

URBAN SPATIAL ANALYSIS AND VIRTUAL MODEL NETWORK OF THE CULTURAL BUILDINGS LOCATED AT THE CULTURAL ROUTE IN SKOPJE, N. MACEDONIA*

UDC 727:004.946(497.7)

Viktorija Mangaroska¹, Liljana Mangaroska², Kosta Mangaroski³

¹International Balkan University, Faculty of Architectural Engineering, Skopje, North Macedonia

²Chief Museum Architect at National Museum of Republic of North Macedonia

³SS Cyril and Methodius University, Faculty of Architectural Engineering, Skopje, North Macedonia

ORCID iDs: Viktorija Mangaroska  N/A
Liljana Mangaroska  N/A
Kosta Mangaroski  N/A

Abstract. *Urban spatial and program organization of virtual network model of the cultural buildings is one of the crucial network developments at the Cultural Route in Skopje, North Macedonia. The methodology of this scientific paper includes urban spatial diagram analysis of the virtual network modeling of the cultural buildings in Skopje: analysis and testing of the developed virtual spatial models in the context of architectural-design and urban-planning interventions, stimulating the processes for their complete inventory, systematization, valorization, integration and adaptation in the virtually created urban environment.*

The method of typological and morphological analysis where the reasons for the morphology and the emergence of cultural development are considered in the context of the relationship with cultural development as development of semantic factors. The modeling method (virtual) which is presented as an analogy and virtual simulation of the current and future conditions of cultural institutions in Skopje. Virtual realistic representation and simulation of the current situation is analyzed in this scientific paper. The situation is critically reviewed and measures are proposed that architects and designers can implement in the virtual modeling of the future state of museums and cultural institutions.

The expected outcome results of this scientific paper is to explore and define the application of virtual modeling in the planning of current and future development of the virtual museum network, in the development of the city Skopje. The research includes: defining the existing and future programming factors that influence the development of the cultural institutions, defining factors in the process of virtual modeling of the spatial organization, location and relational connection of the objects in the field of

Received June 30, 2023 / Revised August 1, 2023 / Accepted August 15, 2023

Corresponding author: Viktorija Mangaroska -,International Balkan University, Faculty of Architectural Engineering, Skopje, North Macedonia
e-mail: vmangaroska@gmail.com

culture in the network; defining the influence factors of the development of the facilities in the field of culture on the virtually created development of the city of Skopje.

Key words: *urban spatial analysis, virtual network modeling, cultural buildings.*

1. INTRODUCTION

According to ICOM (International Council of Museums) the museum is defined as "The museum is a non-profit institution in the service of society and its development, open to the public, conserving, researching and communicating with cultural exhibits, which are used to study, educate and research material evidence of the existence of people and their environment [1]." Museums should perform the following functions: preservation, exhibition, scientific and educational activity through the organization of exhibitions, professional lectures, performances, cultural events.

Functional and program organization of the museum institutions in Skopje include the following premises: administrative part - organization of the function through distribution of professional staff by organizational units, management, storage of a museum complex, depot - department for storage of artifacts, conservation and restoration department, organization of museum materials by collections, exhibition halls - organizing the space by exhibiting exhibits. salon - department for the sale of museum copies, museum tickets, souvenirs, library and documentation department [2].

The typology of museums as cultural buildings in the Republic of North Macedonia is specifically analyzed and classified according to the following aspects:

1. Typology of museums according to the exhibited objects:
 - Museums of applied arts,
 - Archaeological and Historical museums,
 - Ethnographic museums,
 - Natural science museums.
2. Typology of museums according to the meaning of the territory:
 - National museums,
 - Regional museums,
 - City museums.
3. Typology of museums according to the architecture and location:
 - Museums Houses in restored authentic historic buildings and sites.

2. METHODOLOGY OF THE CASE STUDY URBAN ANALYSIS OF VIRTUAL MUSEUM ARCHITECTURE

Virtual spatial models of the museum architecture and the circulation diagrams are an important tool in the architectural project design process, where architects, civil engineers, intercultural managers and potential investors will receive fast and accurate information about the facilities of the cultural institutions, the opportunity to see the ratio of the constructed with the newly designed facilities. When designing architectural objects, it enables the preparation of a large number of variant solutions for one architectural object. The virtual model is used in the process of inventory, systematization and valorization of existing cultural institutions, as well as in proposing possible future architectural solutions in the architectural design process [3].

