa*

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INFLUENCE OF GLAZING TYPE ON ENERGY EFFICIENCY OF INDUSTRIAL BUILDINGS IN THE PROCESS OF REVITALIZATION – A CASE STUDY

UDC 725.4:620.9(497.11)
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692.232.4:691.6(497.11)

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Abstract. *This paper examines the possibilities of improving the energy performance of an existing industrial building by application of the double skin façade on the revitalization of the building envelope in the climatic conditions of the city Novi Pazar, Republic of Serbia. The aim is to examine the impact of choosing the type of glazing, in the processes of revitalization, on the energy needs of industrial buildings for heating and cooling, as well as the contribution of the measures implemented to improve the energy performance of the selected type and model of industrial building. The energy performance of buildings was obtained using the software DesignBuilder and EnergyPlus simulation platform, taking into account the parameters of required internal temperature and climate data for the Republic of Serbia. The comparative analysis of the results of energy simulation according to the criterion of achieving greater energy savings and reduced carbon dioxide emissions was performed. The methodological approach in this research involves creating revitalization scenarios of industrial buildings with a shed roof construction, selection of the specific building according to whose properties by numerical simulation possibilities for energy revitalization depletion were investigated and comparative analysis of the obtained results was performed. The primary objective of this research is to investigate the impact of choosing the type of glazing on the energy performance of industrial buildings with a shed roof construction and to determine the optimal approach to energy revitalization of existing industrial buildings with the implementation of the double skin façade under the climatic conditions of the city Novi Pazar, Republic of Serbia. The results of this paper indicate the negative characteristics of the kopilit glass to solar gains, whose retention requires a large amount of heating energy. While replacing of kopilit glass with a low-energy glass increases the amount of energy required to cooling of the building. With this research, through various revitalization scenarios, it is also indicated that using a double skin façade in the*

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revitalization process of the selected building, has a very similar impact on reducing CO_2 emissions regardless of the type of glazing choice.

Key words: *type of glazing, adaptive reuse, energy efficiency, renewable energy, legislation*

1. INTRODUCTION

Buildings consume about 40% of the total energy in the European Union [1]. Energy efficiency and use of energy from renewable sources represent important measures needed to reduce energy consumption in buildings and environmental pollution [2]. Therefore, the primary parameters that mostly affect an office building energy performance are heating and cooling requirements during the working hours [3].

Analysis of the energy performance of buildings is a topic that has been investigated in numerous important scientific papers through simplified and detailed models based on window properties, building design, and climate conditions [4]. Parameters affecting the amount of energy required for heating and cooling the building are: location, orientation and micro-climate, shape of the building, windows and doors of the building, the orientation, utilization of internal thermal gains (especially the passive solar gain), thermal mass, thermal insulation of the building skin, doors and windows, providing through the envelope of the building, circulation of the heating system and the ventilation system. Simulation of thermal gain with the use of glass in the materialization of building, from the aspect of energy, was sufficiently tested in the previous research [5]. The optimization of energy characteristics of existing industrial buildings for the climatic conditions of the Republic of Serbia in the case of conversion of space has been examined [6]. Numerous experimental studies on the impact of glazing on the energy characteristics of the building have been carried out [7-9], as well as research of numerical simulations by creating dynamic computer models [10].

This paper presents the potential ways of application of double skin facade in the process of reconstruction, as an element of passive solar architecture, re purposing and energy revitalization of the existing building. The existing industrial structure needs to be converted into the building for administrative purposes. The chosen type of industrial building is an industrial hall with a shed roof. By adaptive reuse of existing industrial building in an administrative building is given a proposal of functional zones in the building on the basis of which the thermal loads of functional units have been performed. Model of the newly designed building has been a subject to numerical simulation by use of EnergyPlus software [11] and DesignBuilder software [12] and with those results the values of the energy needed for heating and cooling of the building, carbon dioxide emission, the amount of solar gain have been obtained. The influence of the building on the environment, the reduction of carbon dioxide emissions are discussed as a criteria for improving the energy efficiency of the building. Based on the obtained results of necessary energy and carbon-dioxide emissions in buildings that have a double skin facade as a cover, the optimization of the obtained solutions from the aspect of applying the type of glass is discussed, as the basic element of passive solar systems.

2. METHODOLOGY

Selected type of industrial facility has been created in a computer program and is subject to numerical simulations in order to gain insight into its energy performance. Numerical simulation is carried out in accordance with applicable regulations in the field of energy efficiency of buildings, based on climate characteristics of locations, data on building materials, components and systems, data on electrical equipment, apparatus, and purpose of use of the building. By use of computer simulations of the energy performance of buildings a great advantage when designing new or revitalization of already built facilities is provided. In the first phase of the design already the different alternatives in the design and meeting the expected aesthetic and energy requirements of buildings can be tested.

Simulation of different revitalizations of the chosen model is derived using EnergyPlus simulation platforms, with the help of graphic software DesignBuilder. This software combination was chosen primarily because of the reliability of EnergyPlus program, which is one of the most efficient tools which most other commercial software rely on [13]. And because of the reliability of software Design Builder which obtained simulation data significantly coincide with the real data in the functioning of the building. [14]. In Table 1 is specified five different scenarios of revitalization of the facility, of which 4 involve the application of a double skin facade while one revitalization scenario is a classic tread.

Table 1 Proposed measures of revitalization of selected industrial building

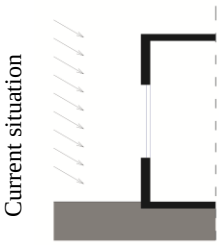
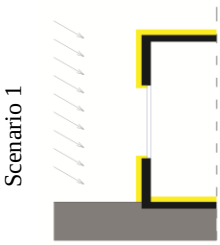
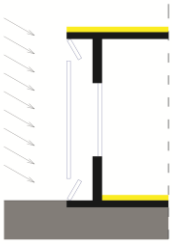
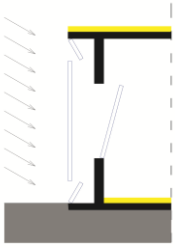
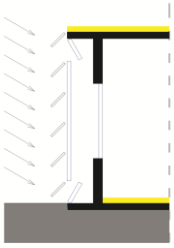
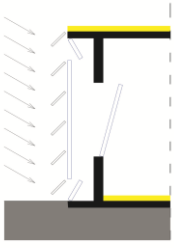
Diagram of revitalization	
Current situation 	**Current situation -** Current situation of the building includes the current condition of the structural elements of the building envelope with constructive assembly building. By observing the selected types of industrial buildings, the lack of insulating layer in the roof, façade walls and floor on ground of the building, becomes evident resulting in a very high coefficient of heat transfer. The windows in the facade wall consist of a single glass thickness of 6 mm and the coefficient of heat transfer U = 5.8 W/m^{2}K (type 1) with a metal frame without thermal break, and a „kopilit“ glass with a coefficient of heat transfer U = 2.8 W/m^{2}K (type 2) . Doors in the facade wall are metal structures with coefficient of heat transfer U = 3.124 W/m^{2}K.
Scenario 1 	**Scenario 1 -** Revitalization of the building cover by adding insulating layers of 15 cm rock wool in façade wall and panel on the ground, while on the roof there is a need to add rock wool in the layer of 20cm. Reconstruction of the windows is followed by replacing the existing metal frames with PVC profiles with the overall heat transfer coefficient U=1.4 W/m^{2}K and replacing the existing glass (type 1 and type 2) with double low-e glass 4+12+4 (Kr) with a coefficient of heat transfer U=1.1 W/m^{2}K. Entrance metal doors were also replaced with a new with overall heat transfer coefficient U=1.25 W/m^{2}K.

Diagram of revitalization	
Scenario 2 	**Scenario 2 -** This type of revitalization includes revitalization of the facility as in Scenario 1 except for the eastern and western façade wall. On the east and west walls there is no planned revitalization of non-transparent parts of the facade but only the reconstruction of the windows as in scenario 1. On the east and west facades a double skin façade was formed whose outer membrane makes the curtain wall at a distance of 60cm from the existing facade wall with a single glass with thickness of 6 mm and the overall heat transfer coefficient U=5.8 W/m^{2}K.
Scenario 2a 	**Scenario 2a -** Scenario 2a is a revitalization scenario 2 advanced by the introduction of night ventilation in order to reduce the energy needed to cool the building in summer. Night ventilation means ventilation of the building, by controlled opening in the lower and upper zone of the double skin façade, opening of the windows and openings of internal openings / skylights of interior doors which would make a constant aeration of 0.5 ac/h between 18 - 06 h increased to a maximum of 1.2 ac/h in the period 1st April to 1st October.
Scenario 2b 	**Scenario 2b -** Scenario 2b also represents an improved revitalization scenario 2 with introduction of blinds on the east and west facades within the double skin facade, which would reduce the energy needed to cool the building in summer. Blinds include fixed horizontal sun-breakers along the double facade, with a width of 50 cm are positioned at an angle of 45 ° in a vertical distance of 80 cm.
Scenario 2c 	**Scenario 2c -** Scenario 2c is improved revitalization scenario 2b with additional introduction of night ventilation in order to reduce the energy needed to cool the building in summer. Night ventilation means ventilation by control of facility openings in the lower and upper zone of double skin facades, the internal control aperture and shutter windows / skylights of interior doors which would provide a constant aeration of 0.5 ac/h between 18 - 06 h increased to a maximum of 1.2 ac/h in the period 1st April to 1st October.

The methodological approach to the development of scenarios that are used for improving the energy performance of the building is guided by the desire to preserve the identity of the existing building, improving the design of the building by use of passive solar principles of architecture, preservation of geometry and ways of opening windows and doors, replacement of inadequate and environmentally unjustified roof cladding with new material.

Software DesignBuilder defined by a physical model of the building with an exact geographical location and use of materials, layers of façade envelope. The software include the scheme of thermal zones, their internal design temperature, time intervals of

use and occupancy, a load of electrical appliances and lighting. Working hours of functioning of the building are defined based on the 40 hour working time per week, respectively, 8h per day in the period 8:00 to 16:00 hours from Monday to Friday. Interior design temperatures are defined by the Regulation on Energy Performance of Buildings (2011) [15], wherein said design temperature out of the working hours is adjusted by ± 4 ° C depending on the mode of heating or cooling facility (table 2). The presence of people, heat output per person, occupancy are also defined according to the Regulations, while the value of the heat output of the electrical equipment and lighting are taken over from the software DesignBuilder depending on the heat zone. Considering that the subject occupies only moderately sheltered location where more than one facade is exposed to the wind, the reported values of the facility ventilation by use of natural ventilation depending on the state of tightness of the building are defined with 0.9 ac/h for existing state and 0.5 ac/h for the state after revitalization. Those parameters are shown in Table 2.

Table 2 Loads of heat zones of people activity, occupancy, timetables, interior design temperature, heat load zone of lighting and electrical devices, ventilation

Data	Office	Corridor	Caffe	Conference room	Dressing room	Storage	WC	Unit
The internal projected temperature for winter conditions	20 / 16	16 / 16	20 / 16	20 / 16	20 / 16	18 / 14	18 / 14	°C
The internal projected temperature for summer conditions	26 / 30	30 / 30	26 / 30	26 / 30	26 / 30	26 / 30	26 / 30	°C
Occupancy per person	0.05	0.10	0.20	0.20	0.05	0.001	0.05	per /m^2
People	80	100	100	80	100	100	100	W/per
Occupancy	08:00 - 16:00	08:00 - 16:00	08:00 - 16:00	08:00 - 12:00	08:00 - 16:00	08:00 - 16:00	08:00 - 16:00	H
Light energy				5				W/m^2 -100 lux
Natural ventilation				0.7				ac/h
Electricity equipment	11.77	1.85	14.72	5	/	/	5.48	W/m^2
External infiltration existing / reconstructed				0.9/0.5				ac/h

2.1. Model for the analysis

The selected industrial building is an apparel hall that belonged to the complex of textile plant "Raska" in Novi Pazar [16]. This building, was built in 1974. and represents the typical industrial building with a shed roof, built in Yugoslavia in that period. The building is industrial building that houses manufacturing facility, toilets and warehouses for the needs of workers. The building is rectangular in shape, orientation north - south with deviation of the north-south direction by 13 °, G + 0 (fig. 1).

In the immediate surroundings of the building there are buildings that used to represent the ancillary facilities of the textile plant "Raska". Based on the position of buildings in the tighter location, the number of floors of surrounding buildings has been

stated. Alongside the northern façade of the observed building there is the administrative building TK "Raska", while along the east facade there is another building that represents separate content of TK "Raska". These buildings with their position, height and shadow affect the solitude of the observed building (Figure 1).

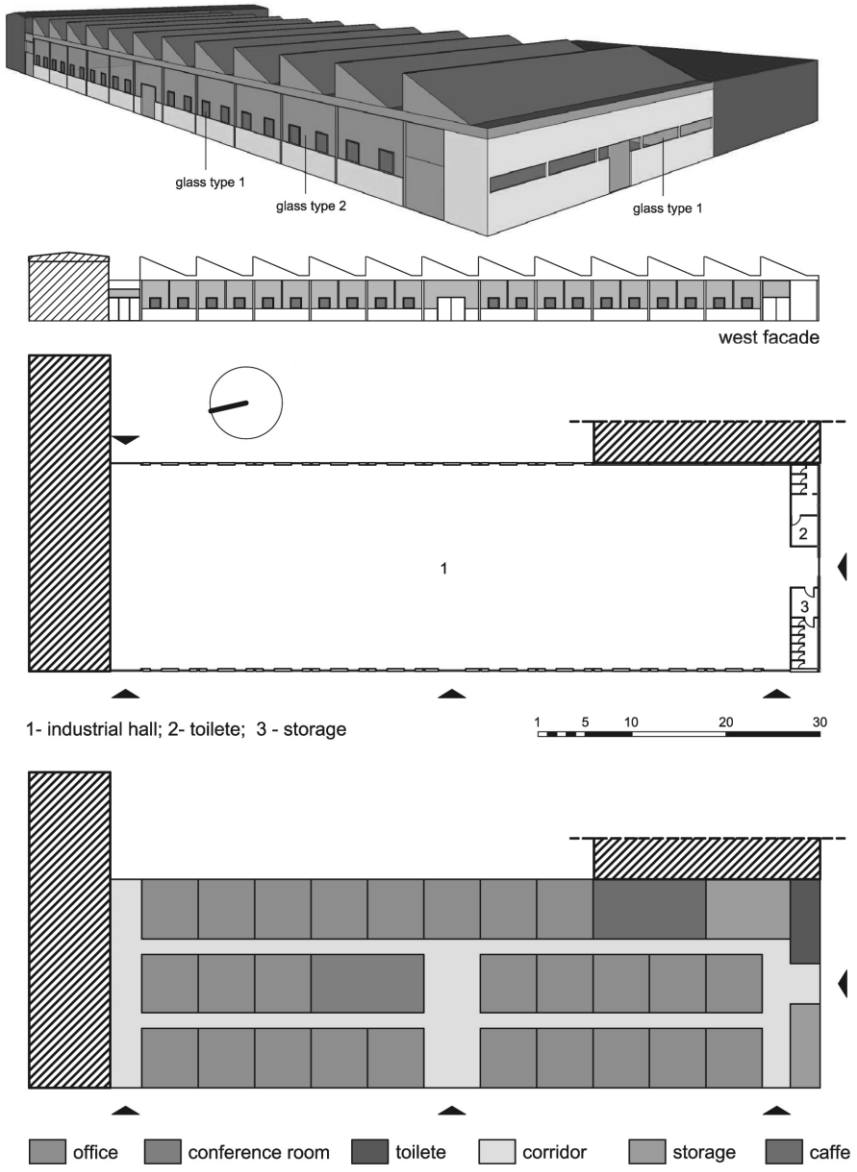


Fig. 1 Ground floor and west facade of Textile factory „Raška“– current conditions, adaptive reuse and model

The production plant is located in the northern part of the building, while the entrance to the building with toilets and utility rooms is located in the southern part of the building. The building has smaller openings for the toilets on the south facade and a larger number of openings on the east and west facades with a uniform scheme followed by a constructive grid. A chosen industrial building has a characteristic roof shape, with northern windows whose contains a specific glass type named kopilit glass.

The structure of industrial hall is made of the steel skeleton structure with a steel grille as a beam carrier. The exterior walls are made of bricks 25 cm thick plastered inside of the longitudinal mortar layer of 2 cm. The rest of the outer walls is an aluform sandwich panel with a 5 cm thick thermal insulation layer. The roof of the building is sloping shed roof construction with an aluform sandwich panel with a 5 cm thick thermal insulation layer. The panel on the ground consists of reinforced concrete layer 10cm thick on gravel pad layer 10 cm thick, with a cast terrazzo as a final layer.

The windows of the industrial building are single with a single-layer glass 6mm thick with heat transfer coefficient U=5.8 W/m^{2}K (type 1) and metal frame without thermal disconnection with coefficient of heat transfer U=6.0 W/m2K, and a „kopilit“ glass (type 2). „Kopilit“ glass is characterized by a very low coefficient of transmission of solar radiation g = 0.40 and a high heat transfer coefficient U = 2.8 W / m^{2}K, which would greatly increase solar gain and reduce transmission losses of heat.

Table 3 presents basic informations about the building, the surface of the thermal cover of the building, volume of heated space, building shape factor and the percentage of transparent surfaces in the building cover.

Table 3 Information about the building

Information about the building	Existing condition
Area of the thermal building envelope A [m^2]	5099.31
The volume of the heated part of the building V [m^3]	8573
Total volume of the building V [m^3]	9271.5
Building shape factor [m^{-1}]	0.55
The share of transparent surfaces [%]	23.22

Renovation and adaptation of the building anticipates repurposing the building for administrative purposes. In the renovation, the attention was paid to the utilization of the existing structure of the building and the existing infrastructure. In fact, when changing the purpose of the space, the existing physical structure and purpose of the existing additional space of the industrial building have been used, while the space reserved for industrial production has been transformed into office space, with conference room and horizontal communication (figure 1). In the aim of better utilization of the space three-tracts with the two corridors and administrative units that are positioned on the central of building, east and west facades of the building have been formed. Achieved surfaces and volumes of the rooms are given in Table 4.

Table 4 Area and volume of the building zones– adaptive reuse

Zone		Area [m^2]	Volume [m^3]
1	Offices	958.2	5160.2
2	Conference room	72.5	387.9
3	Corridor	403.7	2089.6
4	Caffe	54.1	302.9
5	Toilet	24.5	118.6
6	Storage	98.3	513.8
Total		1611.3	8573

3. RESULTS AND DISCUSSION

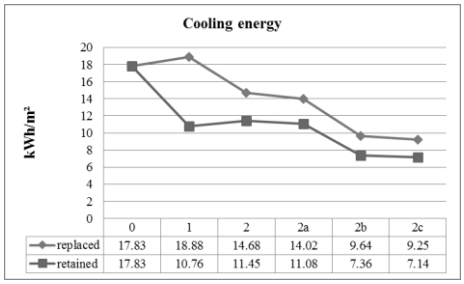
The paper examines the possibilities of reducing thermal gain if the replacement of the „kopilit“ glass is performed and if the existing glass is retained. Accordingly, a simulation of the energy performance of the building was performed for each repair scenario with a difference in glazing, when the single glass (glass type 1) and „kopilit“ glass (glass type 2) are replaced with a double low-emission glass. Or the „kopilit“ glass is retained and the existing single glazing is replaced by the double low-emission glass. The other structural elements on the envelope are treated in accordance with the previously defined remediation scenarios. The results of these simulations relevant to the discussion are shown in Table 5.

Table 5 The results of the simulations in the case of replacement of the „kopilit” glass and when the „kopilit“ glass is retained

	Scenario/current situation	Heating [kWh/m^2]	Cooling [kWh/m^2]	Primary energy [MWh]	CO2 emission [t]	Solar gains [MWh]
Replaced kopilit glass	0	151.92	17.83	341.10	91.92	133.56
	1	41.62	**18.88**	150.24	55.21	205.60
	2	34.64	14.68	125.29	45.34	105.11
	2a	34.64	14.02	122.51	43.87	105.11
	2b	37.11	9.64	108.73	35.07	91.24
	2c	37.11	9.25	107.12	34.21	91.24
Retained kopilit glass	0	151.92	17.83	341.09	91.92	133.56
	1	64.72	10.76	158.51	46.05	123.56
	2	51.70	11.45	143.20	44.46	64.17
	2a	51.70	11.08	141.65	43.64	64.17
	2b	53.86	7.36	130.06	36.18	54.30
	2c	53.86	7.14	129.13	35.69	54.30

By results in Table 5, we can conclude that by replacing a „kopilit“ glass in the revitalization by scenario 1 needed energy for cooling is increasing compared to condition before revitalization.

Also, we can conclude that by retaining a „kopilit“ glass in the revitalization of an industrial building, in the case of the adaptive reuse into a administrative building, the energy characteristics of the building are significantly changed.



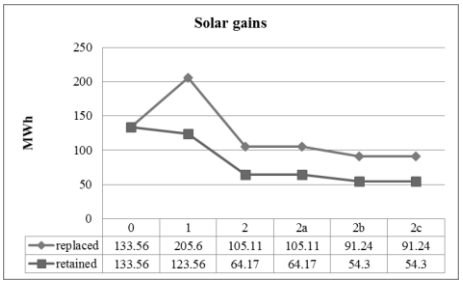
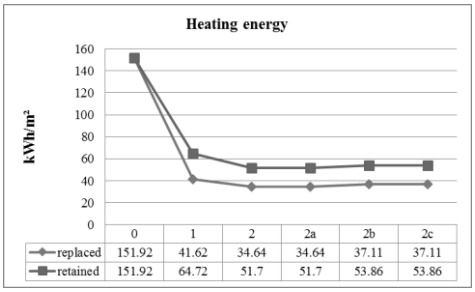


Chart 1 Final energy needed for cooling (left) and solar gains (right)

Reduction of the necessary final energy for cooling the building (Chart 1) is significant (20.97 % - 43.01 %), given that solar gains are reduced (38.95 % - 40.49 %). But reducing solar gains and increasing the heat transfer coefficient by retaining „kopilit“ glass resulted in a large increase in the required final energy for heating the building (45.14 % - 55.50 %). The largest increase in the final energy required for building heating (Chart 2) is noticeable in scenario 1 (55.50 %) where the required amount of final energy per unit area is 64.72 kWh/m2. According to this scenario, was achieved the biggest reducing of the necessary energy for cooling the building (43.00 %) in relation to the condition when the „kopilit“ glass is replaced.

As far as primary energy is concerned, it increases from 1.06 to 1.21 times in case if „kopilit“ glass is retained, depending on the revitalization scenario in relation to the case when „kopilit“ glass is replaced. The least increase in primary energy is still noticeable according to the revitalization scenario 1, which is the result of the conversion of final energy into the primary.



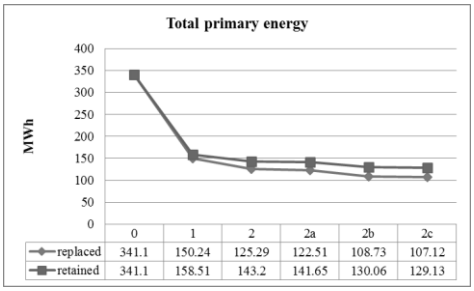


Chart 2 Final energy needed for heating (left) and (right) total primary energy

The CO_2 emission is fairly equal in both glazing cases in all revitalization scenarios that involve the application of a double facade, with the fact that this criterion slightly contributes to the revitalization according to scenarios 2 and 2a when the „kopilit“ glass is retained, and in support of the revitalization according to scenarios 2b and 2c when „kopilit“ glass is replaced. The only difference is noticeable in the case of the revitalization according to scenario 1 where the CO_2 emission was recorded by 9.16 t (16.60%) higher in the case of replacing „kopilit“ glass.

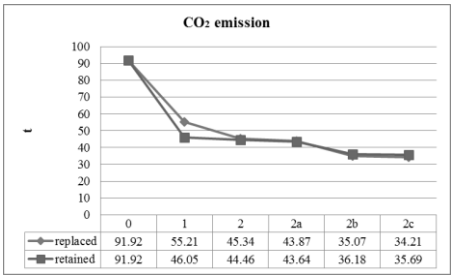


Chart 3 Total CO_2 emission

4. CONCLUSION

The choice of the type of glazing in the materialization of the building envelope is an important factor for influencing the energy characteristics of the building, that is, the amount of energy required for heating and cooling the building.

How much important is the glass on the facade of the building is shown by the results of computer simulations where, based on the obtained results, it was determined that the reduction of the final energy is necessary for cooling, if the „kopilit“ glass is replaced by a double low-e glass 4+12+4 (Kr). Accordingly, it is important to make design decisions in the choice of materialization of the building, in the initial phase of designing a new building or revitalization of the existing building, in order to avoid unwanted effects to the energy characteristics that could have an impact on the necessary comfort in the building.

The results obtained by the simulations indicate an increase in the required cooling energy if the required heating energy is reduced and the solar gain increases, which is directly caused by the use of a particular type of glass. Applying different recovery scenarios suggests the possibility of reducing the required cooling energy by using specific technical solutions, by using night ventilation and blinds. In accordance with this, it is pointed that the application of the double skin facade in the revitalization of industrial buildings in the process of adaptive reuse into an office building is a reasonable approach from an ecological aspect, because scenario 2c achieves a significant reduction in CO_2 emissions compared to other revitalization scenarios.

The recommendation for improving the energy characteristics of the observed model is, of course, replacing the „kopilit“ glass with a double low-e glass 4+12+4 (Kr) and introducing alternative ways of cooling the building, using geothermal energy and active solar energy systems, by placing the FN panels on a shad roof, which has an ideal southern orientation, which would provide a certain amount of electricity energy it would use for cooling the building.

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UTICAJ VRSTE ZASTAKLJENJA NA ENERGETSKU EFIKASNOST INDUSTRIJSKIH ZGRADA U PROCESU SANACIJE – STUDIJA SLUČAJA

Ovim radim se ispituju mogućnosti poboljšanja energetskih karakteristika postojeće industrijske zgrade primenom dvostruke fasade pri sanaciji omotača u klimatskim uslovima grada Novog Pazara, Republika Srbija. Cilj je ispitati uticaj izbora vrste zastakljenja, pri sanaciji, na energetske karakteristike industrijske zgrade i potrebnu finalnu energiju za grejanje i hlađenje, kao i doprinos poboljšanja energetskih performansi odabranog tipa i modela industrijske zgrade. Energetski karakteristike zgrade dobijene su korišćenjem softvera DesignBuilder i EnergyPlus simulacione platforme, uzimajući u obzir parametre potrebnih unutrašnjih temperatura i klimatskih podataka za Republiku Srbiju. Izvršena je komparativna analiza rezultata energetskih simulacija prema kriterijumu postizanja veće uštede energije i smanjene emisije ugljen-dioksida. Metodološki pristup u ovom istraživanju podrazumeva projektovanje scenarija sanacije industrijskih zgrada sa šed krovnom konstrukcijim, izborom konkretnog objekta na kome će se numeričkim simulacijama ispitati mogućnosti za smanjenje energetskih potrena i izvršiti komparativna analiza dobijenih rezultata. Primarni cilj ovog istraživanja je ispitivanje uticaja izbora vrste zastakljenja na energetske performanse industrijske zgrade sa šed krovnom konstrukcijom i utvrđivanje optimalnog pristupa energetskoj sanaciji postojećih industrijskih zgrada sa primenom dvostruke fasade u klimatskim

uslovima grada Novog Pazara, Republika Srbija. Rezultatima ovog rada se ukazuje na negativne karakteristike kopilit stakla u pogledu solarnih dobitaka, čijim zadržavanjem je potrebna velika količina energije za grejanje. Dok se zamenom kopilit stakla niskoenergetskim staklom povećava potrebna količina energije za hlađenje zgrade. Ovim istraživanjem se kroz različite scenarije sanacije ukazuje i na to da se primenom dvostruke pri sanaciji odabrane zgrade vrši vrlo približan uticaj na smanjenje emisije CO_2 nezavisno od odabira vrste zastakljenja.

Ključne reči: *vrsta zastakljenja, adaptacija i prenamena, energetska efikasnost, obnovljivi izvori energije, regulativa*

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ACCESSIBILITY TO PUBLIC INSTITUTION FACILITIES FOR PEOPLE WITH DISABILITIES IN NOVI SAD - EUROPEAN CAPITAL OF CULTURE 2021

UDC 725-056.26(497.113)

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Abstract. *Persons with disabilities and reduced ability to move need to be provided with unimpeded access, movement, staying and working in all buildings with equal treatment as the rest of the people. The objective of this paper was to determine accessibility to public service institutions and educational institutions, as well as possible statistically significant differences in the presence of elements of accessibility between such institutions. The total of 154 buildings in Novi Sad was processed (70 educational institutions and 84 public service institutions). Measuring lists were composed for the purpose of collecting data based on the Rulebook on Technical Standards of Accessibility RS 2013, with the additional use of a meter and subjective visual assessment of a measuring entity. The obtained data were processed in the programme SPSS for Windows, version 20. For the purpose of determining differences among the parametric variables, a T-test for independent samples was used, and in order to determine the differences among the non-parametric variables, a* χ^2 *– test was used, at the deduction level of* $p \leq 0{,}05$*. The obtained results indicate the existence of statistically significant differences in the elements of accessibility among the public service and educational institutions in the territory of the City of Novi Sad, especially with respect to the following variables: type of entrance doors (p=0.027) and opening side of the entrance doors (p=0.000).*

Key words: *persons with disabilities, facilities, accessibility, standards.*

1. INTRODUCTION

Ensuring accessibility to public institutions (health centres, post offices, pharmacies, theatres, cinemas, sport facilities, pre-school institutions, primary and secondary schools, faculties, banks, etc.), represents an integral part of the Strategy for improving the position of persons with disabilities and their better life quality (Government of the RS,

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2007). After ratifying the United Nations Convention on the Rights of Persons with Disabilities with its objective being improving, protecting and ensuring equal human rights and fundamental freedoms of all persons with disabilities, as well as improving the respect of the innate dignity of the respective group of people, the Government of the Republic of Serbia adopted a set of laws and bylaws: *Law on Preventing Discrimination of Persons with Disabilities* (2006), *Strategy for Improving the Position of Persons with Disabilities in the Republic of Serbia* (2007), *Rulebook on Technical Standards of Accessibility* (2013), as well as the *Rulebook on the technical standards of planning, designing and building facilities, ensuring unimpeded movement and access for persons with disabilities, children and senior citizens* (2015). The given rulebooks govern and prescribe technical standards of accessibility as well as the urban planning and technical terms for spatial planning. All of the aforementioned pertains to the public area such as roads, pedestrian areas, access points to facilities intended for public use and special design of the interior of such facilities that must be adapted for use by the persons with disabilities. As part of this, observance of the compulsory accessibility elements must be assured.

According to the World Health Organisation - WHO, five types of health can be distinguished: physical, psychological, social, functional and economic. Disturbance in any of the given categories of health, conditions setbacks in the rest of the health categories, with the consequence of reduced physical abilities (Fejzić, 2007). Persons with reduced physical abilities are the ones whose organism, due to certain physical, psychological or functional deficiencies, is incapable of performing its tasks at an optimal level. However, such persons are members of every community, and they make a large social category in all countries worldwide (Fejzić, 2007).

In Article 3 of the basic provisions of the Law on Preventing Discrimination of Persons with Disabilities of the Republic of Serbia (2006) there is the following notion *"persons with disabilities signifies persons with inborn or acquired physical, sensory, intellectual or emotional disability which due to social or other obstacles do not have the possibilities or have reduced possibilities to participate in social activities at the same level as others, regardless of whether they are able to realise them by using technical aids or support services".*

One of the biggest obstacles in life of young persons with disabilities is the assumption that disability means lack of choice (Morris (2001). Persons with disabilities should have the right – just as everyone else – to choose the way they are going to live their lives, and not to have their choices imposed by doctors, social workers, charities or the society. The Movement of Persons with Disabilities has the following requirements: independence (possibility of choosing own life organisation), civil rights (possibility of playing a full-fledged social role), autonomy (possibility of forming and living a personal life plan) and unimpeded movement (possibility of free movement the same for everyone) (Leutar, 2006).

Barriers represent a disturbance in communication and orientation, which might hinder and/or prevent the possibility of free movement of persons with reduced ability to move or their unimpeded access to the facilities where they reside and work (Rulebook on Technical Standards of Accessibility of the RS, 2013, Article 3). Therefore, it is necessary to apply technical solutions in designing and constructing buildings, which would ensure unimpeded access, movement, residence and work in the facilities to such persons at equal terms as for other people. For this reason, it is imperative that the built environment is properly designed and made all- inclusive (Danso, Ayarkwa & Ayirebi, 2011).

"Accessible building, its part or equipment (ramp, stairs, lift, vertical lifting platform, inclined foldable lifting platform, entrance area, communication, toilet, bathroom, kitchen, room, classroom, working space, apartment, changing cabin, shower, beach and pool entrance area, theatre seats, phone, fax, ATM, electrical installations, doorknobs and window handles, counter, noticeboard, orientation plan for moving inside the building, bus stops and platforms, parking lots, public pedestrian areas, traffic lights, pedestrian crossing, pedestrian island and crossroads) means a facility, part of a building or equipment which ensures meeting the mandatory elements of accessibility prescribed by the Rulebook on Technical Standards of Accessibility" (Rulebook on Technical Standards of Accessibility of the RS, 2013, Article 3).

Mandatory elements of accessibility refer to the elements of designing and building, determining the size, properties, installations, devices and other equipment for the purpose of ensuring access, movement, staying and work of persons with disabilities and reduced ability to move with equal quality as for other people (Rulebook on Technical Standards of Accessibility of the RS, 2013, Article 3).

Mandatory elements of accessibility are the following: elements of accessibility for overcoming altitude differences; elements of movement accessibility and staying in specific space - residential buildings and public facilities; elements of accessibility to public transport (Rulebook on Technical Standards of Accessibility of the RS, 2013, Article 5).

Pedestrian surroundings and accessibility to public facilities and institutions represent the first and very significant obstacles to active inclusion of persons with disabilities or persons with reduced ability to move into regular life activities. The objective of this paper was to determine the aspects of accessibility to public institution facilities and educational institutions, as well as possible statistically significant differences with regard to the existence of accessibility elements among the respective institutions.

2. METHODS

Sample

The sample consisted of the total of 154 institutions in the territory of the City of Novi Sad. Out of the total number of analysed samples, 70 samples were composed of educational institutions, of which: 12 public faculties, 8 private faculties, 19 pre-school facilities, 18 primary schools and 13 secondary schools. The remaining 84 samples were the public service institutions. Such institutions were composed of: 18 post offices, 21 banks, 19 pharmacies, 9 cafés, 10 sport facilities, 7 health centres.

Measuring instruments sample

For the purpose of determining differences in the existence of architectural barriers in various institutions of the City of Novi Sad, measuring lists were used composed in accordance with the Rulebook on Technical Standards of Accessibility of the RS 2013, a meter and the subjective visual assessment of the measuring entity. The research parameters were the following: ground-level and floor aspects of the facility, wheelchair ramp, wheelchair ramp handrails, ramp width, ramp surface slipperiness or coarseness, type of the entrance doors and entrance door opening side.

Description of the measuring procedure

The research data were recorded in the measuring lists, after visiting all the assessed institutions. Certain accessibility elements important for the research were also checked and measured.

Data processing methods

The data were analyzed using IBM SPSS Statistics 20.0 (SPSS ID: 729225). For the purpose of determining the differences among the parametric variables, a parametric method known as the T - test was used for independent samples. This T - test is the best choice for this type of parametric variables and it gives the best results in percentages and clear differences. For purpose of determining the differences among the non-parametric variables, a nonparametric method known as the χ^2– test. The nonparametric method χ^2 gives the best insight in all differences among public and educational institutions in nonparametric variables which are used and which are significant for this study. Both tests clearly show all the percentages of fulfilment of conditions of standards significant for the study. The statistical significance was established at the assessment level of $p < 0.05$.

3. RESULTS

The results of numerical and percentage rates of the type of entrance doors to the educational and public institutions in Novi Sad (Table 1), show that there is statistically significant difference in the type of entrance doors among the educational and public institutions in Novi Sad, in favour of public institutions, in favour of automatic doors. There are eight automatics doors in public institutions and only one automatic door in educational institutions in Novi Sad.

Table 1 Numerical and percentage rates of the type of entrance doors to the educational and public institutions in Novi Sad

Type of entrance doors		Institutions		Total
		Educational	Public	
Regular doors	Number	72	75	147
	% compared to the type of the entrance doors	49.0%	51.0%	100.0%
	% with respect to the institution	98.6%	90.4%	94.2%
Automatic doors	Number	1	8	9
	% compared to the type of the entrance doors	11.1%	88.9%	100.0%
	% with respect to the institution	1.4%	9.6%	5.8%
Total	Number	73	83	156
	% compared to the type of the entrance doors	46.8%	53.2%	100.0%
	% with respect to the institution	100.0%	100.0%	100.0%

$\chi 2=4.885$, df=1, p=0.027

Legend: χ^2- hi square statistics; df - degrees of freedom; p - level of significance

Numerical and percentage rates of the opening sides of the entrance doors to the educational and public institutions in Novi Sad, are presented in Table 2. There is a statistically significant difference with regard to the opening sides of the entrance doors

among the educational and public institutions in Novi Sad have been observed, in favour of outward doors in educational institutions.

Table 2 Numerical and percentage rates of the opening sides of the entrance doors to the educational and public institutions in Novi Sad

Entrance door opening side		Institutions		Total
		Educational	Public	
Inward	Number	18	52	70
	% with respect to the entrance door opening side	25.7%	74.3%	100.0%
	% with respect to the institution	25.0%	68.4%	47.3%
Outward	Number	54	24	78
	% with respect to the entrance door opening side	69.2%	30.8%	100.0%
	% with respect to the institution	75.0%	31.6%	52.7%
Total	Number	72	76	148
	% with respect to the entrance door opening side	48.6%	51.4%	100.0%
	% with respect to the institution	100.0%	100.0%	100.0%

χ^2=27.965, df=1, p=0.000

Legend: χ^2- hi square statistics; df - degrees of freedom; p - level of significance

Percentage rates of elements of accessibility of educational and public institutions in Novi Sad are presented in Table 3.

Table 3 Percentage rates of elements of accessibility of educational and public institutions in Novi Sad

Elements of accessibility and their characteristics		Percentage of accessibility elements which are in standard	Percentage of accessibility elements which are not in standard
Ramp	Width of ramp	13.2%	18.7%
	Handrails on ramps	19.4%	12.5%
	Surface of ramp	23.1%	8.8%
Type of entrance doors	Width of entrance doors	40.6%	59.4%
	Entrance door opening side	56.2%	43.8%

The percentage results rates of elements of accessibility of public and educational institutions which do not have accessibility elements at all and percentage rates of ground level in Novi Sad are presented in Table 4.

Table 4 Percentage rates of elements of accessibility of public and educational institutions which do not have accessibility elements at all and percentage rates of ground level in Novi Sad

Elements of accessibility of institutions which do not have accessibility elements at all	Width of ramp	68.1%
	Handrails on ramps	68.1%
	Surface of ramp	68.1%
Ground level of institutions	Floor level	80%
	Ground level	20%

Compared to other parameters tested: ground level of educational institutions and public institution facilities in Novi Sad, existence of the inclined ramps and handrails on the same, slippery or rough surfaces of the inclined ramps and their width, and the width and types of front doors in the examined facilities, the results of our study show that there are no statistically significant differences among the examined institutions.

4. DISCUSSION

Training of people with severe physical traumas (who must temporarily or permanently use a wheelchair) for return to the previous environment and the way of life they used to live, is the main objective of any rehabilitation (McColl, 2001). The most common problem encountered by persons with disabilities (users of wheelchairs, crutches or walkers) is limited mobility due to inaccessibility to public institution facilities, difficult movement at pedestrian crossings, and the like.

Hence, the objective of this paper was to determine the aspects of accessibility to public institution facilities and educational institutions, as well as possible statistically significant differences with regard to the existence of accessibility elements among the respective institutions.

Novi Sad is the second largest city in Serbia. Like most cities, it was faced with the problem of architectural barriers that prevented the mobility of people with disabilities. The City of Novi Sad identified the problem of accessibility to public and cultural facilities for these people (Figure 1), and in 2012 the Assembly of the City adopted the Strategy on Accessibility to Public Facilities for People with Movement Difficulties ("Official Journal of the City of Novi Sad", No. 21/2012), as well as the Rulebook regulating this area.

Fig. 1 The Serbian National Theatre (exceptional access to the cultural building)
(Photo: Branka Protić – Gava)

The newly built facilities have been adapted by these rules and accessible to persons with disabilities, but older facilities are not subject to this regulation. The City of Novi Sad has invested funds to make the public institution facilities accessible to the public, but conditions for accessibility are not always met in practice with fulfilling the legal regulation. The proof of that is the access to the Main Post Office building in front of which a wheelchair lifting platform was installed but was never operational (Figure 2). This problem should be resolved. Barriers on the roads and accessibility to public institution facilities, schools, faculties, banks, health institutions, theatres, museums, but also to residential buildings and houses must be identified and removed, as noted by many researchers (Bodaghi & Zainab, 2012; Chiwandire & Vincent, 2017).

Fig. 2 Main Post Office building (wheelchair lifting platform has never been operational) (Photo: Branka Protić – Gava)

The results of our study show that about 80.0% of the examined institutions in Novi Sad are not at ground level (80.8% of educational and 79.3% of public institutions), which entails the obligation for them to ensure fulfilment of the required accessibility elements, in this case, ramps. However, a total of 60.2% of the examined facilities are without ramps (55.9% are educational and 63.8% are public institutions). Our results do not coincide with the results of the Centre for Development of Civil Society Zrenjanin (2011) which states that only 9.67% of institutions have appropriate ramps, only two facilities are fully accessible and most facilities are without handrails on the ramps. Namely, the results of our study show that the situation of accessibility to facilities in Novi Sad compared to Zrenjanin is better. Nevertheless, it indicates the need to build ramps on all facilities of public and educational institutions which are still without them.

Some of the inclined ramps built in front of public institutions and residential buildings are not well placed and regardless of the fact that the regulation is respected, persons in wheelchairs cannot use them without the help of another person. Our conclusion coincides with the results of the Bodaghi & Zainab study (2012), in which the view of persons with disabilities differs from the view of architects in terms of the functionality of the ramps. Namely, people with disabilities evaluated the functionality of the same with low grade.

In planning the technical standards when building the ramps, we found out that not all of the ramps met the condition for existence of necessary elements such as handrails (Figure 3), which is shown in the results of our study.

Fig. 3 Ramp which does not meet the standards
(Photo: Branka Protić – Gava)

Half of the examined facilities are without handrails on the ramps (51.6% of educational and 48.4% of public institutions). These results coincide with the results of Bodaghi & Zainab (2012), which state that conditions of accessibility to public buildings and university libraries in Zanjan Province in Iran are not assessed as good enough for people with disabilities and conclude that it is necessary to adapt the design.

Also, the standards prescribe that the ramp should be solid, flat and slip-resistant. The study has established that 72.5% of the examined institutions have ramps that comply with the standards, i.e. 76.9% of educational and 68.0% of public institutions. The results of our study show that no significant difference in respect of the surface of ramps was established among the examined categories of institutions, but the results were better in educational institutions. Public facilities had a better average ramp width of 119.4 cm, although difference among the institutions was not statistically significant, and the width is not in accordance with the Rulebook on Technical Standards of Accessibility of the Republic of Serbia (2013), which prescribes the minimum ramp width of 120 cm. These

results show that the situation regarding accessibility elements to public institutions in Novi Sad is far more favourable than in Zrenjanin (*Zrenjanin, the city accessible to all, 2011*).

The results of our study coincide with the results of Bacha study (2015) which states that many ramps are narrow, with damaged surfaces, of non-standard inclination (over 6%), lacking handrails. Ramps in public buildings do not meet standards, as they are inaccessible for wheelchair users, but also for mothers with children in prams. The author concludes that the main problem of accessibility to buildings and public places equipped with elements of the same is not in disregarding the legal framework, but in the way in which design or adaptation of the existing ones was carried out. Some of the public institutions resorted to the solution of adapting the back doors of the buildings for people with disabilities, thus, on the one hand, fulfilling the legal framework, and on the other hand, making such population invisible and in some way marginalizing them (Bacha, 2015). There are several institutions in Novi Sad that have resorted to this solution.

Some of the health institution facilities in Novi Sad have inadequate access conditions, which coincides with Gačić study (2013) which concludes that the health institution facility examined has inadequate access to the facility, which implies an inadequate width of the ramp, the lack of handrails, curbs and appropriate surface of the ramp. Such results show that it is impossible or very hard for disabled people and people with movement difficulties to move freely, get adequate health care, get educated, visit cultural events (Centre for Development of Civil Society, 2011).

The results of our study show that statistically significant differences between the educational institutions and the public institutions exist only for the types of front door and the side to which a front door is open (inward or outward). Out of the total number of facilities tested in our study, only 5.19% have automatic front doors - 9.52% at the public institutions and 1.43% at facilities of educational institutions (Faculty of Civil Engineering).

According to the Rulebook on Technical Standards of Accessibility of the Republic of Serbia (2013), doors should be opened outwards at institutions highly frequented by people. The study found a statistically significant difference in favour of educational institutions. As for the width of front doors at public institutions, it should be at least 90cm. In our study, the average width of front doors in educational institutions is 80.28 cm, while in the public institutions it is 83.03 cm, which indicates their necessary adaptation.

The University of Novi Sad has paid full attention to establishing good conditions for studying and staying at the University for all students, as well as to development of support to students with disabilities. The University's central building was built by the standards of "universal design": an inclined ramp was installed, all facilities within the building are accessible, the elevator was installed providing accessibility to all floors, there is a toilet for people with disabilities. However, buildings of most faculties have not been fully adapted to students with disabilities, and regardless of the fact that most buildings have the inclined plane for accessed, facilities within the building are not accessible to such student population. At some faculties the access to student services is not adequately enabled, at most faculties the toilets are not adapted, and access to higher floors is not ensured. We must also note the fact that, in addition to a small number of primary and secondary schools in Novi Sad, the majority have not fully met the required legal standards for better accessibility to them by persons with disabilities.

5. CONCLUSION

Inaccessibility to facilities and the movement in a space full of architectural barriers make people with disabilities face dangers which make the built environment unpleasant and unsafe and can even prevent some people from using the space at all.

In spite of the existing legal obligation on accessibility of public facilities for people with movement difficulties, people with disabilities still have difficulty to move smoothly around the city of Novi Sad, the city - the European Capital of Culture 2021, as well as to unhindered access to facilities for education, health care, cultural events and the like.

We have established that the conditions of accessibility to the public institution facilities and educational institutions in Novi Sad do not fully meet the standards for the mobility of persons with disabilities, such as: inclination, height and length of the ramps are inadequate; there are no handrails or no handrails on both sides of all ramps; the handrails length on the ramps are inadequate; access to ATMs is inadequate (height and distance due to the presence of a stair below the ATM); the width of most of the entrance doors is narrow - it does not meet the standards; access to higher floors of institutions is disabled because there is no lift; toilets are not adjusted for people with disabilities. Tactile fields of safety of pedestrian crossings and pedestrian islands are good in the city center but not in the distant parts of Novi Sad. For this reason, it is necessary to meet the requirements for proper design of the environment and to facilitate the movements of people with disabilities. Therefore, it is also necessary to fulfil the requirements in practice following the legal standards.

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PRISTUPAČNOST OBJEKTIMA JAVNIH USTANOVA ZA OSOBE SA INVALIDITETOM U NOVOM SADU – EVROPSKOJ PRESTONICI KULTURE 2021.

Osobama sa invaliditetom i smanjenom mogućnošću kretanja neophodno je obezbediti nesmetan pristup, kretanje, boravak i rad u svim građevinama i to na jednakoj osnovi kao i ostalim osobama. Cilj ovoga rada bio je da se utvrdi pristupačnost objektima ustanova javnog korišćenja i vaspitno-obrazovnih ustanova grada Novog Sada. Obrađeno je ukupno 154 objekta u Novom Sadu (70 vaspitno-obrazovnih ustanova i 84 ustanove javnog korišćenja). Za prikupljanje podataka sačinjene su merne liste na osnovu Pravilnika o tehničkim standardima pristupačnosti RS 2013, a korišćeni su još metar i subjektivna vizuelna procena merioca. Dobijeni podaci obrađeni su u programu SPSS for Windows, verzija 20. Za utvrđivanje razlika između parametrijskih varijabli korišćen je T-test za nezavisne uzorke, a za utvrđivanje razlika između neparametrijskih varijabli korišćen je χ^2– test, na nivou zaključivanja $p\leq0,05$. Dobijeni rezultati upućuju na postojanje statistički značajnih razlika u elementima pristupačnosti između ustanova javnog korišćenja i vaspitno-obrazovnih ustanova na teritoriji grada Novog Sada, i to u sledećim varijablama: tip ulaznih vrata ($p=0.027$) i strana otvaranja ulaznih vrata ($p=0.000$).

Ključne reči: *osobe sa invaliditetom, objekti, pristupačnost, standardi.*

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A METHOD FOR CASE SELECTION IN STRATEGIC URBAN PLANNING

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Abstract. *Strategic planning application is frequent in urban practices. In order to understand this type of planning in a better way, urban researches use and take over good examples of practices from other countries. Selecting examples is most often made without considering their context and the specifics of the urban planning process. In practice, it results in the strategies which are not implemented and the plans which are not realized. The aim of the conducted research is to simplify the urban planners and researchers' choice of compatible good practice cases from different types of environment. This is achieved by creation of an evaluation model, whose role is to help select examples from different environments compatible with the environment where the research is conducted.*

Key words: *strategic urban planning, research methodology, model, case selection*

1. INTRODUCTION

Urban planning is an applicable discipline, and therefore the study of practice examples stands for an important part of various researches in this area. It often happens that in such a case the experiences of good urban planning practice from other areas are used with the aim of better understanding the practice in that particular environment. The critical element in research design is the choice of representative and appropriate examples. An example should be chosen in a way that inconsistency between the case environment and the research subject environment is as small as possible, because every generalization in such a case is more valid. (Bracken, 1981).

The method of case selection which will be used in the research is crucial for a qualitative research, such as urban studies (Nielsen, 2016). In practice, the case selection is often made without a detailed analysis of the processes and the context in which the case is located (Seawright & Gerring, 2008). Usually an attempt is made to apply

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worldwide experiences and methodologies without taking into account the differences of local political, economic, and socio-cultural contexts. The fact that in urban research the connection between the investigated phenomenon and the context is usually blurred and somewhat vague, makes the selection process even more difficult (Campbell, 2003).

The significance and impact of the context have often been explored in the area of strategic management and planning (Poulis et al., 2013). Strategic planning, that is, strategic goals and resources are linked with the social context so it is necessary to have the knowledge of the local economy as well as the social and political structure of the community from the start. Misunderstanding the context or failing to take it into account in strategic planning results in a series of problems: strategies are not implemented, or the processes are not organized in such a way so as to be conducted, they are not consistent with the local problems and conditions but they represent a mere copy of the examples from other environments.

For this practice to be avoided, it is very important to understand the constraints, as well as the potentials of using examples from different environments in urban planning related to strategic planning. The process of strategic planning and the context must be viewed as a whole. When selecting an example, it is very important to use examples that are firmly integrated into the environment, i.e. research, based on the knowledge that is not only theoretical but also applied, context-related (Flyvbjerg, 2006). Sources of data should be multiple (Yin, 2012), so their availability and reliability are important. Because of the firm relationship with the context, the selection of the appropriate example goes much further than the importance of one case, because the case represents a larger group of examples in a similar environment (Seawright & Gerring, 2008).

In order to simplify the selection process of examples from different environments, a study was conducted, which examined the factors that influence the selection of cases. The results of the study will be used to create a model for evaluating various cases from other environments. The first part of the research is completed and will be shown in this article. The aim of this part of the research is to understand the factors influencing the choice of the strategic planning examples from various environments, parameter and data source identification to enable easier choice of the suitable example.

2. METHODOLOGY

According to Seawright and Gerring, there are seven general strategies of case selection depending on the type of case: typical, diverse, extreme, deviant, influential, most similar, and most different (Seawright & Gerring, 2008). Considering the importance of generalization in urban research, and the fact that a generalization is more valid when there is less difference between the cases, this research will be based on a strategy of selecting the most similar case, which is often used in a qualitative research. The most similar case selection strategy consists of several steps: 1) determining the scope of the case – the relevant groups of cases that will be the subject of the research, 2) identifying the parameters which need to match, or have a high degree of similarity, 3) identifying the parameters that need to be fully or to a certain extent different, and 4) selecting one or several appropriate cases most closely related to the research subject. According to this strategy, the examples are similar when their contexts largely coincide (Seawright & Gerring, 2008). Even when exceptional cases appear in the research – as are often examples of successful practices: innovative, creative, and different from common

practice (Campbell, 2003) – this strategy is the most applicable because of the importance of the context, which can used to compare them (Campbell, 2003).