According to the spatial and functional analysis of the existing spatial and functional organization of the National Institution Museum of North Macedonia, with the virtual model the following proposal of interventions in the museum architecture can be tested in the virtual model; reconstruction of the exhibition spaces, reconstruction of administrative spaces, providing and protective measures for depots and premises for conservation and restoration, repair and reconstruction of the depot space with the most modern and sophisticated equipment for storage and storage, reconstruction and rehabilitation of the access plateau, construction of access ramps and elevators-platforms for overcoming the architectural barriers for people with special needs, increased need because the architectural project has a leveling in the levels of the exhibition halls [3].



Fig. 1 National Institution Museum of Macedonia, museum architecture, organizational and spatial structure of the program diagram

Organizational and functional structure in the museum architecture of the National Institution Museum of Macedonia (Fig. 1): 1. Historical exhibition that presents the history from the Ottoman period II World War, 2. Gallery of Icons exhibits the most important icons, iconostasis and frescoes from the post-Byzantine period and the Renaissance period, 3. Ethnology department presents the thematic units from: folk architecture, customs, musical instruments, costumes, jewelry, embroidery and weaving, 4. Complex museum- the building of Kurshumli an, where the exhibition of stone monuments - Lapidarium is located (Fig. 2). The Archaeological collection from the National Museum of Republic of North Macedonia has been transferred to the new building of the Archaeological Museum in Skopje.

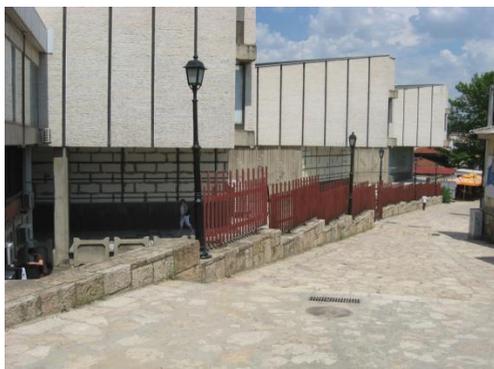


Fig. 2 National Institution Museum of Macedonia, museum architecture, visual context, and form development of the museum architecture

Methodological analysis of the cultural institutions on the Cultural Route in Skopje is defined by the: virtual modeling method that has an analogy and virtual simulation of the current and future conditions of cultural institutions in Skopje; (Fig. 3) virtual realistic representation and simulation of the current situation critically reviewed and measures proposed that architects and designers can implement in virtual modeling of the future state of cultural institutions [5]. The method of typological and morphological analysis where the reasons for morphology and the emergence of culture are considered in the context of the relationship with cultural development, development of semantic factors.

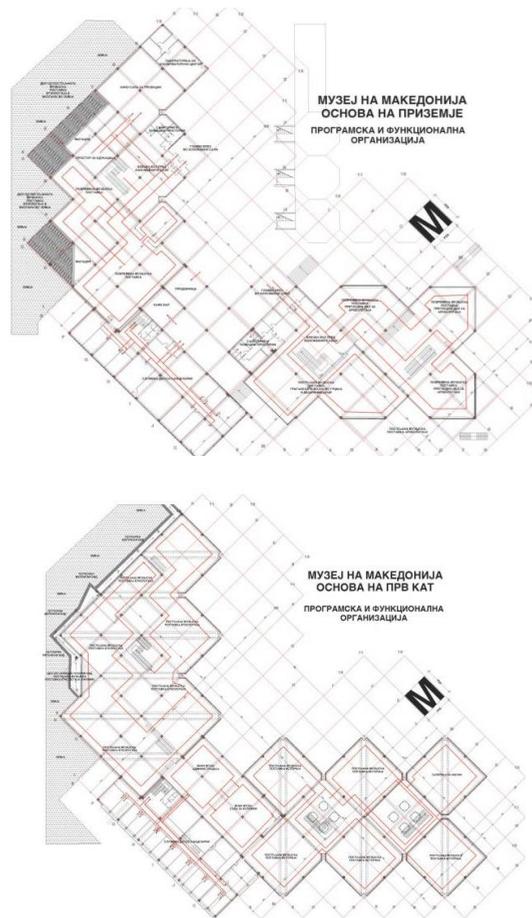


Fig. 3 Presentation of the National Institution Museum of Macedonia, museum architecture and visitors circulation diagram

Virtual network modeling of spatial and program organization of cultural buildings and museums is one of the crucial network development at the Cultural Route in Skopje, North Macedonia.