In order to select the most appropriate case using the most similar case strategy, a model was designed for evaluating examples/cases from different environments. The process of creating the model for the evaluation of cases from different environments consists of three phases, which at the same time represent three phases of the research. The first phase represents the formation of a universal part of the model which is the same for all research in the field of strategic planning and represents the choice of parameters from the general methodology and the area of strategic planning: processes and contexts of planning. In the second phase, which depends on the specific urban research for which cases from other environments are selected, the model specialization is performed: the selection of parameters is carried out, determining which parameters need to be similar and which can differ, and based on that, the weight coefficients are assigned to each parameter. In the third phase, the cases are introduced, the values of the parameters are determined for each case; based on these results, the selection of examples is performed and the preliminary selection of parameters is verified through the iterative-incremental procedure. By introducing new case sets, in each iteration the existing list of parameters and data sources is being improved, and the model is being fine-tuned. (Fig.1)

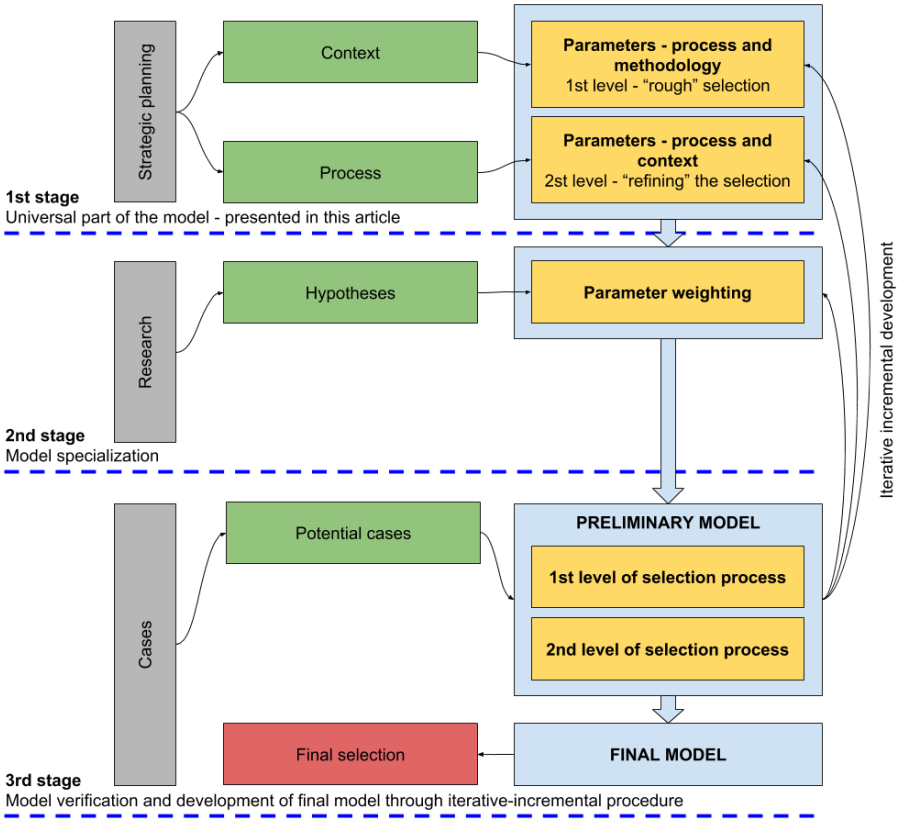

Fig. 1 Model formation procedure

This article presents the first phase of model formation – the formation of a universal part of the model. Through critical analysis of literature in the field of strategic planning and research methodology on case selection, parameters for the evaluation of cases from other environments were selected. Evaluation of the case is done through two steps of selection – "coarse" and "fine" selection, which is the usual procedure for selecting a case study case (Yin, 2012). Based on that, parameters are organized into two groups: parameters for coarse and parameters for fine selection.

The general criteria used to select the parameters of "coarse" and "fine" selection are: 1) the correspondence of the parameters with the principles of the research methodology, 2) compliance with the concept of strategic planning, 3) the representation of parameters explaining the practical possibilities for carrying out the research (for example, access to data, time or money) (Seawright & Gerring, 2008), 4) the optimal quantity of parameters which is not too low to make a selection or too high to disable comparisons and finding of matching examples (Nielsen, 2016), 5) the compliance of parameters with the requirements of a successful generalization of conclusions in the selected cases (Campbell, 2003) and 6) measurability of parameters.

Within the fine selection, the parameters are organized into two subgroups: parameters related to the planning process and those which define the context. Parameters which determine the strategic planning process are key elements of the planning process and are chosen based on the following criteria: 1) to encourage strategic thinking, 2) to influence the achievement of set objectives in strategic planning, 3) to be relevant to action plans later and 4) to influence the implementation (Malekpour, et al., 2015). Within the context of strategic planning – a complex network of social, economic and political activities – parameters which influence the key elements of the planning process and are significant for achieving the goals of strategic planning and implementation have been selected. When selecting parameters, all related disciplines that form the context of strategic planning are taken into account: the parameters of the political, economic, legal and socio-cultural contexts. By introducing a context into the research, related disciplines become significant variables for strategic planning (Campbell, 2003).

The parameters given in this article, obtained by a critical analysis of theoretical sources cannot be considered the final selection of the parameters for the model. By applying the model and introducing real examples and research, and obtaining information derived from practical experiences in a particular context, the list of parameters can be improved.

3. STRATEGIC PLANNING TIME AND LOCAL CONDITIONS

In the course of conducting the research in strategic planning area, it is very important to understand what influences the differences in strategic planning process depending on the environment where it is implemented.

Strategic planning is one of the modern forms of management in the public field. It was created due to the dynamic changes in the society: the changes in economic conditions, the changes in values, technological development, intensified competition, increasingly complex legislation (Lazarevic Bajec, 2009) and impossibility of the existing forms of planning to respond to the problem accordingly.

Strategic planning is most frequently presented as an ideal concept for all conditions. There is a large number of researches that emphasize the qualities of this planning type

such as visionary concept, selectivity, realism, creativity and action orientation. They do not present strategic planning as the reaction to the external influences but the force and driving energy by itself (Newman, 2008). Such approaches often lead to the wrong conclusions, that the strategic planning can be a solution to all the problems of development in different social environments. The idea that strategic planning will solve the problems in the developing countries only because it works in the developed ones is completely wrong (UN HABITAT, 2009). That is why it is important to study actual forms of strategic planning that appear in different types of social and political structures.

Complex environment of decision making and network of relations influences the basic characteristics of the planning process. Goals must be formed within a specific context (economic, cultural, social, political), time, place and level, in accordance with specific topics of interest (Albrechts, 2006).

Thus, we should study both the context in which the planning process is happening as well as the external influences that are shaping the planning process.

3.1. Strategic planning context

John Bryson presents two types of strategic planning with their advantages and disadvantages. The first type is more rational, and it gives advantage to the arranged process; the other one is politics-oriented and depends on the context (Bryson, 2004). He favours the second type which is considered more successful and refers to the importance of the context in strategic planning. Strategic goals and resources are connected to the social context, so it is necessary to carefully balance control and flexibility, formal and informal planning and management, as well as existing and new activities (Lazarevic Bajec, 2009).

The strategies are always made in a specific place at a specific moment (Van den Broeck, 2008). The context is dynamic and therefore it is very important to analyse all the changes that occur during the strategic planning process. It means that the planners in different national, regional and local contexts have different starting points (Newman, 2008).

No strategy can be explained and analysed effectively without considering the context it started from and where it would be realized. According to Jan Bracken, the context can be examined through three components: political, legal and professional (Bracken, 1981). In addition to these, there is an important influence of economic, social and cultural components (Healey, 1997). Because the professional component could be considered a part of the social and cultural components, in this research we studied and used political, legal, economic, social and cultural components of the context in the choice of the parameters.

The political context shapes the institutions and governance. The countries in the world differ a lot, first of all in size, then in the division of territories and different levels of governance. There are clear distinctions in the political systems around the world and their attitude to urban planning (Bracken, 1981). Political system stability is very important for strategy implementation. Strategic planning is said to be an innovation with the chances of survival because it is based on political decisions and it is compatible with them (Bryson, 2004). The government has the greatest responsibility for strategy formulation, monitoring and implementation process management (Lazarevic Bajec, 2009). Strategy implementation quality and efficiency depend on its flexibility. Its flexibility is frequently reflected in horizontal inter-sector cooperation.

The economic context is accompanied by the political context, and it is often considered decisive and dominant compared to the social context, which is one of the criticisms of this type of planning (UN HABITAT, 2009). Market economy favours strategic planning development, while it presents a challenge in the societies with undeveloped market economy.

Legal context refers to the regulatory and legislative framework, and it tries to resolve the conflict between personal and public interest. Finally, social and cultural contexts refer to the capacity of the actors involved in the process, their education, professionalism, cultural attitudes, as well as all the relations and connections between them. Multiculturalism makes harmonizing diverse social capacities challenging, but on a global level it makes different social contexts more similar.

The most important factors that influence the strategic planning process are chosen within each of these categories: 1) political context: government level, political system stability, management flexibility, horizontal and vertical coordination; 2) economic context: market influence; 3) legal context: the existing legislative and regulations; 4) social and cultural context: individual capacities, formal and informal relationships. Hereinafter, it will be explained why each of these criteria are important for selection of cases.

3.2. Strategic planning process

As it has already been mentioned, the dynamic context constantly influences urban planning and management process. Even when the implementation process itself is finished, strategies keep on existing in space and they should always be monitored, changed and adjusted (Bracken, 1981). In order to succeed in responding to all the frequent changes – continuous new decision influx, strategic planning process is conceived as flexible and adaptable.

Thus, one of the first strategic planning definitions describes this planning type as a set of concepts, procedures and tools to help the managers and planners implement their goals more efficiently and increase the planning efficiency. During the planning process, external forces shape the behaviour and relationships among the participants who in turn develop through mutual learning. Consequently, the participants begin to introduce innovation and change into the social environment. Strategic planning process is simultaneously the process of learning, thinking and acting. The final product of the process is not determined at the very beginning, but it represents the result of the effect of the conflicting forces in the context, various types of knowledge, needs, interests, visions and actor ambitions (Bryson, 2004).

In addition to flexibility and adaptability, the characteristic of strategic planning is a continuous iterative process. All the participants return to the beginning several times and check the decisions they have made. Strategic planning is action oriented, but its path is not a straight one. The implementation frequently starts before the planning is finished (Bryson, 2004). Sometimes the implementation starts at the very beginning of planning, following vision and goals definition.

Due to the constant mutual effects between environment factors and adaptation, no strategic planning process can be the same. Each is unique and requires specific modification and harmonization according to the local conditions. There is no determined format for this process. This nature of the strategic planning process additionally complicates the choice of

important parameters. What is common to these processes is that each process is based on the goals and it strives to work harmoniously in order to achieve them.

Five key elements are chosen within a strategic planning process. The elements chosen are the ones that mostly influence the process implementation and success, present in almost every process but varying from one environment to another: actor participation, consensus achievement, finances, division of jurisdiction and formality of the process.

4. Choosing the Parameters for the Case Selection Model

4.2 Parameters for the first level of selection

For the first level of the selection process – the "coarse" selection – a set of parameters which are the basic indicators of the adequacy of the selected case should be used. This group contains parameters that show the main characteristics of the strategic planning, the parameters related to the practicality of the research, and the general methodological problem of case selection. If during the evaluation process it turns out that any of the selected cases are not appropriate, those cases must be eliminated from the selection.

The parameters for the first level of selection are:

1. *Data availability and relevance*. This represents one of the most critical aspects for the case selection. Data about other environments frequently originate from secondary sources that cannot be asserted as unbiased and are often subjective. If the planning process has been transparent, the paperwork accompanying the process is easily available, such as the initial agreements, stakeholder analysis, reports, etc. In order to conduct the valid research, it is desirable to have access to the primary sources: official and unofficial documents, a chance to observe the process, conduct a series of interviews in order to confirm the data accuracy etc. (Yin, 2012).
   Data sources: documents created in the process or the interviews
2. *The sector where strategic planning is situated*. There is a big difference between strategic planning in private and public sectors. Public authorities do not have the flexibility of private enterprises (Lazarevic Bajec, 2009). However, it frequently happens that models are transferred from private into public field leading to unfeasible plans. The public-private partnerships blurred the boundaries between private, public and non-profit sectors (Bryson, 2004). Private sector has become a part of public affairs. Although the boundaries between the sectors can be blurred, when selecting an example, it is important to identify which sector is the strategic planning a part of, because this has a major impact on the planning process.
   Data sources: basic data on strategic planning process
3. *Strategic planning goals*. The goals are shaping the planning process. They are evolving and are added during the whole process when it is necessary to 'push' it in the desired direction (Bryson, 2004). There are several levels of the goals: from general to operative, from long-term to short-term goals, and they all have to be mutually compatible and function together. The goals can be oriented toward the final product or the process. It is important to choose the goals that are coherent and similarly oriented in the case selection process.
   Data sources: strategies and action plans

4. *The presence of strategic planning stages*. Every strategic planning process has to contain the elements of strategic thinking, learning and acting. In the first part of the planning process – strategy creation, they are often not that clear and apparent, but they are very prominent in the implementation phase. Therefore the process must be considered in full. Planning and management are connected and cannot function without one another (Bryson, 2004).
   Data sources: the initial agreement (presenting the process draft) and reports (about the stages achieved)

4.3 Selected parameters for the second level of selection:

Parameters for the second level of selection – the "fine" selection – are organized into two subgroups: parameters relating to the planning process and context of strategic planning. Depending on the weight, which will be assigned to them in the second phase of the research, they can have varying influence on the selection or elimination of the cases.

The parameters for the second level of selection regarding the elements of strategic planning process are:

1. *Active involvement of all the interested actors*. The involvement of the actors makes the strategic planning process a very complex one. It is necessary to involve the local government representatives, private investors, experts and local community. It is also important that all the actors are involved throughout the process, from the agreement on goals to the implementation. In cases when new actors are introduced into the implementation process, we can say that the implementation becomes a 'moving target' (Bryson, 2004). It is sometimes useful to involve new actors in the implementation in order to be able to perform strategy evaluation, but it is not a good idea in case of the complex process of strategic planning involving a large number of actors. Studying the involvement of actors is very important for the case selection because not all interested parties are involved in some environments, or they are only ostensibly involved, or there is no involvement from the beginning of the process etc.
   Data sources: participation plan, stakeholder analysis, actor information data
2. *Provision of consensus among all relevant actors on the goals, that is, actions within the action plans*. Consensus achievement does not simultaneously mean fulfilment of wishes for all the actors. In order to fully or at least partially fulfil the interest of all actors involved, the process of consensus achievement should be conducted in such a way that all the actors are well-informed, actively engaged, interested, that creative thinking and knowledge exchange is fully developed, all the necessary information exist and that the goal are practical (Innes & Booher, 1999). In some cases consensus is not necessary as an indicator of the process success. (Bryson, 2004). It is important for the case selection whether the consensus is achieved because it affects the accomplishment of the plan.
   Data sources: the actors' written agreement on the goals and the interviews with the participants in the process.
3. *Financing*. Budget allocation is of crucial importance for strategy implementation. The budget represents the most important document made in the course of strategic planning. The difficulties in budget creation arise from the political context. Short-

term budgets most frequently appear in practice due to political uncertainty, instead of the long-term, comprehensive, innovative, proactive, as well as goal and priority oriented budgets. The problem lies in the fact that planning is completely separated from implementation. In order to overcome that, it is necessary to make the plan before the budget allocation, and that the planned action is timely marked in the annual calendar of each individual actor. There are several modern financing models identified in strategy implementation: performance budgeting, value based budgeting, rolling budget and forecast, zero-based budgeting, activity based budgeting and entrepreneurial budgeting. It is very important that the financing is time-adjusted, according to the activities defined in the action plans.

Data sources: budget, public companies' plans and programs

4. *Division of jurisdiction*. The system of jurisdiction division is in close relation to budget. It is necessary to establish a management structure that will use the resources available in the best way (Lazarevic Bajec, 2009). The responsibilities of each actor in the process are clearly defined through action plans and explicit duties of each unit, team or individual in charge of implementation. It is very important that there is a clear understanding by those implementing the plan about what should be done, when and who should do it (Bryson, 2004) in order to implement the strategy successfully.

   Data sources: action plan and reports

5. *The relations between the formal and informal system*. As we have already mentioned in this article, strategic planning originated as a set of concepts and procedures which can be helpful for managers in the management process (Bryson, 2004). Strategic planning was a completely informal process at the very beginning. In certain environments parts of the process were formalized i.e. linked to the formal systems. In others, they remain informal so the link to the formal system is often unclear. Henry Mintzberg discusses the advantages and disadvantages of the strategic planning formalization. He makes a clear distinction between strategic planning and the strategic thinking. The strategies cannot be made as a part of the planning process; instead they are created through creative and intuitive processes. They have to arise from informal communication among people at different levels. If they became a part of the formal process, they would lose the creativity and intuitiveness. On the other hand, formalized processes are very good in acquiring the necessary information for effective strategy formulation. This type of process guarantees discipline and commitment to effective strategy implementation. Whether the process belongs to the formal or informal type can be an indicator of the process flexibility and adaptability, as well as the quality indicator of those managing the process (Mintzberg, 1994).

   Data sources: laws, secondary sources describing the planning system and reports in the course of the planning process.

Parameters within the planning context that influence the second stage of case selection from other environments (political, economic, social and cultural):

1. *Level of government*. The countries of the world differ a lot, primarily in size, territorial division and different levels of government. There are large differences between regional levels, for example, in Russia and Serbia. When selecting the case, it is necessary to check whether the levels in which the strategic planning is

happening are compatible. Management structure in planning institutions is a very important factor that influences the process. Hierarchical organization accepts strategic planning process flexibility with a lot of difficulties, while a centralized system most often prevents the implementation of strategic planning.
Data sources: laws and secondary sources describing authority organization levels

2. *Political system stability*. Implementation of strategies mostly depends on the stability of the political system. Frequent changes in the government and unstable political mandates make it impossible to implement strategies, finance agreements, etc. In the event of a change in the government, the implementation of strategies is often interrupted, because it can be interpreted as giving credibility for opposition parties (UN HABITAT, 2009). Political system instability reflects on the budget and long-term financing inability.
Data sources: information on ruling coalitions and their mandates
3. *The existing laws regulating the planning process*. When we speak of the legal framework, it is very difficult to make comparisons because the countries' systems differ a lot. The most important are the laws dealing with government structure, planning, construction, land, and therefore they should be considered in the case selection.
Data sources: the laws dealing with the government structure, planning, construction, land
4. *Flexibility within the administration*. The administration has the greatest responsibility in process management, strategy formulation, monitoring and implementation. It is expected to secure the implementation of strategies, establish instruments and make decisions to help strategy implementation. It often happens, in developing countries and countries in transition, that the authorities still do not understand their new role of business management so they only provide services (Lazarević Bajec, 2009). Flexibility of administration depends on management team capacities, but it can also be reflected in realized innovations or quality of horizontal cooperation. Strategic planning can be conducted with more creativity in flexible authorities.
Data sources: city budget, other reports on local government work
5. *Connection between strategies on horizontal and vertical levels*. The coordination between strategies in terms of timeframes and topics is important. Strategies on the same level from different fields should be coordinated. Similarly, the strategies on different levels should be coordinated, as well as strategies between private and public sectors. Also, it is important that general strategies are made before partial ones. It is necessary to analyse the strategy position in case selection because it sometimes happens that the same problems are treated in several strategies, and/or there are areas developed in more details in other strategy (Lazarević Bajec, 2009).
Data sources: strategies at various levels and in different sectors
6. *Capacities of individuals taking part in the process*. There are great differences in capacities of individuals from different environments. First of all, local government representatives, experts, local community and private investors all take or should part in the planning process. Concerning the local community, in democratic societies, the citizens are familiar with the way the market works, the costs, benefits, competencies and responsibilities of actors (Lazarevic Bajec, 2009). Such knowledge, necessary for strategic planning process, is not established in underdeveloped market economies. Likewise, the planner education is very different from one country to another. The

qualification of management team is also very important as it is required from the management to have a good overall view of the planning process and direct the planning process. Flexibility, innovation and creativity depend on it (Mintzberg, 1994).
Data sources: attitude and behaviour evaluation studies, interviews with participants in the process

7. *Institutional capacities* – the qualities of formal and informal connections. The process of thinking, acting and therefore learning is a component of strategic planning. One of the factors of successful implementation is the quality of networks established among the participants in the process (Bryson, 2004). There are clearly built relations and networks in the environments where strategic planning is a frequent practice. There is a greater possibility for strategic planning to be successful in such environments because the institutional capacities are improved through a permanent iterative process.
Data sources: attitude and behaviour evaluation studies, interviews with participants in the process

5. CONCLUSION

The key problem when selecting the cases is the availability of data from other environments. In order to conduct a detailed analysis, it is necessary to use a large number of documents. That requires access to written documents created in the process of strategic planning, holding interviews with participants, and adequate capacity to monitor and observe the selection process. This is the right way to conduct a valid research. An extensive volume of information together with a large number of sources that they are derived from, and the variety of parameters from different fields which have to be considered, all indicate how complex the problem of a case selection from different environments can be, even though this is often not fully realized.

An important issue that demands further investigation is the verification of the case selection model. The model is improved through constant iterations and addition of new cases. However, the question arises: at what point does the model reach the necessary level of quality? It is necessary to conduct further investigation on the assessment procedure of the proposed model.

The contribution of this research is methodological in nature and helps researchers in choosing an appropriate case/example for their research. In addition to informing them of the complexity of the problem, the planned model will enable them to reach more accurate results. If proper, compatible examples were always used for urban research, new findings would provide more practical guidelines for the practice.

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METOD ZA IZBOR PRIMERA USPEŠNE PRAKSE U STRATEŠKOM URBANISTIČKOM PLANIRANJU

Primena strateškog planiranja je česta u urbanističkoj praksi. Radi boljeg razumevanja ovog oblika planiranja u urbanističkim istraživanjima se koriste i preuzimaju inostrani primeri uspešne prakse. Najčešće se izbor vrši bez razmatranja konteksta iz kog su primeri preuzeti i karakteristika procesa planiranja. To u praksi rezultira strategijama koje se ne implementiraju i planovima koji se ne sprovode. Cilj sprovedenog istraživanja je bio da se urbanim planerima i istraživačima pojednostavi izbor odgovarajućih primera dobre prakse iz različitih sredina. To se postiže formiranjem modela za evaluaciju, čija je uloga da izoluje primere iz različitih sredina koji će biti kompatibilni sa konkretnim slučajem iz sredine u kojoj se vrši istraživanje.

Ključne reči: *strateško urbanističko planiranje, metodologija istraživanja, model, primeri uspešne prakse*

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DESIGNING OF CHILDREN PLAYGROUNDS FROM THE ASPECT OF USED SURFACING WITH A GOAL OF CHILDREN SAFETY ON THE EXAMPLE OF THE CITY OF NIŠ

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Abstract. *When designing children playgrounds, one should take into consideration numerous factors dictating safety of the children spending time on the playground. Accessibility of individual parts of the playground, and quality of the equipment, types of used materials in terms of durability, non-toxicity, are only some of the factors which can have impact on the safety. Also important are separation of children age-groups as well as of the conflicting activities, visible labels and supervision. Also, the spacing between the individual parts of equipment and types of used surfaces should be considered. This paper analysis materials of the playground as an element in designing, aimed at children safety. The research includes areas for children play in the city of Niš, The analysis of children playgrounds was performed on the most frequented parks in Niš – in Čair park, Sveti Sava park and Fortress park. Also, there is an analysis of the children playground in the retail park Stop Shop in Niš, which has been built most recently. The goal of the paper is finding the actual condition of the children playgrounds in Niš, from the mentioned aspect, as well as building awareness about the importance of designing of safe children playgrounds.*

Key words: *children playgrounds, surfaces, equipment, designing*

1. INTRODUCTION

The children's desire and need to play is innate. It is very important for a child to satisfy this need from the beginning for the proper development of its personality. Self-recognition of own abilities, self-esteem, team spirit, potential for solving of conflicting situations, development of different verbal and social skills are only some of the things learned through the play with their peers. Children play, and learn through it, depending on the age, almost all day long. Firstly at home, with the parents, then in a kindergarten with their peers and teachers, and during the day on children playgrounds and play houses [1,2].

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Considering the time every child spends on a playground and importance of the time spent on the development of psycho-motor abilities of a child it is very important to create a good, and primarily, safe design of children playgrounds [3,4].

When designing children playgrounds, numerous factors should be taken into consideration. Children using playgrounds are most often 1-12 years old. Assessment of the children age – of future users is very important in designing, because the type of equipment that will be designed, which will provide different types-levels of games, depends on it. Different types of games, i.e. different playing zones will be attractive to different groups of children.

The following key factors are important for the playground design:

- Accessibility
- Age separation
- Conflicting activities
- Lines of visibility
- Labels and/or labelling
- Supervision [5]

In particular, potential injuries must be taken into consideration, so as to minimize the risk. One should take into consideration:

- Potential falls off and around equipment
- Need for a protective surface layer which absorbs the impact around and under the equipment
- Size of openings in order to prevent heads becoming trapped in them
- Range of equipment and other design characteristics, connected to the age of the users and arrangement of equipment on the playground
- Procedures during installation and maintenance
- General hazard presented by the sharp edges [5].

The selection of materials must be based on many characteristics of the individual play areas: height of equipment; age of users; dispersion of elements; normal weather conditions; maintenance costs; installation costs; equipment life expectancy; and environmental concerns. The functionality of the different types of materials is the most significant concern for a school or public entity that is installing or upgrading a playground [6,2]. In this paper, we are primarily dealing with materials used as surfacing of children playgrounds.

2. THE PLAYGROUND SURFACE AND SELECTING A SURFACING MATERIAL

The playground surface is one of the most important safety aspects in preventing and avoiding serious injuries resulting from falls and tumbles. Hard surfaces such as concrete and asphalt are inappropriate for underneath swings and jungle-gyms. Even soil or grass is an inadequate surface for a playground because constant use compacts the ground and diminishes its shock absorbing ability [3,7]. An even, resilient surface that offers protection to children's limbs and attenuates impact is required. Children should always be closely supervised in any playground by a responsible adult [8,4].

Vivid colours to reflect natural light and increase visibility, colour contrast between playground equipment and surfacing to avoid tripping hazards, changes in surface elevation can also be highlighted with designs or colour change [9]. The surface of the impact area shall be free from sharp edged parts or projections and shall be installed without creating any entrapment situation.

There are two types of surfacing options for playgrounds: loose-fill and unitary materials. The most frequently used loose fill surfacing materials are tree bark, woodchips and shredded rubber mulch. In addition, the most frequently used unitary materials are rubber matting (either as tiles or poured rubber surface), turf and topsoil and carpet surfacing (with sand and similar material underneath). Moreover, it is important to visually accentuate these areas. Protective surfacing must be maintained in an appropriate way. Every deviation can result in a considerable reduction of protective function.

2.1. Loose-fill surfacing materials

Important advice when considering loose-fill materials:

1. Loose-fill materials become compacted in time for at least 25% because of usage and weather effects.
2. Surfacing often requires frequent maintenance to ensure that the depth is always maintained above the minimal value. The areas under swings and at the exits are prone to dispersing, which requires constant maintenance of these areas.
3. The perimeter of the playground should provide a method of containing the loose-fill materials.
4. Install the marks showing the minimal depth of loose-fill materials in order to retain the original material depth.
5. Good drainage must be provided because the standing water reduces efficiency and causes compaction and disintegration of material.
6. Critical depth can be reduced in winter, during the ground freezing periods.
7. No wood mulch containing wood products treated with copper-chrome-arsenic (CCA) can be used.

Sand is one of the easiest products to maintain. It is easy to smooth out its surface and children love playing in it. However, the downside of this surfacing is that cats often soil it, while crushed glass or some other materials can be buried in the sand and can represent a hazard to children. In addition, in the freezing conditions, sand can become hard as concrete and can be used only after the sun warms up the surface or if materials is manually broken and made suitable for use [3].

Pea gravel is an old surfacing material for children playgrounds. It consists of large aggregate grains, the size of pea kernels. Pea gravel is still popular, but is increasingly being replaced with synthetic materials.

The advantages of pea gravel are: economy, easy maintenance and evening of surface. In addition, it does not attract animals like sand. The downside of pea gravel is that it can be a severe choking hazard for children under age of three, because they swallow the grains of the surfacing, and put them in the nose or ears.

It creates a problem for maintenance of the grass and surfaces surrounding the playground. Lawn mowers can throw the gravel significant distances [3].

Wood Chips - This material is cheaper than the other so it is suitable for playgrounds with limited budget. This material is easy to find, it is easy to move from one place to another. It is not toxic, does not contain colour or additives. It is good for fall attenuation and impact absorption [11]. The downside of this material is that it requires constant maintenance. It is water absorbent, so it is difficult to drain. It is prone to rotting, and according to some research, on average 25 % of material must once a year be replaced (figure 1) [3].

Fig. 1 Wooden playground mulch [12]

Recycled Loose Fill Rubber consists of 100% pure recycled rubber. Even though it is somewhat more expensive than the wood based surfacing, it is more economic in a long run, because it does not disperse so the maintenance cost is lower. Considering that it is loose, it is easily drained, does not attract insects or animals. It has one of the highest impact attenuation ratings. It is soft to touch and splinter free. It does not decompose [11].

2.2. Unitary surfacing materials

Unitary materials are generally rubber mats and tiles or a combination of energy-absorbing materials held in place by a binder that may be poured in place at the playground site and then cured to form a unitary shock absorbing surface. Unitary materials are available from a numbers of different manufacturers, many of whom have a range of materials with differing shock absorbing properties. New surfacing materials, such as bonded wood fibre and combinations of loose-fill and unitary, are being developed [13,14].

Poured in Place Rubber (PIP) surfaces are most common. A wide range of colours allows you to add an element of graphic fun to the playground by creating inlaid shapes and themed design. In most cases, it consists of two layers, a cushion layer made of clean, recycled tire rubber and a decorative wear course layer comprised of fine virgin EPDM or TPV granules. It is installed over asphalt, concrete or compacted aggregate on a base of soil. The depth of the layer varies depending on the need – place where it is installed and predicted wear and fall height. Advantages of this type of surfacing are easy installing, availability in different colours and potential for subsequent colouring and decoration, as well as easy maintenance (figure 2) [11].

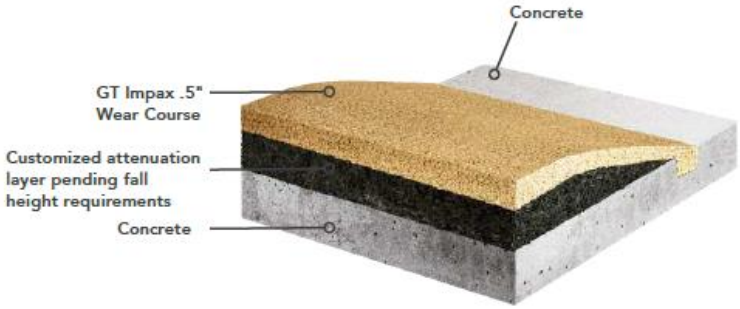

Fig. 2 Poured in place rubber surfacing example [11]

Synthetic turf brings the look of nature to your play environment. In playground applications, we include a cushion layer that provides fall protection. After the Synthetic Grass layer is installed, infill is worked in among the blades to discourage blade flattening and help reduce surface temperature [11]. Such type of surface offers a natural look, colder surface in relation to other types of surfaces, does not require a high level of maintenance – it is not mown, watered and quickly dries out so children can play on it earlier after rainfall than on other types (figure 3).

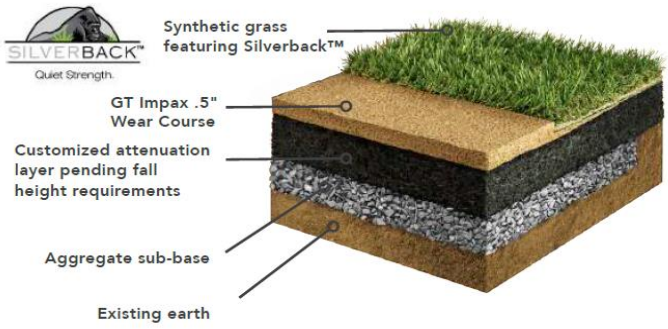

Fig. 3 Synthetic grass [14]

Recycled rubber interlocking tiles are also easy to maintain, they are durable and accessible. They are also suitable for indoor use, because they are not poured in place. They can be found in different colours and thicknesses depending on the needs. The surface is easy to repair, by replacing the damaged tiles with new ones (figure 4).

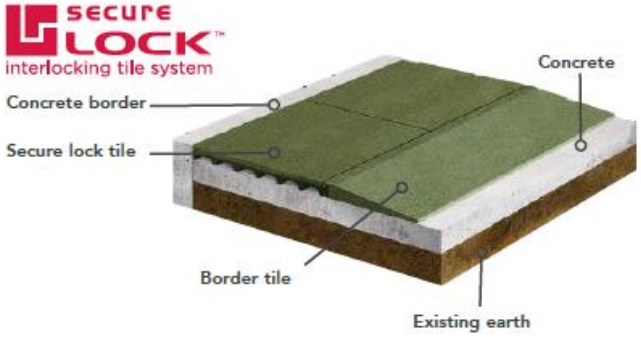

Fig. 4 Recycled rubber tiles [11]

Recycled Bonded Rubber – coarser grains of recycled rubber than in case of the poured rubber are used. There are no seams as in rubber tiles. Such type of the surfacing is cheaper that the previously mentioned. The surface is porous and provides water penetration. It is comprised of a precise combination of wire free, cleaned pigmented recycled rubber and a polyurethane binder. It is installed and troweled by hand to provide a resilient, seamless appearance. Larger rubber strands provide the natural look of loose fill surfacing without the disadvantages of displacement (figure 5) [11].

Carpet surfacing with sand and similar material underneath is also the possible type of surfacing that is rarely used.

Fig. 5 Recycled Bonded Rubber [11]

3. NIŠ PLAYGROUNDS CASE STUDY ANALYSIS

The city of Niš has a large number of park spaces in its territory. The largest are Čair park, the Fortress complex which, even though occupies a large surface has a relatively small number of amenities for children, and Sveti Sava park in the Nemanjić Boulevard. In addition, almost every building block has an inner yard with a minimum of equipment intended for children play – seesaws, swings, slides and jungle-gym.

3.1. Čair park

Čair park is positioned in the central part of Niš. It occupies an area of 16,4 hectares [15]. The complex itself is made of two entities, one large green area with various amenities intended mostly for children, and a sport and recreational complex composed of outdoor and indoor pools, football pitches, fitness center, ice rink. The complex is intended for a wide variety of users, containing indoor and outdoor areas where various health, recreation, education, culture, art, entertainment, trading activities are taking place. As early as in the period of Ottoman domination it was named - Čair – a garden - for the lush greenery in it. Next to the complex, there is a large number of cafés and sweet shops.

The section intended for children playground changed in time. Individual parts of the park are being added playground equipment, which changed their purpose. Therefore, there is a number of subareas in Čair, earmarked for these activities. The older children playgrounds, i.e. equipment installed before a number of years is in a rather poor condition, figure 6. Mostly, the surfacing under the swings and slides are damaged, so the children jump or fall on asphalt or concrete instead of on rubber when they play. The foundation zones of equipment in time became visible, regarding that topsoil is removed due to swinging, so these concrete pieces represent an additional hazard for children safety [16].

Fig. 6 Equipment in Čair park – inadequate surface, photo A. M. Petronijević

A part of the park which is equipped with the equipment relatively recently, by the donation of the Forum shopping centre, was designed in, 2011 so that it largely meets the mentioned standards, figure 7 and figure 8. An enclosed area which was built in this campaign has climbing equipment, seesaws, swings, huts, artificial rock for climbing. Very commendable is usage of rubber tiles as surfacing, which minimizes the injuries of children on jumping, falling etc. The downside is that the individual parts of the equipment are mutually very narrowly spaced [16].

There is a problem because of the lack of maintenance. After years of usage, the rubber tiles are missing, so now, instead of rubber surface, the topsoil prevails.

Fig. 7 Newer part of the park renewed with the Forum donation. Current condition. Čair, photo A. M. Petronijević

Also problematic is the narrow spacing between individual pieces of equipment.

In 2015, City Municipality of Mediana installed a playground item in a form of a pirate ship, so called „The Nis Galley“, figure 9. The supporting structure is made of steel sections, and floor of the ship and outer skin of wooden planks. One can also observe the absence of adequate surfacing between the slides and swings, and of protective sheathing of the steering wheel, which makes it a potentially dangerous place for children [16].

Fig. 8 Newer part of the park renewed with the Forum donation. Current condition. Čair, photo A. M. Petronijević

Fig.9 Galley in Čair. Čair, photo A. M. Petronijević

3.2. Sveti Sava Park

Sveti Sava park is one of the largest and most visited parks in the city. In the park, with finely organized green park areas, the central position is occupied by the Church of Holy Emperor Constantine and Empress Helena. There is different children equipment, a fountain with a bridge, small theatre for the smallest children, a building of the City Municipality of Mediana, elementary school Sveti Sava and multitude of cafes, shops and sports facilities on the park periphery.

Both here and in Čair park, there is a problem of inadequate equipment maintenance. The City Municipality of Mediana, arranged a plateau north of the church in 2009, by building a fountain and a bridge and an entire complex for children play [16].

The steel structure of the central composition intended for playing is clad in chipboards painted in light colours, with Cyrillic letter motifs, figure 10. The platform floor, and the staircase is made of wooden planks. Here also, the surfacing the children land on after coming down the slide is worn out. The wooden steps are decrepit. Also, the rubber surface under the swings around the ring is dilapidated and worn out in places (figure 11) [16].

Fig. 10 Equipment in Sveti Sava Park, installed in 2009., photo A. M. Petronijević

Fig. 11 Equipment in Sveti Sava Park, installed in 2009, photo A. M. Petronijević

The situation in the newer area, equipped in 2016 is better. The first playground built as a result of Imlek company campaign "Moja Kravica - Rasti srećno", was built exactly in this park, figure 12. The entire equipment is placed on the rubber surfacing, and the used materials are adequate for the stated purpose.

Fig. 12 Equipment in Sveti Sava Park, installed in 2016. photo A. M. Petronijević

3.3. The Fortress

The Fortress of Niš is certainly the most attractive area in the city. It is a city hallmark. There are numerous amenities in the Fortress, from cultural, tourist, educational to the entertaining. The relatively small area inside the walls is intended for child play. The individual cafés east of the Fortress gate install such equipment in the summer season. Permanently constructed equipment exists at only few places in the fort. It is installed directly on soil, without any layers of sand or rubber, figure 13 [16].

Fig.13 Equipment in the Fort, installed directly on the soil, photo A. M. Petronijević

3.4. Stop Shop retail park

It becomes increasingly common to install the playgrounds in the shopping malls either indoor or outdoor. The concept is that one of the parents would spend time with the children, while the other would go shopping. So, in Nis, in the Roda center, there is a children playground inside the building, and in the Stop-Shop retail park, there is an outdoor area. The Stop-Shop retail park can boast of safe equipment, proper spacing and complete rubber surface, figure 14. Time will tell whether this will disappear in time, like that in other playgrounds in the city, or it will be better maintained. The area is completely enclosed, which facilitates the parent supervision of the children movements and activities [16].

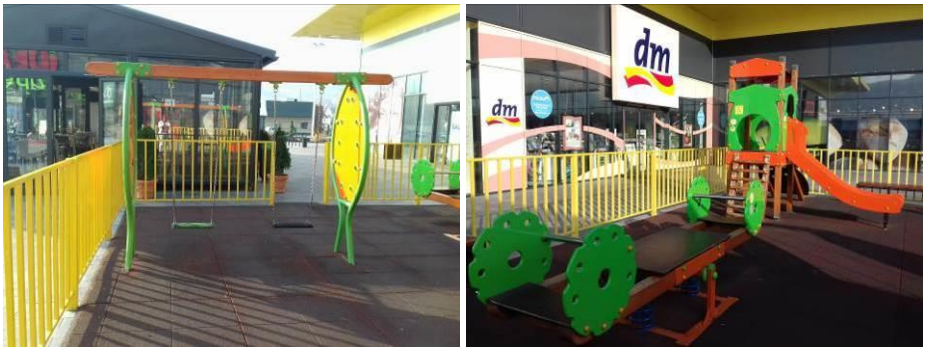

Fig. 14 Good practice example, Retail park in Niš, photo A. M. Petronijević

4. DISCUSSION AND CONCLUSIONS

The paper presents a number of playgrounds in the area of the city of Niš. The largest complexes have been chosen, both in terms of the area and the number of users, in order to provide the truest possible idea of their condition. The presented data suggest the following: the playgrounds which are older, such as Čair park, or some of its older parts, then children playgrounds in the Fort, feature inadequate surfacing. It is most often asphalt, concrete or soil. If it is soil, it is very frequent case that it is displaced from the impact areas (beneath the swings, seesaws, slide landings), which increased the fall height, making the specific equipment unsafe (also found on the playground within Čair park) Also, because of this, the foundation elements of the equipment became exposed, leaving the concrete protruding from the earth, thus presenting a severe hazard for children.

The playgrounds designed in the previous ten years already have incorporated rubber elements, such rubber tiles or poured rubber, usually placed in places, under the seesaws and slides. Considering the long usage of such playgrounds, and the lack of maintenance, the surfacing is partially or fully damaged – in the part of Čair park built with the donation by the Forum shopping centre, as well as in the parts of Sveti Sava park. A third group of playgrounds are those constructed in the last 5 years, with adequate and still well-maintained surfacing – part of the playground in Sveti Sava park built during the campaign „Moja kravica - rasti zdravo", and the entire playing area in the retail park Stop Shop.

Nowadays, with easily available adequate materials, and with a large number of recommendations about the usage of material in the world and locally, and with the regulations on safety on children playgrounds [16], there is no excuse for the designers to ignore this aspect while designing. Safely designed playground, and usage of safe materials, maintained according to the recommendations, is a guarantee of children safety when they use these areas, which is the primary task of any of us.

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PROJEKTOVANJE DEČJIH IGRALIŠTA SA ASPEKTA PRIMENJENJIH PODLOGA SA CILJEM BEZBEDNOSTI DECE NA PRIMERU GRADA NIŠA

Prilikom projektovanja dečjih igrališta u obzir treba uzeti brojne faktore koji utiču na to da vreme koje deca provedu na igralištu bude pre svega bezbedno. Pristupačnost pojedinih delova igrališta, zatim kvalitet samog mobilijara, vrste primenjenih materijala u smislu trajnosti, netoksičnosti su samo neki od faktora koji mogu uticati na bezbednost. Bitni su takođe i razdvajanje starosnih grupa dece, konfliktne aktivnosti, vidne oznake, nadzor. Treba se, takođe, voditi računa o međusobnim razmacima pojedinih delova mobilijara, kao i o vrstama primenjenih podloga. U ovom radu je vršena analiza materijalizacije igrališta kao elementa projektovanja, sa ciljem bezbednosti dece. Istraživanjem su obuhvaćeni prostori za igru dece u gradu Nišu. Analiza dečjih igrališta je vršena na najfrekventnijim parkovima u Nišu – u parku Čair, parku Svetog Save i parku u Tvrđavi. Takođe je urađena analiza dečjeg igrališta u okviru ritejl parka Stop Shop u Nišu, koje je najnovijeg datuma izgradnje. Cilj rada je utvrđivanje stvarnog stanja dečjih igrališta u Nišu, sa spomenutog aspekta, kao i podizanje svesti o važnosti projektovanja bezbednih dečjih igrališta.

Ključne reči: *dečja igralista, podloge, bezbednost, oprema, projektovanje*

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CROWDSOURCING IN PARTICIPATORY PLANNING: ONLINE PLATFORMS AS PARTICIPATIVE ECOSYSTEMS

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Abstract. *Insufficient public presence within the traditional participatory activities in urban planning is largely caused by their incompatibility with the communication preferences of the public they are addressing. Accordingly, this research is aimed at identifying alternative approaches which enable the creation of new communication channels and improve the level and quality of participation. Starting from the hypothesis that technological development has changed the way we communicate, the goal of this research is to provide the deeper understanding of the current potentials and problems of internet participation in urban planning and also to point out on the future development strategies, which could address the problems we are facing today. By analyzing case studies in which Internet communication is used for this purpose, as well as publicly available data about user activities within the popular web platforms, we investigate the main advantages and disadvantages of the described practice, as well as the opportunities of the application of new communication approaches and technological trends, such as crowdsourcing activities and blockchain technology.*

Key words: *urban planning, participatory planning, crowdsourcing, blockchain, internet*

1. INTRODUCTION

When we talk about urban planning, we know that its subject is related to changes in which the whole society finds interest. British urban planner, Patsy Healey, emphasizes how easy it is to ignore the significance of these changes, even though they have a strong impact on our lives (Healey, 1997). Consequently, this also affects the response to the participatory activities in various urban planning projects. But the lack of interest is more consequence than a cause. The reason for insufficient participation can also be found in overlapping the time of traditional public meetings with the work hours of potential participants, their moving and transportation difficulties, and their determination to avoid

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public confrontation. Even when there is participation, the results gained through traditional methods cannot be viewed as a real reflection of the community needs, because participants cannot be familiar with all the problems. Therefore it is very important to provide as many different participants as possible (Brabham, et. all, 2010), which is one of the reasons why this research is focused on investigation of the new possibilities for internet participation.

Since commercial use of internet had a revolutionary impact on information and communication technologies, reaching the new users become much faster than it was the case with other media - like radio receivers and personal computers before the emergence of a global network (Feldman, 2002). Its uniqueness is based on the ability to distribute information across the entire world of human activity, so it becomes the technological basis for creating the network as the organizational form of the information age (Castells, 2002). It becomes clear that internet can provide the planners with additional solutions for the creation of participative communication channels which would be free from the contextual boundaries characteristic for traditional methods. The situation in which it is possible to create, receive and broadcast information faster and easier than ever before, in combination with the general availability of technical devices, has also led to the emergence of a crowdsourcing phenomenon (Howe, 2006), which puts focus to the mass, or an undefined group of unknown individuals who approach the collective finding of the answer and its final design in the requested form. The potential of its application in different fields is described by an integral definition which states that crowdsourcing is a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task. The undertaking of the task, of variable complexity and modularity, and in which the crowd should participate bringing their work, money, knowledge and/or experience, always entails mutual benefit. The user will receive the satisfaction of a given type of need, be it economic, social recognition, self-esteem, or the development of individual skills, while the crowdsourcer will obtain and utilize to their advantage that what the user has brought to the venture, whose form will depend on the type of activity undertaken. (Estellés-Arolas, et. all, 2012). Since the Internet is an environment that does not know the limitations we encounter in the physical space, crowdsourcing can be implemented as the core principle within the online tools and platforms which can offer more flexible approach than traditional meetings. Starting from the assumption that groups have more knowledge than individuals, it is only necessary to create contexts in which they will be encouraged to participate (Howe, 2008).

The main goal of this research is to provide the deeper understanding of the current potentials and problems of crowdsourced participation in urban planning and also to point out on the future development strategies, which could address the problems we are facing today. This is achieved through the following methodology:

- Examining crowdsourcing and its common approaches in order to provide more information about possible actions within the planning procedures.
- Examining the user behavior models and their general activity within different internet platforms. Since we know that the existence of participatory platform is no guarantee for the participation itself, it is important to provide more information about the way people create content within it.
- Analysis of the case studies which included online participation as an integral activity during different urban planning projects in order to present different

approaches and get more insights about the possibilities of their implementation in various planning stages.

- Comparative analysis of user participation data gathered from two internet platforms - Wikipedia and Steemit. While the first one represents the largest online encyclopedia, the second platform is based on an innovative blockchain technology which enables us to consider its potential in the creation of decentralized online crowdsourcing platforms which could become the important tool in the future participatory planning. The published content on both platforms is not taken in consideration during this research, not only because they cannot be observed as scientific sources, but also because the information it contains is not relevant for the research goal. Instead of that, we analyzed open data related to the user activity level in order to discover potentials for increased engagement and participation in urban planning projects which base part of their activities on participation through online platforms and similar web-based concepts.

2. CROWDSOURCING AND ITS POTENTIAL IN URBAN PLANNING

The main reason for creating the participative online platforms dedicated to specific urban planning problems is their ability to harness the wisdom of the crowds in the way which was not possible before because the collective intelligence of communities was largely untapped by traditional public participation methods (Brabham, et. all, 2010).

However, an important question relates to the way in which the crowdsourcing principles are implemented in the mechanisms we are addressing to the masses. Howe further explains this, by stating that crowdsourcing is not a single strategy but the umbrella term for a group of approaches that depend on some contribution from the crowd (Howe 2008):

- Crowd wisdom (Collective intelligence) – Every crowd member possesses specific knowledge about a general issue, and synergy of their minds may come with the results that largely surpass the results of individuals or teams, regardless of their qualifications and expertise.
- Crowd creation – These are usually activities which include delegating different tasks to the crowd, in order to harness their creativity.
- Crowd voting – Organizing the information based on the voting preferences of the crowd. This does not necessarily relate to conscious voting – it could be based on mass preferences and other patterns.
- Crowdfunding - Getting financial support for projects and ideas from people who support it and are usually willing to donate money in exchange for symbolic gifts or benefits.

Depending on the problems they are addressing, participatory platforms can take on different forms, with their relevance depending on whether and to what extent they stimulate the interest of the crowd, both through the contexts they create and some of the above-described approaches.

3. WHAT MOVES THE CROWD?

Speaking of urban planning, we can consider the act of participation as a process in which individuals or groups are creating the value in form of information and transfer it to planners and other participants. In the context of internet participation, regardless of

the form and functionality of the platform that is used as a communication channel, we can say that the act of participation is actually the act of creating the value in the form of user-generated content (UGC).

Enabling participative functions is not the guarantee that participation will actually happen, so it is absolutely needed to analyze the user activity on existing ones. Just like in traditional methods, we may face the low-interest problems, especially when we know that participatory platforms are not attractive by themselves in the era of social networks and another web 2.0. concepts.

It is very important to take a look at participatory tendencies on popular internet platforms. Online encyclopedia Wikipedia is created and expanded exclusively thanks to community contributions, so many were surprised when the "Gang of 500" theory was introduced in 2006. According to it, 50% of all edits were carried out by 0.7% users (524 people), while 2% of users (1,400 people) wrote over 73.4% of all edits (Gajewski, 2016). This data is almost in correlation with the Internet "1% Rule ", which different variations speak almost identical thing - the dominant number of users still falls into the category of content consumers. Bradley Horowitz, former director of Yahoo and vice president at Google, talked about this phenomenon through *Yahoo! Groups* user behavior analysis and point out that 1% of users will create a group or launch a new topic within an existing group, 10% of users will actively participate in discussions, while the 100% of the users will benefit from the activities of the previous groups (Horowitz, 2006).

So even in the case of the platforms which are proven in high traffic and interest generation, we do not speak about the high percentage of content producing users. If we talk about the hypothetical platform dedicated to urban planning problem, this could mean that not all users will take the action and participate through their UGC. We could presume that high community awareness about the specific urban topic could lead to increased participatory interest, but that is applicable to the traditional methods too. Speaking of the participatory activities which usually do not generate much public and media attention (which could, for example, be included within the urban pocket or urban acupuncture projects), we can almost be sure that the standalone internet platform could not become participation catalyst by itself. But before we explore the additional horizons in the search for the answer, it is needed to explain what internet platform should provide during the participatory process.

4. EXAMPLES OF ONLINE PARTICIPATORY APPROACHES IN URBAN PLANNING

Ensuring all the conditions for online participation is a far more complex task than creating the platform itself. It is necessary to plan and provide a user environment and information that will enable participants to understand the context in which the project is being developed and the real needs that initiated the planning process. Brabham is speaking about the platform model in the hypothetical planning case where new neighborhood development is proposed to the city planning commission, and the public involvement program is launched in order to identify the potential impact on the community and find solutions to problems (Brabham, 2009). According to him, it is necessary to form an adequate open call and give as much information as possible to the potential participants – about the site where the construction is planned, timetable, expected number of new residents, etc. These questions and answers should form the basic elements of the

crowdsourcing call. Also, it is desirable that as much information as possible be included in this call - maps, list of business entities in the area. The call should also include specific professional information and data because there is no need to underestimate the ability of the mass to interpret and use them. All of these should be available on the dedicated website, along with the information about bounties, prizes and other perks which could bring the satisfaction to the participants. This could be the money, but also the prizes sponsored by local companies, communal service discounts, rights for naming some of the public buildings, etc. An understandable guide or template for the right formatting and proposal submissions should also be posted, and all user-generated entries should be publicly available for the crowd voting and other types of feedback. This does not necessarily mean that the crowd is deciding what should be included in the plan. There are many approaches to implementing their preferences into the planning procedure. For example, planners could combine different solutions, or launch the new call based on the specific entry, etc.

A concept similar to this generic model has been tested during the case of the planning the design of the bus station in the Salt Lake City, Utah. After they were introduced with the problem and available information, people around the world were asked to send their ideas. User registration was enabled from June 5 to July 24, 2009, while 338 users, mostly from the United States, United Kingdom, Germany, Austria, India, Australia, Ireland, and Canada, were registered. A total of 258 solutions was proposed, while more complex 3D concepts were submitted in the later phase of the contest. Participants not only enjoyed submitting their own designs but also in voting, commenting and following the popularity of other ideas (Brabham, et. all, 2010). Website oriented participation brings more benefits owing to the fact that it is accessible to a wide range of users. Its maintenance after the project does not cost much so it can be reused or used as an educational or another tool.