The methodology of this scientific paper includes the following principles [3]:

1. Analysis and testing of the developed virtual spatial models in the context of architectural-design and urban-planning interventions,
2. Stimulating the processes for their complete inventory,
3. Systematization, valorization, integration and adaptation of the virtually created urban environment.

Objectives of the scientific research of the virtual museum network of the Cultural Route as methodology for spatial diagram analysis are [3]: analysis of the urban and spatial connection of the museum complexes in an urban context - cultural paths, virtual model of the Cultural Route -spatial and functional organization and connection in the

museum complex, importance of the database in determining the functional aspect of architectural planning by the architect and designer, functional program and spatial analysis of museums, analysis of the trajectory of the movement and circulation of museum visitors - simeza, planning the current and future development of the architectural space through a virtual model, planning of spatial and functional organization of the interior design of the exhibitions by the architects and curators, spatial and functional planning at the city level and organization of spatial cultural buildings.

The network of cultural institutions facilitates the exchange of information, skills, knowledge and experience, by holding meetings, workshops, publications and developing cooperation programs, in order to have a wider social impact [4].

3. RESULTS FROM THE RESEARCH OF THE VIRTUAL NETWORK SPATIAL AND PROGRAM ORGANIZATIONS OF MUSEUMS

Analysis of the spatial-urban context of the location of the Cultural Route in the city of Skopje, Macedonia is spatially defined with the following cultural buildings: starting with the beginning with the Museum of the City of Skopje in the central city area along Macedonia Street through Macedonia Square, the Stone Bridge, the Old Skopje Bazaar as an old oriental urban complex from the 16th-17th century, and final destinations the building of the Museum of N. Macedonia, the building of the Museum of Contemporary Art located at the Skopje Fortress. The analysis of the virtual museum network is focused on the museums as focal points in the urban network on the trajectory of the Cultural Route in Skopje, North Macedonia.

The following national and local museums were identified in the process of the mapping of the museums in the virtual museum network (Fig. 4): national museums: NI Museum of Macedonia – Skopje (Fig. 6), NI Museum of Contemporary Art - Skopje, NI Museum of the Macedonian Struggle for Statehood and Independence - Skopje, NI Museum of the Holocaust - Skopje, NI Art Gallery - Skopje, NI Memorial House of Mother Teresa - Skopje, NI Archaeological Museum of Macedonia, and local museums: Museum of the City of Skopje.



Fig. 4 Photo-documentation of the cultural institutions in the Cultural Route in Skopje

Morphological analysis of the cultural institutions in Skopje, North Macedonia is conducted by mapping and identification of virtual model criteria on the trajectory with cultural contents [6]:

1. Spatial criteria

- defining the spatial urban scope
- length of connection of cultural institutions.
- defining the shortest and longest distance,
- defining the diversity of contents

2. Time criteria

- beginning, end, frequency of visit
- time interval of visit,
- scheduled time visits through a virtual curator,
- the time interval of permanence - one-year, multi-year, seasonal)

3. Cultural criteria (purpose and significance of the cultural paths, cultural and content aspects of the permanent and temporary exhibitions of the cultural buildings and museums.

In the process of analyzing the spatial distances between the cultural institutions on the Cultural Route in Skopje (Fig. 5), it can be concluded that it has relatively small distances of 100 - 500 m, walking communication diagram. The communication between the cultural institutions on the Cultural Route in Skopje can take place on the pedestrian streets, paths, without crossing the pedestrian with the vehicular traffic [7]. The time required for movement of pedestrians from one object to another ranges from 10-15 minutes. The distance between cultural institutions due to the favorable configuration of the terrain, is easily accessible to people with disabilities, considering that culture should be accessible for all visitors of the cultural buildings and museums.