Fig. 1 Screenshot from the Next Stop Design site (accessed on 30th December 2018). Source: http://first.nextstopdesign.com

Because of its simple, yet a well-rounded concept, this project had its second iteration which dealt with the planning of an intersection in one of the Salt Lake City neighborhoods. Both of the projects are still accessible via the website, but the central

web destination does not have to be an explicit requirement in order to maintain successful online participation. For Example, UN Habitat is using the Minecraft game within their "Block By Block" initiative, to gather the idea about urban space designs from the specific crowds. In April 2014, Block By Block was applied during the Aldea Digital Festival in Mexico City. The goal was to find a proposal to redesign Plaza Tlaxcoaque in the city center. Through the plugin named PlotMe, thousands of identical models of the scene were created on the public server, and each of them was assigned to individual users who applied for participation. They were introduced with the details of the task, and after that, they had three hours to propose a solution. At any moment, the public could follow the creative process through the link. The results were surprising, as more than 7,000 young people responded while delivering over 1400 ideas and 431 complete projects. All the collected ideas were presented to the city representatives as an inspiration for the future improvement of public spaces. Many proposals demonstrated the depth of thinking and ability to identify the most specific community needs. The winning entry came from a person who is only 12 years old and was based on the zoo, urban gardens, medical center, fountains and space for outdoor games (Westerberg, Von Heland, 2015).

A good example that crowdsourcing does not have to exclusively involve the use of new technologies and the development of independent web tools, but can represent an innovative use of existing ones, is the planning case of the new parking location in Canmore, Canada (Meng, Malczewski, 2010). More parking place was equally needed by residents and tourists who often came to the city for wellness and recreational activities.

The Planning Department proposed four potential locations for the project, but it remained open for citizens' proposals, stressing that certain criteria (distance from the main road, tourist facilities, housing, etc.) must be respected. The method for public participation was fully based on the Web PPGIS approach, by using the existing service ArgooMap. ArgooMap is a software solution in the form of an internet forum based on maps, intended for discussions while allowing participants to make their own contributions in the form of references to specific geographic locations.

Although the mechanics were very clear, users were introduced with a simple interface which contained all the necessary guidelines and instructions for the proper use of the web tool. In order to raise the needed public awareness, the project was advertised in local newspapers and on different websites, and the citizens had the opportunity to submit their proposals and suggestions within three months. During that time 58 persons participated with their contributions. Considering the fact that because of the previously described reasons, traditional methods usually do not achieve such a response, we can see that relocating these kinds of activities into the Internet environment could be a good way to improve the current situation.

In addition to the information we get by direct input into the custom web tools, it is also very important to analyze data related to user preferences within different web platforms and applications which are not closely related to urbanism topics. A good example is research on user behavior on Twitter and Foursquare, which was aimed at examining the use of public space in Boston and Chicago (Xiaolu, Zhang, 2016).

The basic idea was to collect data that users are sharing with each other and then classify and display them within a geographic information system. The chosen platforms were compatible and in accordance with the urban objectives because of their key characteristics. At the time of research, Foursquare was a social network where users shared their location, which later could be classified through different categories. Also, location information could be also shared via Twitter.

So basically, by using the well-known platforms with the existing user base, researchers could focus on the development of algorithms which would collect the tweets with foursquare references. After the data was collected, results were applied in the space maps, which indicated the points of public interest within different categories: travel, and transport, outdoor and recreation, food and restaurant, shop and service, nightlife, etc.

5. The Need for New Horizons

Due to the speed of technology changes and the need for a reaction that is more often appearing as an instinctive reflex and not a planned approach, we come to situations in which the Internet is used as a participatory environment, but without a longer-term strategic plan. However, the presented case studies are illustrating two types of successful online approaches. In the case of Next Stop Design, we had an open website with a clear participation procedure. In the second case, the existing technology was used in a non-typical context to trigger the crowd creativity. Both approaches reflect two general tendencies in online participation today – development of the web platforms which would gather entries in an open or specific form, or using different network connected tools to communicate with the crowd during the participatory workshops.

Users are changing their habits, and trends are disappearing even faster than their appearance. If the Minecraft is attractive at this moment, it does not mean that will be the case in the near future. This was not the first time of using the popular game for participation activities - Second Life game was also used in the participatory planning as a tool for analyzing avatar behavior in the simulated virtual environment (Foth, et. all, 2010). The Minecraft example, just as the parking planning in Canmore, illustrates how software solutions could be used in order to create contexts which could trigger the collective wisdom of the crowd. However, the crowdsourcing approach in urban planning processes does not have to always relate to them. Extracting the needed information from Foursquare and Twitter showed some valuable insights, while it maintains significant resource efficiency - thanks to the fact it used well known, populated platforms.

On the other hand, if we are planning development of long-term participatory online spaces, which could serve equally for participatory activities and raising the general awareness about participation importance, we should take a look forward and analyze potential forthcoming trends in the context of planning needs. The main reason for this is reflected in the 1% Rule – so if we want to maintain continuous interactions in our online communities and trigger the crowd wisdom in the best possible way, we have to think about additional methods which could increase their motivation and interest.

6. Blockchain Technology as a Participation Catalyst

After the blockchain came into our reality, taking a central position in the mainstream through reports about the success of Bitcoin, many organizations recognized the potential of this technology. This was a completely new way of organizing data. In blockchain systems, all user data and transactions are stored in encrypted data chains, which are stored at different points within the network. Any change in the chain requires the consensus of all participants who own a copy of the database, making the system almost absolutely secure

and resistant to the risks inherent in classic databases. This has been recognized as a potential in almost all areas of human activity, both for the sake of security and for the fact that these are decentralized systems in which decisions are not passed by a central authority but are achieved by consensus. When different industries talk about the blockchain, they often use a definition which states it is a distributed ledger representing a network consensus of every transaction that has ever occurred (Tapscott, 2016).

Soon, blockchain becomes the basis for different projects and startups. Creating a blockchain ecosystem such as Ethereum has initiated the launch of new businesses with their own cryptocurrencies while creating a significant impact on the market. Blockchain changed the rules by eliminating the middleman and central authorities and providing the users with tokens that have unstable, but real market value. This was the case with social platforms. Finally, it becomes possible to enable the users to monetize their content, so the profit was not anymore in the hands of centralized companies but the community which was distributing the rewards among its members through the simple act of crowd voting. Today, one of the most popular ecosystems of this type is Steem blockchain.

Given that the platforms on Steem blockchain support activities based on four basic types of crowdsourcing, it has been examined how the STEEM as its native cryptocurrency can affect the overall user activity with its market value, or can there be a deviation of the "Rule 1 % ", which relate to the activity of users who create, evaluate and consume the content? The basic intention was to check if the direct possibility of financial reward for participatory entries in the form of UGC, can increase the number of active users or impact their behavior within the specific platform. In order to achieve this, this research used the data publicly available on Steemit platform as a part of regularly, user performed analytics and reporting.

In an earlier analysis of internet participation, the activity of Wikipedia platform users was divided into three groups: contributors - contributed at least 10 times, active contributors - at least 5 times in the previous month and Very active contributors - contributed at least 100 times in the previous month (McConnell, Huba, 2006). This categorization is taken as a marker for later comparison with activity of Steem platforms users. But before that, the data from the period of July – August 2017 was taken from the public available source at Wikimedia Stats website (https://stats.wikimedia.org). This range was picked because the Steem cryptocurrency had a low and stable value, so it could not impact the activity within the blockchain (as was the case during the famous bull market in December 2017). This data is shown in the table below (Table 1).

Table 1 Statistics from Wikipedia (English) platform in the period of July - August 2017

Wikipedia (English)				
Number of registered users	Active users	Number of submitted edits/content	Active percentage of users	Average number of entries per user
25872501	411522	4499205	1.59%	11

The average value of submitted UGC per active account in the analyzed period is 11, which would place the average active user at the very border between the participant and the active participant, according to the aforementioned categorization from 2006. By analyzing steem blockchain activity in the same range (Table 2), we can see that its users created enough content to place them extremely high in relation to the activity of Wikipedia users. Everything becomes more indicative because the total number of active user accounts never broke the 1% rule. Based on that, we can say that in the context like

this, users are participating within the same percentage range as on traditional platforms, but with more entries which is probably caused by the possibility to be evaluated and rewarded by the community.

Table 2 Statistics from Steem blockchain platform in the period of July - August 2017

Steem Blockchain				
Number of registered users	Number of active users	Number of submitted posts/comments	Active percentage of users(average)	Average number of entries per user
1096067	56999	4300310	5.2%	75

As it was stated in the research methodology description, Steemit, Wikipedia and other online platforms cannot be treated as relevant scientific sources in the content domain, but it is still possible to approach them as models that can provide valuable insights into user behavior. Data generated through human activity and not directly by their creative and intellectual work (statistics, average values, time spent on web pages etc.) becomes the basis in which we can spot patterns that are hard to detect in isolated environments which are not massively visited. These platforms, while respecting transparency and openness rules, make their databases open to the public, which is a unique opportunity to use them as a resource for additional analysis and research.

7. CONCLUSION

The application of crowdsourcing in different fields is important because it represents the new communication layer which correlates to the communication habits of those we address. These habits are an actual consequence of the fact that the internet has become a resource without which it is almost impossible to function and perform daily tasks.

By examining the ways in which crowdsourcing activities can be performed, this research has pointed to the basic forms of crowdsourcing activities that can be combined depending on the needs of a specific project. As a particularly important factor, the level of user activity was treated, as well as the fact that creating participatory environments does not guarantee that participation will occur. This is very important because in this way we avoid the risk of transferring problems from traditional methods to online environments. It is necessary to prevent investing in the development of participatory platforms that will be innovative but not visited.

Fast technological advancement is also one of the reasons why we should consider the upcoming trends and anticipate the future behavioral patterns of the public with whom we communicate. Comparing blockchain as an innovative concept that decentralizes communication with classic online platforms showed that users who receive direct financial rewards usually create more content then in the cases where participation is rewarded by other means. This indicates the possibility of creating decentralized environments where users create their own rules and independently participate and evaluate suggestions among themselves. Eventually, these could become social platforms, aimed at connecting planners with their publics. In this way, it is not only possible to realize multiple participatory activities within a single platform but to create a valuable database of projects, in which both experts and the general public will find their interest.

According to this, we can formulate following results:

- Crowdsourcing in participatory planning offers a more versatile approach than traditional methods, which can result in increased engagement of the targeted public. However, while it is able to overcome common limitations of traditional methods, such as time requirements, meetings in physical space and confrontation with other participants, it is needed to develop integrated solutions which would be applicable in different urban planning projects in order to create online spaces which would be widely recognized and have significant impact on current practice.
- Internet users who are participating on different internet platforms are more engaged and productive when the activism is evaluated by the community and valorized through direct rewards. Since blockchain technology can be used for the creation of decentralized, transparent and community-driven systems based on crowdsourcing and user rewarding, it should be further researched in order to timely recognize and create long-term online participatory spaces which could be used for different planning objectives that require public involvement.

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CROWDSOURCING U PARTICIPATIVNOM PLANIRANJU: INTERNET PLATFORME KAO PARTICIPATIVNI EKOSISTEMI

Nedovoljno prisustvo javnosti u okviru tradicionalnih participativnih aktivnosti u urbanom planiranju uglavnom je uzrokovano njihovom neusklađenošću sa komunikacionim preferencijama javnosti kojima se obraćaju. U skladu sa tim, ovo istraživanje je realizovano sa ciljem prepoznavanja alternativnih pristupa koji omogućuju stvaranje novih kanala komunikacije i mogu uticati na unapređenje nivoa i kvaliteta participacije. Polazeći od premise da je tehnološki razvoj promenio način na koji komuniciramo, cilj istraživanja je da omogući potpunije razumevanje trenutnih potencijala i problema internet participacije u urbanom planiranju, kao i da ukaže na buduće razvojne strategije koje mogu pružiti odgovore na probleme sa kojima se suočavamo danas. Analizirajući studije slučaja u kojima je internet komunikacija primenjena u ove svrhe, kao i javno dostupne podatke o korisničkim aktivnostima u okviru popularnih web platformi, ukazuje se na osnovne prednosti i nedostatke opisane prakse, kao i šanse koje u ovoj oblasti donose novi komunikacioni pristupi i tehnološki trendovi, poput crowdsourcing aktivnosti i blokčejn tehnologije.

Ključne reči: *urbano planiranje, participativno planiranje, crowdsourcing, blokčejn, internet*

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SOCIOLOGICAL DIMENSION OF URBAN PLANS: GENERAL URBAN PLAN OF PRIŠTINA FROM 1953, ARCH. DRAGUTIN PARTONIĆ

UDC 711.4(497.115 PRIŠTINA)"1953"

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Abstract. *This study aims to define the importance of a sociological component in urban plans and determine its impact on the overall quality of urban documentation and subsequently on the quality of urban life. Social transformations which took place after the Second World War, new social and political order in Kosovo, within which Priština became the main administrative city, resulted in a need for new administrative, cultural, social and other facilities, which indispensably caused development of first urban plans.The specific aim of this study is directed towards identification and determination how the General Urban Plan of Priština from 1953 designed by Dragutin Partonić, professor at the Faculty of Architecture in Belgrade, affected important social and cultural changes of the city. Actually, this document also presents the beginning of modernization of Priština.*

Key words: *Modernization, modernism, Priština, urban plans, Dragutin Partonić*

1. INTRODUCTION

Sociologists, who have dealt with urban sociology as a science aiming to study various types of manifestations of urban life by describing, classifying and interpreting it in an appropriate manner, agree that sociological dimension of cities had been the subject of interest even prior to sociology becoming a separate science. Urban sociology defines a city as a space where specific social phenomena take place influencing the transformation of that space with their operation (Čaldarović, 1985:5).

All distinguished theoreticians of architecture and urbanism have agreed that the social-economic state of affairs directly affects the shaping of cities. Thus Bruno Zevi[1],

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[1] Bruno Zevi (1918-2000). Italian architect, writer and theoretician. He was a student of Walter Gropius at the "Graduate School of Design", on Harvard University.

one of the best theoreticians of architecture of the twentieth century, introduced fundamental social changes of a society among four main factors which, apart from natural evolution of taste, scientific and technological development and new aesthetic theories, have a great impact upon the formulation of architecture of the twentieth century (Zevi, 2012:3).

Camillo Sitte[2], deemed as the founder of modern urbanism, alike, in his "City Planning According to Artistic Principles" published in Vienna in 1889, states the following: "And we are standing in the back with a ruler and a pair of calipers thinking that the question of feeling (for the city) could be resolved with geometry" (Zite, 2006:11). Regardless of the fact that the stated book was more focused on the physical shaping of cities, this quote draws attention to the process of the shaping of the cities that includes several components which are not physical and measurable, but above all spiritual, cultural and sociological, without which an urban space is insignificant.

Regardless of the fact that a city in its historical development has been under the continued influence of socio-economic factors, and has always been the best indicator of a general development of a society, its social dimension started to be studied within the framework of a separate discipline only towards the end of the ninetieth century and especially at the start of the twentieth century. The North American city of Chicago, with the total of 550.000 inhabitants in 1880, with already 1.100.000 in 1890, 1.600.000 in 1910, 2.700.000 in 1920 and the number of inhabitants reaching 3.300.000 in 1930 (Mellor, 1977:291), was an indicator of an expansive growth of the cities in the twentieth century.

Within these circumstances, a school was established in Chicago as a transition from the speculative cabinet approach, to social reality focusing on sociology as an exact science, which through its empiric research and with application of specific methodology, significantly contributed to development of urban sociology (Vujović and Petrović, 2005:13).

The most prominent representatives of the Chicago school were: Robert Park, Ernest Burgess and Luis Wirth who had been developing a sociological concept called "ecologic approach and urbanism as a way of life". Ecology is a term taken from the natural sciences to mean harmonization of animals and plants with the environment. According to Park, "from the very morning a city looks like a big mechanism of selection which in an infallible manner selects those individuals from the entire population who are most suitable to live in one or in a determined specific zone" (Park, 1952:79). In cities, events are sequenced according to "natural zones", through processes of competition, emigration and inheritance, analogous to the processes taking place within the biological ecology. Wirth's thesis on urbanism *as a way of life* is less connected to internal change of the city than with what urbanism is, as a manner of social existence. Wirth deems that: "The degree a modern world could be considered "urban", cannot be measured exactly by the degree of population living in cities. The influence cities have on social life of citizens is bigger than indicated by population percentage, because a city is not only a place of residence and workplace of a modern person, but the starting and the control center of economic, political and cultural life, which has, within its realms, included distant communities by creation of structural zones, population and various activities in one Cosmos" (Wirth, 1938:342).

[2] Kamilo Zite (Camillo Sitte) - (17 April 1843 – 16 November 1903) A painter, architect, urban designer and planner. In 1889 he published a book called "City Planning According to Artistic Principles" which had five editions until 1922. It was published in Serbian by „Građevinska Knjiga" (Construction book), from Belgrade in the edition called „Big books of architecture", which had three editions until 2006. Based on the principles and definitions presented in this book, Camillo Sitte is considered as the founder of modern urbanism.

The Marxist theory of cities developed by Marx and Engels, although not presented as a systematized research of cities but included in several works related to: division of work, alienation, analysis of capital, class fight, etc. Engels' analyses were more focused on housing issues of labor class, and did not significantly contribute to a modern city phenomena and mass urbanization. According to this theory, "urbanization is a demonstration of irrationalness of capitalism, and a city is only a stage for social drama taking place in the streets" (Mellor, 1977:XIII).

Henri Lefebvre, one of the most prominent authors of a Neo-Marxist orientation, as opposed to the ecological approach, applied a dialectic approach, which enables the application of changes of the main characteristics of cities in accordance with changes of an adequate social-historical context, as well as an insight into the dynamics of the urbanization process. According to him, urbanization takes place on a linear basis, from the zero point to complete urbanization, but the very process is characterized by the transition in phases composed of various models of space production. Lefebvre deems that a city space is produced as an expression of relationships in social production and presents material and symbolic reflection of a specific society (Grbin, 2013:475-491) or even more concrete, a city is a projection of global society in space (Vujović and Petrović, 2005:16).

Additionally, professor Ranko Radović, demonstrated an inseparable link between architecture and sociological structure of a certain area, according to which the very need for architecture results from a social moment of a certain society and each and every object is "based on social tissue" (Radović, 1998:119). According to him "folklore, traditional construction is not a style but a view of the world and of life, of nature and the spirit of a place, attitude towards life processes and material, towards the climate and authenticity. It is the world of truth and reality" (Radović, 1990:7-24).

Actually, it is exactly Lefebvre's theory that a city presents a physical projection of specific social relationships which represent the main starting point for analyzing GUP from 1953, in relation to social issues of the post-war Priština. The methodological approach is directed towards social transformations of the entire society in Priština during the implementation of the Plan. The relation between the degree of the implementation of the Plan and how and to which extent this affected the degree of social urbanization was determined with the application of a multidimensional analysis.

2. General Urban Plan of Priština from 1953, arch. Dragutin Partonić

2.1. Social and historical circumstances of Priština

It is impossible to understand the general characteristics of the timeline and the context of a city, without having the basic information about the previous circumstances in this area which directly or indirectly impacted upon general phenomena of the second half of the twentieth century Priština.

Archaeological excavations performed on several locations in the vicinity of Priština, such as near Valac, Matican, Gračanica, Donje Brnića and such indicate that this specific area was densely populated already in the late Neolithic period (Ćetković and Maletić, 1982:33). The existence of settlements in Metal Age is documented in the archaeological findings in the valley of the Gračanka River near a village called Donje Brnića, in the northern part of the present-day Priština. The remains of *Ulpiana* (second century of our

era), the capital of Roman province *Dardania*, are located ten kilometers south-east of Priština. Later, in the sixth century, *Ulpiana* became the second capital of Emperor Justinian I and was known as *Iustniana Secunda*. Also, many important Roman roads, among which the Roman army road *Via Egnatia* was the most important, are located in the vicinity of Pristina today (Nušić, 1902:45).

Owing to the development of mining in the settlements around Priština, such as the mine in Novo Brdo, but also the fertile land of the Kosovo valley, in the early medieval century, Priština rapidly became an important place in the region. It is believed that, in the times of the Nemanjić rule, the castle of King Milutin (1282-1321) was located somewhere in-between Kamen Džamije (Mosque of the rock) and Sahat Kula (Tower clock). Also, in the fourteenth century, Priština was the capital of Vuk Branković, even after the Battle of Kosovo (1389) when he had dual reign with the Ottomans until 1455, when it fell under the complete reign of the Ottoman Empire and when the presidency of *Sandžak* was transferred,[3] and Priština remained at the level of *Kazaja*.

In 1660, a Turkish travel writer, Evliya Celebi[4] described Priština as "a city of 2060 big and beautiful houses, with Alaj Beg castle and the building of court, standing out from the others. The city was beautified by big castles, with nicely arranged yards and greenery, mosques, two big temples, eleven "Hans" and three hundred shops, as well as citizens who were very pleasant" (Çelebiu, 2008:18).

With the establishment of the Kosovo *vilayet* in 1877, two years later Priština became the seat of *vilayet* until 1893 when this status was taken over by Skoplje until 1912. After 1912, Priština became the centre of the province of Kosovo, until the administrative division into "banovinas" of the Kingdom of Yugoslavia at that time, when Priština was only the center of the district within the Vardar *banovina*. During the Second World War, the city was under the reign of Mussolini[5] until the surrender of Italy, when ownership of the city was taken over by the Nazi Germany.

In 1946, Pristina became an administrative center of Autonomous Kosovo and Metohija area within the composition of National Republic of Serbia, Federal National Republic of Yugoslavia at that time.[6] Due to the changes of the Constitution in 1963, Pristina became the capital of Autonomous province of Kosovo and Metohija.[7] According to 1974 Constitution, Kosovo became an autonomous province, thus taking up a much

[3] Sandžak – according to Ottoman administrative system, the hierarchy of territorial organization was on the level of "vilayet" consisting of several "sandžaks", while a "sandžak" consisted of several "kazajas", and "kazajas" consisted of several "nahijas".

[4] Evliya Celebi (1611-1684) –Turkish travel writer who, in the period from 1640 to 1676, as per the request and with support from the Big Port (Ottoman reign) travelled through the entire Ottoman Empire and the area. During his travel, he did travel recordings which he published later in ten volumes under the original title *"Sejahatname"*. In December 1660 he travelled around Kosovo, in February 1662 he travelled around north Albania and Montenegro, in November 1670 through south Albania, and these recordings have a significant role in the fifth to the eighth volume published in Ottoman language.

[5] Benito Mussolini – The leader of the fascist Italy until 1943. During the Second World War, after the occupation of Yugoslavia and Greece, in May 1941, Mussolini, under the Albanian state, inside the fascist Italy, joined the majority of territories populated by Albanians, including the greater part of the territory of Kosovo.

[6] See Constitution of the Federal People's Republic of Yugoslavia, article 2 adopted on 31 January 1946 in Belgrade

[7] See Constitution of the Socialist Federative Republic of Yugoslavia, article 111 adopted by the National Assembly on 7 April 1963 in Belgrade.

better position within the Federation, which is directly reflected on the development of its capital.[8]

In various time periods, there are many travel writers and various documents which include data on the population numbers in Pristina. Starting from the first Ottoman *defters* in the fifteenth century all the way to various proofs based on diplomatic reports and church statistics data. In the period from the first post-war official census in 1948 until the last conducted in the Socialist Federal Republic of Yugoslavia in 1981, Pristina population numbers increased from 19.631 to 108.083.[9]

Table 1 Pristina population, 1486 – 1981

Year	Source	No.of families	No. of inhabitants
1486	Turski defter (Turkish statistical registry)	392	-
1569/70	Mudasal Defter (Detailed statistical registry)	692	-
1669	Evliza Celebi (itinerary)	2.060	-
1685	Archbishop Pjetër Bogdani (report sent to Vatikan)	3.000	-
1689	Coronelli („Iliricum")	4.000	-
1737	Feliks de Bozur (itenerary)	-	8.000
1811	Baron De Gamera (itenerary)	-	12.000
1812	Anton Vas (French diplomat, report)	-	9.000
1850	Gedeon Jurišić	3.000	12.000
1898	Turski defter (Turkish statistical registry)	3.690	12.375
1902	Branislav Nušić	3.760	18.000
1910	Jovan Cvijić	4.000	18.800
1921	The first census of the Kingdom of Yugoslavia	-	14.338
1931	The second census of the Kingdom of Yugoslavia	-	16.358
1937	Monograph of Pristina	-	16.000
1948	Official census in SFRY	4.667	19.631
1953	-	5.634	24.081
1961	-	9.059	38.593
1971	-	14.813	69.514
1981	-	21.017	108.083

(Source: General Urban Plan of Pristina until 2000– Municipal Assembly of Priština, 1987.)

Taking into consideration social circumstances of this area through Don Martindale historic approach based on which a human society is considered as a historical product, as well as its institutional approach based on which social life is determined by various institutions (Vujović and Petrović, 2005:27) in case of Pristina, it is clearly identified both historical and institutional factor in the shaping of social characteristics of the population.

[8] See Constitution of Socialist Federal Republic of Yugoslav, article 1, article 2, article 4, article 291, article 295, article 311, article 313, article 324, article 354, article 355, article 356, article 398 adopted in 1974 in Belgrade. With these institutional changes, for the first time two autonomous provinces, Vojvodina and Kosovo were recognized as constitutional units of the Federation.

[9] Official census of Socialist Federal Republic of Yugoslavia from 1948 and 1981. Federal Statistical Bureau.

2.2. Sociological dimension of General Urban Plan of Pristina from 1953

„Modern architecture has to make crystal clear the new social way of life"
(Han-Magomedov, 2005:444).

A slogan taken from the first issue of the Soviet architecture magazine "Modern architecture" (*Современная архитектура"*) from 1927, shows that the Soviet constructionists believed in social transformation through architecture and the spirit of a constructive movement based on social and not technical revolution, can be considered as a post-war slogan used for transformation of Pristina's society through architecture.

Pristina cannot be taken into consideration outside of the entire time and social context of the entire area. The development of architecture on the territory of ex-Yugoslavia from the Berlin congress, Balkan wars until the thirties of the XX century was characterized by folklore and eclectic architecture. Following 1930, structures began to strongly manifest the principles of modernism in architecture. Thus, until the Second World War, "modernism had established itself as the ruling form of architecture production, through which the ideas of Yugoslav unity found their identity formula through a universal and abstract language, annulling the differences among national ethnicities" (Konstantinović, 2013:86). The situation was interrupted by the Second World War. The post-war Yugoslavia, as a socialist country initially based on Soviet communism, with multiethnic, multilingual and multi-religious population with similar pre-war territory, had a task to continue creating a common identity of South Slavs, initiated during the pre-war period. With the crucial change in social establishment from a monarchy based on principles of capitalistic product to socialism where a state owns the means for production, the possibility of continuation of creation of Yugoslav nation based on the pre-war principles, ceased to have any meaning. Thus, the initiated pre-war modern architecture could be accepted in program and function, but other forms, as points of unity of nation in a new social system and "new ideals" had to be found. The post-war country based on the communist system, with transformations of "labor self-management", as a way of inclusion of "peoples' masses" in the decision making processes, transformed itself into an unusual system of social organisation both in relation to rigid Eastern communist societies on which it was based and Western states based on principles of free market. This inter-zone positioning of the new state between the communist and capitalist world, inevitably reflected upon the approach to architecture where "the language of architecture was typical neither for the socialist societies of those types nor for totalitarian regimes which tested architectural stylistic areas for mediation of their own ideologies" (Konstantinović, 2013:87).

Straight after the Second World War, a five-year plan 1947-1951 for the revival of Yugoslavia was created. Within this specific plan, 47 general and regulation plans of cities and settlements were creted in the Republic of Serbia, engaging experts of that time. In relation to the model of the pre-war planning, which was reliant upon regulation, both physical and zoning, in the post-war period, normative and program planning based on communities was introduced (Milašinović Marić, 2011:3-15). „It should be emphasized that architecture, as well as overall culture and society of that time were under the powerful dictates of ideology of communist power, so that the rigidity of normativism and prescribed plans and models was felt in each segment of creativity (Milašinović Marić, 2017:273). In this context, the Partonic General Urban Plan for Pristina was among the first plans which was adopted in 1953.

However, Pristina was different. While other capitals of Yugoslavia at that time started the first phase of modernization in-between the two world wars, Pristina was not the case. The urban development of Pristina prior to the Second World War was a spontaneous development of the city which was organized in settlements (*mahalla*), which consisted of low-rise mainly ground and single floor individual-housing facilities, where people were grouped usually based on family relationships or origin based on which the *mahallas* got their names (*Muhaxher mahala, Lokac mahala, Dalmatinska mahala, etc.*). Houses were connected by narrow streets and without any planned urban structure. The only joint public space and the main part of the city was "*čaršija"*[10] as a place of gathering of citizens and the roofed traditional Ottoman market *("bezistan"),* which was located in the central part of the city. A significant number of shops within the *bezistan*, were owned by the Jews who lived in the central part of the city where they had their Synagogue, which was demolished in the fifties of the twentieth century.

Fig. 1 Functional zoning of Pristina GUP 1953, arch. Dragutin Partonić.
(Source: Pristina Municipal Archive, Stock: SO-KK, Box: 1(1-21) 2(1-14), No. 587)

[10] Čaršija – world of Persian origin, a combination of „čehar su" or „čaršu" meaning four flows referring to the gathering of people from four sides of the world (Vujović and Petrović, 2005:400)

New political establishment after the Second World War within which Pristina became an administrative center of the Autonomous Kosovo-Metohija province, within Federal People's Republic of Yugoslavia, required an urban reorganization so that the new rule could realize its economic, cultural and social objectives through urban planning of the city. Thus, in 1950, the development of General Urban Plan started, with Dragutin Partonić, professor at the Faculty of Architecture in Belgrade, as the author. The Plan was adopted in 1953 and it presents the first post-war urban document of Pristina. At that time, according to the official census of the particular year, 24.081 inhabitants lived in Pristina on the total urban area of 223 hectares, while the planning document referred to a city with 50.000 inhabitants.[12] For the first time, the Plan defined main functional zones such as: individual construction, combined construction, line construction, block construction, hospital center etc., which had not been defined prior to the Plan. Apart from the above, the Plan included construction of a new road with two boardwalks on both sides, in the south-north direction, next to which main public and social buildings such as: cultural center, theatre, summer stage, press building, house of the army, house of techniques, as well as multi-housing blocks, were planned for. The majority of the listed buildings along this line were later realized, although not on the exact planned locations, because in the years to come the Plan was elaborated in several detailed plans, which redefined the positions of several main public buildings.

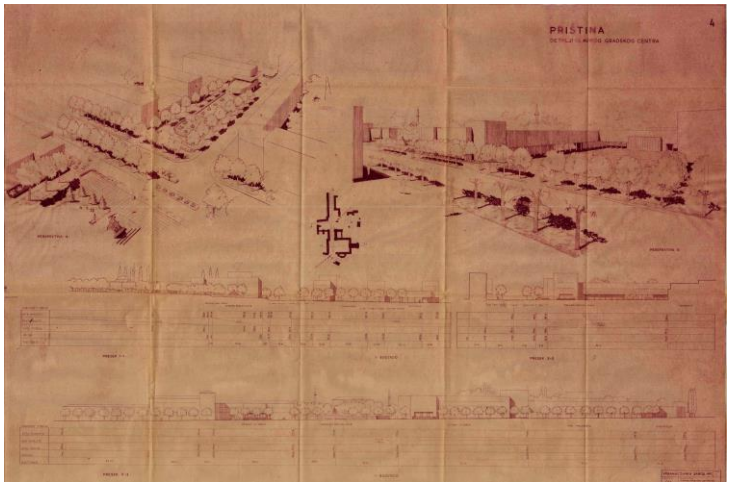

Fig. 2 Detail of the city center of Pristina GUP 1953, arch. Dragutin Partonić.
(Source: Pristina Municipal Archive, Stock: SO-KK, Box: 1(1-21) 2(1-14), No. 587)

Due to the lack of institutional and human resources for the implementation of Partonić Plan, a communal technical service within the municipality of Pristina was established in 1957 and later, in 1961, Urbanism Institute of the municipality of Pristina

[12] General Urban Plan of Pristina, arh. Dragutin Partonić. Municipal Archive of Priština, Fond SO-KK, Box 1(1-21) 2(1-14), Nr. 587. Complete graphic part of the Plan is available while textual part of the Plan is partially kept.

was founded as the first expert institution dealing with urban planning of the city, to which the Plan itself and professor Partonić could be considered to have contributed to.

Fig. 3 Boulevard "Marshal Tito", 1963. Constructed based on Partonić's GUP (Source: Kosovo Archives)

Regardless of the fact that the sociological study of the city and the citizens on the territory of Yugoslavia at that time started only in the sixties of the twentieth century (Vujović and Petrović, 2005:396), it cannot be stated that the Partonić Plan disregarded the social issues of the city. Surely, based on the general legal establishment of "equality of a self-managed society", the Plan had to recommend spatial resolutions which would enable development of social activities of "equal citizens". Thus, the Plan planned for particular zones based on functional characteristics, so as to enable equal spatial development of the city.

In the fifties of the twentieth century Pristina with multi-ethnic, multi-religious, multi-cultural population, with big economic differences among layers of society inherited from the pre-war times during which business people were owners of all real estates in the very center of the city, we have to agree that it was not easy at all. Thus, "equality" on one side and urban zoning on the other, according to which construction of the main institutions in the national ownership was planned for and then realized, the first housing blocks were also foreseen which were populated by representatives of "new leadership", which resulted in social segregation of the population, where the *esnafs*,[13] were no longer in the city center but some new people with ties and wives who were not covered by *feredža,*[14] who go to work together or walk together in the city center. This was an important social event for Priština in the fifties of the previous century, because, for the first time, the form of use of public space was made equal both for men and women.

[13] Esnaf – Turkish word meaning Association of craftsmen dealing with the same business or craft, who cooperate so as to jointly realize their rights and objectives. In case of Pristina, the majority of them lived in the central part of the city where they had their shops at the exact location where Partonić Plan had foreseen main administrative and social buildings and first housing blocks.

[14] Feredža – Islamic garment for women covering entire body and face

a) b)

Fig. 4 a) Women in Pristina in the beginning of the 20th century (Source: Archive of Kosovo), b) women in Pristina in the 1960s (Source: E. Mekuli and D.Qukiq, Priština, Prishtinë: Kuvendi Komunal i Prishtinës, 1965)

The pre-war bearers of power, following the nationalization of their property were forced to move to the outskirts of the city, where owing to this Plan, basic infrastructure conditions were created. This migration within the city affected the urbanization of the peripheral parts of the city not only with the provision of the necessary infrastructure, but also the creation of new urban population at the outskirts of the city reducing urban segregation.

The Plan also had to offer city space for the realization of social activities in the spirit of a "self-managed" society to the new "proletarian citizen". In view of this, the first city squares surrounded by the main social and institutional buildings were planned for.

The post-war Yugoslavia as a socialist country, was not oriented towards emphasizing spiritual and material values of each entity individually, but was trying to uniform them all by creating a new joint identity, which actually presented a favorable atmosphere for the development of modernism in architecture which based on similar universal principals disregarding the elements of architectural heritage, ornaments, as well as elements of regionalism in architecture. This tendency could be witnessed in the Partonić Plan. Ignorance of the vernacular architecture from the period of Ottoman empire, which could have been kept as a continuity of collective memory, and as a way of life, destruction of certain religious buildings with which certain layers of population were spiritually connected such as Roman catholic church near the present day hotel "Grand Prishtina", Lukar mosque near the present day hotel "Bozhur" as well as Jewish Synagogue, as the only temple in the city, made the local population consider modernization as imposing on them. In addition, the majority of Albanian population, as the predominant community in the city, as the only non-Slavic entity in the Federation of that time, an entity with significantly different tradition in all social characteristics, felt very unnatural in the new social establishment. Everything that came out from the particular establishment was deemed as imposed, strange and unacceptable. This resulted in the creation of two social layers. The first one, a smaller number of people who considered modernization as stylish

and advanced, as a way to go. Usually those people resided in the central part of the city and were directly involved in the new management structures. The second one, a bigger number of people who refused all that was linked to modernization, who were deeply linked with traditional way of life and who mainly lived at the outskirts of the city, in illegally constructed facilities, not affected by the Plan at all.

Apart from contribution to the resolution of many urban problems of the city, Partonić Plan, could be considered as a driving force of the economic development of the city. The newly-planned streets, public areas, public and housing buildings... required big financial investment and engagement of new workforce for the realization of those. Within these circumstances, first construction companies were established to employ significant number of workers thus gradually improving the overall economic situation of the middleclass population.

3. Concluding Remarks

Based on the above, it could be concluded that the Partonić General Urban Plan of Priština, as the first post-war urban document, regardless of the deficiencies we identified, presents a basis for the commencement of modernization of Pristina. This document planned for the main social institutions which had a leading role within all social segments of life. Shortly upon its realization, the main city promenade included in this Plan, was turned into the main arena of social and cultural events, maintaining the described status even today. This area represents the first public area in Pristina equally accessible to both genders, which had not been the case earlier.

The establishment of construction and other companies due to the realization of the Plan, enabled a certain number of local populations from the poorest class to get employment within state companies for the first time. Having in mind that the population in question was the one skeptical towards modernization, this act directly affected their viewpoint for the sole reason that they were included in its realization.

New housing blocks, which were designed for the new population whose gravitation to the new administrative center was expected, present the first urban structure of the city. The majority of new inhabitants of these blocks came from the surrounding rural settlements or smaller urban areas of Kosovo, who lived a traditional life in big families with strong family ties etc. Generally, family members with some education with chances of getting employment in the newly-formed institutions came to the city. The fact that they left other family members in rural settlements meant that they maintained linkages with them. This process actually had mutual effect– urbanization of villages on one hand and realization of the city on the other, a process being developed further for many years to come, and it is continuing even today, putting the society of Pristina in a blearily formulated social class, which presents just another example of incomplete or distorted modernization in the Balkans.

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SOCIOLOŠKA DIMENZIJA URBANISTIČKIH PLANOVA: GENERALNI URBANISTIČKI PLAN PRIŠTINE IZ 1953. GODINE, ARH. DRAGUTIN PARTONIĆ

Ovaj rad ima za cilj da definiše značaj sociološke komponente u urbanističkim planovima, i odredi njen uticaj na celokupni kvalitet urbanističkih dokumenata a samim tim i kvalitet urbanog života. Društvene transformacije koje su se desile posle drugog svetskog rata, opšti pravni poredak Kosova, u kome Priština zauzima mesto glavnog administrativnog grada, rezultirale su potrebom za novim administrativnim, kulturološkim, društvenim i drugim objektima, što je prouzrokovalo neminovno izradu prvih urbanističkih planova. Poseban istraživački cilj je usmeren ka identifikovanje i utvrđivane kako GUP iz 1953. godine, autora Dragutina Partonića, profesor na arhitektonskom fakultetu u Beogradu, uticao na značajne društvene i kulturoločke promene u gradu. U stvari ovaj dokumenat predstavlja i početak modernizacije Prištine.

Ključne reči: *Modernizacija, modernizam, Priština, urbanistički planovi, Dragutin Partonić*

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EFFECTS OF THE GEOMETRY OF RESIDENTIAL BUILDINGS WITH A SUNSPACE ON THEIR ENERGY PERFORMANCE

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Abstract. *The increase in energy consumption in building design and construction and the issues related to environmental protection have steered many current researchers toward examining the ways to reduce total CO_2 emissions, which resulted in the development of various measures to increase energy efficiency. One measure for more cost-efficient and rational use of energy resources in individual residential buildings is the application of passive solar systems with a sunspace. This paper presents the effects of the shape factor of a residential building with a passive sunspace on the total consumption of heating and cooling energy. The total amount of energy required for building heating and cooling was calculated by means of dynamic modelling using EnergyPlus software. The simulations were run according to the meteorological parameters for the city of Niš. For simulation purposes, models of residential buildings with a passive sunspace and square- and rectangle-shaped floors were designed. The variations between the models include different building shape factor, floor geometry, surface area of the southern façade, and glazing percentage, i.e. window-to-wall ratio (WWR). Examination of the models with WWR=20%, WWR=40%, and WWR=60% revealed that the elongated shape of a building with the aspect ratio of 2.25:1, with the longer side of the façade facing south, is the most favourable in terms of heating energy consumption. For the same WWRs, the elongated shape of a building with the aspect ratio of 1.56:1, with the longer side of the façade facing south, is the most favourable in terms of cooling energy consumption. As WWR increases, so does the amount of energy required to cool the building. The biggest increase in heating energy consumption was observed in buildings with the aspect ratio 1:2.25, with the shorter side facing south.*

Key words: *passive system design, sunspace, residential building, energy efficiency*

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1. INTRODUCTION

Since 1990 the emissions of pollutants from fossil fuel combustion in building design and construction have increased by 45% [1]. Through its strategies and action plans, the EU is promoting energy efficiency measures for residential buildings, considering that three quarters of energy demand in building design and construction originate from this very sector. EU directives and strategies have set an ambitious goal to reduce the 1990 CO_2 emissions by 90% by 2050 [2].

Use of passive solar systems can provide up to 50% [3] savings in building heating through the application of specific architectural and urban planning solutions. The geometric characteristics of a building are determined in the early design stages, since the building geometry affects its energy efficiency. Košir et al. analyzed the causality of consumption of the energy required for heating and cooling buildings in Ljubljana depending on their geometry on the one hand and on their window-to-wall ratio (WWR) on the other hand [4]. Their results suggest that, in a humid continental climate and with a low building WWR, energy is prevalently consumed for heating rather than cooling. Heating energy consumption decreases as the WWR increases, which in turn increases the cooling energy consumption. Premrov et al. studied the climate conditions in Athens and Seville for the purpose of determining the energy required for heating and cooling buildings with a wooden construction, characterized by low thermal mass in relation to the WWR, glazing type, and different building geometry [5]. Although numerous authors attempted to establish a correlation between the building shape factor and energy consumption, Granadeiro et al. demonstrated that, with the presence of significant solar gain, the shape factor cannot be an indicator of heating and cooling energy consumption [6].

The results obtained in the present study indicate the total energy required for heating and cooling of a residential building with a passive sunspace depending on the building shape factor, floor geometry, southern façade surface area, and the WWR. The energy performance of a residential building with a passive sunspace system was analyzed for rectangular and square floors. For the set conditions, the EnergyPlus software [7] was used for dynamic modelling in order to determine the amount of energy required for heating and cooling to ensure proper functioning of a building in terms of thermal comfort for the climate area of the city of Niš.

2. PASSIVE SYSTEMS WITH A SUNSPACE

Passive solar building design allows the maximum penetration of sunlight through the transparent surfaces during the day and its storage within the building structure or thermal mass. Passive systems that collect solar radiation should be designed in accordance with the urban planning parameters and climate conditions of the location (meteorological parameters, terrain, distance from neighbouring buildings, green areas at the location, etc.), for the buildings to be heated as much as possible during the winter and not overheated during the summer. According to the manner of heat transfer, passive systems are classified as direct (solar radiation is received through the windows) or indirect (solar radiation is received by means of a Trombe wall, sunspace, solar air collectors, and the like). [8]

Passive systems with a sunspace consist of glazed portions integrated with the building and used as passive receptors of solar radiation, with the ability to temporarily store it (partition wall, sunspace floor) and transfer it to the building interior. They also represent 'buffer zones', as they protect the adjacent interior heated space against sudden external temperature changes.

Figure 1 shows the types of sunspaces according to their placement in relation to the main building (M1–M6), according to the type of partition separating the sunspace from the adjacent room (T1–T4), and according to the position of the thermal mass (A1–A4).

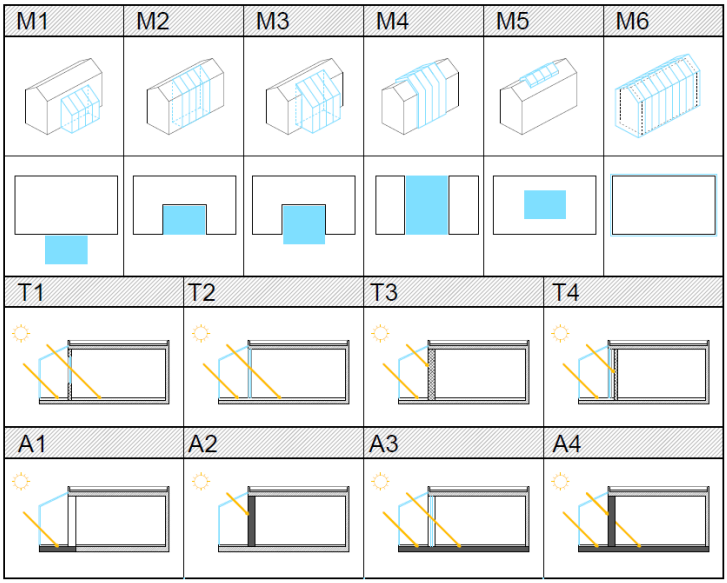


Fig. 1 Types of sunspaces according to: their placement in relation to the main building (M1–M6); the type of partition separating the sunspace from the adjacent room (T1–T4); the position of the thermal mass (A1–A4) [9]

The types of sunspaces according to their placement in relation to the main building (Figure 1) include the following: M1 – attached sunspace; M2 – fully integrated sunspace; M3 – partially integrated sunspace; M4 – laterally integrated sunspace; M5 – atrium sunspace; M6 – sunspace envelope around the primary building. The types of sunspaces according to the type of partition (Figure 1) include: T1 – sunspace with a thermal storage wall and a direct system (window) built into the thermal storage wall; T2 – sunspace with a transparent partition; T3 – sunspace with a thick thermal storage wall; T4 – sunspace with a Trombe wall. The types of sunspaces according to thermal mass position in a single residential building with passive sunspace (Figure 1) include: A1 – thermal mass is the sunspace floor; A2 – thermal mass is the partition wall; A3 – thermal mass is the sunspace and living area floors; A4 – thermal mass is the sunspace and living area floors, as well as the partition wall.

3. METHODOLOGY

3.1. Description of the software

Investigation of energy performance of a residential building with a passive sunspace system for different building shape factor, floor geometry, surface area of the southern façade, and glazing percentage, i.e. window-to-wall ratio (WWR) was conducted using EnergyPlus software.

EnergyPlus software is comprised of multiple programme modules forming a whole, which can calculate the energy required for heating and cooling of buildings with different systems or different energy sources [10]. The simulation centres on a model building exposed to various external influences and to different utilization regimes. EnergyPlus software relies on the location and position of the building itself, as well as on meteorological parameters and the external conditions surrounding the building. The input data include latitude, longitude, elevation, and the time zone, which allows the calculation of the Sun's position on any day of the year [10]. The most relevant meteorological data used as inputs include air temperature, relative humidity, air pressure, direct and diffuse solar radiation, cloudiness, wind direction and speed, as well as auxiliary precipitation data [10].

EnergyPlus simulation software was previously used for sunspace studies by Chiesa et al. to determine the influence of sunspaces on the reduction of energy demand for heating for different climate conditions of the examined locations in Europe [11]. Ulpiani et al. used EnergyPlus to investigate energy consumption of a residential building with an integrated sunspace in the Mediterranean climate [12]. EnergyPlus was also used to simulate energy consumption in studies of shape factors in high-rise office and public buildings [13-16] as well as in individual residential buildings [17].

3.2. Description of the analyzed models of buildings with a sunspace

Three MODELS of a residential building with a passive sunspace system (Figure 2) were developed. They were used to determine the total energy required for heating and cooling, energy only for heating, and energy only for cooling, depending on the building shape factor, floor geometry, southern façade surface area, and different WWRs.

The first building MODEL (MODEL-I, Fig. 2) has only the ground floor G and the floor area P_o = 92.16 m^2. The second building MODEL (MODEL-II, Fig. 2) has the ground floor G and the floor area P_o=184.32m^2, while the third analyzed MODEL (MODEL-III, Fig. 2) has the ground floor G, the 1st floor (+1) and the area P_o=184.32m^2. The overview of the MODELS (Figure 2) indicates that the area of the second and third MODEL building is double the area of the first MODEL building. The models were set up this way so that it would be possible to determine the effect of the length and surface area of the southern façade containing the sunspace in relation to the heating and cooling energy required for proper functioning of the building. The floor area of the third MODEL building is the same as the second, only over two storey levels (P+1) instead of one. The height of a storey is uniform for all models (H=3m). The volume of MODEL-I is V_1=276 m^3, while the volume of MODEL-II and MODEL-III is V_2=552 m^3.

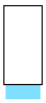
	D1	C1	B1	A	B2	C2	D2
							
Aspect ratio	1:2.25	1:1.56	1:1.26	1:1	1.26:1	1.56:1	2.25:1
S (m^2)	309.12	302.4	300.3	299.52	300.3	302.4	309.12
f_o	1.12	1.09	1.087	1.083	1.087	1.09	1.12
MODEL I number of storeys: G P_o=92.16 m^2 H=3m V_1=276.48 m^3							
S (m^2)	542.1	536.37	532.62	531.46	532.62	536.37	542.1
f_o	0.98	0.97	0.963	0.96	0.963	0.97	0.98
MODEL II P_o=184.32 m^2 number of storeys: 2xG H=3m V_2=552.96 m^3							
S (m^2)	433.32	420.48	416.28	414.72	416.28	420.48	433.32
f_o	0.78	0.76	0.753	0.75	0.753	0.76	0.78
MODEL III number of storeys: G+1 P_o=184.32 m^2 H=6m V_2=552.96 m^3							

Fig. 2 Overview of the analyzed models of a residential building with a passive sunspace (MODEL-I, MODEL-II, and MODEL-III)

Residential building with a passive sunspace and square- and rectangle-shaped floors were analyzed (Figure 2). The starting MODEL is MODEL-A with a square floor and the aspect ratio 1:1. This MODEL was used as a reference because it has the lowest shape factor: for MODEL-IA the shape factor is 1.083; for MODEL-IIA the shape factor is 0.96; and for MODEL-IIIA the shape factor is 0.75. Changes in the floor aspect ratio of MODEL-A yielded the variants B, C, and D. Variant B has the aspect ratio 1.26:1, variant C 1.56:1, and variant D 2.25:1 (Figure 2). Variants B, C, and D were used to create their sub-variants B1 and B2, C1 and C2, and D1 and D2. With variants B1, C1, and D1, the shorter side of the building containing a sunspace is facing south. Variants B2, C2, and D2 are facing south with their longer side, which contains the sunspace (Figure 2). For all models considered, the sunspace dimensions are uniform – 6.0x2.4 m. The effect of glazing on the amount of energy required for heating and cooling was analyzed for different WWRs of all façades, specifically WWR=20%, WWR=40%, and WWR=60%.

During the definition of the starting models of buildings with a sunspace, the elements of the thermal envelope were also defined, as they are typical constructions used in Serbia, which has a humid continental climate. Thermal envelope heat transfer coefficient values are defined in terms of maximum allowed values provided in the Rulebook on Energy Efficiency of Buildings in Serbia [18], which pertains to the new residential buildings. Table 1 shows the calculated and maximum values of coefficient **U** for façade walls, flooring and roofing, and windows of all the analyzed MODELS of single residential buildings with a passive sunspace.

Table 1 Calculated and maximum values of coefficient U for the designated elements of the building's thermal envelope

Construction type	Structural assembly elements	U [W/m^{2}K]	U_{max} [W/m^{2}K]
Façade walls	mortar 2cm, brick wall 25cm, thermal insulation 10cm, mortar 1cm	0.29	0.30
Floor	parquet flooring 2.2 cm, cement screed 3cm, thermal insulation 10cm, hydro insulation, lean concrete 10cm, gravel 10cm	0.28	0.30
Flat roof	Cement screed 4cm, hydro insulation, thermal insulation 15cm, sloping concrete 5cm, thermal insulation 7cm, RC slab 14cm, mortar 2cm	0.15	0.15
Glazing	Double glazed, PVC	1.50	1.50

The glazing of the passive sunspace used in this study is the same as the glazing of the thermal envelope. Windows are double glazed with low emissivity glazing of 6/13 mm and framed with PVC material. Heat transfer coefficient for glazing is U=1.5 [W/m^{2}K]. The total solar transmission of the glazing is SHGC=0.568.

4. RESULTS

Annual energy required for heating and cooling and the total annual energy required for heating and cooling were calculated for the defined models (MODEL I, MODEL II, MODEL III) of a residential building with a passive sunspace and their variants with different floor aspect ratios and window-to-wall ratios WWR=20%, WWR=40%, and WWR=60%. The results are shown in Table 2.

Table 2 Annual amount of energy required for heating, cooling, and both heating and cooling of the analyzed models of residential building with a passive sunspace (MODEL-I, MODEL-II, and MODEL-III) for window-to-wall ratios WWR=20%, WWR=40%, and WWR=60%.