Distances between the cultural buildings on the Cultural Route in Skopje and distances of the distances between the cultural buildings in the Cultural Route

Od objektot Музеј на Град Скопје (Стара железничка станица) до објектот Музеј на современа уметност	Меѓусебно растојание	Време потребно за совладување на тоа растојание со пешачење
Стомен куќа на Мајка Тереза	326,28 м	Змин 57 сек
Градска фонтана на плоштад Македонија	235,06 м	Змин 25 сек
Плоштад Карпошевски	280,36 м	Змин 35 сек
Музеј на македонската револуционерна борба за самостојност	74,31 м	Омин 55 сек
Македонски народен театар	126,45 м	Тмин 30 сек
Археолошки музеј на Македонија	33,29 м	Омин 25 сек
Национална галерија - Дует пазиници	216,67 м	Змин 47 сек
Македонска филхармонија	206,63 м	Змин 45 сек
Национална галерија - Чајке аџи	244,22 м	Змин 55 сек
НУ Музеј на Македонија	679,08 м	Вмин 49 сек
НУ Музеј на современа уметност		
Вкупно Музеј на град Скопје - НУ Музеј на современа уметност	1769,67 м	21мин 23сек

РЕСТОЈАНИЈА ПОМЕЃУ МУЗЕИТЕ	Меѓусебно растојание	Време потребно за совладување на тоа растојание со пешачење
Музеј на град Скопје	326,28 м	Змин 57 сек
НУ Спомен куќа на Мајка Тереза	589,73 м	Бмин 55 сек
Музеј на македонската револуционерна борба за самостојност	126,45 м	Тмин 30 сек
Музеј на холокаустот		
Археолошки музеј на Македонија	484,14 м	Бмин 55 сек
НУ Музеј на Македонија	679,08 м	Вмин 49 сек
НУ Музеј на современа уметност		
Вкупно Музеј на град Скопје - НУ Музеј на современа уметност	1769,67 м	21мин 23сек

Fig. 5 Spatial analysis of museums in the Cultural Route; Museum of N. Macedonia

**PRODUCTION OF SPATIAL PROTOTYPE - VIRTUAL MODEL OF THE MUSEUM OF N MACEDONIA
AS PART OF THE CULTURAL ROUTE IN SKOPJE**

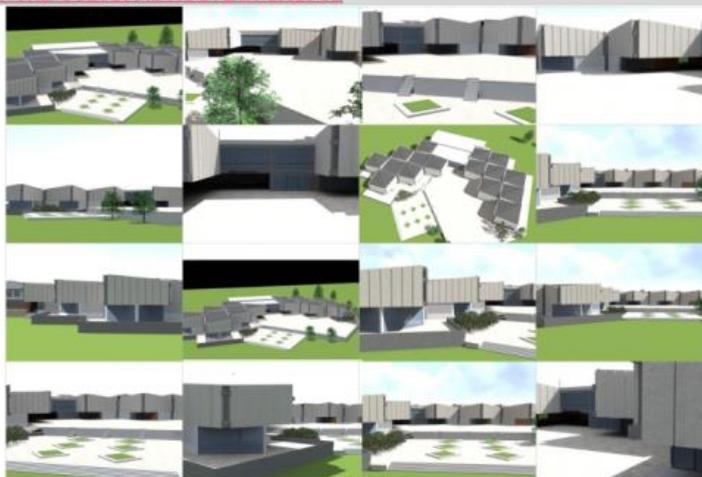


Fig. 6 Virtual Model of Museum of North Macedonia, Source: Author

The virtual network enables the connection of objects in the field of culture in a virtual context (Fig. 7), which will be of great importance in terms of: planning of activities, smooth organization of cultural events, circulation of visitors in the urban spatial matrix defined through the Cultural Route, defining the trajectory of the movement of cultural users and tourists in an urban context, which will enable a visit to several museum complexes in the city, planning the time interval of their visits to the cultural architectural buildings, opportunities for planning and development of exhibition spaces and architectural space planning by architects, museum professionals and users [8].

**PRODUCTION OF SPATIAL PROTOTYPE - VIRTUAL MODEL OF OLD BAZAAR IN SKOPJE,
AS PART OF THE CULTURAL ROUTE IN SKOPJE**

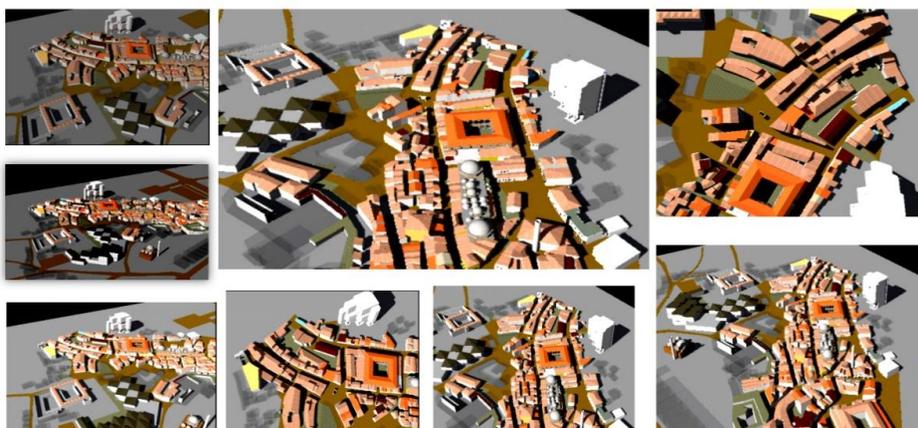


Fig. 7 Virtual Network 3D modeling of the cultural institutions and cultural heritage buildings in the Old Carsija in Skopje

4. DISCUSSION

The sustainable development of museums and cultural institutions at the virtual network of the Cultural Route in Skopje, North Macedonia include: virtual mapping of cultural buildings in Skopje through modern information and communication technologies concentration of cultural buildings in the network increasing cultural activities in the context of revitalization of cultural institutions in the long period located in the virtual network, attracting sponsorship due to the growing interest of the general population to visit cultural institutions and cultural events, involvement of project managers who will organize networked cultural activities, Skopje Art Festival, Skopje Summer Festival, increasing the interest of the media, which will actualize the presentation of the city on a regional, national and international cultural level [9].

The Strategy for Sustainable Development of the virtual network of the Cultural Route in Skopje, North Macedonia is defined by the following aspects: complete protection and revitalization of the existing, newly built and historical buildings of the Old Skopje Bazaar, construction of historical trade facilities and other business and commercial facilities next to the museums and their connection with the core of the Old Skopje Bazaar, virtual reality, visual presentations, panoramas for all museums in the Cultural Route, organization of simultaneous creative workshops in all cultural buildings for making jewelry, handicrafts in the Old Skopje Carsija, organization of simultaneous cultural events, manifestations and performances, architectural workshop for traditional construction, creating virtual network web page by entering all the information about the old and new cultural buildings and posting maps with markings of cultural institutions around the Old Skopje Bazaar.

5. CONCLUSION

This scientific paper research explores and defines the application of virtual modeling in planning of the current and future development of the virtual modeling museum network, in Skopje, North Macedonia: defining the existing and future programming factors that influence the development of the cultural institutions, defining factors in the process of virtual modeling of the spatial organization, location and relational connection between cultural buildings in the network; defining the influence factors of the development of cultural buildings on the virtually created development of the city of Skopje. With the method of virtual typological and morphological analysis considered is the urban context of the relationship with cultural development as development of semantic factors [10].

The scientific paper explores and defines the application of virtual modeling in the planning of current and future development of the virtual modeling museum network, in the development of the city Skopje, North Macedonia. The virtual modeling method is presented as an analogy and virtual simulation of current and future conditions of cultural buildings in Skopje. The situation is critically reviewed and measures are proposed that architects and designers can implement in the virtual modeling of museums [11].

The virtual methodology has a great contribution for inventory and valorization of new buildings, existing buildings, analysis of buildings based on given morphological characteristics, etc. The applicability of virtual reality and virtual modeling enables the creation of new programmatic and functional analytical virtual diagrams [12]. The new methodology of virtual modeling has an active application in the process of optimal

spatial and program organization of the new and existing facilities in the cultural buildings in Skopje. Architectural and urban design in the future will be carried out exclusively with the application of computers in a virtual world, with new modern software packages in accordance with the new achievements in computer technology.