	D1	C1	B1	A	B2	C2	D2
Floor aspect ratio	1:2.25	1:1.56	1:1.26	1:1	1.26:1	1.56:1	2.25:1
sf (shape factor)	1.12	1.09	1.087	1.083	1.087	1.09	1.12
MODEL-I WWR=20%							
Annual energy required for heating (kWh)	3498.06	3496.95	3490.54	3473.49	3455.81	3462.16	**3448.31**
Annual energy required for cooling (kWh)	3708.2	3261.26	3083.53	2981.45	2874.84	**2832.82**	2840.8
Annual energy required for heating and cooling (kWh)	7206.26	6758.21	6574.07	6454.94	6330.65	6294.98	**6289.11**
MODEL-I WWR=40%							
Annual energy required for heating (kWh)	3358.48	3368.54	3360.28	3343.47	3315.77	3309.32	**3265.64**
Annual energy required for cooling (kWh)	6441.05	5624.03	5293.9	5070.16	4876.48	**4803.33**	4827.25
Annual energy required for heating and cooling(kWh)	9799.53	8992.57	8654.18	8413.63	8192.25	8112.65	**8092.89**
MODEL-I WWR=60%							
Annual energy required for heating (kWh)	3306.61	3309.39	3291.49	3263.85	3232.9	3218.72	**3172.34**
Annual energy required for cooling (kWh)	9027.42	7871.52	7423.1	7091.43	6813.07	**6704.64**	6720.35
Annual energy required for heating and cooling (kWh)	12334	11180.9	10714.6	10355.3	10046	9923.36	**9892.69**
sf (shape factor)	**0.98**	**0.97**	**0.963**	**0.96**	**0.963**	**0.97**	**0.98**
MODEL-II WWR=20%							
Annual energy required for heating (kWh)	6918.13	6892.7	6853.48	6851.42	6771.24	6757.13	**6684.21**
Annual energy required for cooling (kWh)	3766.18	3319.6	3175.56	3028.51	2928.08	**2873.04**	2921.9
Annual energy required for heating and cooling (kWh)	10684.3	10212.3	10029	9879.93	9699.32	9630.17	**9606.11**
MODEL-II WWR=40%							
Annual energy required for heating (kWh)	6537.7	6504.43	6450.39	6426.62	6329	6295.03	**6173.07**
Annual energy required for cooling (kWh)	7678.33	6683.06	6326.12	6009.27	5792.13	**5696.8**	5816.63
Annual energy required for heating and cooling (kWh)	14216	13187.5	12776.5	12435.9	12121.1	11991.8	**11989.7**
MODEL-II WWR=60%							
Annual energy required for heating (kWh)	6304	6245.45	6193.06	6154.6	6047.28	5995.62	**5857.41**
Annual energy required for cooling (kWh)	11721.9	10281	9716.99	9234.22	8891.05	**8758.43**	8924.38
Annual energy required for heating and cooling (kWh)	18025.9	16526.5	15910.1	15388.8	14938.3	14754.1	**14781.8**
sf (shape factor)	**0.78**	**0.76**	**0.753**	**0.75**	**0.753**	**0.76**	**0.78**
MODEL-III WWR=20%							
Annual energy required for heating (kWh)	6799.06	6744.28	6711.93	6661.2	6627.89	6629.77	**6597.19**
Annual energy required for cooling (kWh)	6419.49	5607.14	5269.79	5098.2	4867.63	**4787.63**	4805.16
Annual energy required for heating and cooling(kWh)	13218.6	12351.4	11981.7	11759.4	11495.5	11417.4	**11402.4**
MODEL-III WWR=40%							
Annual energy required for heating (kWh)	6303.98	6236.4	6189.14	6125.15	6066.17	6043.57	**5971.65**
Annual energy required for cooling (kWh)	12598.4	11078.3	10445.1	10033.5	9640.26	**9511.49**	9593.39
Annual energy required for heating and cooling(kWh)	18902.4	17314.7	16634.3	16158.7	15706.4	**15555.1**	15565
MODEL-III WWR=60%							
Annual energy required for heating (kWh)	6103.1	6011.36	5948.32	5872.95	5801.69	5775.3	**5708.98**
Annual energy required for cooling (kWh)	18397.2	16265	15399.5	14787.7	14240.6	**14066.8**	14183.3
Annual energy required for heating and cooling (kWh)	24500.3	22276.3	21347.9	20660.6	20042.3	**19842.1**	19892.3

Figure 3 shows a diagram of the energy required for heating and cooling of the analyzed models of residential building with a passive sunspace for MODEL-I for WWR=20%, WWR=40%, and WWR=60%.

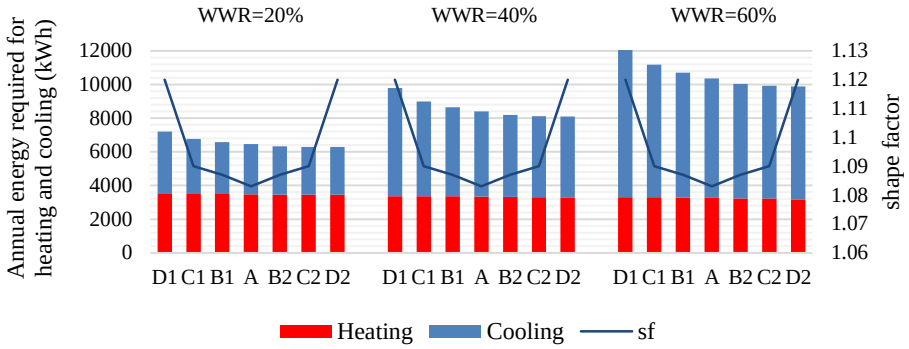


Fig. 3 Annual energy required for heating and cooling for MODEL-I variants and window-to-wall ratios WWR=20%, WWR=40%, and WWR=60%

Table 3 shows the percentages of the increase/decrease of required amount of energy for heating and cooling of the analyzed models of residential building with a passive sunspace for MODEL-I for WWR=20%, WWR=40%, and WWR=60%, in relation to the referential MODEL-A.

Table 3 Percentage of increase (+) and decrease (–) of the total energy required for heating and cooling of a building with a sunspace for MODEL-I

MODEL-I	WWR 20%						
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+0.71%	+0.68%	+0.49%	ref	–0.51%	–0.33%	–0.72%
Change of energy required for cooling	+24.38%	+9.39%	+3.42%	ref	–3.58%	–4.99%	–4.72%
Change of total energy required for heating and cooling	+11.64%	+4.70%	+1.85%	ref	–1.93%	–2.48%	–2.57%
MODEL-I	WWR 40%						
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+0.45%	+0.75%	+0.50%	ref	–0.83%	–1.02%	–2.33%
Change of energy required for cooling	+27.04%	+10.92%	+4.41%	ref	–3.82%	–5.26%	–4.79%
Change of total energy required for heating and cooling	+16.47%	+6.88%	+2.86%	ref	–2.63%	–3.58%	–3.81%
MODEL-I	WWR 60%						
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+1.31%	+1.40%	+0.85	ref	–0.95%	–1.38%	–2.80%
Change of energy required for cooling	+27.30%	+11.00%	+4.68%	ref	–3.93%	–5.45%	–5.23%
Change of total energy required for heating and cooling	+19.11%	+7.97%	+3.47%	ref	–2.99%	–4.17%	–4.47%

Figure 4 shows a diagram of the energy required for heating and cooling of the analyzed models of residential building with a passive sunspace for MODEL-II for WWR=20%, WWR=40%, and WWR=60%.

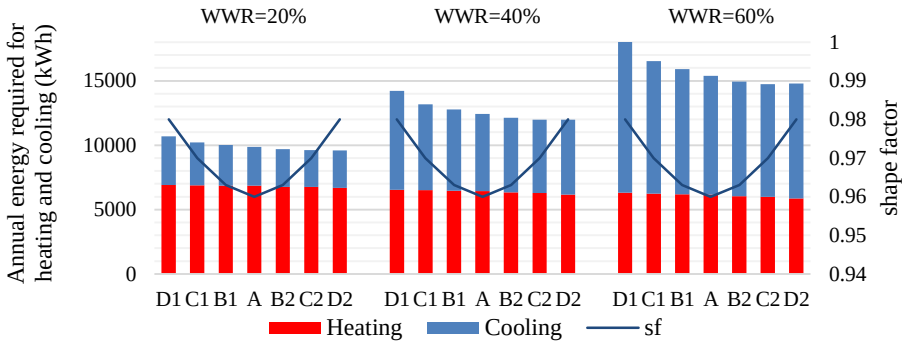


Fig. 4 Annual energy required for heating and cooling for MODEL-II variants and window-to-wall ratios WWR=20%, WWR=40%, and WWR=60%

Table 4 shows the percentages of the increase/decrease of required amount of energy for heating and cooling of the analyzed models of residential building with a passive sunspace for MODEL-II for WWR=20%, WWR=40%, and WWR=60%.

Table 4 Percentage of increase (+) and decrease (–) of the total energy required for heating and cooling of a building with a sunspace for MODEL-II

MODEL-II	WWR 20%						
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+0.97%	+0.60%	+0.03%	ref	–1.17%	–1.38%	–2.44%
Change of energy required for cooling	+24.36%	+9.61%	+4.86%	ref	–3.32%	–5.13%	–3.52%
Change of energy required for heating and cooling	+8.14%	+3.36%	+1.51%	ref	–1.83%	–2.53%	–2.77%
MODEL-II	WWR 40%						
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+1.73%	+1.21%	+0.37%	ref	–1.52%	–2.05%	–3.95%
Change of energy required for cooling	+27.77%	+11.21%	+5.27%	ref	–3.61%	–5.20%	–3.21%
Change of energy required for heating and cooling	+14.31%	+6.04%	+2.74%	ref	–2.53%	–3.57%	–3.59%
MODEL-II	WWR 60%						
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+2.43%	+1.48%	+0.62%	ref	–1.74%	–2.58%	–4.83%
Change of energy required for cooling	+26.94%	+11.34%	+5.23%	ref	–3.72%	–5.15%	–3.36%
Change of energy required for heating and cooling	+17.14%	+7.39%	+3.39%	ref	–2.93%	–4.12%	–3.94%

Figure 5 shows a diagram of the energy required for heating and cooling of the analyzed models of residential building with a passive sunspace for MODEL-III for WWR=20%, WWR=40%, and WWR=60%.

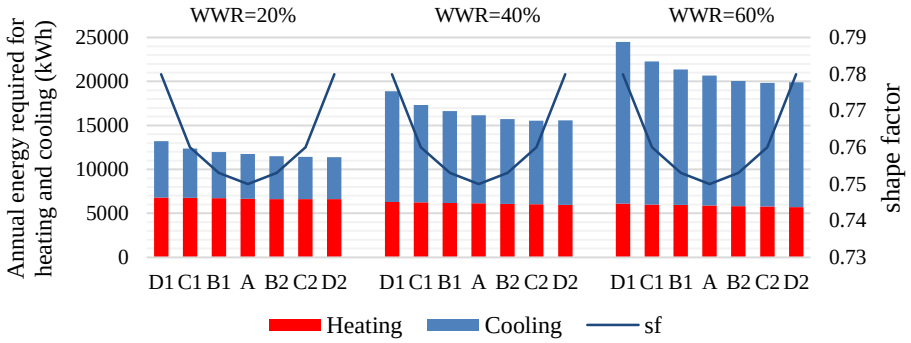


Fig. 5 Annual energy required for heating and cooling for MODEL-III variants and window-to-wall ratios WWR=20%, WWR=40%, and WWR=60%

Table 5 shows the percentages of the increase/decrease of required amount of energy for heating and cooling of the analyzed models of residential building with a passive sunspace for MODEL-III for WWR=20%, WWR=40%, and WWR=60.

Table 5 Percentage of increase (+) and decrease (–) of the total energy required for heating and cooling of a building with a sunspace for MODEL-III

MODEL-III WWR 20%							
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+2.07%	+1.25%	+0.76%	ref.	–0.50%	–0.47%	–0.96%
Change of energy required for cooling	+25.92%	+9.98%	+3.37%	ref	–4.52%	–6.09%	–5.75%
Change of energy required for heating and cooling	+12.41%	+5.03%	+1.89%	ref	–2.24%	–2.91%	–3.04%
MODEL-III WWR 40%							
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+2.92%	+1.82%	+1.04%	ref	–0.96%	–1.33%	–2.51%
Change of energy required for cooling	+25.56%	+10.41 %	+4.10%	ref	–3.92%	–5.20%	–4.39%
Change of energy required for heating and cooling	+16.98%	+7.15%	+2.94%	ref	–2.80%	–3.74%	–3.67%
MODEL-III WWR 60%							
Percentage of the change of required energy	Floor geometry sub-variants						
	D1	C1	B1	A	B2	C2	D2
Change of energy required for heating	+3.92%	+2.36%	+1.28%	ref	–1.21%	–1.66%	–2.79%
Change of energy required for cooling	+24.41%	+9.99%	+4.14%	ref	–3.70%	–4.87%	–4.09%
Change of energy required for heating and cooling	+18.58%	+7.82%	+3.33%	ref	–2.99%	–3.96%	–3.72%

5. DISCUSSION

When designing residential buildings with a passive sunspace system that use the available solar energy for heating, it is necessary to know the Sun's position and the angle of incidence of solar rays depending on the time of year. In humid continental climate conditions of the city of Niš and in relation to its geographic location (43.3209° N, 21.8958° E), during the summer the Sun rises from the northeast, travels high across the south, and sets in the northwest. During the winter, it rises from the southeast and arcs

at a low angle of incidence across the south to set in the southwest. This means that the increase of the exposed surface of the southern façade provides higher efficiency of solar radiation during the winter months, whereas the decrease of the exposed surface of the eastern and western façades reduces overheating in the summer. During the summer, especially in the afternoon, the western façade tends to overheat. On the other hand, the building envelope enables heat exchange between the internal and the external space, whereby it is important to make as few transmission losses as possible through the building envelope while maintaining the maximum heat gain of the passive sunspace in the winter and the minimum heat gain in the summer.

According to the results provided in Table 3 for the analyzed sub-variants of MODEL-I and for the listed window-to-wall ratios (WWR=20%, WWR=40%, WWR=60%), it can be concluded that, in terms of energy required for heating, MODEL-I D2 is the most favourable, while MODEL-I C2 is the most favourable in terms of energy required for cooling. When a comparison of the energy required for heating with WWR=20% is made between MODEL-I D1, whose shorter side is facing south, and MODEL-I D2, whose longer side is facing south, with the same building shape factor, the amount of energy required for heating will be higher by 1.43% in MODEL-I D1. The amount of energy required for cooling in MODEL-I D1 is higher by 29.1% compared to MODEL-I D2, under the same conditions. The calculated total annual energy required for heating and cooling in MODEL-I D1 is 14.21% higher than in MODEL-I D2 (Table 3); with WWR=40%, between the respective MODELS, the total annual energy required for heating and cooling is 20.28% higher. In case of WWR=60%, the total annual energy required for heating and cooling would be higher by 23.58%.

Based on the results for the analyzed sub-variants of MODEL-II and for the listed window-to-wall ratios (WWR=20%, WWR=40%, WWR=60%) provided in Table 4, it can be concluded that, in terms of energy required for heating, MODEL-II D2 is the most favourable, while MODEL-II C2 is the most favourable in terms of energy required for cooling. When a comparison of the energy required for heating with WWR=20% is made between MODEL-II D1, whose shorter side is facing south, and MODEL-II D2, whose longer side is facing south, with the same building shape factor, the amount of energy required for heating will be higher by 3.41% in MODEL-II D1. The amount of energy required for cooling in MODEL-II D1 is higher by 27.88% compared to MODEL-II D2, under the same conditions. The calculated total annual energy required for heating and cooling in MODEL-II D1 is 10.91% higher than in MODEL-II D2 (Table 4); with WWR=40%, between the respective MODELS, the total annual energy required for heating and cooling is 17.9% higher. In case of WWR=60%, the total annual energy required for heating and cooling would be higher by 21.08%.

When a comparison of the energy required for heating with WWR=20% is made between MODEL-III D1, whose shorter side is facing south, and MODEL-III D2, whose longer side is facing south, with the same building shape factor, the amount of energy required for heating will be higher by 3.03% in MODEL-III D1. The amount of energy required for cooling in MODEL-III D1 is higher by 31.67% compared to MODEL-III D2, under the same conditions. The calculated total annual energy required for heating and cooling in MODEL-III D1 is 15.45% higher than in MODEL-III D2 (Table 5); with WWR=40%, between the respective MODELS, the total annual energy required for heating and cooling is 20.65% higher. In case of WWR=60%, the total annual energy required for heating and cooling would be higher by 22.3%.

These results lead to a conclusion that there is no simple linear dependency between the WWR and the increase percentage of the total annual energy required for heating and cooling. Another conclusion is that the increase of total energy consumption is the result of a considerable increase of the energy required for cooling (Figure 3-5).

Based on the results presented above, it can be observed that the least energy required for heating of a building with a sunspace was found for a building with the largest southern façade area for the biggest WWR. This can be related to the angle of incidence of solar radiation typical for the winter period, when the solar exposure time of the southern façade is longer than that of other façades, which provides the better passive heating of the building. For the same reason, the solar exposure time of the southern façade is shorter during the summer compared to the eastern and western façades. The analysis of the same shape factor of the building, while taking into account the cooling requirements in the summer, leads to a conclusion that it is more favourable to have a larger surface area of the southern façade at the same given sunspace size. The maximum savings in the annual energy required for heating and cooling of the analyzed residential building with a passive sunspace, possible through southern orientation of the longer side of the building, amount to 23.58%, 21.08%, and 22.3% for MODEL-I, MODEL- II, and MODEL-III, respectively.

In the building design stage, insufficient knowledge of the influence of building shape, orientation, and WWR on energy consumption in the summer or in the winter can result in later disadvantages, which are only partially rectifiable after the construction is completed and the building goes into use. The results presented in this paper can help achieve better energy efficiency of buildings depending on the floor aspect ratio, defined in the initial design stages, and on the WWR, which, in addition to the passive sunspace, allows direct passage of sunlight.

6. CONCLUSION

This paper considered the amount of energy required for heating and cooling of single building with a passive sunspace for different floor geometry, southern façade surface area, shape factor, and three window-to-wall ratios: WWR=20%, WWR=40%, and WWR=60%. Three building MODELS were analyzed: MODEL-I (number of storeys G and floor area P_o= 92.16 m^2), MODEL-II (number of storeys G and floor area P_o= 184.32 m^2), and MODEL-III (number of storeys G+1 and floor area P_o= 184.32 m^2).

The results indicated that, in terms of the amount of energy required for heating, MODEL-I D2, MODEL-II D2, and MODEL-III D2 were the most favourable. The D2 sub-variant for all MODELS has the same aspect ratio of 2.25:1 and the longer side of its façade, where the sunspace is installed, is facing south. In terms of the amount of energy required for cooling, MODEL-I C2, MODEL-II C2, and MODEL-III C2 were the most favourable. The C2 sub-variant for all MODELS has the same aspect ratio of 1.56:1 and the longer side of its façade, where the sunspace is installed, is facing south.

Upon analysis of the aforementioned MODELS of residential building with a passive sunspace, it was concluded that there is no direct proportional dependency between the building shape factor and the total amount of energy required for heating and cooling. As the WWR increases, so does the amount of energy required for cooling, whereas the amount of energy required for heating slightly decreases under the same conditions. In

building models with a higher WWR, the required amount of energy required for cooling is larger than the amount of energy required for heating, so its share in the total energy consumption also increases.

Adequate sizing of the south-facing façade can significantly reduce the amount of energy required for heating and cooling. In buildings with the same shape factor and WWR, savings in total energy consumption for heating and cooling can be as much as 23% higher when the longer façade of the building is facing south. The paper examined the window-to-wall ratios of WWR=20%, WWR=40%, and WWR=60% for all façades. A recommendation for further research is to define the window-to-wall ratio individually in relation to façade orientation. This would determine the optimal window-to-wall ratio of the southern façade in relation to the eastern, western, and northern ones. The results presented in this study can be used as recommendations in the design of residential buildings with a sunspace.

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UTICAJ GEOMETRIJE STAMBENOG OBJEKTA SA STAKLENOM VERANDOM NA NJEGOVE ENERGETSKE PERFORMANSE

Porast potrošnje energije u sektoru zgradarstva i problemi koji se odnose na zaštitu životne sredine, usmerili su mnoga aktuelna istraživanja na smanjenje ukupne emisije CO_2, što je u sektoru zgradarstva uslovilo formiranje različitih mera za povećanje energetske efikasnosti. Jedna od mera za ostvarivanje ušteda i racionalno korišćenje energetskih resursa kod individualnih stambenih obejakat je i primena pasivnih solarnih sistema sa staklenom verandom. U radu je prikazan uticaj faktora oblika stambene zgrade sa pasivnim sistemom staklenom verandom na ukupnu potrošnju energije za grejanje i hlađenje. Proračun ukupne potrebne energije za grejanje i hlađenje zgrade izvršen je dinamičkim modelovanjem pomoću softverskog paketa Energy Plus. Prilikom sprovođenja simulacija, korišćeni su meteorološki parametri za područje grada Niša. Formirani su modeli stambenog objekta sa pasivnim sistemom staklenom verandom kvadratne i pravougaone osnove. Varijacije u modelima obuhvataju različit faktor oblika zgrade kao i geometriju osnove zgrade, površinu južne fasade objekta i procenat ostakljenja. Rezultati istraživanja modela sa procentom ostakljenja WWR=20%, WWR=40%, WWR=60% pokazuju da je izdužena forma zgrade sa odnosom stranica 2.25:1 gde je duža strana fasade okrenuta ka jugu, najpovoljnija sa aspekta potrošnje energije za grejanje. Za iste procente ostakljenja najpovoljniji odnos stranica osnove sa aspekta potrošnje energije za hlađenje je izdužena forma zgrade sa odnosom stranica 1.56:1 gde je duža strana fasade okrenuta ka jugu. Sa povećanjem procenta ostakljenja raste i potrebna energija za hlađenje zgrade. Najveći porast u potrošnji energije za grejanje je kod objekata sa odnosom stranica 1:2.25 koji su kraćom stranom okrenuti ka jugu.

Ključne reči: *pasivni sistemi, staklena veranda, stambena zgrada, energetska efikasnost*

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FACTORS OF ESTHETIC PREFERENCE, SPACE AND FORMS

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Abstract. *Why does the the man feel more comfortable in some surroundings than in some other and what is there in the surroundings and in a the man that causes that state of his spirit? It is obvious that one`s reactions to surroundings are reflexive and uncontrolled, yet they happen according to certain patterns. To adjust to his natural surroundings as much as he can, during evolution the the man developed mechanisms (intuitive reactions) that made it possible for him to react to the changes in his environment much faster and more effectively, which was of the key importance for survival. By developing intuitive reactions to surroundings, the the man acquired a special apparatus through which he sees much more in his surroundings than he is aware. Esthetic reactions and esthetic preferences make a part of that apparatus and they have an adaptive role. Thanks to rewarding certain behaviors with comfortable feelings, elements and physical characteristics (compositions, relationships) useful for survival that the man notices in his surrounding have become beautiful to him. Evolutionary psychology, psychology, esthetics and neuroesthetics all research why and how the the man reacts to certain physical characteristics of the surroundings. The goal of this research is to check if the the man notices elements and relations from natural surroundings in architectural space, since evolution "taught" him that he needs them for survival. It also aims to check how the the man reacts to the preferred shapes, relations, and compositions from natural surroundings when they are found in architectural space and to check factors that influence esthetic preferences. Discoveries of esthetic reactions, esthetic preference and evolutionary base of those reactions can be applied in architecture in order to create space and shapes that are customized for the the man.*

Key words: *evolution, intuitive reactions, esthetic preferences, form, natural environment, space*

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1. INTRODUCTION

The questions how the the man estimates beauty and why something is beautiful to the the man, are questions with which philosophy deals, but lately, thanks to technologies and new scientific disciplines that have been made, psychology, evolutionary psychology and neuroaesthetics all research esthetic reactions. There are especially interesting studies and attitudes of evolutionary psychologists about esthetic needs, reactions and preferences, their origin and significance for the the man, as well as neuroaesthetics` discovery about reactions of certain parts of the brain to certain stimuli that are esthetically acceptable (beautiful) to the the man. Evolutionary psychology monitors esthetic needs, esthetic reactions and esthetic preferences as adaptations that have been developed during evolution and that are functioning as means of providing the survival. If we speak about esthetic needs, the term "need" means a lack of something in the organism, by whose satisfaction, normal functioning and survival is made possible. The fact that "beauty" is a need says enough about the significance and function of esthetic reactions and esthetic preferences. In order to provide satisfaction of esthetic needs, esthetic reactions and esthetic preferences are genetically conditioned, inherited from ancestors, and they are occurring according to the intuitive reactions developed during the evolution independently of the the man`s will. It can be stated that esthetic reactions which originate in the satisfaction of esthetic needs are much more significant for the the man than a bare sense of comfort which occurs during perception of the stimuli. The term "stimulus" is used to mark everything (of material or non-material nature) that the the man can perceive with his senses. Because of the function of esthetic reactions and their significance for survival, it is necessary to pay a special attention to reaction to stimuli that originate in nature. They are important to the the man in terms of survival (shelter, natural surrounding). Those are factors that influence esthetic reactions and preferences of the stimuli that he himself has created during cultural development. Psychologists consider that esthetic reactions depend on objective (physical) characteristics of a stimulus. At the beginning of the twentieth century psychologists devoted themselves to the research of subjective experience of an observer which depends on the previous experience, considering that they are more important for esthetic reactions. Evolutionary psychology consolidates the two approaches and believes that the the man`s reactions to a stimulus are conditioned by its physical characteristics due to evolutionary acquired preferences towards the physical characteristics and intuitive reactions to surrounding, which determine the subjective experience. Physical characteristics of a stimulus and reactions which occur during perception of the characteristics are important for esthetic reactions. During the evolution, the the man has been taught to prefer the stimuli of certain physical characteristics. Comfortable emotions occurring during the perception make a part of intuitive reactions to the surrounding and their role is to provide satisfaction of needs and behavior that is useful for survival.

Evolutionary psychology considers that esthetic needs, reactions and preferences have been developed during evolution in order to solve certain adaptive problems and to provide survival to the the man. In this work are used viewpoints and studies of evolutionary psychology to explain esthetic reactions and evolutionary conditioned esthetic preferences towards the surrounding and especially towards shapes and relations from natural surroundings in which the the man dwells and which have provided him with conditions to survive. It was affirmed that the the man has esthetic preferences which he has developed

during evolution towards certain physical characteristics of natural surroundings. While dwelling in natural surroundings, he also develops preferences towards the shapes that he sees. It can be said that esthetic preferences are influenced by certain factors such as genetically acquired preferences, previous experience with stimuli and natural surroundings in which the the man dwells. Based on studies of evolutionary psychologists, established genetically conditioned esthetic reactions and preferences, natural surroundings in which the the man dwells, and previous experience with stimulus, it is possible to establish physical characteristics of stimuli that the the man prefers esthetically. Architects and urbanists can use these while creating architectural space.

1.1. Aims of the research

The man values the space in which he dwells thanks to intuitive reactions that he developed during evolution. He will not value the space as esthetically acceptable and convenient for living if in his surrounding he does not recognize elements towards which he developed preferences, which he was "learned" to recognize during evolution. Based on research of psychology, evolutionary psychology and neuroaesthetic, it is possible to define physical characteristics of a surrounding that the man prefers, good overview of the surrounding, possibility to see but not to be seen, alternative way out, greenery, sun, water, organic forms of curved edges, shapes from the surrounding, especially plants and terrain, pyramidal form, rugged outline of decomposed form. The aim of the work is to check if the man notices previously stated elements and relations from natural surroundings in architectural space and how he reacts to them, to examine preferred shapes, relations and compositions from natural surroundings in architectural space towards which the man has positive reactions, and to examine factors which influence esthetic preferences.