REFERENCES

1. <https://icom.museum/en/resources/standards-guidelines/museum-definition/> (14.06 2023)
2. Pleizier D., van Lammeren R., Scholten H., J., van de Velde R., Using virtual reality as information tool in spatial planning, in Proceed. EuroConference on methods to support interaction in geovisualisation environments, 2004
3. V. Mangaroska, PhD research thesis "Virtual Modeling of spatial and functional organization of sustainable development of cultural institutions in Skopje, N. Macedonia", pp 150-210, pp 204-230, Faculty of Architecture, Ss Cyril and Methodius University Skopje, 2015
4. Piersch S., Radford A., Woodbury R., Making and Using a City Model-Adelaide, Australia in ECAADE 2001 Conference Helsinki, 2001
5. Pittman, K. A laboratory for the visualization of virtual environments. Landscape and Urban Planning, 21, 1992
6. Pletinckx, D. D. Callebaut, A. Killebrew, N. Silberman, Virtual-reality heritage presentation at Ename, IEEE Multimedia 7 (2) 45-48, 2000
7. G. Geser, Promoting Cultural Tourism, Historic Towns and Cultural Tourism in the Experience Economy- Concepts and Requirements, Salzburg Research, Culture Group, may 2007
8. Pritchard D, Enhancing Understanding Through Real-Time Urban Simulations, in conference proceedings of CUPUM 05- Computers in Urban Planning and Management., The Design and Development of a Virtual 3D City Model, 2005
9. Poria, Y., Reichel, A., Biran, A., Heritage Site Perceptions and Motivations to Visit, Journal of Travel Research, Sage Publication, USA, 2006
10. Van Puffelen Frank, Culturele Economie in de lage landen, Amsterdam, 2000. Virtual museum of Canada. <http://www.virtualmuseum.ca>, 2011
11. Virtual Culture: Identity and Communication in Cybersociety, ur. Steven G. Jones, SAGE Publications, 1998
12. Virtual City Models - New Approaches in Urban Simulation and City Planning using Virtual Reality Tools Alberto Bendinger, Ingolf Jung, imk Automotive, Chemnitz, 2014

URBANA PROSTORNA ANALIZA I VIRTUALNA MREŽA MODELA KULTURNIH OBJEKATA KOJI SEN ALZE NA KULTURNOJ RUTI U SKOPLJU, S. MAKEDONIJA

Urbana prostorna i programska organizacija virtuelnog mrežnog modela kulturnih objekata jedan je od ključnih razvoja mreže Kulturne rute u Skoplju, Severna Makedonija. Metodologija ovog naučnog rada obuhvata analizu urbanističkog prostornog dijagrama modeliranja virtuelne mreže kulturnih objekata u Skoplju: analizu i testiranje razvijenih virtuelnih prostornih modela u kontekstu arhitektonsko-dizajnerskih i urbanističko-planskih intervencija, podsticanje procesa njihovog kompletnog inventorisanja, sistematizacije, valorizacije, integracije i adaptacije u virtuelno stvorenu urbanu sredinu.

Metoda tipološke i morfološke analize u kojoj se razlozi morfologije i nastanka kulturnog razvoja razmatraju u kontekstu odnosa sa kulturnim razvojem kao razvojem semantičkih faktora. Metoda modeliranja (virtuelna) koja je predstavljena kao analogija i virtuelna simulacija sadašnjeg i budućeg stanja kulturnih institucija u Skoplju. U ovom naučnom radu analizira se virtuelno realistično predstavljanje i simulacija postojećeg stanja. Kritički se sagledava situacija i predlažu mere koje arhitekti i dizajneri mogu implementirati u virtualno modeliranje budućeg stanja muzeja i kulturnih institucija.

Očekivani rezultat ovog naučnog rada je istraživanje i definisanje primene virtuelnog modeliranja u planiranju sadašnjeg i budućeg razvoja mreže virtuelnih muzeja, u razvoju grada Skoplja. Istraživanje obuhvata: definisanje postojećih i budućih programskih faktora koji utiču na razvoj institucija kulture, definisanje faktora u procesu virtuelnog modeliranja prostorne organizacije, lokacije i relacionog povezivanja objekata iz oblasti kulture u mreži; definisanje faktora uticaja razvoja objekata u oblasti kulture na virtuelno stvoreni razvoj grada Skoplja.

Ključne reči: urbana prostorna analiza, virtualno mrežno modeliranje, kulturni objekti