1.2. Methods of the research

In order to define preferred characteristics of the surrounding and then analyze and define preferred shapes, compositions and relations in architectural space, the author used the compilation method of research and poll method. Due to technology development, scientists acquired possibility of observing brain activity while perceiving stimuli and therefore, they could define to which elements in the surroundings the man reacts positively and which shapes and relations in the space he prefers. There was a research in psychology, evolutionary psychology and neuroaesthetic. It encompassed the man`s needs, reactions to a surrounding and mechanisms according to which the reactions are manifested. It made it possible to affirm characteristics of the surroundings, shapes and relations in natural surrounding that the man prefers. Based on the research and defined preferences toward the surrounding, the author of the text designed and conducted a poll in order to test how respondents react to similar characteristics in architectural space. The questions within the poll were designed in a way to test respondents' reactions to preferred shapes and relations in architectural space, to test if they notice them, and how they react to them. One pair of photographs depicted objects with surrounding that is strongly expressing preferred elements, while another pair of photographs depicted less expressed elements. In each question, the respondents were asked to decide in which of the object they would like to live. This poll included one hundred respondents.

2. Esthetic Needs and Reactions as Adaptations that Make Survival Possible

By development of intuitive reactions to surrounding during evolution and mental and anatomic adaptations, the man has acquired the capability to estimate physical characteristics of surrounding, whether they are beneficial or not for life and survival, and to react accordingly. Some of the intuitive reactions which have been developed in order to enable survival to the man are also esthetic reactions to stimuli. All changes done on the man`s body and brain that have been happening during evolution, happened in order to enable the man`s survival and species continuation. Evolutionary psychologists consider that human brain has not evolved less than his body. (Kardum 2004) As a result of adaptation to surrounding, intuitive reactions developed in both brain and body, which regulated the man`s reactions to surrounding. Also, the man developed special parts of brain that are in charge of esthetic reactions and thanks to them, the man has survived. Psychological processes, as well as anatomic structures and physiological mechanisms made survival and reproduction easier to our ancestors, so the intuitive reactions within our brains are equally products of evolutionary processes as our bodies are. Brain of a newborn baby is a set of reprogrammed, abundant in content and specialized mental modules which evolved, similarly as our bodily organs did, due to successfully solving certain adaptation problems. (Kardum 2004) Thanks to the technological achievement and possibility of scanning a brain with magnetic resonance, and monitoring brain activities during observation of stimuli, a new science was developed. It studies parts of brain which react to a certain stimulus, and it is called Neuroaesthetic. Today, it is assuredly known which parts of brain are active depending on a type of stimulus and how brain and body react to stimulus. The very fact that the man had to develop organs that make possible for him such complex reactions to surrounding, and a special part in the brain which is in charge of esthetic reactions to stimuli, confirms how important they are for the survival. Kaplan says that esthetic is not a reflection of caprice people achieve, but it is, as it seems, a guide for the human behavior which has far reaching consequences. (Kaplan 1987) Therefore, esthetic reactions to stimulus have been developed during evolution, they are genetically conditioned and are processed autonomously, independently of huthe man`s will. As studies showed, other living beings also possess similar mechanisms according to which they react to stimuli, because of the need to provide survival. Because of intuitive reactions that developed during evolution, intrinsic to every human, it is possible to determine regularities in esthetic reactions to certain types of stimuli and their characteristics. Determined preferred characteristics of stimuli say a lot about esthetic preferences of the man and his tendencies toward certain forms, elements, and compositions in surrounding. This can be very useful to architects while creating living space.

2.1. Biological base of esthetic reactions

Thanks to neuroaesthetic, nowadays scientists can assuredly know which part of the human brain is active when a person observes something that is “beautiful” that evokes pleasant emotions within them. Nancy Etcoff defined beauty as “something” that activates the center for comfort in the brain. Stimuli that activate the center for comfort in the brain are beautiful, according to her. (Atcoff 1999, Atcoff et all 2001, Zeki 2011) There is a logical question to be asked: Who decides and based on what, which part of the brain will be active? How does the brain make a selection of stimuli and direct them into a certain part of the brain which is in charge of arrangement of that type of stimuli? It is

obvious that this process takes place autonomously, without any influence of consciousness. This capability was acquired by brain during evolution. In our subconsciousness we genetically received experiences from our ancestors. As stated above in the research of scientists from Max Planck Institute, when the man reacts to stimuli from the surrounding, a higher activity of the brain is noticed prior to the the man becoming aware that his body reacts to surrounding. That proves that the reactions to stimuli from the surrounding and esthetic reactions take place according to a determined mechanism and without a possibility of controlling these reactions by the aware part of brain. (Haynes 2007) Based on previously stated facts it can be concluded that esthetic reactions are genetically conditioned and that there is a regularity in people`s reactions to certain types of stimuli because of their same base and function, biological changes and development of the man`s organs during evolution. Therefore, it is possible to determine genetically conditioned and developed preferences toward surrounding, its certain forms, colors and compositions. It is important to emphasize that esthetic reactions do not depend solely on genetically conditioned preferences that have been inherited, but also on conditions of environment in which the man lives and previous affective reactions to stimulus.

2.2. Evolution and esthetic reactions

Scientists have been studying the issue of existence of universal beauty and the phenomenon of natural beauty which affects people equally, regardless of era, age, education, tradition and ethnicity. What is so special in nature and in the man that makes nature so unique? The human brain was developed in an organic and biocentric surrounding and therefore, it is completely normal that even today people have the need for ancient surrounding. It would be a miracle if all characteristics learned during evolution, were erased during several thousand years of civilization. (Markus 2005) It was noticed that psychiatric patients in hospitals reacted positively to photographs showing natural surrounding and that all recorded attacks on the photographs were on those of impressionists' photographs. (Urlich 1986) Kardum says that evolutionary psychology negates the presumptions about the human mind as of general-purpose machine for solving problems. He considers that millions of years of evolution have been connected to specific challenges of surrounding. By natural selection process, that led to development of specific cognitive mechanisms. Therefore, evolutionary psychology does not consider the human brain to be a mechanism of general purpose upon which culture should impress a certain content through learning processes. Evolutionary psychology considers that emotions and psychological processes are adaptations that started by the process of evolution during natural selection because they made survival and reproduction easier in our ancestor`s environment. (Kardum 2004) Esthetic needs and esthetic reactions have not been developed during evolution only for the man to be able to estimate if something is beautiful or not. Their purpose and function are much more important for the man than a bare feeling of satisfaction. The fact that a special part of the brain that is in charge of esthetic reactions was developed implicates their significance for survival when solving adaptation problems. During evolution, thanks to esthetic reactions and needs, the man has developed preferences towards some stimuli that is important for survival. At the same time, evolution has made him acquire a capability of adjusting to the environment in which he lives. Therefore, two things are important: beside evolutionary acquired esthetic preferences, the man, thanks to adaptive function of esthetic needs and reactions, develops preferences towards the environment in which he lives, and the preferred forms found in the environment become the themes of his creating.

3. Factors which Influence Esthetic Preferences

Based on previous observations it can be stated that following factors influence esthetic reactions and preferences:

- evolutionary acquired preferences toward certain physical characteristics of stimulus,
- previous affective experience with the stimulus and the context in which it is perceived,
- forms and shapes from natural surroundings in which the man dwells

3.1 Influence of evolution on esthetic preferences

The simplest example of esthetic preference, its function and importance is esthetic preference of the opposite sex. If the man did not prefer the opposite sex, he would not survive. Such intuitive reactions were not developed solely in the man, but also in animals, so we have an example that during choosing its partner, a swallow chooses one who has more symmetric tail. Zebras choose those with more regular design. German biologist Joseph Reichholf considers that sensory functions and information processes function similarly in humans and animals. (Reichholf) It can be said that animals possess intuitive esthetic reactions and preferences which have been developed during evolution, so this can be another proof that we cannot discuss a phenomenon that is learned during socialization, because animals are not capable of learning such thingS, nor is it a completely individual process which depends on an individual, depending on physiological attitudes and subjective factors. Therefore, it is a phenomenon that is consciously controlled but it happens according to previously estimated mechanisms developed during evolution, both autonomously and subconsciously.

3.1.1. *Previous exposure to stimulus and esthetic preferences*

The man and animals react to stimuli very similarly due to genetic bases of the reactions. Studies of psychologists on effects of previous exposure to a stimulus showed that a repeated exposure to a stimulus causes an increase of esthetic preference and positive affective reaction to the stimulus, both in humans and animals. The term stimulus is used to mark an observed object. (Janković 2010, see Zajonc 1968, 1980, Borstein 1989) The fact that the man and animals react very similarly to stimuli indicates two important things:

1. Genetic base of esthetic reactions and preferences. They have been developed during evolution and they are not learned but genetically inherited,
2. While dwelling in a certain surrounding and during his adjustment to it, the man develops preferences toward shapes in the surrounding.

Every man has certain knowledge and experience. A group of authors researched their influence on perceiving a stimulus, its evaluation, esthetic impression and emotions that are evoked consequently. They concluded that firstly, stimuli need to be integrated in the existing knowledge. That enables classification, which is in a reciprocal relation to so-called cognitive overpowering. It is pivotal in evaluation of an artistic piece, from which esthetic judgment and esthetic impressions are drawn. (Janković 2010 see Leder, Belke, Oeberst, Augustin 2004) If we cannot integrate a certain stimulus into an existing knowledge, we will not be able to classify and position it in relation to already existing structures which make evaluation possible to us. Therefore, there will not be cognitive overpowering over the stimulus, which will consequently affect esthetic impression and

emotions following it. (Janković 2010) It is needed to recall Wilson who says that a human brain has never been an empty board, and human nature is not a written part of the board, but it exists as an inherited rule of mental development. (Wilson 1984) So, the man uses knowledge that he genetically inherited in order to value some deed of nature or man-made deed, according to intuitive esthetic reactions which he has also developed during evolution, thanks to the development of brain and its parts functioning as esthetic reactions.

It is possible to state that the man prefers certain shapes and compositions since he has long been meeting them in nature and he was born with inborn knowledge of them. That is why integration, classification and positive evaluation of the shapes and composition that he notices in surroundings are certain and they lead to a very positive esthetic impression and to positive emotions. Since the man long dwelt in natural surroundings, he developed esthetic preferences toward forms and shapes from the surrounding, which are inherited genetically. Beside genetically acquired preferences, esthetic reactions depend on the surrounding due to the development of the preferences toward the surrounding while dwelling in it. That is also an adaptation made during evolution, which is explained by the effect of the previous exposure. The explanation can be found in studies done by Etcoff, Gerhard and Orians. The psychologist Nancy Etcoff from the Harward University experimentally affirmed that during observation of esthetically attractive photographs of men and women, the same part of the brain in charge of regulation of sense of pleasure is activated in each person and the reaction is more intense if they have previously seen the photographs. The marks that the participants in the experiment gave to certain photographs equaled the level of activation of pleasure center, and photographs marked more positively were followed by a more intensive reaction of the center. A similar research was done by a psychologist Ashley Gearhardt from the Yale University, who did a research on craving for things which cause pleasure, that is, food. She came to a conclusion that, during time brain has been learned so well that the cravings occur faster and faster and the man does not crave for food but for the emotions that occur during its consuming. (Gerhardt 2008) Identical conclusions were drawn by a team from the Harward University, led by Nancy Etcoff, questioning people who used narcotics. They noticed that narcotics affect the pleasure center the same way as in the case of esthetically acceptable people. (Etcoff et all 2001)

3.1.2. *Development of preferences influenced by reward system*

Orians discusses rewards and pleasurable feelings, as intuitive reactions which ensured that certain activities that are very important for the man to be genetically represented enough in generations to be. He says that diet and sexual intimacy are greatly rewarded and that there is no need for detailed examination to find out that those activities that are not rewarded would not be represented enough in next generations. (Orians 1992) The same argument is true when choosing a habitat. The worse the habitat, the less ancestors would survive and reproduce. (Orians 1980) Therefore, there is a pleasure center in brain which is in charge of extremely pleasurable feelings to stimuli that are positively graded due to genetic base and adjustment to the surrounding. The brain center for pleasure can be activated by various triggers and the result is always the same: very pleasurable feelings in people, followed by physiological changes in a body. Those feelings are memorable which is why people want to repeat them. When choosing a habitat and shelter, the man has evolutionarily developed a capability to subconsciously use the pleasure center which is activated during esthetic reactions to surrounding and it remembers pleasurable feelings which the man tends to repeat. In this way,

the man acquired ability to use genetically acquired preferences toward surrounding, ability to adapt and to develop esthetic preferences towards the surrounding beneficial for survival, which relates to adaptive function of esthetic needs and reactions.

Fig 1 Source: http://www.wikiwand.com/en/Scots_pine

Fig 2 Source: https://opusteno.rs/slike/201207/najvisa-planina-jugozapadne-srbije-15073/planina-golija-srbija-11.html

During the research, when respondents were asked to choose the surroundings they prefer, of two pictures with very similar natural surroundings, 95% of them chose picture number 2 which shows surroundings with a thicker tree top. The author of the text interviewed shepherds who were nomads on lowlands in winter and they said that they were looking for as thick forest as possible because they were warmer in such surroundings during night. The majority of participants have never spent a night in nature nor have they had the shepherds' experience, but due to the intuitive reactions and knowledge acquired during evolution which is genetically conveyed, they chose the surrounding that is more beneficial for survival. That represents a good example of influence of evolution on esthetic preferences. Evolution sets things in a way that, thanks to intuitive reactions and development of esthetic preferences, participants liked the forest in picture 2 because it gives conditions more beneficial for survival. That is the function of esthetic reactions and preferences developed during evolution.

3.1.3. *Subjective and objective factors of esthetic preference*

Searching for an answer to the question which factors influence the man`s estimation whether something is beautiful, scientists dealt with objective and subjective characteristics of esthetic reaction and preference. Some of them came to a conclusion that it is physical characteristics of an observed object (stimulus) that influence preferences, and others that esthetic reactions and preferences depend only on subjective mechanisms of the observer and the way he experiences the object (stimulus) he observes. Philosophers think that beauty is not a trait of things around us, but the subject himself and his soul`s powers (Steiner 1997), while Fehner is the founder of experimental research on stimulus characteristics and esthetic preference testing. Fehner and his followers started at the point that objective, physical traits of stimulus are in the essence of esthetic preference, and for a long time (the 19th and 20th century) many scientists accepted this thesis and did researches on the psychical traits of stimuli and their influence on esthetic preference. However, at the

end of the 20th century attention was drawn to subjective factors of esthetic preference. Those are subjective mechanisms which are basically esthetic preferences. They deal with the way the observer reacts to what he sees and the starting point is the thesis that esthetic preference does not depend on objective traits of stimulus, by itself, but on the way in which the traits are experienced by an observer. (Janković 2010) Steven and Rachel Kaplan developed a model of environmental preferences which takes into consideration psychological influences of an individual that influence the outcome of esthetic judgment. (Orians 1986, see Kaplan and Kaplan 1983) Therefore, there are two approaches in history of esthetic reactions study:

- objective, that tends to define physical characteristics of a stimulus that the man values positively and
- subjective, that tends to define subjective psychological factors which influence esthetic reactions, esthetic valuing of objective characteristics of the stimulus and outcome of esthetic preferences.

Lately, by observing esthetic reactions as adaptations to surrounding developed during evolution, evolutionary psychology consolidates two approaches, affirming physical characteristics of surrounding to which the man reacts and psychological mechanisms developed during evolution, which are in the base of those subjective reactions. In other words, evolutionary psychologists tend to explain the connection between objective physical characteristics of stimuli (objects) and subjective impression and esthetic evaluation of stimuli by an observer which is occurring on a subconscious level according to intuitive reactions to surrounding that were developed during evolution.

3.2. Previous affective experience with stimuli and the context in which stimuli are perceived as a factor of preference

An important factor which influences esthetic preference is a previous experience with stimuli and the context in which the stimulus (object) is perceived. Reacting subconsciously and autonomously to the stimulus observed, there are intuitive reactions to surrounding and adequate emotions, so the human body experiences physiological changes which the man feels and remembers. When he sees the same or a similar object in a different context, he will recall the emotions which first appeared and, regardless of change of the context, if the initial experience with that object was negative, he will perceive it negatively due to the negative context in which he perceived it first and tied his emotions for the event. An example of how the context in which the object is previously perceived influences esthetic preference is a poll. Preferences of people of different age to apartmental facilities were tested. The object in figure 3 got very contrary comments and reactions. While some participants perceived the object as a house from horror movies, others perceived it as a fairytale house. So, depending on the context in which the participants perceived a similar object with which they connected the shape of the given object, they reacted in a following way: adults saw a house from a horror movie, and perceived that kind of shape in a very negative context which evoked negative emotions, so they marked the object negatively.

Fig 3 https://www.houzz.com/photos/traditional-exterior-traditional-exterior-birmingham-phvw-vp~851929

Fig 4 http://www.montazneidrvenekuce.info/vijesti/drvene-kuce-honka-kvaliteta-i-ekologija/107

A five-year old child who has not watched horror movies saw the roof of the object like "sea" and reacted positively, in a similar way like other participants who did not perceive this shape of a house in a negative context.

In the same poll the object in figure 4 was shown. According to comments (warm, domestic, family, chimney, natural, peace) and preferences, majority of the participants who remember some earlier days, architecture and way of life, perceived the object in a way that they related it to objects they perceived in a different context, very positive. They were recalling their childhood because the shape of the house reminded them of houses from that period, so the esthetic reactions to this object were very positive. So, a context in which the stimulus is perceived affects emotions and, at the same time, esthetic reactions and preference of an observer. Evoked emotions depend on a context in which the stimulus is perceived, they are memorized and by perception of a similar stimulus, the man will recall the memorized emotions. If some stimulus is perceived in a positive context, some positive emotions will be evoked that will connect to the stimulus and positive esthetic reactions. Later, if stimulus similar to the previous one in a certain context is perceived and is related to certain emotions, the man will recall those emotions and react esthetically positive to the stimulus. House in picture 3 does not differ much from most of the houses and it is not intimidating, but the context in which some people perceived a similar object, of which this house reminded them, is very negative and intimidating, which resulted in negative emotions and esthetic reactions. The fact that the previous experience with stimuli (objects) and context in which the man dwelt and perceived certain forms influence his esthetic reactions is of a great importance for architects when creating living space.

3.3. Natural surroundings` influence on preferences

Many studies show that natural surroundings influence esthetic preferences and that the man prefers shapes, forms and relations he sees in a surroundings in which he dwells. With his research, Orians founds the theory of savannah in which he explains the relation of the man to his surroundings. He says that the man prefers surrounding that is considered to have been the surrounding in which he originated, region of East African savannah. Even though the tested group had not lived in savannah, they reacted very positively to the pictures of the savannah, which leads us to a conclusion that the man

genetically conveys esthetic preferences to his descendants. (Orians 1975) Those are genetically conditioned esthetic preferences of natural surroundings. Another important influence of the natural surrounding is that it influences development of preferences during dwelling in it. Studies have shown that children react more affectively to pictures of the African savannah than adults. It is considered to be a consequence of adults having spent more time in new surroundings than children, so they developed esthetic preferences toward the surroundings in which they live. Therefore, the man has genetic preferences toward natural surroundings but, thanks to mental and anatomic adaptations, he acquired capability to develop preference to shapes and forms he sees in the surroundings in which he dwells.

3.3.1. *Adaptation to surroundings and preference development*

The explanation for the phenomenon of development of the preferences towards forms from natural surroundings is possible to find in the studies of psychologists and evolutionary psychologists. First, we need to start from the phenomenon of previous exposure. Many scientists have dealt with the phenomenon and there have already been discussions about the studies of Nancy Etcoff during which she noticed that people react more positively to photographs of the opposite sex if they have seen them before. (Etcoff 1999) Janković says that repeated exposure to a stimulus causes more positive reactions to the stimulus. (Janković 2010) Previous exposure to the stimulus causes an increase of esthetic preferences and more positive affective reaction to the stimulus. The more the stimulus is known, the more beautiful and pleasurable it will be, estimated by an observer. Duration of exposure to the stimulus influences the process of making esthetic judgment. (Ognjenović 1980, 1986, 1991 Lazić 1988, Graovac 1989) From the previously mentioned studies it can be concluded that previous experience with an object and familiarity with the object influence esthetic reactions and the man`s preferences. The more the man dwells in surroundings in which he perceives certain objects, shapes and forms, the more acceptable they will be for him. Lesser preference of unknown objects has an adaptive function and serves to protect organisms, by leading to reduction of interaction with unknown objects, until they are proven not to be dangerous for the organism. (Hil 1978) Janković defines the concept of esthetic preferences as an intensity of our esthetic experience with an object. (Janković 2010) In other words, a man will esthetically prefer objects with which he has greater intensity of esthetic experience so it happens that a man, while dwelling in natural surroundings, develops esthetic preferences toward surroundings, shapes and forms that he sees in nature. Therefore, there are some examples when construction builders built after shapes of plant species. The pillars in Egypt were built in the shape of old papyrus and lotus, or in Greece, the Corinth pillar with capital was built in the shape of acanthus. The builders used forms and shapes from the surroundings which they were familiar with and toward which they developed esthetic preferences. They could not use plant shapes from another region because they were unfamiliar to them.

3.3.2. *Influence of preferences toward natural surroundings on architecture*

An example of development of esthetic preferences toward natural surroundings in which the man lives is also the Dinaric log. The connection between shape of the Dinaric log and natural surroundings was noticed and described by Jovan Cvijić. He that the house is in harmony with its surroundings, looks and vegetational clothes of the region. (Cvijić 1922) Cvijić noticed the connection between the shape of the Dinaric log and

vegetation and the connection between the shape of the log and the region it was built in. Free-standing tree tops of conifer have the shape of equilateral triangle. The roof of the Dinaric log has the identical shape. Psychologists affirmed that the main predictors of esthetic preferences in natural surroundings are plant species. Especially tree tops and terrain (Gabr 2005) which Cvijić noticed and stated by observing the Dinaric log in its surroundings. So, the main predictors of the man`s esthetic preferences are plants and terrain. The man prefers shapes and forms he sees in plants in natural surroundings in which he lives and forms of the terrain, compositions and relations that exist in his surroundings. Shapes of plants and terrains can serve to builders to estimate esthetic preferences of users of the space, but at the same time, they influence the esthetic preferences of constructors and their creations because constructors tend to build preferred forms into their work.

4. CONCLUSION

Esthetic reactions and preferences have adaptive function. They are developed in order to secure survival. They are influenced by physical characteristics of stimuli and subjective impression of an observer which is conditioned by evolutionary development, previous experience of the man with the same or similar stimulus and surroundings in which the man dwells, which respondents showed in the poll. The poll showed that the man subconsciously reacts to architectural space in the same way that he reacts to natural surroundings. He notices its characteristics that enable conditions that are more suitable for dwelling, and he does it unconsciously. In addition, the poll showed that previous experience with certain space and forms, the context in which an observer noticed them and emotions that were arisen during observation influence the observer`s reactions and preferences. Beside generally known factors which influence creating of space, such as social-economic, natural, cultural and technological factors, another very important factor when creating space is the psychological factor. The psychological factor is represented by reaction of the man to surroundings according to patterns and intuitive reactions developed during evolution and preferences developed during dwelling in the surroundings. The man possesses inborn preferences toward space. That provides security and conditions needed for survival. He is taught to recognize them in surroundings, but at the same time, thanks to development of mental and anatomic adaptions and due to the need of as good adjustment as possible, he acquired the ability to memorize previous experiences with objects and space, and to develop preferences of the surroundings in which he dwells. Because of evolutionary base of reactions to surroundings and based on factors which influence esthetic preferences, it is possible to estimate physical characteristics of the surroundings that the man prefers. With studies, psychologists affirmed that the man, due to his security and esthetic needs, prefers a good overview of the surroundings, dismantled space that provides shelters, possibility to see and not to be seen, greenery, sun, wind, organic forms of curved edges, shapes of the surroundings, especially of plants and terrains. It is obvious that the man prefers shapes and elements of natural surroundings with which he has had previous positive experience, which he knew well and which were important for his survival. He values if the space is esthetically acceptable or not based on whether the mentioned elements are present.

Psychological research defined physical characteristics of surroundings towards which the man has positive reactions. Therefore, photographs given in the poll depicted architectural space containing elements of natural surroundings, shapes and relations that the man prefers in natural surroundings. The poll showed that respondents had positive reactions to a good overview of surroundings, possibility to see and not to be seen, alternative way-out, decomposed space that offers refuge, greenery, sun, water, organic forms of curved edges, plant and terrain shapes from the surroundings, pyramidal forms, rugged outline and decomposed shape of objects. It can be stated that research and assumptions on surroundings preferences that were defined based on research of evolutionary psychology, psychology and neuroaesthetic, can be applied in architectural space. Respondents recognized the characteristics in architectural space and they reacted positively which led them to choose space with expressed physical characteristics. Evolution taught them to recognize those characteristics in surroundings, so they said that they would choose that kind of space for living instead of space that does not have the mentioned characteristics.

Esthetic preference factors, preferred shapes, relations and compositions from the surroundings that the man notices and prefers in architectural space can be useful for architects and urbanists. When architects and urbanists are familiar with evolutionary conditioned esthetic reactions (influence of previous experience to esthetic reactions and influence of natural surroundings, plant shapes and terrain morphology) they are able to use it when creating architectural space. In this way, they will create space that is customized for the man.

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FAKTORI ESTETSKIH PREFERENCIJA PROSTORA I FORMI

Zašto se čovek u nekom okruženju prijatnije oseća i šta je to u okruženju i u čoveku što izaziva takvo stanje duha? Očigledo je da su čovekove reakcije na okruženje refleksne i nekontrolisane ali se dešavaju po određenim obrascima. Da bi se što bolje prilagodio prirodnom okruženju čovek je tokom evolucije razvio mehanizme moji su mu omogućili da puno brže i efikasnije reaguje na promene u svojoj okolini što je bilo od ključnog značaja za opstanak. Bilo kakva aktivnost u prirodnom ili izgrađenom okruženju ne može da prođe bez aktiviranja tih mehanizama. Razvojem mehanizama reakcija na okruženje čovek je stekao poseban aparat kroz koji vidi puno više u okruženju nego što je svestan. Estetske reakcije i estetske preferencije su deo tog aparata i imaju adaptivnu ulogu. Zahvaljujući nagrađivanju ugodnim osećanjima određenih ponašanja, elemenata, fizičkih karakteristika okruženja (kompozicija, odnosa) korisnih za opstanak koje čovek opaža u okruženju, čoveku su vremenom postali lepi. Evoluciona psihologija, psihologija, estetika, neuroestetika se bave istraživanjima kako i zašto čovek reaguje na određene fizičke karakteristike okruženja. Cilj rada jeste proveriti da li čovek u arhitektonskom prostoru zapaža elemente i odnose iz prirodnog okruženja jer je evolucijom "naučen"da su mu potrebni za opstanak. Proveriti kako reaguje na preferirane oblike, odnose i kompozicijeiz prirodnog okruženja u arhitektonskom prostoru, kao i faktore koji utiču na estetske preferencije. Saznanja o estetskim reakcijama, estetskim preferencijama i evolucionoj osnovi tih reakcija se mogu primeniti u arhitekturi s ciljem kreiranja prostora i oblika u prostoru po meri čoveka.

Ključne reči: *evolucija, mehanizmmi reakcija,estetske preferencije, forma, prirodno okruženje, prostor*

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